T. O. 1F-80A-2

MAR 15

# HANDBOOK
# ERECTION AND MAINTENANCE INSTRUCTIONS

## USAF SERIES
## F-80A-1, F-80A-5, F-80A-10, RF-80A-5, RF-80A-10, RF-80A-15, RF-80A-20, AND RF-80A-25
## AIRCRAFT

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## LIST OF REVISED PAGES ISSUED

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| Page No. | Date of Latest Revision |
|---|---|
| * B | 28 June 1957 |
| * C | 28 June 1957 |
| i | 19 June 1956 |
| ii | 19 June 1956 |
| iii | 2 May 1954 |
| iv | 19 June 1956 |
| v | 2 May 1954 |
| vi | 2 May 1954 |
| vii | 2 May 1954 |
| 1 | 10 March 1948 |
| 3 | 10 March 1948 |
| 4 | 10 March 1948 |
| 5 | 31 December 1952 |
| 6 | 25 November 1956 |
| 6A | 13 January 1956 |
| 6B | 13 January 1956 |
| 7 | 31 December 1952 |
| 8 | 10 March 1952 |
| 9 | 31 December 1952 |
| 10 | 25 November 1956 |
| 11 | 5 October 1956 |
| 12 | 1 November 1948 |
| 12A | 1 October 1955 |
| 12B | 1 October 1955 |
| 12C | 1 October 1955 |
| 12D | 1 October 1955 |
| 15 | 1 October 1955 |
| 17 | 1 October 1955 |
| 18 | 9 July 1947 |
| 20 | 20 January 1947 |
| 22 | 20 January 1947 |
| 24 | 29 April 1955 |
| 25 | 29 April 1955 |
| * 26 | 28 June 1957 |
| * 27 | 28 June 1957 |
| 28 | 14 July 1950 |
| 29 | 5 October 1956 |
| 30 | 25 November 1956 |
| 30A | 19 June 1956 |
| 30B | 19 June 1956 |
| 31 | 19 June 1956 |
| 32 | 19 June 1956 |
| 32A | 19 June 1956 |
| 32B | 25 November 1956 |
| 32C | 1 June 1949 |
| 32D | 1 June 1949 |
| 33 | 14 July 1950 |
| 34 | 10 March 1948 |
| 36 | 1 November 1948 |
| 39 | 30 April 1952 |
| 41 | 10 March 1948 |
| 42 | 10 March 1948 |
| 43 | 25 November 1956 |
| 45 | 10 March 1948 |
| 46 | 28 September 1951 |
| 46A | 30 April 1952 |
| 47 | 28 September 1951 |
| 48 | 30 April 1952 |
| 49 | 9 July 1947 |
| 50 | 25 November 1956 |
| 50A | 25 November 1956 |
| 50B | 15 August 1952 |
| 50C | 2 May 1954 |
| 50D | 15 August 1952 |
| 50E | 25 November 1956 |
| 51 | 15 August 1952 |
| 52 | 2 May 1954 |
| 52A | 2 May 1954 |
| 52B | 15 August 1952 |
| 53 | 9 July 1947 |
| 54 | 15 August 1952 |
| * 58A | 28 June 1957 |
| * 59 | 28 June 1957 |
| 60 | 2 May 1954 |
| 60A | 2 May 1954 |
| 60B | 2 May 1954 |
| 61 | 10 March 1948 |
| 63 | 20 January 1947 |
| 64 | 20 January 1947 |
| 68 | 10 March 1948 |
| 71 | 25 November 1956 |
| 72 | 31 March 1947 |
| 73 | 28 September 1951 |
| 76 | 1 June 1949 |
| 77 | 1 June 1949 |
| 78 | 1 June 1949 |
| 79 | 20 January 1947 |
| 80A | 1 October 1955 |
| 80B | 1 June 1949 |
| 80C | 28 September 1951 |
| 80D | 28 September 1951 |
| 80D-1 | 1 October 1955 |
| 80E | 2 May 1954 |
| 80F | 28 September 1951 |
| 80G | 28 September 1951 |
| 81 | 1 June 1949 |
| * 82 | 28 June 1957 |
| * 82A | 28 June 1957 |
| 83 | 2 October 1954 |
| 84 | 1 October 1955 |
| 85 | 25 November 1956 |
| 87 | 2 October 1954 |
| 89 | 19 June 1956 |
| 91 | 2 May 1954 |
| 92A | 31 December 1952 |
| 93 | 25 November 1956 |
| 94 | 15 August 1952 |
| 95 | 2 May 1954 |
| 96 | 1 October 1955 |
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| 98 | 20 January 1947 |
| 103 | 10 March 1948 |
| 104 | 25 November 1956 |
| 104A | 25 November 1956 |
| 105 | 2 May 1954 |
| 106 | 1 August 1948 |
| 107 | 1 August 1948 |
| 109 | 28 September 1951 |
| 110 | 1 October 1955 |
| 110A | 25 November 1956 |
| 111 | 25 November 1956 |
| 112 | 15 April 1949 |
| 113 | 10 March 1948 |
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| 117 | 1 June 1949 |
| 118 | 1 June 1949 |
| 119 | 19 June 1956 |
| 120 | 31 December 1951 |
| 120A | 25 November 1956 |
| 120B | 25 November 1956 |
| 120C | 14 January 1957 |
| 121 | 14 January 1957 |
| 122 | 25 November 1956 |
| 122A | 25 November 1956 |
| 122B | 28 September 1951 |
| 122B-1 | 25 November 1956 |
| 122B-2 | 14 January 1957 |
| 122C | 14 January 1957 |
| 122D | 5 October 1956 |
| 123 | 19 May 1948 |
| 124 | 20 January 1947 |
| 126 | 20 January 1947 |
| 127 | 20 January 1947 |
| 128 | 10 March 1948 |
| 128A | 10 March 1948 |
| 128B | 10 March 1948 |
| 130A | 1 October 1955 |
| 131 | 1 October 1955 |
| 132 | 1 October 1955 |
| 132A | 31 December 1952 |
| 132B | 31 December 1952 |
| 132C | 31 December 1952 |
| 132D | 31 December 1952 |
| 132E | 31 December 1952 |
| 132F | 31 December 1952 |
| 132G | 31 December 1952 |
| 132H | 31 December 1952 |
| 132J | 31 December 1952 |
| 132K | 31 December 1952 |
| 133 | 31 December 1952 |
| 134 | 10 March 1948 |
| 136 | 10 March 1948 |
| 136A | 10 March 1948 |
| 136B | 31 December 1952 |
| 137 | 31 December 1952 |
| 138 | 10 March 1948 |
| 140 | 10 March 1948 |
| 141 | 10 March 1948 |
| 142 | 31 December 1952 |
| 142A | 31 December 1952 |

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## LIST OF REVISED PAGES ISSUED (Continued)

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

| *Page No.* | *Date of Latest Revision* |
|---|---|
| 142B | 31 December 1952 |
| 143 | 10 March 1948 |
| 145 | 10 March 1948 |
| 146 | 1 October 1955 |
| 147 | 1 October 1955 |
| 148 | 30 April 1952 |
| 150 | 14 July 1950 |
| 150A | 30 April 1952 |
| 151 | 14 July 1950 |
| 152 | 30 April 1952 |
| 152A | 15 April 1949 |
| 153 | 1 October 1955 |
| 154 | 1 June 1949 |
| 154A | 1 October 1955 |
| 155 | 31 December 1951 |
| 156 | 30 April 1952 |
| 156A | 28 September 1951 |
| 157 | 28 September 1951 |
| 159 | 28 September 1951 |
| 160 | 31 December 1951 |
| 160A | 25 November 1956 |
| 160B | 11 August 1954 |
| 160C | 11 August 1954 |
| 160D | 25 November 1956 |
| 160E | 25 November 1956 |
| 160F | 14 January 1957 |
| 162 | 14 January 1957 |
| 163 | 1 October 1955 |
| 164 | 2 May 1954 |
| 165 Deleted | 15 April 1949 |
| 166 Deleted | 15 April 1949 |
| 167 | 2 May 1954 |
| 168 | 2 May 1954 |
| 169 | 28 September 1951 |
| 170 | 2 May 1954 |
| 170A Deleted | 15 April 1949 |
| 171 | 10 March 1948 |
| 172 | 15 April 1949 |
| 173 | 15 April 1949 |
| 174 | 2 May 1954 |
| 175 | 2 May 1954 |
| 176 | 2 May 1954 |
| 177 | 19 June 1956 |
| 178A | 19 June 1956 |
| 179 | 25 November 1956 |
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| 183 | 28 September 1951 |
| 184 | 28 September 1951 |
| 185 | 28 September 1951 |
| 187 | 11 August 1954 |
| 188 | 25 November 1956 |
| 188A | 25 November 1956 |
| 188B | 25 November 1956 |
| 188C | 25 November 1956 |
| 189 | 2 May 1954 |
| 190 | 2 May 1954 |
| 190A | 1 June 1949 |
| 190B | 10 March 1948 |
| 190C | 10 March 1948 |
| 190D | 10 March 1948 |
| 190E | 10 March 1948 |
| 190F | 10 March 1948 |
| 190G | 2 May 1954 |
| 190H | 10 March 1948 |
| 191 | 28 September 1951 |
| 192 | 20 January 1947 |
| 193 | 28 September 1951 |
| 196 | 5 October 1956 |
| 196A | 5 October 1956 |
| 197 | 20 January 1947 |
| 202 | 2 May 1954 |
| 203 | 11 August 1954 |
| 204 | 11 August 1954 |
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| 206 | 10 March 1948 |
| 206A | 25 November 1956 |
| 207 | 25 November 1956 |
| 208 | 9 July 1947 |
| 209 | 9 July 1947 |
| 211 | 1 October 1955 |
| 213 | 2 May 1954 |
| 214 | 2 May 1954 |
| 215 | 28 September 1951 |
| 217 | 9 July 1947 |
| 218 | 9 July 1947 |
| 219 | 20 January 1947 |
| 220 | 2 May 1954 |
| 221 | 2 May 1954 |
| 222 | 2 May 1954 |
| 224 | 2 May 1954 |
| 224A | 28 September 1951 |
| 225 | 20 January 1947 |
| 226 | 2 May 1954 |
| 227 | 2 May 1954 |
| 228 | 10 March 1948 |
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| 230 | 10 March 1948 |
| 231 | 14 January 1957 |
| 232 | 9 July 1947 |
| 235 | 2 May 1954 |
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| 237 | 28 September 1951 |
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| 240 | 10 March 1948 |
| 240A | 28 September 1951 |
| 242 | 19 June 1956 |
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| 246 | 15 August 1952 |
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| 250A | 10 March 1948 |
| 250B | 10 March 1948 |
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| 252 | 1 August 1948 |
| 253 | 10 March 1948 |
| 254 | 10 March 1948 |
| 255 | 28 September 1951 |
| 263 | 1 November 1948 |
| 264 | 9 July 1947 |
| 264A | 2 May 1954 |
| 265 | 9 July 1947 |
| 266 | 2 October 1954 |
| 266A | 9 July 1947 |
| 266B | 25 November 1956 |
| 266C | 25 November 1956 |
| 267 | 10 March 1948 |
| 268 | 10 March 1948 |
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| 270 | 10 March 1948 |
| 271 | 10 March 1948 |
| 272 | 10 March 1948 |
| 273 | 10 March 1948 |
| 274 | 10 March 1948 |
| 274A | 10 March 1948 |
| 274B | 10 March 1948 |
| 274C | 10 March 1948 |
| 274D | 10 March 1948 |
| 274E | 1 November 1948 |
| 275 | 10 March 1948 |
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| 279 | 28 September 1951 |
| 280 | 19 June 1956 |
| 281 | 1 October 1955 |
| 282 | 1 October 1955 |
| 283 | 1 October 1955 |
| 284 | 1 October 1955 |
| 284A | 25 November 1956 |
| 284B | 28 September 1951 |
| 284C | 25 November 1956 |
| 284D | 25 November 1956 |
| 284E | 25 November 1956 |
| 285 | 25 November 1956 |
| 286 | 10 March 1948 |
| 287 | 10 March 1948 |
| 288 | 20 January 1947 |
| 289 | 28 September 1951 |
| 290 | 2 May 1954 |
| 290A | 2 May 1954 |
| 290B | 31 December 1952 |
| 290C | 31 December 1952 |
| 291 | 1 August 1948 |
| 292 | 2 May 1954 |
| 293 | 2 May 1954 |
| 294 | 14 July 1950 |
| 294A | 10 March 1948 |
| 294B | 14 July 1950 |
| 294C | 5 October 1956 |
| 294D | 14 July 1950 |
| 294E | 31 December 1952 |
| 294F | 19 June 1956 |
| 294G | 19 June 1956 |
| 295 | 19 June 1956 |
| 296 | 10 March 1948 |
| 296A | 1 November 1948 |
| 296B | 31 December 1952 |
| 296B-1 | 31 December 1952 |
| 296C | 1 August 1948 |
| 296D | 30 April 1952 |
| 297 | 28 September 1951 |
| 298 | 30 April 1952 |
| 298A | 2 May 1954 |
| 298B | 2 May 1954 |
| 299 | 15 April 1949 |
| 300 | 28 September 1951 |
| 300A | 31 December 1952 |
| 300B | 2 May 1954 |
| 301 | 2 May 1954 |
| 302 | 28 September 1951 |
| 303 | 28 September 1951 |
| 304 | 1 October 1955 |
| 304A | 28 September 1951 |
| 304B | 19 June 1956 |
| 304C | 19 June 1956 |
| 304D | 19 June 1956 |
| 305 | 19 June 1956 |
| 307 | 28 September 1951 |
| *308 | 28 June 1957 |
| 308A | 19 June 1956 |
| 308B | 10 March 1948 |
| 309 | 10 March 1948 |
| 310 | 2 May 1954 |
| 310A Dele'd | 28 September 1951 |
| 310B Dele'd | 28 September 1951 |
| 311 | 10 March 1948 |
| 312 | 10 March 1948 |
| 312A | 1 October 1955 |
| 313 | 1 October 1955 |
| 314 | 1 August 1948 |
| 314A | 1 October 1955 |
| 314B | 31 December 1952 |
| 314C | 1 October 1955 |
| 314D | 1 October 1955 |
| 315 | 31 December 1952 |
| 316 | 2 May 1954 |
| 316A | 2 May 1954 |
| 316B | 2 May 1954 |

* The asterisk indicates pages revised, added or deleted by the current revision.

## LIST OF REVISED PAGES ISSUED (Continued)

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

| *Page No.* | *Date of Latest Revision* |
|---|---|
| 316C | 2 May 1954 |
| 316D | 28 September 1951 |
| 317 | 28 September 1951 |
| 318 | 28 September 1951 |
| 319 | 10 March 1948 |
| 320 | 19 June 1956 |
| 320A | 19 June 1956 |
| 320B | 28 September 1951 |
| 321 | 19 June 1956 |
| 322 | 19 June 1956 |
| 322A | 10 March 1948 |
| 322B | 19 June 1956 |
| 323 | 31 December 1952 |
| 324 | 30 April 1952 |
| 326 | 19 June 1956 |
| 326A | 30 April 1952 |
| 326B | 19 June 1956 |
| 326C | 19 June 1956 |
| 326D | 19 June 1956 |
| 326E | 19 June 1956 |
| 327 | 19 June 1956 |
| 328 | 30 April 1952 |
| 328A | 19 June 1956 |
| 328B | 19 June 1956 |
| 328C | 15 May 1955 |
| 328D | 15 May 1955 |
| 329 | 15 May 1955 |
| 330 | 15 August 1952 |
| 330A | 10 March 1948 |
| 330B | 10 March 1948 |
| 331 | 10 March 1948 |
| 332 | 10 March 1948 |
| 332A | 10 March 1948 |
| 332B | 31 December 1952 |
| 332C | 31 December 1952 |
| 332D | 15 August 1952 |
| 333 | 10 March 1948 |
| 334 | 31 December 1952 |
| 334A | 31 December 1952 |
| 334B | 1 June 1949 |
| 335 | 15 August 1952 |
| *336 | 28 June 1957 |
| *336A | 28 June 1957 |
| *336B | 28 June 1957 |
| 337 | 10 March 1948 |
| 338 | 10 March 1948 |
| *338A | 28 June 1957 |
| 338B | 30 April 1952 |
| 338C | 30 April 1952 |
| 338D | 31 December 1952 |
| 338E | 31 December 1952 |
| *338F | 28 June 1957 |
| *338G | 28 June 1957 |
| 338H | 31 December 1952 |
| 338H-1 | 1 October 1955 |
| *338J | 28 June 1957 |
| *338K | 28 June 1957 |
| 339 | 2 October 1954 |
| 340 | 10 March 1948 |
| 340A | 10 March 1948 |
| *340B | 28 June 1957 |
| 340B-1 | 25 November 1956 |
| 340C | 1 October 1955 |
| 340D | 2 May 1954 |
| 340E | 2 May 1954 |
| 341 | 10 March 1948 |
| 342 | 31 December 1952 |
| 342A | 15 August 1952 |
| 342B | 5 October 1956 |
| 343 | 5 October 1956 |
| 344 | 2 May 1954 |
| 345 | 5 October 1956 |
| 346A | 5 October 1956 |
| 348 | 28 September 1951 |
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| 348B | 30 April 1952 |
| 348C | 2 May 1954 |
| 349 | 2 May 1954 |
| 352 | 28 September 1951 |
| 353 | 1 October 1955 |
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| 356B | 15 April 1949 |
| 356C | 14 July 1950 |
| 357 | 28 September 1951 |
| 360 | 28 September 1951 |
| 360A | 1 October 1955 |
| 361 | 25 November 1956 |
| 362 | 2 May 1954 |
| 364 | 19 June 1956 |
| 364A | 25 November 1956 |
| 365 | 25 November 1956 |
| 366 | 20 January 1947 |
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| 368A | 10 March 1948 |
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| 374B | 15 August 1952 |
| 375 | 15 August 1952 |
| 376 | 15 August 1952 |
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| 378A | 10 March 1948 |
| 378B | 10 March 1948 |
| 379 | 10 March 1948 |
| 380 | 15 April 1949 |
| 380A | 2 May 1954 |
| 380B | 14 January 1957 |
| 381 | 15 August 1952 |
| 382 | 31 December 1952 |
| 382A | 10 March 1948 |
| 382B | 10 March 1948 |
| 385 | 15 August 1952 |
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| 394 | 15 August 1952 |
| 396A | 1 October 1955 |
| 396B | 31 December 1952 |
| 396C | 1 October 1955 |
| 397 | 28 September 1951 |
| 398 | 15 August 1952 |
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| 400 | 20 January 1947 |
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| 405 | 20 January 1947 |
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| 422 | 10 March 1948 |
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| 443 | 1 October 1955 |
| 444 | 1 October 1955 |
| 445 | 2 May 1954 |
| 446 | 1 October 1955 |
| 447 | 15 May 1955 |
| 448 | Deleted 31 December 1952 |

* The asterisk indicates pages revised, added or deleted by the current revision.

# TABLE OF CONTENTS

# LIST OF MATERIAL SPECIFICATION CHANGES

Certain material specifications called out in this publication have been superseded by specifications identified by other numbers. Whenever the old specification number is referred to in the text, reference to this table will indicate the superseding specification number. Future changes in specifications referred to throughout this publication will be reflected by revision to this list.

| Old Specification No. | New Specification No. | Old Specification No. | New Specification No. |
|---|---|---|---|
| AN-O-3 | MIL-O-6086 | AN-G-24 | MIL-G-6711 |
| AN-G-5 | MIL-L-3545 | AN-G-25 | MIL-G-3278 |
| AN-M-5 | TT-M-261 | AN-L-29 | MIL-L-7178 |
| AN-D-6 | MIL-D-3545 | AN-F-32 | MIL-F-5616 |
| AN-G-6 | MIL-G-7187 | AN-C-52 | MIL-C-6708 |
| AN-O-6 | MIL-L-7870 | AN-C-53 | JAN-A-669 |
| AN-O-7 | MIL-O-6083A | AN-F-58 | MIL-F-5624 |
| AN-O-8 | MIL-L-6082A | AN-C-86 | MIL-T-5542A |
| AN-T-8 | TT-T-548 | AN-VV-N-96 | TT-N-97 |
| AN-O-9 | MIL-O-6081A | AN-C-147 | MIL-C-5544 |
| AN-G-10 | MIL-G-7118 | AN-C-154 | MIL-C-5547 |
| AN-O-11 | MIL-L-6085A | AN-C-178 | MIL-C-5545A |
| AN-F-13 | MIL-F-5566 | AN-O-366 | MIL-O-5606 |
| AN-G-14 | MIL-L-6032 | AN-TT-P-656 | MIL-P-6889 |
| AN-G-15 | MIL-L-7711 | USAF 3515 | MIL-G-4343 |
| AN-A-18 | MIL-A-6091 | U.S. Army 2-120 | MIL-L-644A |


*Frontispiece*

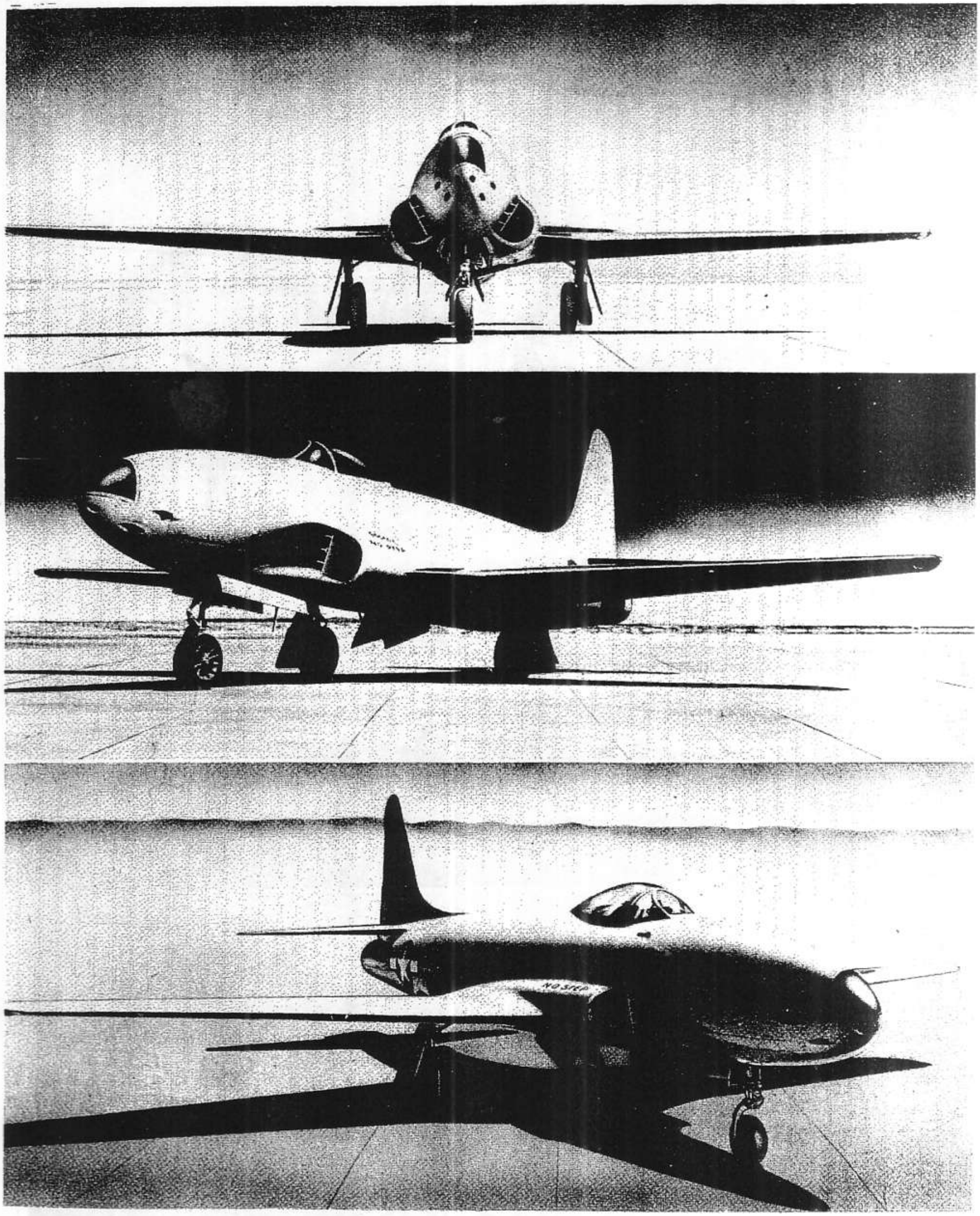


*Figure 1 — The P-80A Airplane*

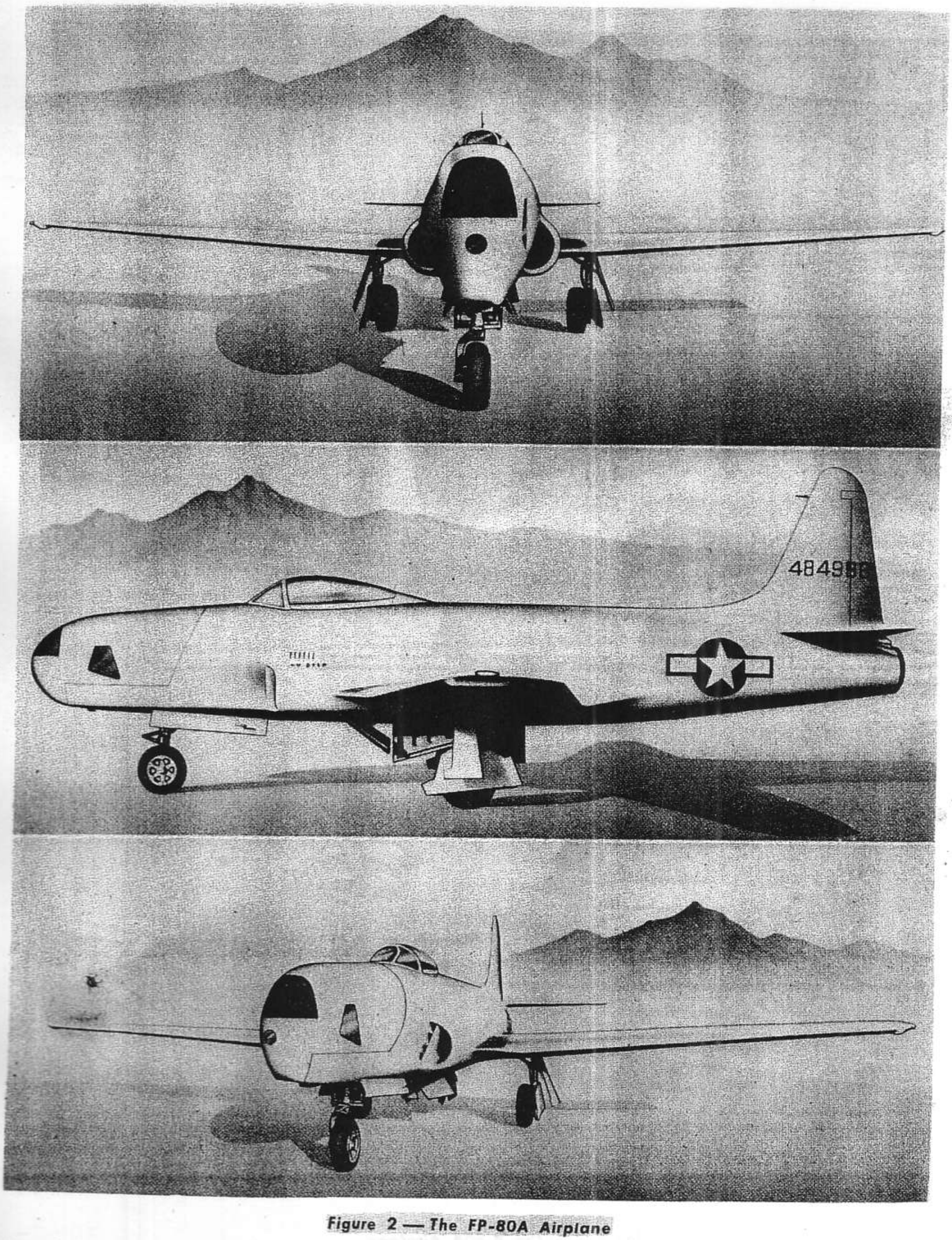
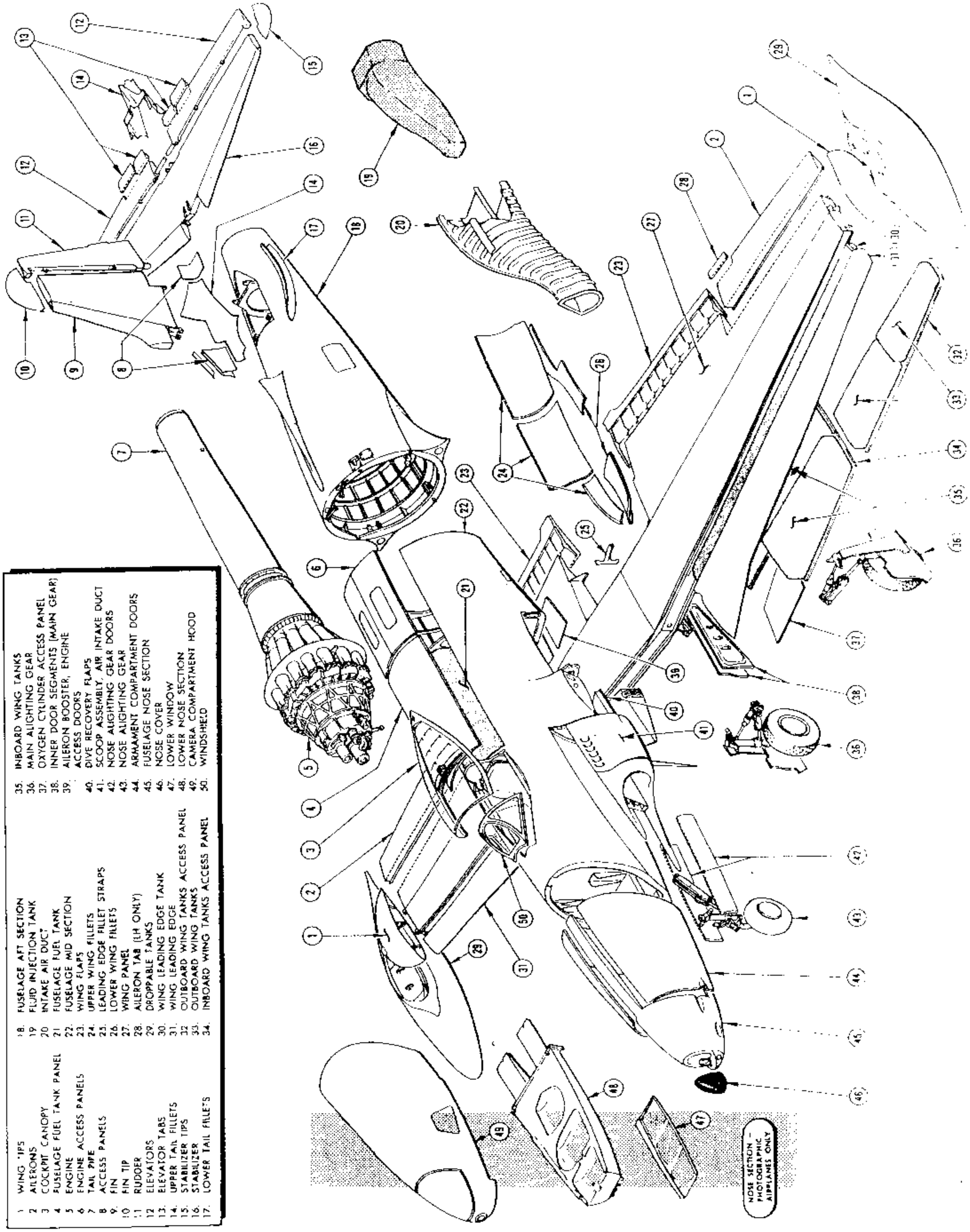


Figure 2 — The FP-80A Airplane



| | | | | | |
|---|---|---|---|---|---|
| 1. | WING TIPS | 18. | FUSELAGE AFT SECTION | 35. | INBOARD WING TANKS |
| 2. | AILERONS | 19. | FLUID INJECTION TANK | 36. | MAIN ALIGHTING GEAR |
| 3. | COCKPIT CANOPY | 20. | INTAKE AIR DUCT | 37. | OXYGEN CYLINDER ACCESS PANEL |
| 4. | FUSELAGE FUEL TANK PANEL | 21. | FUSELAGE FUEL TANK | 38. | INNER DOOR SEGMENTS (MAIN GEAR) |
| 5. | ENGINE | 22. | FUSELAGE MID SECTION | 39. | AILERON BOOSTER, ENGINE ACCESS DOORS |
| 6. | ENGINE ACCESS PANELS | 23. | WING FLAPS | 40. | DIVE RECOVERY FLAPS |
| 7. | TAIL PIPE | 24. | UPPER WING FILLETS | 41. | SCOOP ASSEMBLY, AIR INTAKE DUCT |
| 8. | ACCESS PANELS | 25. | LEADING EDGE FILLET STRAPS | 42. | NOSE ALIGHTING GEAR DOORS |
| 9. | FIN | 26. | LOWER WING FILLETS | 43. | NOSE ALIGHTING GEAR |
| 10. | FIN TIP | 27. | WING PANEL | 44. | ARMAMENT COMPARTMENT DOORS |
| 11. | RUDDER | 28. | AILERON TAB (LH ONLY) | 45. | FUSELAGE NOSE SECTION |
| 12. | ELEVATORS | 29. | DROPPABLE TANKS | 46. | NOSE COVER |
| 13. | ELEVATOR TABS | 30. | WING LEADING EDGE TANK | 47. | LOWER WINDOW |
| 14. | UPPER TAIL FILLETS | 31. | WING LEADING EDGE | 48. | LOWER NOSE SECTION |
| 15. | STABILIZER TIPS | 32. | OUTBOARD WING TANKS ACCESS PANEL | 49. | CAMERA COMPARTMENT HOOD |
| 16. | STABILIZER | 33. | OUTBOARD WING TANKS | 50. | WINDSHIELD |
| 17. | LOWER TAIL FILLETS | 34. | INBOARD WING TANKS ACCESS PANEL | | |



*Figure 3 — Major Assemblies, Exploded View*

1. AN/ARN-6 RADIO COMPASS LOOP ANTENNA
2. AMMUNITION BOXES (6)
3. ARMAMENT COMPARTMENT JUNCTION BOX
4. AN/ARC-3 & AN/ARN-6 RADIO INSTALLATION
5. INSTRUMENT PANEL
6. BULLETPROOF WINDSHIELD PANEL
7. GUN SIGHT
8. REAR VIEW MIRROR
9. SEAT
10. "G" VALVE
11. FUEL LEVEL GAGE
12. FUEL TANK
13. INTAKE AIR DUCT
14. AN/ARN-6 RADIO SENSE ANTENNA
15. ENGINE CONTROL VALVE
16. FUSELAGE AFT-SECTION ATTACHING POINT
17. TAIL PIPE SLING
18. TAIL PIPE SUPPORT RACK
19. TAIL PIPE
20. GYROSYN COMPASS FLUX VALVE
21. TAIL PIPE CLAMP
22. ELEVATOR TAB MOTOR
23. ENGINE
24. INTAKE AIR SEAL
25. JATO HOOKS
26. ENGINE MOUNTS
27. FUEL FLOW METER
28. AILERON BOOSTER UNIT
29. WING SPARS
30. DIVE RECOVERY FLAPS
31. AILERON TORQUE ROD
32. ELEVATOR PUSH-PULL ROD
33. SCR-695-A RADIO INSTALLATION
34. SUB-COCKPIT JUNCTION BOX
35. BATTERY
36. SCR-695-A RADIO ANTENNA
37. ELEVATOR AND AILERON CONTROL ASSEMBLY
38. NOSE ALIGHTING GEAR
39. RUDDER PEDALS
40. LANDING LIGHTS
41. FUSELAGE NOSE-SECTION ATTACHING POINT
42. CASE EJECTION DOOR
43. BALLAST BOX
44. AIR-SPEED PITOT
45. .50 CALIBER MACHINE GUNS (6)

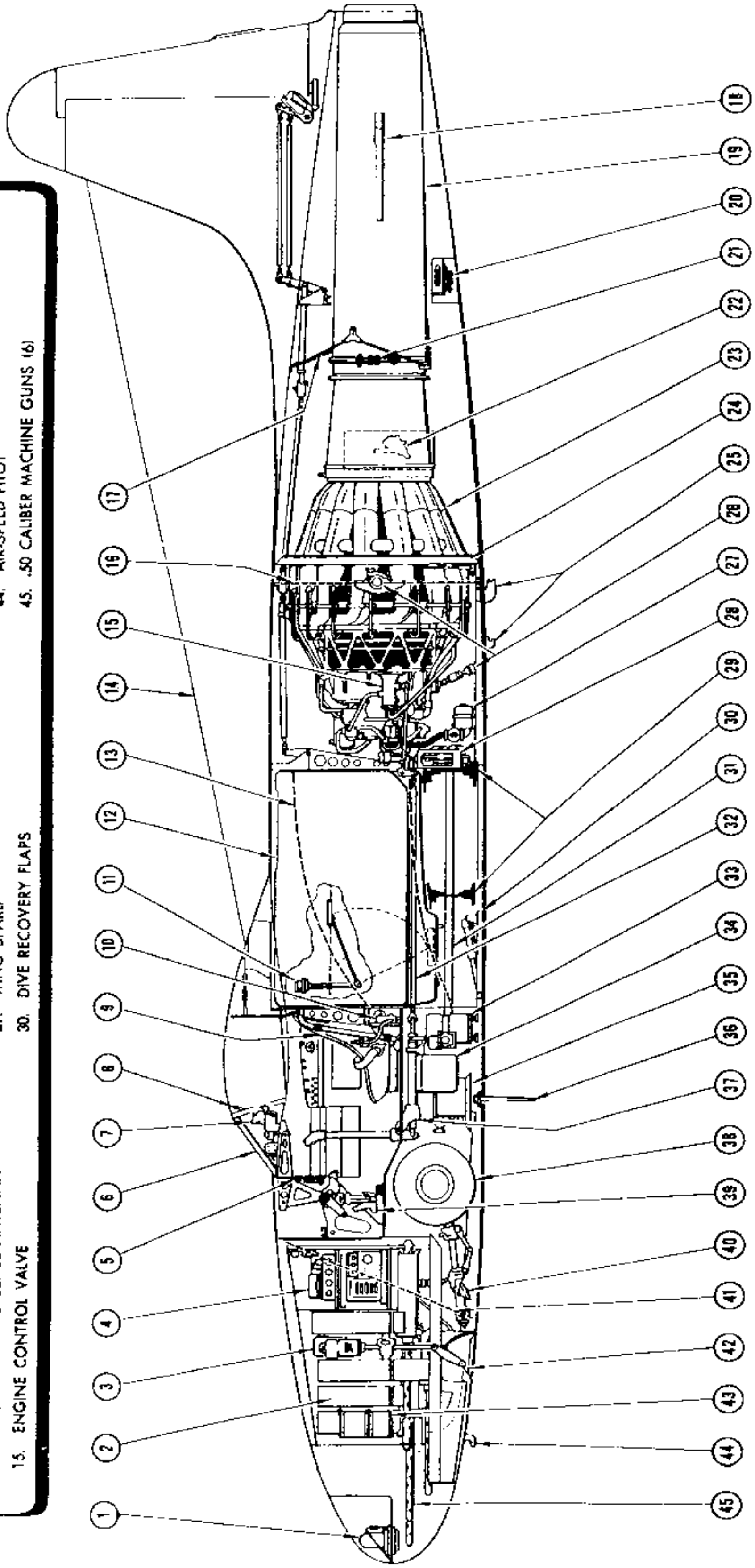


*Figure 4 — Interior Arrangement of the P-80A Airplane*

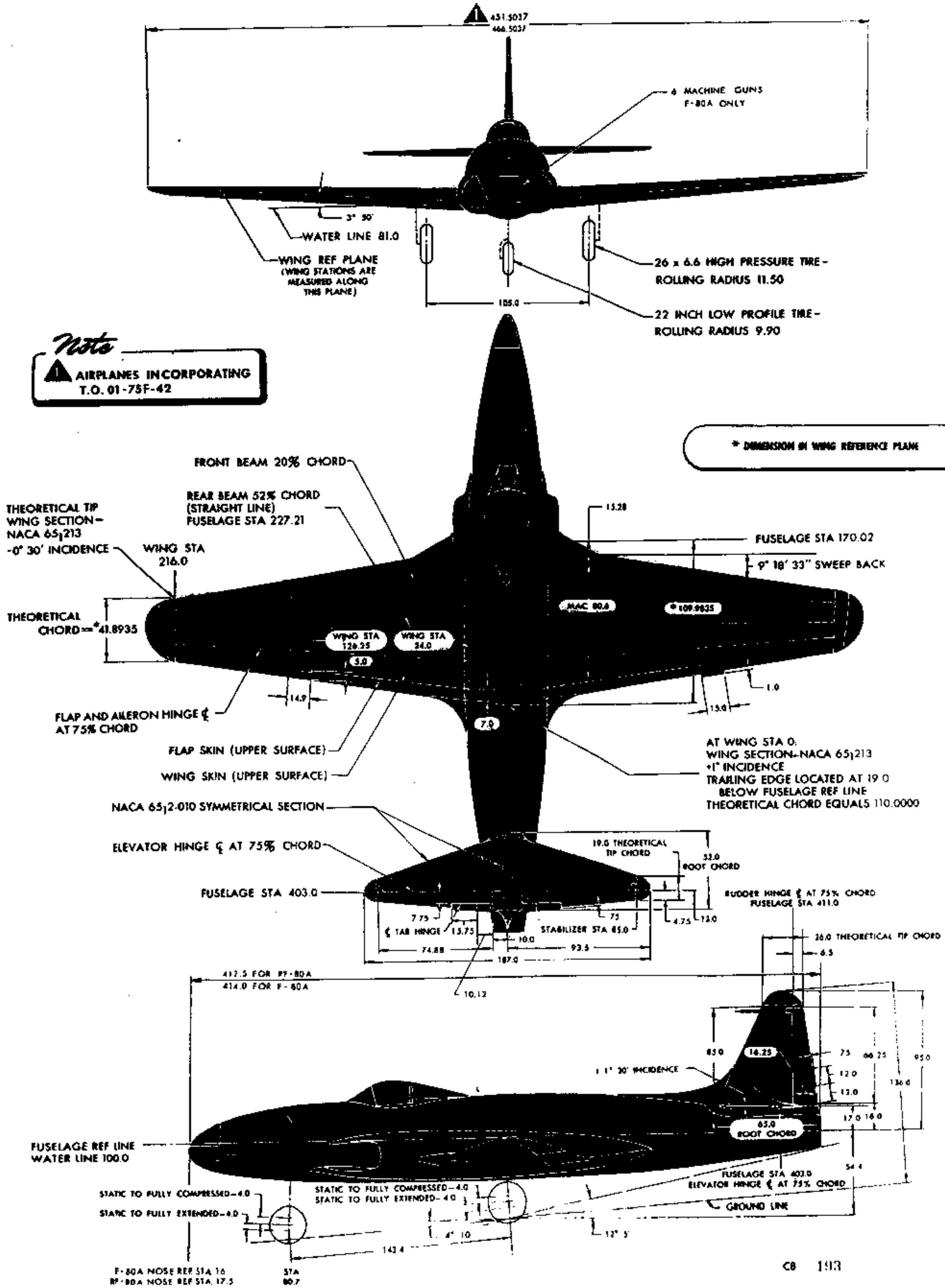



*Figure 5 — General Dimensions*

# SECTION I

# DESCRIPTION, DIMENSIONS, AND LEADING PARTICULARS

**Note**

This handbook will employ the use of both the prefix "P" and the prefix "F" with model designations. It is intended that all model designations will eventually be identified with the prefix "F." Refer to the following table until this change has been accomplished.

| *Model* | *Is Identical to* |
|---|---|
| P-80A | F-80A |
| FP-80A | RF-80A |

## 1. DESCRIPTION.

The Model F-80A-1-LO and F-80-5-LO are all-metal, low wing, single seat, high speed airplanes designed and manufactured by the Lockheed Aircraft Corporation for the interception and attack of hostile aircraft. The power source is a single turbo-jet engine located aft of the cockpit. This airplane also incorporates an improved laminar flow wing section, aileron control hydraulic boost mechanism, pressurized cockpit, heavy fire power, and provisions for carrying droppable fuel tanks or bombs.

The Model RF-80A-5-LO is a photographic airplane similar to the F-80A, except that the complete nose section has been redesigned to accommodate photographic equipment in place of armament equipment.

The F-80A-10-LO and RF-80A-10-LO airplanes are modernized versions of the F80A-1-LO, F-80A-5-LO, and RF-80A-5-LO airplanes, and differ from them as follows:

*a.* Installation of AN/ARN-6 radio compass.

*b.* Installation of jato units.

*c.* Installation of 7½-inch hydraulic accumulator.

*d.* Installation of fluid injection system.

*e.* Installation of nose pitot mast on F-80A-10 airplanes only.

*f.* Installation of dual external power receptacles.

*g.* Installation of single-lever engine control valve.

*h.* Installation of accelerometer.

*i.* Installation of plenum chamber fire warning units.

*j.* Modification of wing tips.

*k.* Modification of heating, cooling, and pressurization system.

*l.* Modification of auxiliary air pressure system.

*m.* Miscellaneous electrical modifications.

*n.* Installation of fluid injection and fuel de-icing systems.

F-80A-10 airplanes bearing the following Air Forces serial numbers have been modified for operation under extreme cold weather conditions: 44-85375, 44-85376, 44-85380, 44-85421, 44-85422, 44-85438, 44-85472, 44-85478, 44-85484, 44-85488, 45-8303, 45-8309, 45-8311, 45-8313, 45-8316, 45-8318, 45-8320, 45-8321, 45-8326, 45-8328, 45-8329, 45-8336, 45-8339, 45-8342, 45-8343 and 45-8355. All aircraft which are winterized by service activities must incorporate the items noted below. Essentially, this winterization consists of the following items:

*a.* Replacement of I-16 emergency fuel pump with Pesco S-1342A pump;

*b.* Modification of fuel system to utilize left leading-edge tank for gasoline starting, plus installation of warning light to indicate when gasoline system is in operation;

*c.* Installation of IP739C-1 or IP739CA-1 engine-driven fuel pump;

*d.* Installation of drop tank emergency jettisoning switch;

*e.* Installation of drain plugs in drop tanks;

*f.* Installation of self-locking valves in all fuel drain lines;

*g.* Installation of provisions for motoring the engine without energizing the ignition system;

*h.* Relubrication of bearings, wing-flap position indicator cable, K-14 gunsight range control, and machine guns;

*i.* Installation of hydraulic accumulator air-pressure gage;

*j.* Installation of AN6287-1 air valve assemblies in hydraulic accumulator and landing gear struts;

*k.* Installation of winterized aileron booster shut-off valve;

*l.* Installation of modified brake line swing joint;

*m.* Installation of winterized "O" and "V" rings in all hydraulic units;

*n.* Installation of type B-7 gun switch relay kits;

*o.* Installation of winterized radio and electronic equipment;

*p.* Installation of auxiliary windshield defroster;

*q.* Installation of cockpit temperature indicator;

*r.* Replacement of synthetic rubber with natural rubber in engine-control-lever seal, canopy seal, and canopy-to-windshield seal;

*s.* Identification of airplanes as suitable for use in arctic regions, in accordance with T. O. 07-1-1 as applicable.

The RF-80A-15 airplanes bearing the following Air Force serial numbers have been converted from F-80A airplanes by Lockheed Aircraft Service, Inc.: 44-85013, 44-85015, 44-85019, 44-85038, 44-85039, 44-85047, 44-85049, 44-85062, 44-85063, 44-85059, 44-85101, 44-85109, 44-85122, 44-85142, 44-85155, 44-85160, 44-85161, 44-85163, 44-85168, 44-85172, 44-85177, 44-85181, 44-85182, 44-85196, 44-85205, 44-85239, 44-85242, 44-85244, 44-85253, 44-85260, 44-85268, 44-85269, 44-85279, 44-85281, 44-85283, 44-85287, 44-85291, 44-85297, 44-85310, 44-85315, 44-85320, 44-85322, 44-85324, 44-85330, 44-85356, 44-85366, 44-85379, 44-85393, 44-85397, 44-85398, 44-85411, 44-85442, 44-85448, 44-85464, 44-85466, 44-85476, 45-8319, 45-8325, 45-8327, 45-8337, 45-8346, 45-8350, 45-8351, 45-8359, 45-8362, and 45-8406. This conversion is generally similar to the RF-80A-5 and RF-80A-10 airplanes except as noted in Section IV, Paragraphs 17bb, 25 and 26e. The nose section has been redesigned to accommodate various camera arrangements.

The RF-80A-20 and RF-80A-25 are conversions of the RF-80A-10 and RF-80A-15 and differ from them as follows:

*a.* Installation of the J33-A-35 engine.

*b.* Installation of the AN/ARC-27 command radio.

*c.* Installation of the AN/APW-11 identification radar.

The following F-80A and RF-80A airplanes have been converted to F-80C-11 and RF-80C-11 airplanes by Lockheed Aircraft Service, Inc.: 44-84994, 44-85001, 44-85004, 44-85007, 44-85009, 44-85012, 44-85014, 44-85024, 44-85025, 44-85029, 44-85041, 44-85051, 44-85057, 44-85060, 44-85071, 44-85072, 44-85080, 44-85088, 44-85098, 44-85104, 44-85105, 44-85107, 44-85110, 44-85112, 44-85120, 44-85124, 44-85125, 44-85128, 44-85132, 44-85134, 44-85135, 44-85150, 44-85151, 44-85154, 44-85166, 44-85167, 44-85171, 44-85175, 44-85176, 44-85178, 44-85179, 44-85180, 44-85183, 44-85190, 44-85191, 44-85201, 44-85210, 44-85216, 44-85217, 44-85225, 44-85226, 44-85227, 44-85229, 44-85230, 44-85231, 44-85237, 44-85240, 44-85245, 44-85246, 44-85247, 44-85249, 44-85252, 44-85261, 44-85262, 44-85264, 44-85270, 44-85284, 44-85285, 44-85290, 44-85293, 44-85300, 44-85321, 44-85328, 44-85333, 44-85334, 44-85342, 44-85345, 44-85363, 44-85364, 44-85370, 44-85374, 44-85384, 44-85386, 44-85390, 44-85392, 44-85394, 44-85395, 44-85400, 44-85401, 44-85402, 44-85405, 44-85406, 44-85410, 44-85414, 44-85416, 44-85418, 44-85423, 44-85424, 44-85427, 44-85429, 44-85430, 44-85431, 44-85432, 44-85434, 44-85435, 44-85437, 44-85440, 44-85441, 44-85446, 44-85450, 44-85456, 44-85468, 44-85480, 44-85482, 44-85486, 44-85490, 45-8305, 45-8307, 45-8315, 45-8324, 45-8330, 45-8331, 45-8334, 45-8335, 45-8347, 45-8348, 45-8354, 45-8357, 45-8358, 45-8363, 45-8372, 45-8373, 45-8374, 45-8375, 45-8383, 45-8421, and 45-8477. This conversion consists of the installation of the J33-A-35 engine, an ejection seat using an M-5 catapult and M-3 initiator, and provisions for an AN/ARC-27 command radio. For information on this equipment consult T. O. 1F-80B-2.

The wing is full cantilever, stressed aluminum-alloy skin construction, made in one unit. Wing leading-edge sections, wing tips, ailerons, and flaps are detachable. Interior structure consists of two main spars and one auxiliary spar for the attachment of the ailerons and split-type flaps. Space is also provided for installing self-sealing fuel tanks, oxygen cylinders, and attachment and enclosure of the main alighting gears. Wing flaps are installed to increase the lift and drag of the airplane.

Ailerons of conventional design and control as operated by lateral motion of the control stick.

The fuselage structure is aluminum-alloy construction, built in three sections: nose, mid section, and aft section. The mid section and aft section are easily separable at station 277.5, to accommodate the power plant installation. A self-sealing fuel tank is installed in the mid section immediately aft of the cockpit. The cockpit is covered by a transparent plastic canopy of the "free blown" type which slides in tracks and can be jettisoned in an emergency. An aid conditioning system is provided including equipment for pressurizing the cockpit and for providing the pilot with the proper amount of air at a controllable temperature. Two hydraulically operated dive-recovery flaps are incorporated in the bottom of the fuselage at approximately station 164.

The fuselage aft section incorporates the tail structure consisting of a horizontal stabilizer, two elevators, a vertical fin, and a rudder. Fore-and-aft motion of the control stick moves the elevators through a system of torque tubes and push-pull rods. The rudder is controlled by the rudder pedals and a cable system. At the extreme end of the fuselage aft section a steel ring serves to increase structural rigidity and a steel panel on the bottom serves to resist scuffing in event of tail low landings.

Armament equipment of the F-80A consists of six .50 caliber machine guns with ammunition trays for 300 rounds per gun mounted in the nose section of the fuselage. A computing gun sight is mounted in the cockpit directly behind the bulletproof windshield on the center line of the airplane. One gun camera is mounted in the outboard leading edge of the right-hand air intake scoop, and a gun camera is mounted in each of the two wing pods. Provisions are made for carrying eight 5-inch HVAR rockets, four under each wing.

Sufficient armor plate is provided to protect the pilot from front and rear. Provisions are made in each wing tip to carry a bomb weighing from 100 to 1000 pounds, in lieu of the droppable fuel tanks. On airplanes incorporating T. O. 1F-80-203 the wing tips have been modified to carry centerline droppable fuel tanks, and provisions have been made in the wing for a bomb rack to be carried in an under-the-wing pylon.

Communication equipment of the F-80A consists of a short-range command transmitting and receiving radio (AN/ARC-3), beacon receiver radio (BC-1206C), and identification radio (SCR-695A). The beacon receiver radio is replaced by a radio compass, AN/ARN-7 in the RF-80A and AN/ARN-6 in later F-80A-5 airplanes. Instruments and equipment necessary for day and night flying are provided. In airplanes incorporating F80/SB-115, the SCR-695A identification radio has been replaced by AN/APX-6 identification radar equipment.

Hydraulically operated tricycle alighting gear consists of two main gears retracting inward, and a nose gear retracting aft. When retracted, all gears are enclosed by flush doors. Brakes on the main-gear wheels are of the single-disc, three-spot type, hydraulically controlled by differential action of two master cylinders, one connected to each rudder pedal. A shimmy damper is provided on the nose gear. The nose gear has provisions for forward towing, and the main gear has provisions for forward and aft towing of the airplane.

A 1000-psi pressure hydraulic system is provided which operates all of the main hydraulic actuating units. An emergency hydraulic system is provided to actuate the alighting gear in event of failure of the main system.

A low-pressure demand oxygen system is installed. The oxygen supply is directed to the pilot from cylinders located in the wing and fuselage nose structures through a pressure demand regulator in the cockpit.

Wing flaps, elevator trim tabs, aileron tabs, and ammunition ejection-chute doors are all electrically actuated.

Fuselage and wing stations are shown on figure 6.

## 2. DIMENSIONS.

For principal over-all dimensions, see figure 5.

## 3. LEADING PARTICULARS.

Airplane designation by Army Air Forces, F-80A-1-LO, F-80A-5-LO, RF-80A-5-LO, F-80A-10-LO, RF-80A-10-LO, RF-80A-15-LO, RF-80A-20-LO, and RF-80A-25-LO.

*a.* PRINCIPAL DIMENSIONS. — Airplane in level flight position unless otherwise stated.

COMPLETE AIRPLANE.

| | |
|---|---|
| Span (Wing) | 38 ft 10.5 in. |
| Span (Wing) Airplanes Incorporating T.O. 01-75F-42 | 37 ft 7.5 in. |
| Length (Not including distance tail pipe extends beyond aft end) | |
| F-80A-1, F-80A-5, F-80A-10 | 34 ft 6 in. |
| RF-80A-5, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 | 34 ft 4.5 in. |
| Height (Airplane on Ground) | 11 ft 4 in. |

WING

| | |
|---|---|
| Airfoil Section | Root: NACA $65_1213$, a = .5 |
| | Tip: NACA $65_1213$, a = .5 |
| Chord at Root (Theoretical) | 110.00 in. |
| Chord Near Tip (Theoretical) | 41.80 in. |
| Incidence at Root | +1° |
| Incidence at Tip | −0° 30′ |
| Dihedral at Trailing Edge of Wing Reference Plane | 3° 50′ |
| Sweepback at Leading Edge | 9° 18′ 33″ |

HORIZONTAL STABILIZER

| | |
|---|---|
| Airfoil Section | NACA $65_12$-010 Sym Section |
| Span | 15 ft 7 in. |
| Chord at Root (Theoretical) | 52.00 in. |
| Chord at Tip (Theoretical) | 19.00 in. |
| Incidence | −1° 30′ |
| Dihedral | 0° |

FIN

| | |
|---|---|
| Airfoil Section | NACA, $65_12$-010 Sym Section |
| Height (From bottom of Rudder) | 77.00 in. |
| Chord at Root (Theoretical) | 65.00 in. |
| Chord at Tip (Theoretical) | 26.00 in. |

FUSELAGE

| | |
|---|---|
| Width (Maximum) | 56.00 in. |
| Height (Maximum) | 56.00 in. |
| Length (Not including distance tail pipe extends beyond aft end) | |
| F-80A-1, F-80A-5, F-80A-10 | 34 ft 6 in. |
| RF-80A-5, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 | 34 ft 4.5 in. |

*b.* AREAS.

| | |
|---|---|
| WING (Including Projected Fuselage Area) | 237.70 sq ft |
| Ailerons (Two, Including Tabs) | 17.60 sq ft |
| Aileron Trim Tab (Left Side) | 0.48 sq ft |
| Aileron Bend Tab (Right Side) | 0.10 sq ft |
| WING FLAPS (Total) | 30.70 sq ft |
| DIVE RECOVERY FLAPS (Total) | 5.80 sq ft |
| HORIZONTAL TAIL SURFACES | |
| Stabilizer | 34.80 sq ft |
| Elevators (Two, Including Tabs) | 9.00 sq ft |
| Elevator Trim Tabs (Total) | 0.71 sq ft |
| Elevator Spring Tabs (Total) | 0.65 sq ft |
| VERTICAL TAIL SURFACES | |
| Fin | 17.20 sq ft |
| Rudder (Including Tab) | 5.30 sq ft |

*c.* SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES.—Refer to section IV, paragraph 15 for detailed instructions and allowable tolerances for setting of control surfaces.

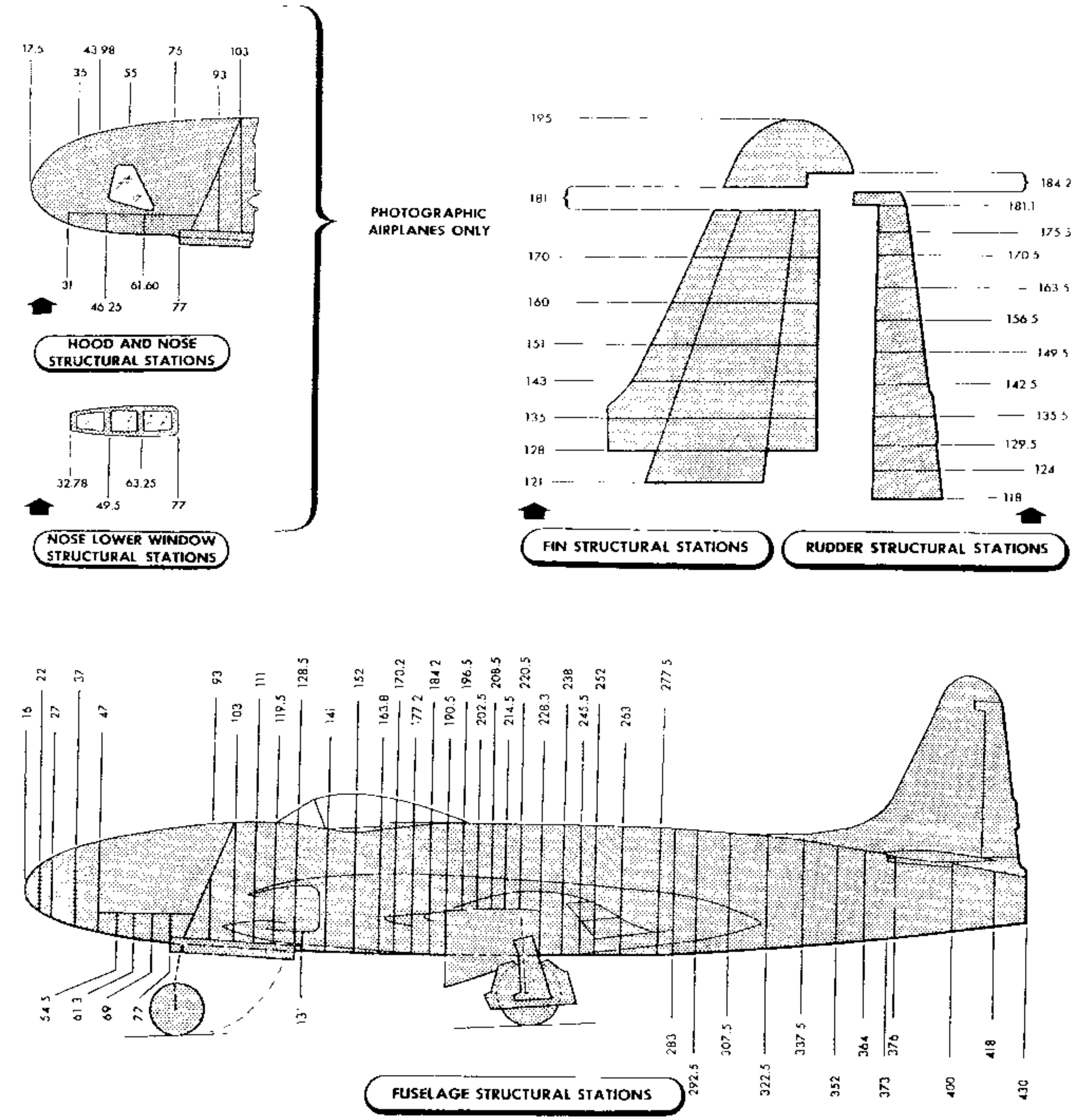



*Figure 6 (Sheet 1 of 2 Sheets) — Stations Diagram*

| | Inches | Degrees |
|---|---|---|
| STABILIZER | 0 | 0 |
| FIN Offset from Fuselage Center Line | 0 | 0 |
| AILERONS | | |
| Up Travel from Neutral | 6.05 | 20 |
| Down Travel from Neutral | 6.05 | 20 |

(Measured between upper skin surface of aileron and upper skin surface of flap at trailing edge. Flap must be fully retracted before taking measurements.)

| | Inches | Degrees |
|---|---|---|
| ELEVATORS | | |
| Up Travel from Neutral | 7.84 | 38 |
| Down Travel from Neutral | 3.34 | 16 |

(Measured between the upper skin surface of the spring tab and the upper surface of the adjacent fairing at inboard trailing edge. Measure to point on the tab adjacent to the fairing trailing edge, not to the extended trailing edge.)

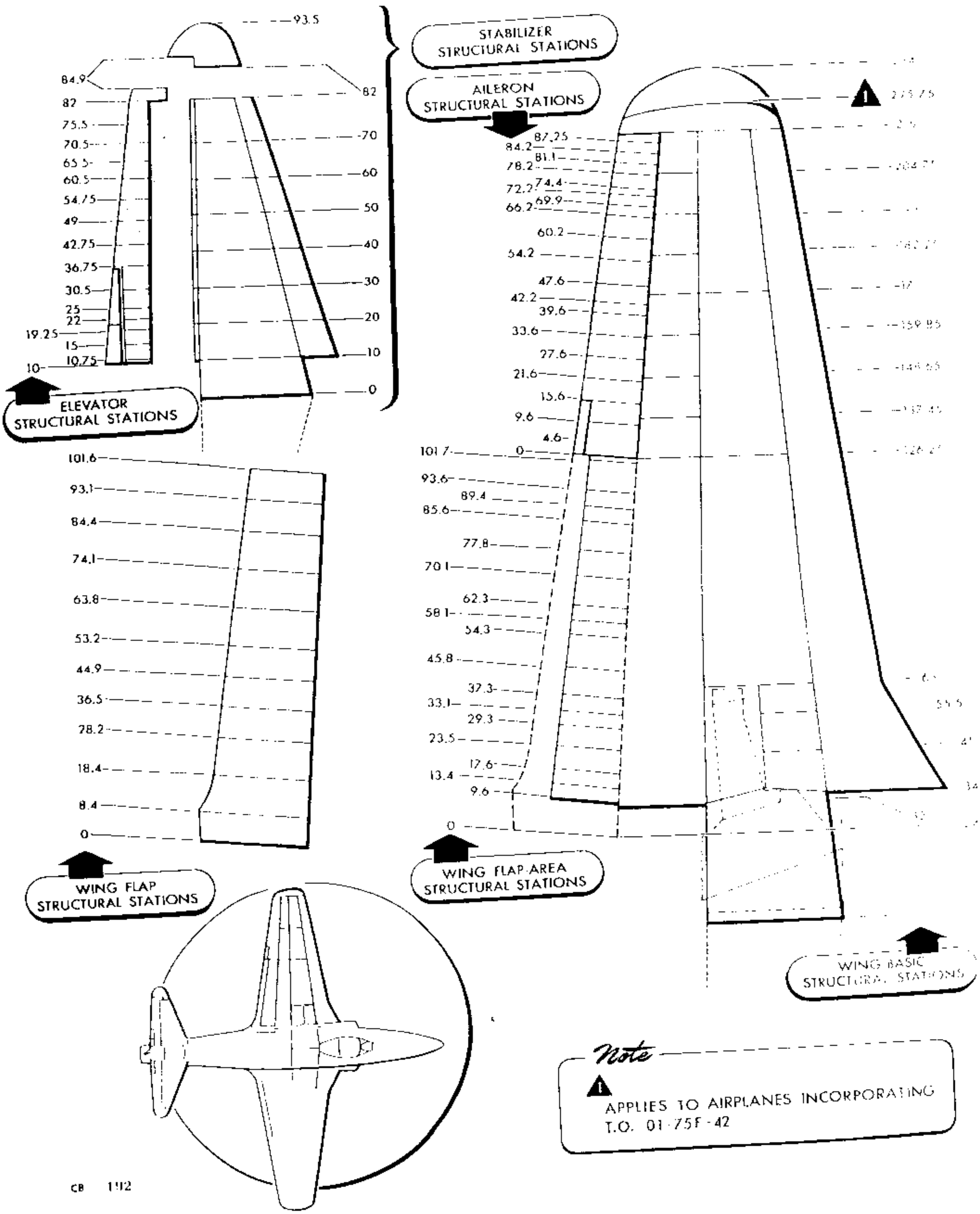



Figure 6 (Sheet 2 of 2 Sheets) — Stations Diagram

| | Inches | Degrees |
|---|---|---|
| RUDDER | | |
| Right Travel from Neutral | 8.43 | 30 |
| Left Travel from Neutral | 8.43 | 30 |
| (Measured between center line of rudder trailing edge at bottom of rudder and center line of fairing.) | | |
| TRIM TABS | | |
| Elevator | | |
| Up Travel from Trailing Edge (Elevator Down) | | |
| Inboard End (Total) | 1.16 | 20° 20′ |
| Outboard End (Total) | 0.63 | 20° 20′ |
| (5° 20′ Servo plus 15° Trim) | | |
| Down Travel from Trailing Edge (Elevator Up) | | |
| Inboard End (Total) | 2.13 | 37° 40′ |
| Outboard End (Total) | 1.15 | 37° 40′ |
| (12° 40′ Servo plus 25° Trim) (Measure to a point on the tab adjacent to the elevator trailing edge, not to the extended trailing edge.) | | |
| Aileron | | |
| Up Travel from Trailing Edge | 1.29 | 20 |
| Down Travel from Trailing Edge | 1.29 | 20 |
| (Measured between upper skin surface of tab and upper skin surface of aileron at outboard trailing edge of tab.) | | |
| ELEVATOR SPRING TABS | | |
| Up Travel from Trailing Edge | | |
| Inboard End | 0.74 | 10 |
| Outboard End | 0.56 | 10 |
| Down Travel from Trailing Edge | | |
| Inboard End | 1.63 | 22 |
| Outboard End | 1.26 | 22 |

(Measured between upper surface of tab skin and upper surface of adjacent fairing at inboard trailing edge. Measure to point on the tab adjacent to the fairing trailing edge, not to the extended trailing edge.)

| | Inches | Degrees |
|---|---|---|
| WING FLAPS | | |
| Down Travel (See figure 39) | | |
| Inboard End | 14.00 | 45 |
| Outboard End | 9.75 | 45 |
| DIVE RECOVERY FLAPS, | | |
| Down Travel (See figure 58) | | 35 |

*d.* WHEEL TYPE ALIGHTING GEAR.

| | |
|---|---|
| MAIN GEAR | |
| Type | Hydraulically Retractable |
| Tread | 105 in. |
| Shock Struts | |
| Type | Air-oil |
| Make and Part No. | Cleveland Pneumatic Tool Co. 8455-00 L/R, or Menasco 506,000 L/R |
| Fluid Required | |
| Specification No. | AN-O-366 |
| Trade Name Identification | Gen. Petroleum RD 10-220<br>Std. Oil of N. J. WS-491<br>Intava Grade 672 |
| Wheels | |
| Type | Goodyear 530746M-1, 22 x 6.6 |
| Tires | 26 x 6.6 12-ply rayon, Type VII, Specification MIL-C-5041 |
| Brake and Disc Assy | Goodyear 511980M, Single Disc, 14.5 x 2.375 |
| NOSE GEAR | |
| Type | Swiveling, Hydraulically Retractable |
| Shock Strut | |
| Type | Air-oil |
| Make and Part No. | Cleveland Pneumatic Tool Co. 8456-00, or Menasco 506,500 |
| Fluid Required | |
| Specification No. | AN-O-366 |
| Trade Name Identification | Gen. Petroleum RD 10-220<br>Std. Oil of N. J. WS-491<br>Intava Grade 672 |
| Wheels | |
| Type | Bendix 145120 Low-profile Cantilever type, 22 x 7.25 |
| Tire | 22 x 7.25-11.50 Low-profile, 8-ply rayon, Type VI |

*e.* ENGINE

| | |
|---|---|
| Manufacturer | General Electric Co. or Allison Division of General Motors Corporation |

| | | |
|---|---|---|
| AF Designation | | |
| | F-80A-1 Airplanes | J33-A-9 or J33-GE-11 |
| | F-80A-5 and RF-80A-5 Airplanes | J33-A-17 |
| | F-80A-10, RF-80A-10 and RF-80A-15 Airplanes | J33-A-9A, or B, J33-GE-11A or B, J33-A-17 or -17A, or J33-A21 |
| | RF-80A-20 and RF-80A-25 | J33-A-35 |
| Fuel | | Specification MIL-F-5624 Grade JP-4 |
| Oil | | Jet Engine Specification No. MIL-0-6081. Use Grade 1010 for temperatures above +20°F (—6.7°C), either Grade 1010 or Grade 1015 for temperatures between +20°F (—6.7°C) and —20°F (—28.9°C), and Grade 1005 for temperatures below —20°F (—28.9°C). |

*f.* TANK CAPACITIES.

FUEL (Approximate Usable Capacity)

**Note**

In those airplanes incorporating T. O. 01-75F-42, each droppable fuel tank has 230 U.S. (191.6 Imperial) gallons capacity.

| | *Gallons* | |
|---|---|---|
| | *U.S.* | *Imperial* |
| Early Airplanes | | |
| Standard | 337 | 280 |
| Droppable Tanks | 330 | 274 |
| Total | 667 | 554 |
| Later Airplanes | | |
| Standard | 425 | 353 |
| Droppable Tanks | 330 | 274 |
| Total | 755 | 627 |

OIL.—Sufficient oil (3.0 U.S., 2.5 Imperial gallons) is carried in the bottom of the engine accessory gear drive case; hence an auxiliary oil tank is not required. Two U.S. (1.7 Imperial) gallons of oil is sufficient for the engine flush run.

HYDRAULIC FLUID (Approximate)

| | *Gallons* | |
|---|---|---|
| | *U.S.* | *Imperial* |
| Main System Total (Includes Tank, Plumbing Lines, and Units) | 3.90 | 3.24 |
| Main System Tank | 1.40 | 1.16 |
| Emergency System Tank | 0.72 | 0.60 |

FLUID INJECTION (Approximate)

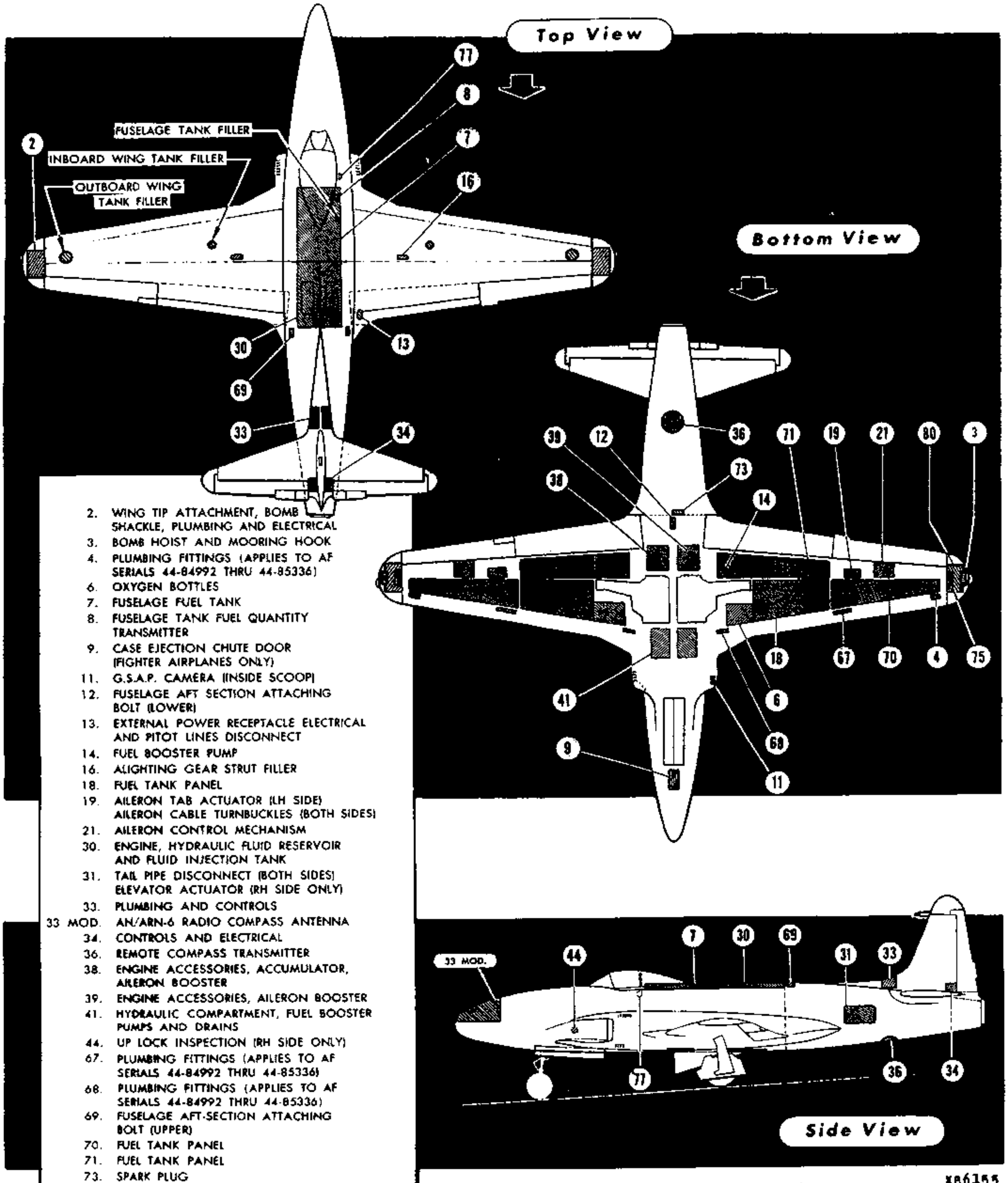
| | *Gallons* | |
|---|---|---|
| | *U.S.* | *Imperial* |
| Two Tanks | 60 | 49.75 |
| FUEL DE-ICING | 30 | 24.90 |
| Minimum | 5 | 4.15 |

# SECTION II

# SHIPMENT AND ERECTION PROCEDURE

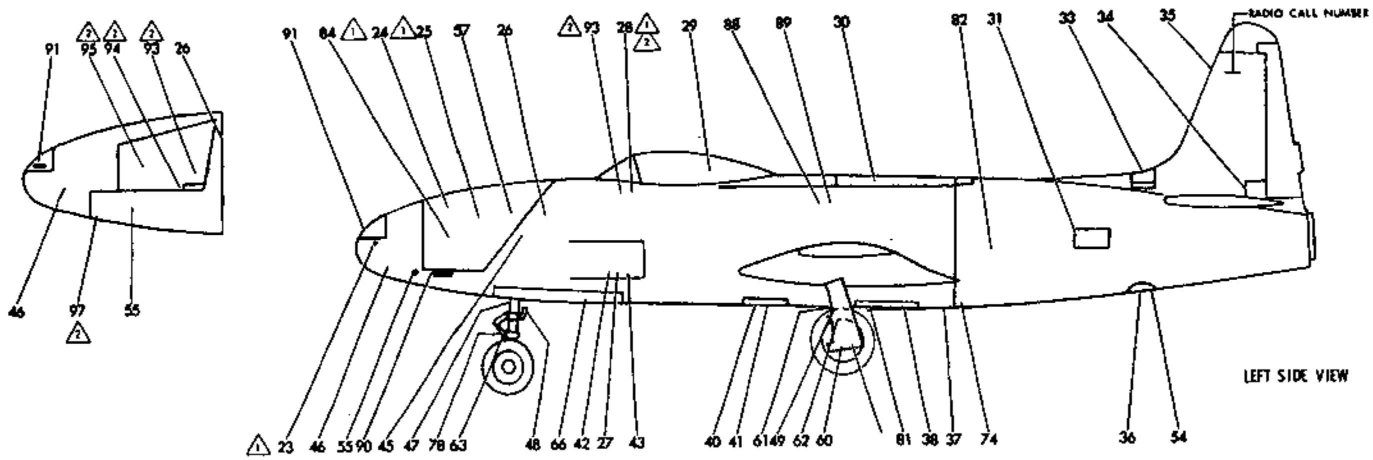
See Technical Order OO-80AA-1.

Airplanes will be protected with AN-C-52 compound instead of strippable plastic. AN-C-52 compound will be removed with kerosene, Specification No. AN-VV-K-211, or solvent, Federal Specification No. P-S-661. Airplanes will be crated in an AN-C-118 crate.




2. WING TIP ATTACHMENT, BOMB SHACKLE, PLUMBING AND ELECTRICAL
3. BOMB HOIST AND MOORING HOOK
4. PLUMBING FITTINGS (APPLIES TO AF SERIALS 44-84992 THRU 44-85336)
6. OXYGEN BOTTLES
7. FUSELAGE FUEL TANK
8. FUSELAGE TANK FUEL QUANTITY TRANSMITTER
9. CASE EJECTION CHUTE DOOR (FIGHTER AIRPLANES ONLY)
11. G.S.A.P. CAMERA (INSIDE SCOOP)
12. FUSELAGE AFT SECTION ATTACHING BOLT (LOWER)
13. EXTERNAL POWER RECEPTACLE ELECTRICAL AND PITOT LINES DISCONNECT
14. FUEL BOOSTER PUMP
16. ALIGHTING GEAR STRUT FILLER
18. FUEL TANK PANEL
19. AILERON TAB ACTUATOR (LH SIDE) AILERON CABLE TURNBUCKLES (BOTH SIDES)
21. AILERON CONTROL MECHANISM
30. ENGINE, HYDRAULIC FLUID RESERVOIR AND FLUID INJECTION TANK
31. TAIL PIPE DISCONNECT (BOTH SIDES) ELEVATOR ACTUATOR (RH SIDE ONLY)
33. PLUMBING AND CONTROLS
33 MOD. AN/ARN-6 RADIO COMPASS ANTENNA
34. CONTROLS AND ELECTRICAL
36. REMOTE COMPASS TRANSMITTER
38. ENGINE ACCESSORIES, ACCUMULATOR, AILERON BOOSTER
39. ENGINE ACCESSORIES, AILERON BOOSTER
41. HYDRAULIC COMPARTMENT, FUEL BOOSTER PUMPS AND DRAINS
44. UP LOCK INSPECTION (RH SIDE ONLY)
67. PLUMBING FITTINGS (APPLIES TO AF SERIALS 44-84992 THRU 44-85336)
68. PLUMBING FITTINGS (APPLIES TO AF SERIALS 44-84992 THRU 44-85336)
69. FUSELAGE AFT-SECTION ATTACHING BOLT (UPPER)
70. FUEL TANK PANEL
71. FUEL TANK PANEL
73. SPARK PLUG
75 BOMB HOIST HOOK
77. EMERGENCY HYDRAULIC TANK—RH SIDE ONLY (APPLIES TO AF SERIALS 44-85337 AND SUBSEQUENT)
80. WING TIP ATTACHMENT, BOMB SHACKLE AND PLUMBING

*Figure 7 — Access Provisions and Identification*




| NO. | STENCIL NOTE | LOCATION OF MARKINGS |
|---|---|---|
| 1. | SHACKLE | TOP OF WING TIP R&L. |
| 2. | CAUTION: SET CABLE RING ON RELEASE ARM | TOP OF BOMB SHACKLE COVER R. & L. |
| 3. | MOOR HERE | BOTTOM OF WING TIP ADJACENT TO BOMB HOIST CONNECTION R&L |
| 4. | PLUMBING FITTINGS | CENTER OF DOOR R&L. |
| 5. | DRAIN FUEL HERE | BOTTOM SURFACE OF WING ADJACENT TO PLUGS R&L. |
| 6. | OXYGEN BOTTLES | CENTER OF PANEL R&L. |
| 7. | FUEL TANK PANEL | CENTER OF COVER R&L. |
| 8 | FUEL LEVEL TRANSMITTER | ADJACENT TO DOOR R&L |
| △1 9. | SHELL EJECTION | CENTER OF DOOR R&L. |
| 10. | NO STEP | TOP OF DUCT FILLET, R&L. |
| 11. | CAMERA ACCESS DOOR | CENTER OF DOOR |
| 12. | FUSELAGE DISCONNECT BOLT | ADJACENT TO COVERS FUS. STA. 277.50 R&L |
| 13. | 24 VOLTS EXT. POWER RECEPT. ELECTRICAL DISCONNECT | CENTER OF DOOR R.H. ONLY. |
| 14. | FUEL BOOST PUMP | CENTER OFF DOOR R. & L. |
| 15. | LIFT HERE | DIRECTLY FWD OF LUG R. & L. |
| 16. | LANDING GEAR STRUT FILLER USE OIL SPECIFICATION MIL-O-5606 | ON COVER PLATE USE RED LETTERS R. & L. |
| 17. | ATTACH JACK PAD HERE | UNDER SIDE OF WING ADJACENT TO 1/4-INCH SCREWS. L. & R. |
| 18. | FUEL TANK PANEL | CENTER OF PANEL R. & L. |
| 19. | TURNBUCKLES-AILERON CONTROL | CENTER OF DOOR R. & L. |
| 20. | AILERON TAB MOTOR. | EDGE OF DOOR L.H ONLY |
| 21. | AILERON CONTROL MECH. | CENTER OF DOOR R. & L. |
| 22 | DISCONNECT ELECTRICAL AND PLUMBING BEFORE REMOVING TIP | NEAR TIP JOINT. R. & L. |
| △1 23. | PLUMB LINE | ADJACENT TO PLATE NUT L.H. ONLY |
| △1 24. | GUN LEVELING LUGS | IN ARMENT COMPARTMENT ON VERTICAL POST |
| △1 25. | ARMAMENT JUNCTION | IN ARMAMENT COMPARTMENT ON BOX COVER |
| 26. | USE OIL SPECIFICATION MIL-O-5606 | ON BRAKE HYD. RESERVOIR |
| 27. | LEVEL HERE | IN NOSE WHEEL WELL ADJACENT TO LEVELING LUGS |
| △1 28. | U.S. AIR FORCE F-80A-- A.F. SERIAL NO. ---A. SERVICE THIS AIRPLANE WITH MIL-F-5624A FUEL. IF NOT AVAILABLE CONSULT T.O. 06-5-1 FOR EMERGENCY ACTION | LEFT SIDE OF FUSELAGE ONLY 6-INCHES BELOW CANOPY SILL AND IN LINE WITH AFT EDGE OF WINDSHIELD |
| △2 28. | AIR FROCE MODEL RF-80A-- A.F. SERIAL NO.--A. SERVICE THIS AIRPLANE WITH MIL-F-5624A FUEL. IF NOT AVAILABLE T.O. 06-5-1 WILL BE CONSULTED FOR EMERGENCY ACTION | LEFT SIDE OF FUSELAGE ONLY 6-INCHES BELOW CANOPY SILL AND IN-LINE WITH AFT EDGE OF WINDSHIELD |
| 29. | DUMMY ARMOR PLATE WEIGHT OF DUMMY PLATE --- LBS. WEIGHT OF ACTUAL PLATE --- LBS. | FWD FACE OF PLATE IN COCKPIT. |
| 30. | HYDRAULIC TANK. | CENTER OF ENGINE ACCESS DOOR L.H ONLY |
| 31. | TAIL PIPE DISCONNECT | BOTTOM OF DOOR |
| 32. | ELEVATOR TAB MOTOR | TOP OF DOOR R.H ONLY |
| 33. | PLUMBING AND CONTROLS. | CENTER OF DOORS R & L. SIDES. |
| 34 | CONTROLS AND ELECTRICAL. | CENTER OF DOOR R & L. |
| 35. | ANTENNA DISCONNECT | LEADING EDGE R.H. ONLY. |
| 36. | REMOTE COMPASS | CENTER OF DOOR. |
| 37. | PLUMB LINE (RED RING) | ADJACENT TO PLATE NUT L.H ONLY |
| 39 | ENGINE ACCESS HYD. GROUND TEST CHECK, AILERON BOOSTER ACCUMULATOR | CENTER OF DOOR L.H. ONLY |
| 39. | ENGINE ACCESS AILERON BOOSTER | CENTER OF DOOR R.H. ONLY. |
| 40. | DANGER: DO NOT TAXI OR TOW AIRPLANE WITH DOOR OPEN | INSIDE CENTER OF DOOR (RED LETTERS) |
| 41. | HYDRAULIC COMPT. FUEL BOOST PUMPS AND DRAINS | OUTSIDE EDGE OF DOOR R. & L. |
| 42. | OXYGEN FILLER VALVE INSIDE WHEEL WELL | OUTSIDE OF SHIP L.H. NEAR WHEEL WELL |
| 43. | USE OIL SPECIFICATION MIL-O-5606 | AFT END OF NOSE WHEEL WELL CENTER OF REMOVABLE PANEL |
| 44. | UP LOCK INSPECTION | ADJACENT TO COVER L.H. ONLY |
| △1 45. | DUMMY ARMOR PLATE WEIGHT OF DUMMY PLATE --- LBS. WEIGHT OF ACTUAL PLATE --- LBS. | BOTH SIDES OF FUSELAGE FORWARD SIDE OF PLATE |
| 46. | ATTACH JACK PAD HERE | BOTH SIDES OF FUSELAGE. STA. 37.00 LOWER |
| 47. | USE OIL SPECIFICATION MIL-O-5606 | ON SHOCK STRUT IN VISIBLE LOCATION |
| 48. | USE OIL SPECIFICATION MIL-O-5606 | ON SHIMMY DAMPER CYLS. IN VISIBLE LOCATION (RED LETTERS) |
| 49. | USE OIL SPECIFICATION MIL-O-5606 | ON SHOCK STRUT IN VISIBLE LOCATION |
| 50. | 1.00 WIDE 26.00 LONG WHITE LINE STA. 64.00 AFT. | ON CENTER LINE OF SHIP |
| 51. | EXTERNAL CANOPY HANDLE | ABOVE EXTERNAL CANOPY HANDLE (BLACK LETTERS) RH ONLY |
| 52. | PUSH | ON EXTERNAL CANOPY HANDLE USE RED ARROW (BLACK LETTERS) |
| 53. | DO NOT USE TO LOCK CANOPY | BELOW EXTERNAL CANOPY HANDLE (RED LETTERS) RH ONLY |
| 54. | DO NOT USE STEEL SCREWS TO HOLD COVER. | BOTTOM EDGE OF DOOR (RED LETTERS) |

**NOTE**

△1 APPLIES TO F-80A AIRPLANES

△2 APPLIES TO RF-80A AIRPLANES

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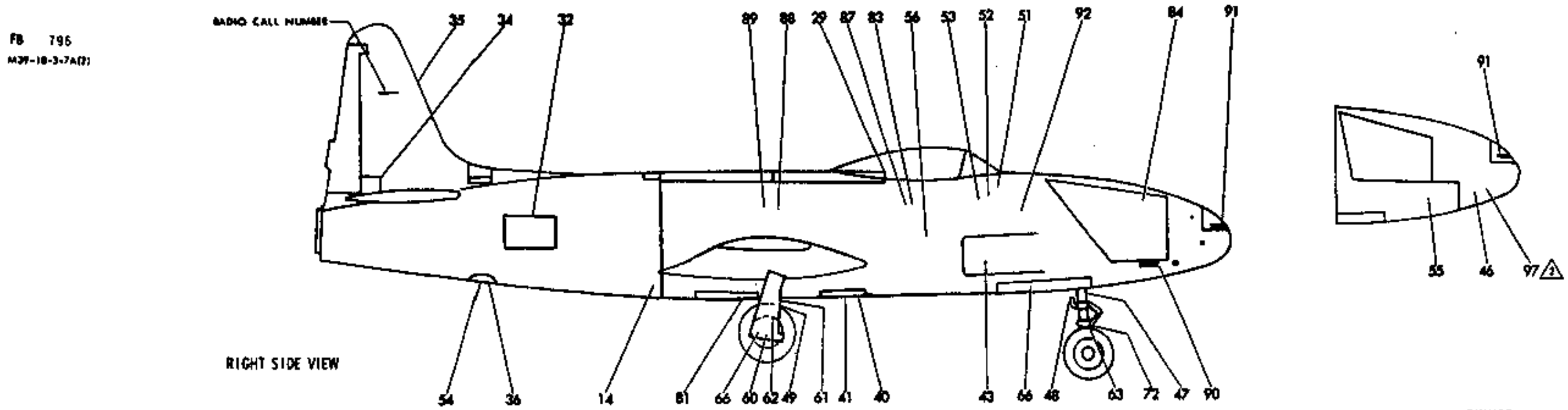
Figure 7A — Airplane Markings Diagram (Sheet 1 of 4)




| NO. | STENCIL NOTE | LOCATION OF MARKINGS |
|---|---|---|
| 55. | AIR SPEED STATIC | BELOW ARMAMENT DOOR (BLACK LETTERS) |
| 56. | MAP CASE | CENTER OF MAP CASE (RED LETTERS) |
| △1 57. | SPARE YAW INDICATORS AND RESIN LENS | INSIDE R.H. ARMAMENT DOOR. (BLACK LETTERS) |
| △2 57 | PUSH | ON CAMERA DOOR RELEASE HANDLE |
| 58 | WARNING DO NOT FILL | ACROSS FILLER WELL (RED LETTERS) |
| 59. | GROUND HERE | AROUND GROUNDING RECEPTACLE ON 3-INCH BLACK BACK GROUND |
| 60. | EMERGENCY TOW | PAINT AFT TOW RING RED. STENCIL ADJACENT TO RING ON MAIN LANDING GEAR R&L |
| 61. | TOW HERE | FWD. TOW RING AT INTERSECTION OF SIDE STRUT & SHOCK STRUT LUG. STENCIL (RED LETTERS) ON SHOCK STRUT R&L |
| 62. | TOW HERE | FWD TOW RING ON SLIDING PISTON TUBE - STENCIL (RED LETTERS) ON TUBE R&L |
| 63. | TOW HERE | NOSE GEAR AT LOWER TORQUE ARM PIN STENCIL (RED LETTERS) |
| 64. | HOIST HERE | BESIDE WING LIFT LUG (BLACK LETTERS) |
| △1 65. | WARNING: KEEP FINGERS CLEAR, DOOR CLOSES INSTANTLY WHEN GUN TRIGGER IS RELEASED | FWD OF SHELL EJECTION CHUTE (RED LETTERS) |
| 66. | FOR CORRECT TIRE INFLATION PRESSURE SEE T.O. 04-10-1 | L.H. NOSE WHEEL DOOR & CENTER MAIN LANDING GEAR DOORS (BLACK LETTERS) |
| 67. | PLUMBING FITTINGS | CENTER OF DOOR |
| 68. | PLUMBING FITTING | CENTER OF DOOR |
| 69. | FUS. DISCONNECT BOLT | ON OR ADJACENT TO COVERS NEAR FUS. STA. 227.50 |
| 70. | FUEL TANK PANEL | CENTER OF PANEL |
| 71. | FUEL TANK PANEL | CENTER OF PANEL |
| 72. | CAUTION: MAXIMUM 45° TURN | NOSE LANDING GEAR STRUT, ON FRONT (RED LETTERS) |
| 73. | SPARK PLUG ACCESS | CENTER FUSELAGE STATION 277.50 |
| 74. | STA. 277.50 | LOWER - FUS. STA. 277.50 |
| 75. | MOOR HERE | BOTTOM OF WING TIP BOMB HOIST CONNECTION R & L. |
| 76. | TIP LIGHT CONNECTION | TOP OF WING TIP, R & L. |
| 77. | EMERGENCY HYDRAULIC TANK - FILL HERE USE OIL SPECIFICATION MIL-O-5606 | AROUND EMERGENCY HYDRAULIC TANK FILLER WELL |
| 78. | GROUND TEST VALVE WARNING: VALVE MUST BE IN FWD POSITION BEFORE TAKE OFF. | ON 176503-6 TRIM PANEL R. H SIDE OF COCKPIT (RED LETTERS) |
| 79. | WARNING: ACCIDENTAL OPERATION OF FLAP MAY CAUSE SERIOUS INJURY. BEFORE WORKING IN HYDRAULIC COMPARTMENT<br>1. PUT DIVE FLAP SWITCH IN DOWN POSITION<br>2. SHUT OFF HYDRAULIC PUMP AND BLEED PRESSURE FROM ACCUMULATOR BY OPERATING AILERON BOOST.<br>3. TURN DIVE FLAP SAFETY SWITCH VALVE HANDLE TO HORIZONTAL POSITION AND SAFETY. | EIGHT INCHES FROM UPPER EDGE AND IN CENTER OF EACH DIVE FLAP DOOR (OUTSIDE) DIMENSIONS OF STENCIL NOTE SHALL BE 4.75-INCHES BY 5.50-INCHES |
| 80. | DISCONNECT ELECTRICAL AND PLUMBING BEFORE REMOVING TIP. | BOTTOM SIDE OF WING TIP ON LARGE ACCESS PANEL R & L. |
| 81. | CHECK THAT HOOKS ARE COCKED BEFORE FLIGHT. | INSIDE OF MAIN LANDING GEAR DOOR R & L. |
| 82. | BATTERY LOCATION: AFT OF NOSE WHEEL. EMERGENCY BATTERY DISCONNECT LEVER LOCATED IN R.H. AFT COCKPIT. | 12.00-INCHES AFT AND 18.00 INCHES ABOVE TRAILING EDGE OF WING ON L.H SIDE ONLY (BLACK LETTERS) |
| 83. | CAUTION EMERGENCY BATTERY DISCONNECT | CENTER NOTE AT FUS. STA. 154.00 ON R.H SHELF ABOVE BATTERY DISCONNECT HANDLE (WHITE LETTERS) |
| △1 84. | CLEAR YAW INDICATOR BEFORE CLOSING DOOR | ON BOTH ARMAMENT DOORS 3/8-INCH (RED LETTERS) STA. 64.00 |
| 85. | PAINT .18-INCH WIDE CONTINUOUS LINE 3-INCH LONG ON UPPER SURFACE AND 12-INCHES LONG ON LOWER SURFACE | WING TIP, WING STA. 228. (BLACK LETTERS) R&L |
| 86. | PAINT .18-INCH WIDE CONTINUOUS LINE 3-INCHES LONG ON UPPER SURFACE AND 12-INCHES LONG ON LOWER SURFACE. | WING TIP, WING STA. 227 (BLACK LETTERS) R&L |
| 87. | PAINT .25 RED & WHITE STRIPES ON EMERGENCY LANDING GEAR CONTROL HANDLE PER AIR FORCE SPECIFICATION 98-24105 | INSIDE COCKPIT R.H. SIDE SHELF |
| 88. | NO STEP | ON TOP SIDE OF INTAKE DUCT AFT END. |
| 89. | NO STEP | ON TOP SIDE OF VANE AT AFT END. |
| △1 90. | WARNING: DO NOT OPERATE SHELL EJECTION DOOR ON GROUND UNLESS NOSE LANDING GEAR IS STRAIGHT | OUTSIDE BOTH SIDES BELOW ARMAMENT DOORS (RED LETTERS) |
| 91. | CONDUCTING PLASTIC. DO NOT PAINT. | ON PLASTIC NOSE (BLACK LETTERS) |
| 92. | SURFACE CONTROL LOCK. | COCKPIT RIGHT SIDE (RED LETTERS) |
| △2 93. | ROTATE HANDLE TO OPEN HOOD. | ABOVE RELEASE HANDLE ON LEFT SIDE OF CAMERA HOOD |
| △2 94. | PUSH | ON CAMERA DOOR RELEASE HANDLE |
| △2 95. | HOLD HERE WHILE OPENING AND CLOSING HOOD. USE CARE IN HIGH WIND | ABOVE HAND HOLD ON LEFT SIDE CAMERA HOOD |
| △2 96. | ANTENNA ACCESS. | ON BOTTOM OF SHIP ON ANTENNA ACCESS COVER |
| △2 97. | PLUMB LINE. | ADJACENT TO PLATE NUT STA. 47 (RED) |
| 98. | FILLER WELL - MIL-F-5624A FUEL 67.5 U.S. GALLONS. | LOCATE ON FILLER WELL DOOR WITH 1-INCH BORDER ON ADJACENT STRUCTURE SURROUNDING FILLER WELL DOOR. USE PAINT INSIGNIA RED SHADE 509 SPECIFICATION MIL-L-7116 R. & L. |
| 99. | FILLER-WELL - MIL-F-5624A FUEL 49.4 U.S GALLONS. | THIS NOTE SAME AS 98. |
| 100. | FILLER WELL - MIL-F-5624A. FUEL 207 U.S. GALLONS. | THIS NOTE SAME AS 98. |

Figure 7A — Airplane Markings Diagram (Sheet 2 of 4)

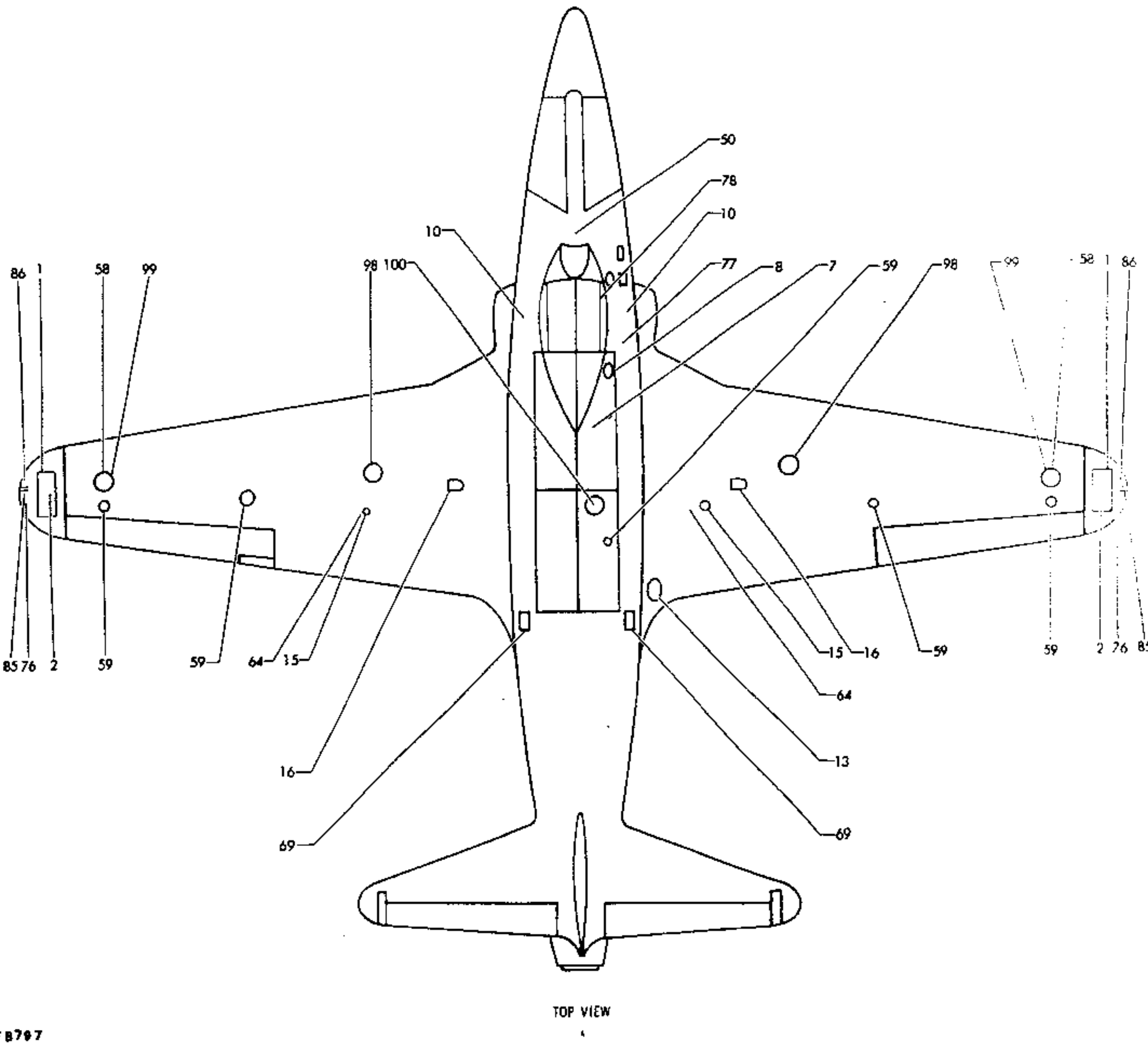



*Figure 7A — Airplane Markings Diagram (Sheet 3 of 4)*

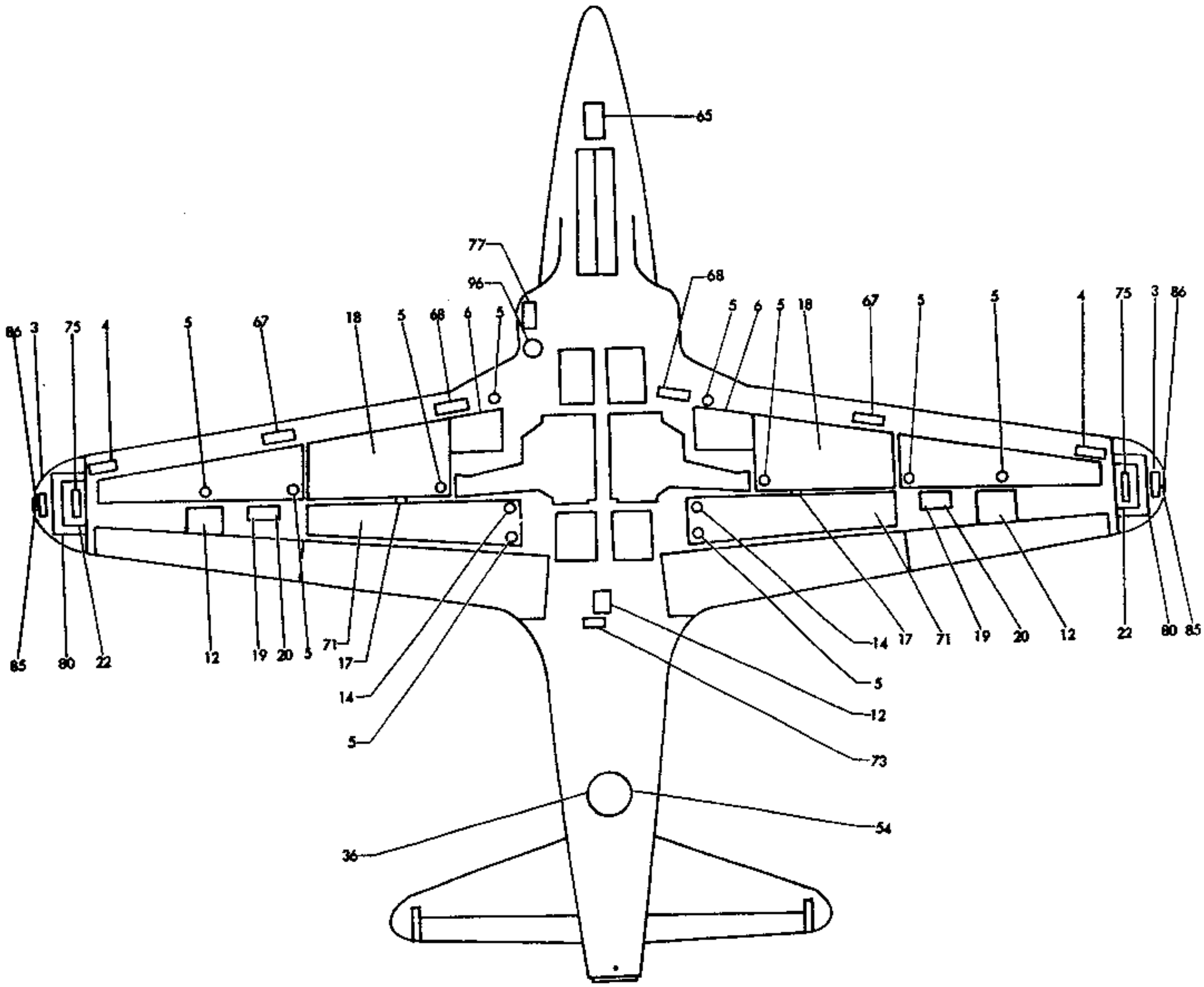



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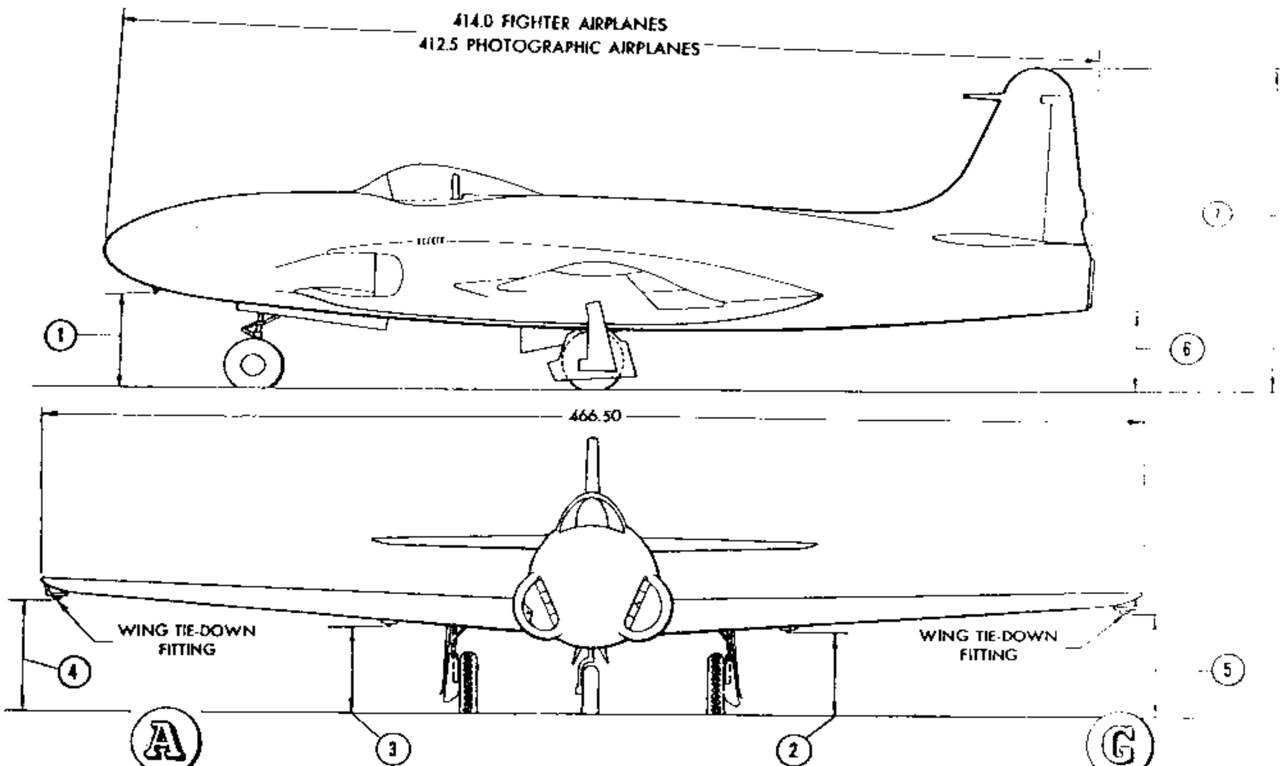
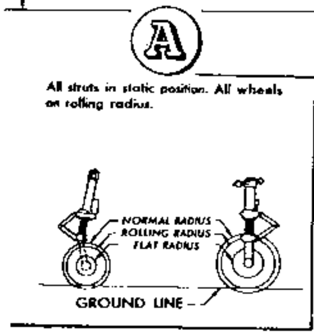
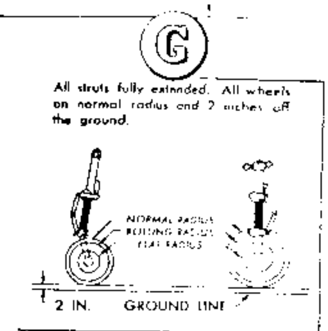
*Figure 7A — Airplane Markings Diagram (Sheet 4 of 4)*

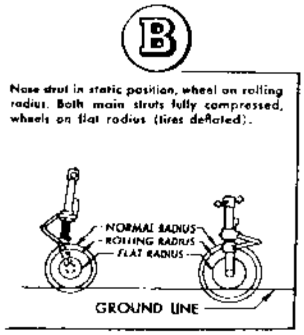


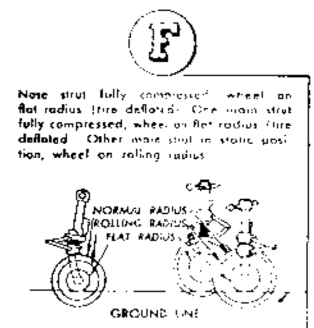



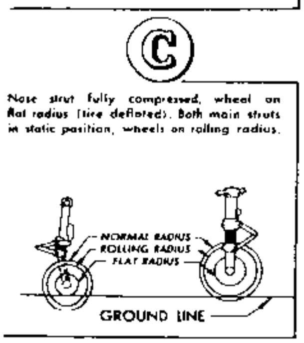



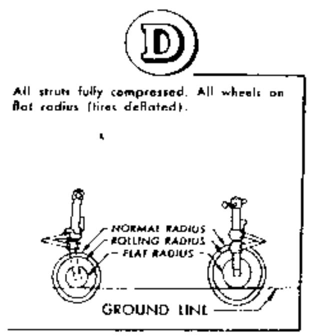

| REF. | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| *1 | 45.4 | 47.3 | 37.6 | 39.5 | 46.2 | 38.5 | 52.5 |
| **1A | 45.7 | 47.8 | 37.6 | 39.8 | 46.6 | 38.8 | 53.0 |
| *2 | 36.6 | 29.9 | 36.8 | 30.1 | 38.3 | 38.5 | 43.9 |
| *3 | 36.6 | 29.9 | 36.8 | 30.1 | 28.0 | 28.3 | 43.9 |
| 4 | 44.3 | 37.8 | 44.3 | 37.8 | 27.4 | 27.4 | 51.6 |
| 5 | 43.3 | 37.8 | 44.3 | 37.8 | 54.5 | 54.6 | 51.6 |
| 6 | 31.7 | 15.8 | 40.5 | 24.6 | 23.7 | 32.5 | 39.1 |
| 7 | 136.7 | 120.8 | 145.5 | 129.6 | 128.7 | 137.5 | 144.1 |

*JACK POINTS—JACK PADS ATTACHED
**PHOTOGRAPHIC AIRPLANES ONLY



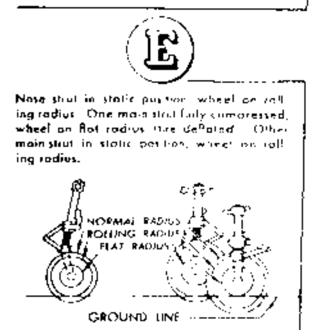
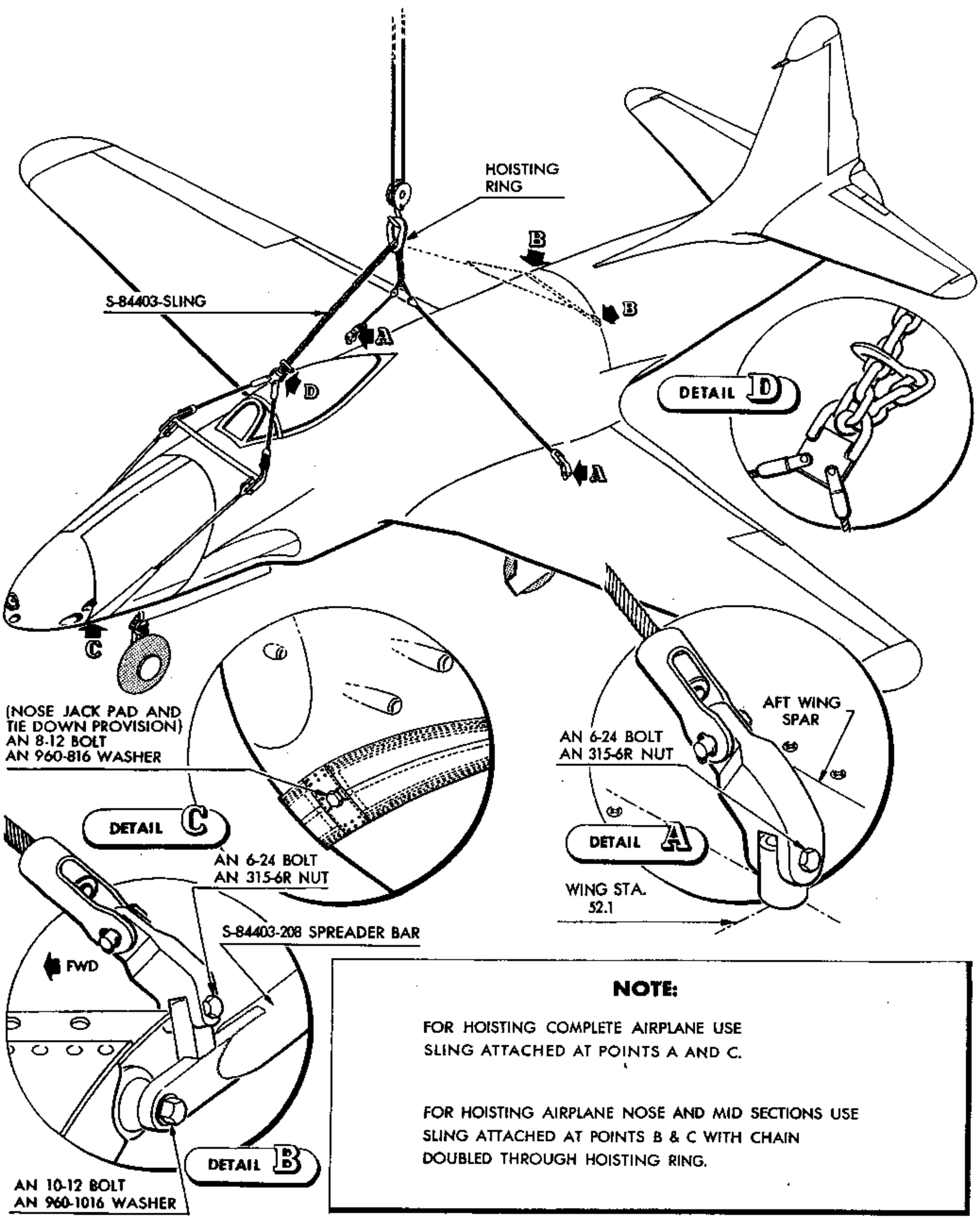




*Figure 8 — Ground Handling Dimensions*




**NOTE:**

FOR HOISTING COMPLETE AIRPLANE USE SLING ATTACHED AT POINTS A AND C.

FOR HOISTING AIRPLANE NOSE AND MID SECTIONS USE SLING ATTACHED AT POINTS B & C WITH CHAIN DOUBLED THROUGH HOISTING RING.

*Figure 9 — Hoisting the Complete P-80A Airplane*

# SECTION III

# HANDLING AND GENERAL MAINTENANCE INSTRUCTIONS

## 1. ACCESS AND INSPECTION PROVISIONS.

Access doors and removable inspection panels are shown in figure 7.

**Note**

Be sure all access doors and inspection panels are securely fastened and flush with the skin before the airplane is flown.

## 1A. AIRPLANE MARKINGS.

Airplane markings are shown on figure 7A.

## 2. GROUND HANDLING.

*a.* GENERAL.—Tighten all structural bolts to torque limits specified in the "Wrench Torque Table" in section IX, except as noted in the text or on illustrations throughout this handbook.

Ground handling for the P-80A and FP-80A airplanes is essentially the same except that sling S-84403 and storage dolly S-84706 as used on the P-80A cannot be used for the FP-80A. Information on such items for the FP-80A will be submitted at a later date.

Refer to figure 8 for ground handling dimensions.

*b.* HOISTING.

(1) HOISTING THE COMPLETE AIRPLANE. *(See figure 9.)*—Hoist the complete fighter airplane with sling No. S-84403.

Attach the canvas part of the sling to the under side of the fuselage nose that provides for the attachment of the nose jack pad and tie-down fitting at point marked "ATTACH JACK PAD HERE." The hoisting lugs for attaching the aft cable of the sling are located in the upper surface of the wing at points marked "HOIST HERE." Before the sling may be attached, screw a No. NAS205 screw into the top of each hoisting lug and raise the lugs into position. The hoisting ring should be approximately two-thirds of the way aft on the chain that connects the forward and aft cables of the sling. Secure the chain through the forward cable ring as shown in detail D, figure 9. Raise the airplane slightly. If the airplane does not hang level, lower it, and move the hoisting ring forward or aft until the airplane hangs level when it is hoisted.

(2) HOISTING THE AIRPLANE LESS ENGINE AND FUSELAGE AFT SECTION.—Proceed as directed in paragraph (1) preceding.

(3) HOISTING THE FUSELAGE NOSE AND MID SECTIONS. *(See figure 9.)*—Hoist the fuselage nose and mid sections of fighter airplanes with sling No. S-84403. This sling is the same as that used for hoisting the complete airplane, but is rigged in a different way.

Attach the canvas part of the sling to the under side of the fuselage nose as described in paragraph *b*(1) preceding. Double the chain between the forward and aft cables of the sling through the hoisting ring, and secure it near the aft cable ring, in a manner similar to that shown in detail D, figure 9. Attach the sling aft spreader bar to the two upper aft-section to mid-section attachment points. Attach the aft cables of the sling to the lugs on the spreader bar. The hoisting ring should be approximately one-third of the way aft on the chain.

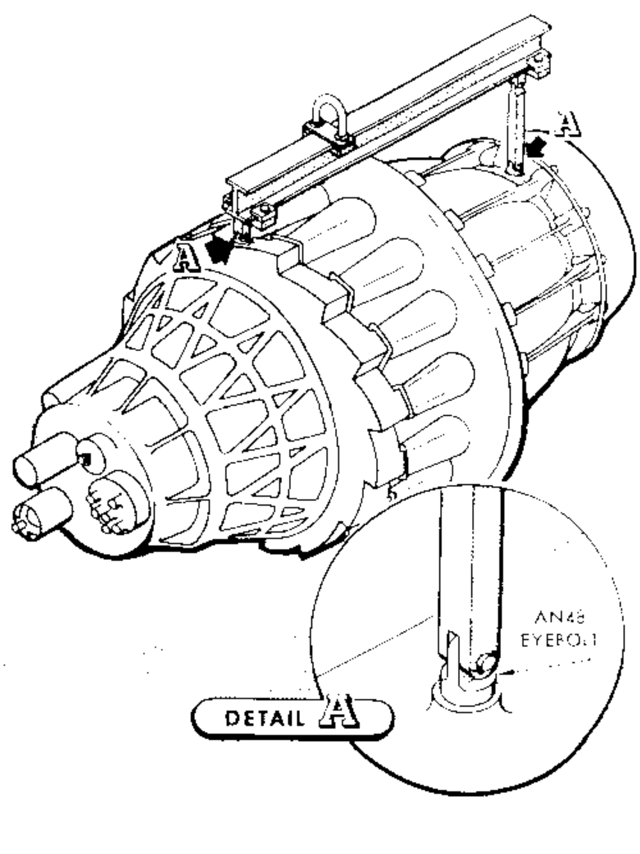



*Figure 10 — Hoisting the Engine*

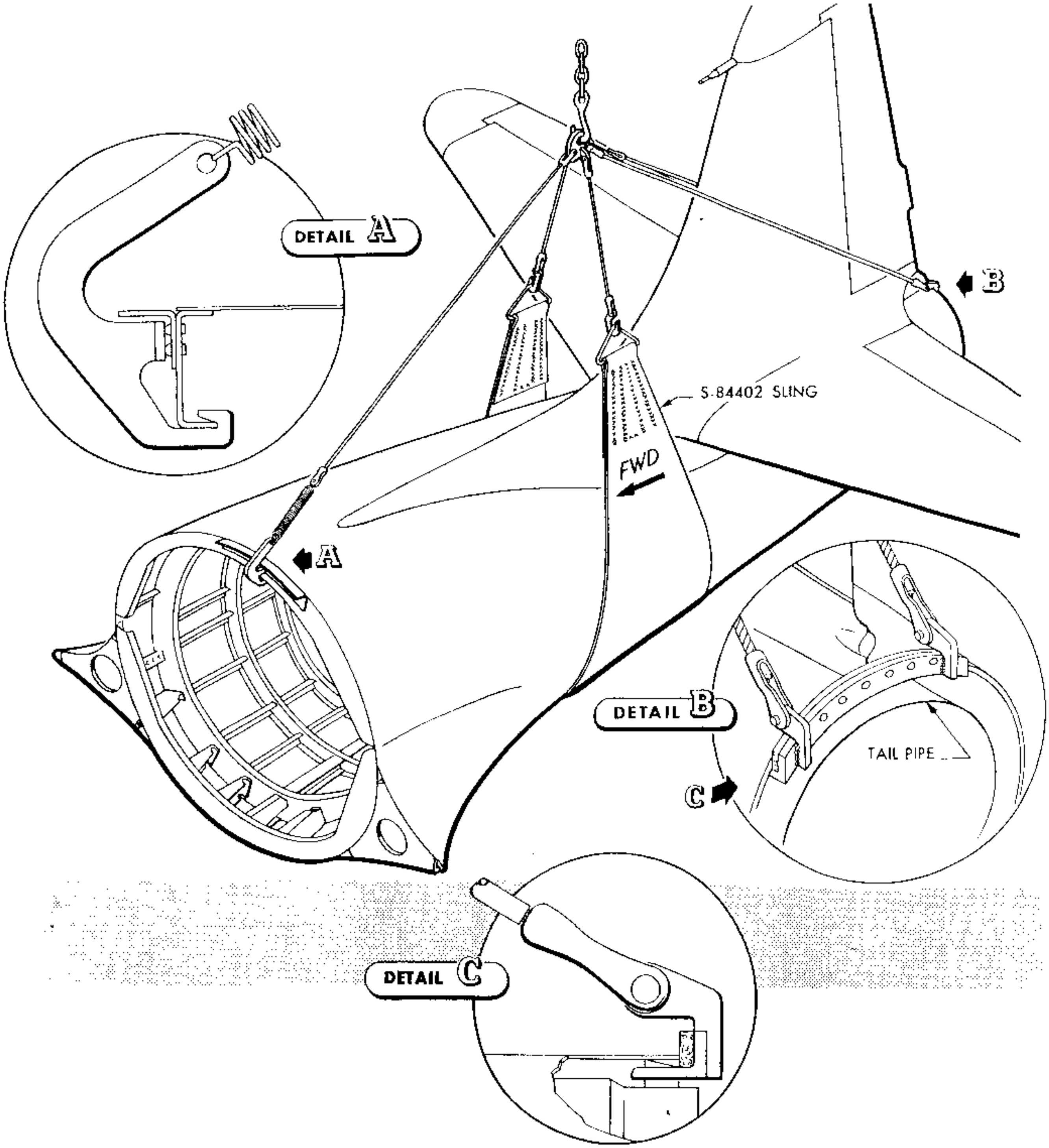



*Figure 11 — Hoisting the Fuselage Aft Section*

Raise the sections slightly. If the sections do not hang level, lower them, and move the hoisting ring forward or aft until the sections hang level when they are hoisted.

(4) HOISTING THE ENGINE. *(See figure 10.)*—To hoist the engine, install AN48 eyebolts in the two tapped holes in top of the engine and attach the sling.

(5) HOISTING THE FUSELAGE AFT SECTION. *(See figure 11.)*—Hoist the fuselage aft section with sling No. S-84402. Place the canvas part of the sling under the fuselage so that the center line of the sling is slightly forward of the leading edge of the horizontal stabilizer, or so the canvas just touches the horizontal stabilizer. Attach the hook of the forward cable to the top of the forward bulkhead. Attach the hook of the aft cable to the top of the tail pipe opening. Do not attach the aft cable hook to the tail pipe.

When the sling is properly rigged and the section is hoisted, the spring between the forward hook and cable should not stretch more than approximately 2 inches, thus indicating the section is properly balanced for hoisting. If, when the section is raised, the spring stretches more than 3 inches, move the canvas part of the sling slightly forward. If the spring stretches less than 1 inch, move the canvas aft.

(6) HOISTING THE WING. *(See figure 12.)*—Hoist the wing with sling No. S-80503. Place the spreader bar so that the hoisting lug is aft, or toward the wing trailing edge. Attach the forward cable lugs of the sling to the upper holes of the forward wing-to-fuselage attachment fittings. Be sure the cables are attached to the point marked "P-80" on the lugs. Attach the aft cable

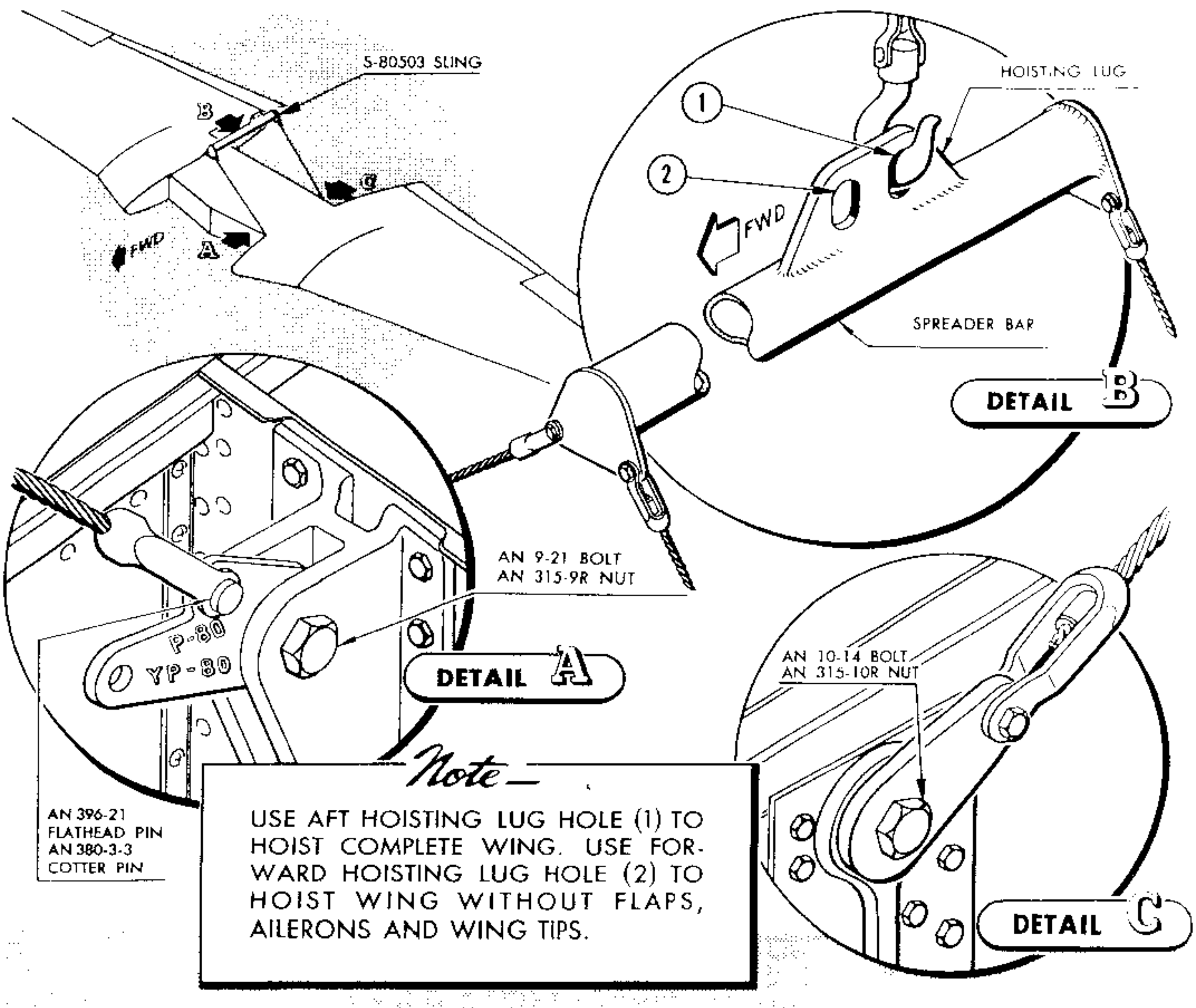



*Figure 12 — Hoisting the Wing*

lugs of the sling to the upper holes of the aft wing-to-fuselage attachment fittings.

Use the aft hole in the hoisting lug for hoisting the complete wing. Use the forward hole in the hoisting lug for hoisting the wing without flaps, aileron, and wing tips.

*c.* STORAGE STANDS.

(1) FUSELAGE AFT SECTION. *(See figure 13.)* —A portable cradle, No. S-84702, should be used for major overhaul, storage, transporting, or mating the fuselage aft section. Back the cradle under the fuselage until the center of the forward frame is approximately 30 inches from the aft end of the fuselage.

To one side and at each end of the cradle are adjusting screws and cranks, permitting adjustment of the cradle to the fuselage under varying conditions. Floating frames in each end of the cradle will allow the fuselage to be rolled from side to side to a maximum of 10 degrees. Clamps are provided at each end to hold the frames in the desired position.

(2) WING. *(See figure 14.)* — A dolly, No. S-84704, should be used to support the wing in two places for major overhaul, handling, or storage. Each end of the dolly can be adjusted independently of the other, through a range of 40 to 51 inches in height. Two floor locks are provided on the under carriage to hold the dolly in place.

(3) FUSELAGE NOSE AND MID SECTION. *(See figure 15.)*—A dolly, No. S-84706, should be used to support the fuselage nose and mid sections of the fighter airplane for major overhaul, handling, or storage. The aft end of the dolly provides four supports, two for attachment to the forward wing-to-fuselage fittings, and two for attachment to the aft wing-to-fuselage fittings. The forward end of the dolly provides a padded cradle to support the fuselage nose section. Floor locks are provided on the under carriage to hold the dolly in place. A dolly suitable for the photographic airplane will be indicated at a later date.

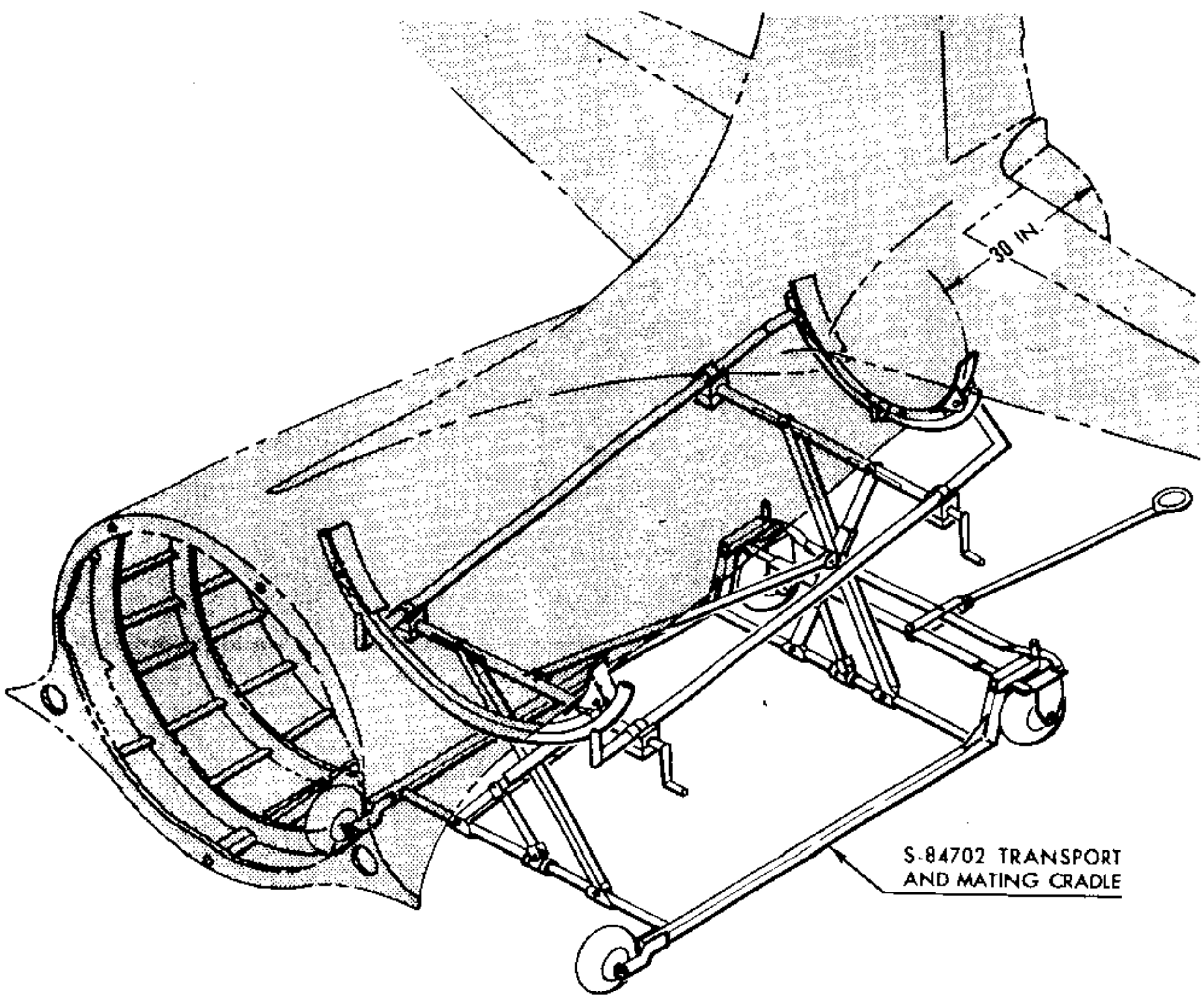



*Figure 13 — Storage Cradle for Fuselage Aft Section*

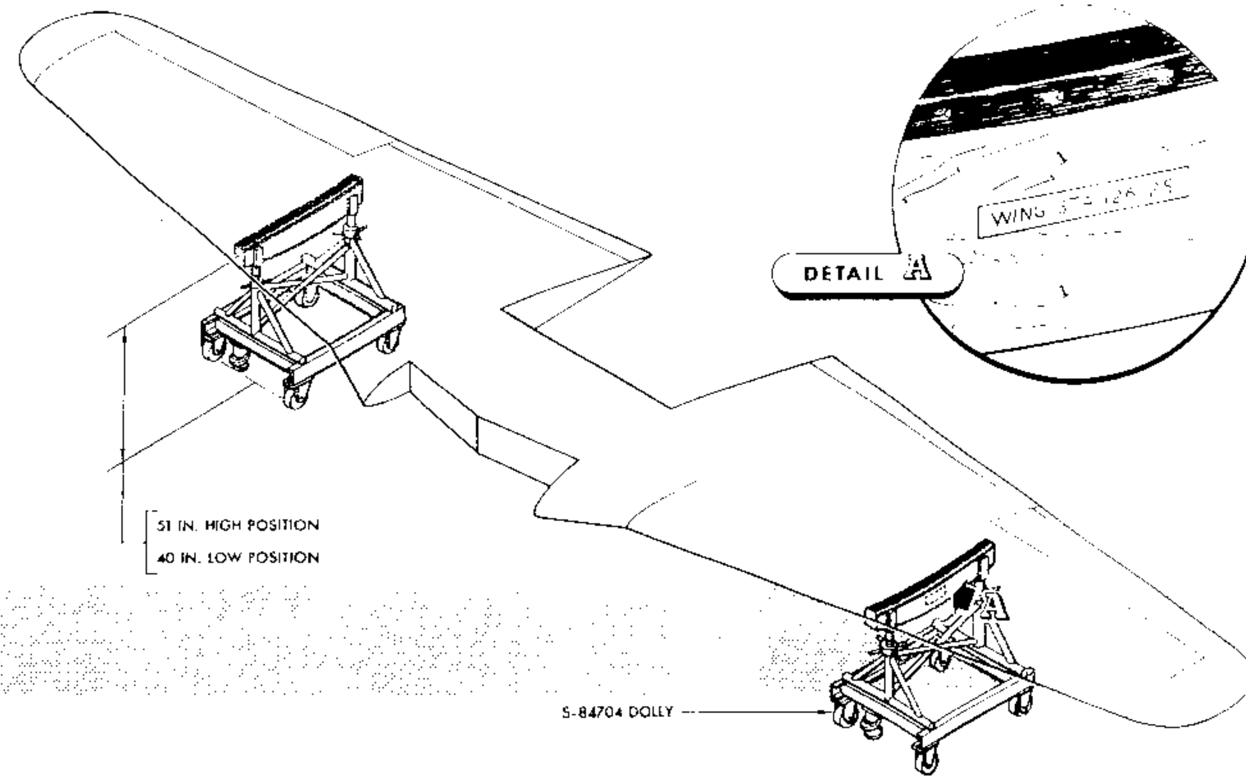



*Figure 14 — Storage Dolly for Wing*

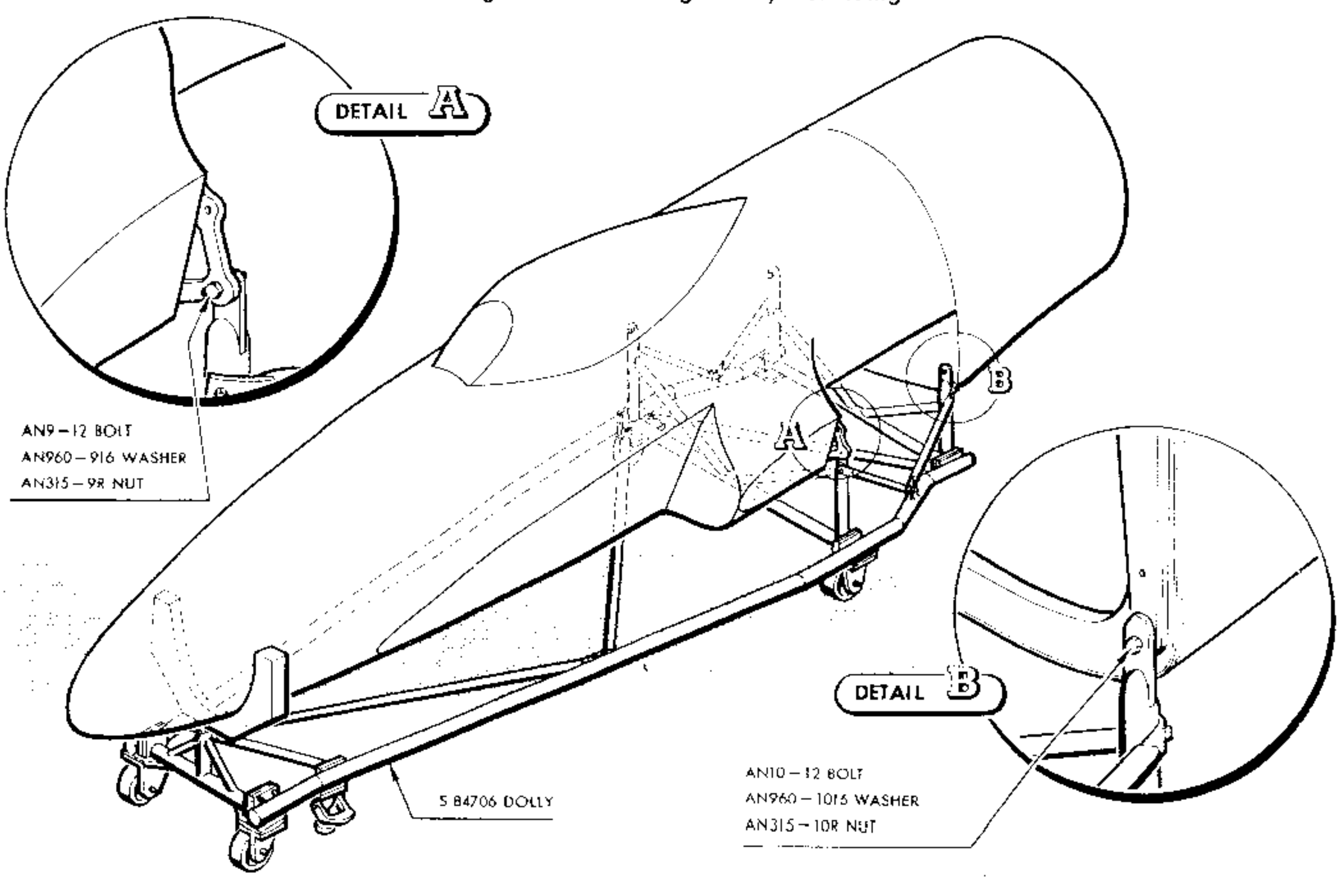



*Figure 15 — Storage Dolly for P-80A Fuselage Nose and Mid Section*

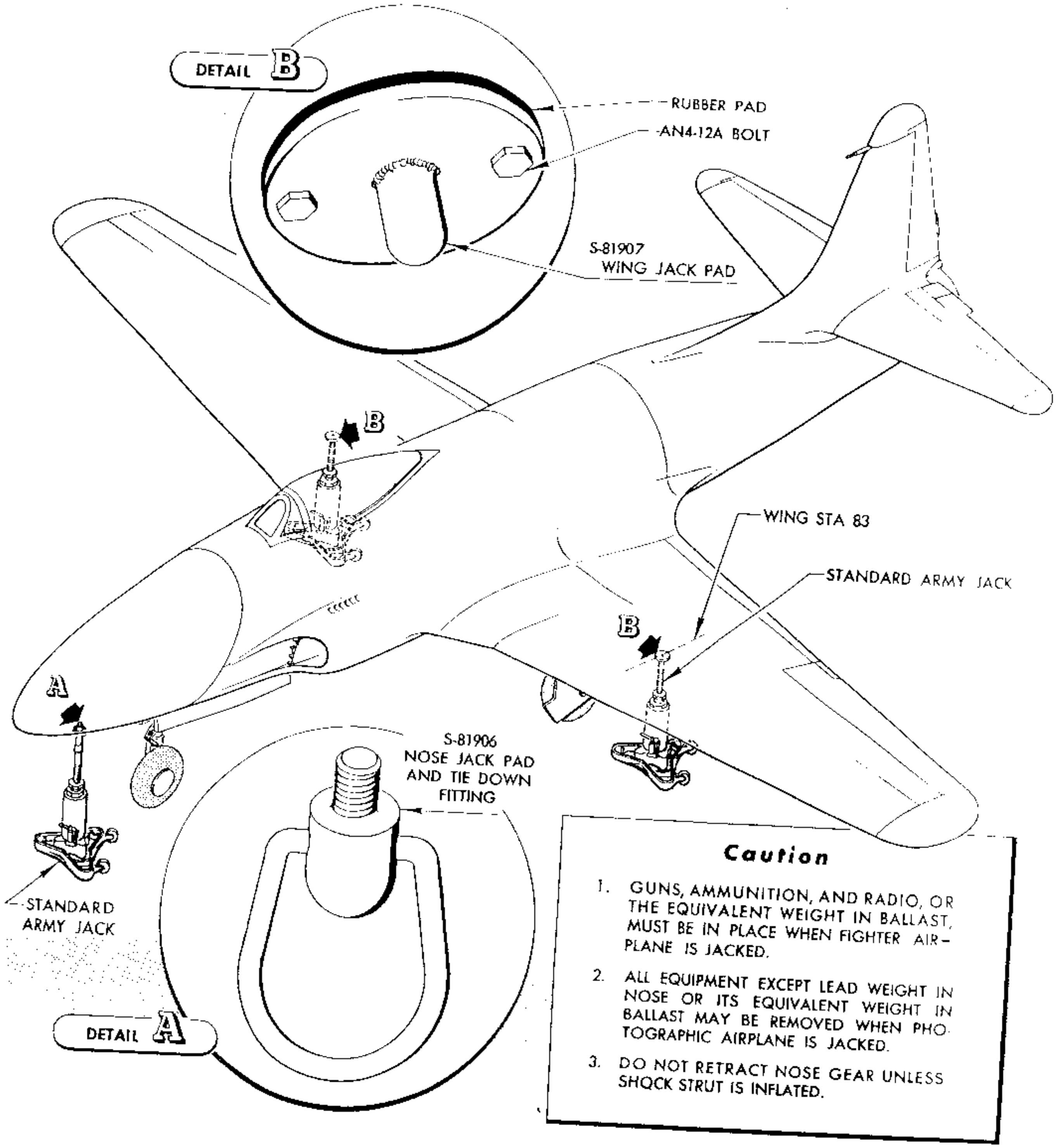



*Figure 17 — Jacking*

*10.* Armament and radio or their equivalent weight in ballast, must be in place when the fighter airplane is jacked.

*11.* All equipment except the lead weight in the nose, or equivalent weight in ballast, may be removed when the photographic airplane is jacked.

*12.* Do not open or close camera compartment hood when photographic airplane is on nose jack.

*e.* LEVELING. *(See figure 18.)*

(1) Pads upon which to place a spirit level are attached to the lower longerons in the nose wheel well, two on the right side and one on the left. These leveling pads may be used as an aid in leveling the airplane for boresighting. (See section IV, paragraph 20*d.*)

(2) Provisions for attaching plumb lines to the forward and aft ends of the airplane are provided on the left side of the airplane, and are marked with red circles and stamped "PLUMB LINE." The forward plumb line provision is on the side of the fuselage nose near the landing light. The aft plumb line provision is on the lower left side of the fuselage directly below the wing trailing edge, and near the juncture point of the fuselage aft and mid sections. Plumb lines are used in leveling the airplane for boresighting. (See figure 240.)

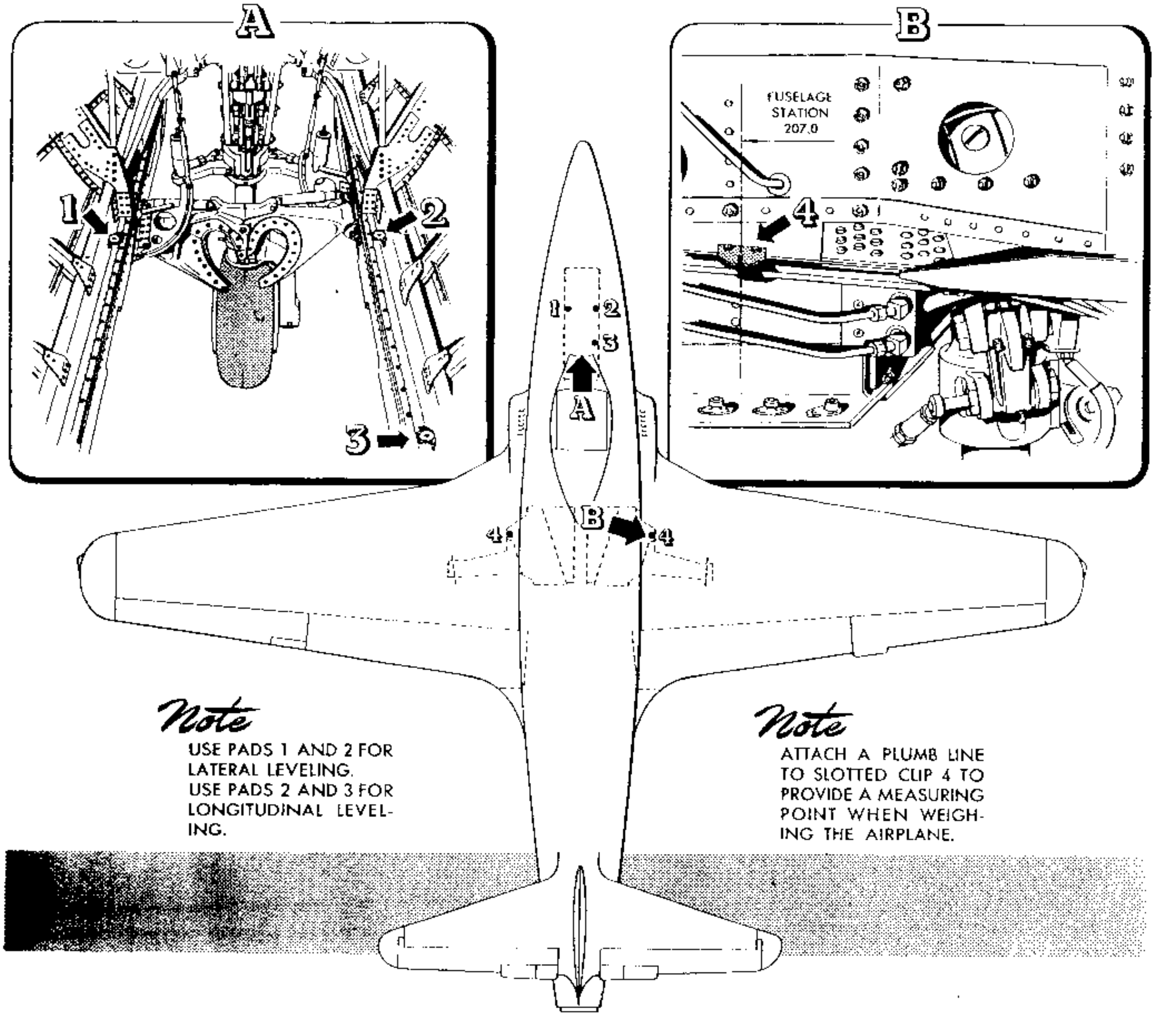



*Figure 18 — Leveling and Measuring Points*

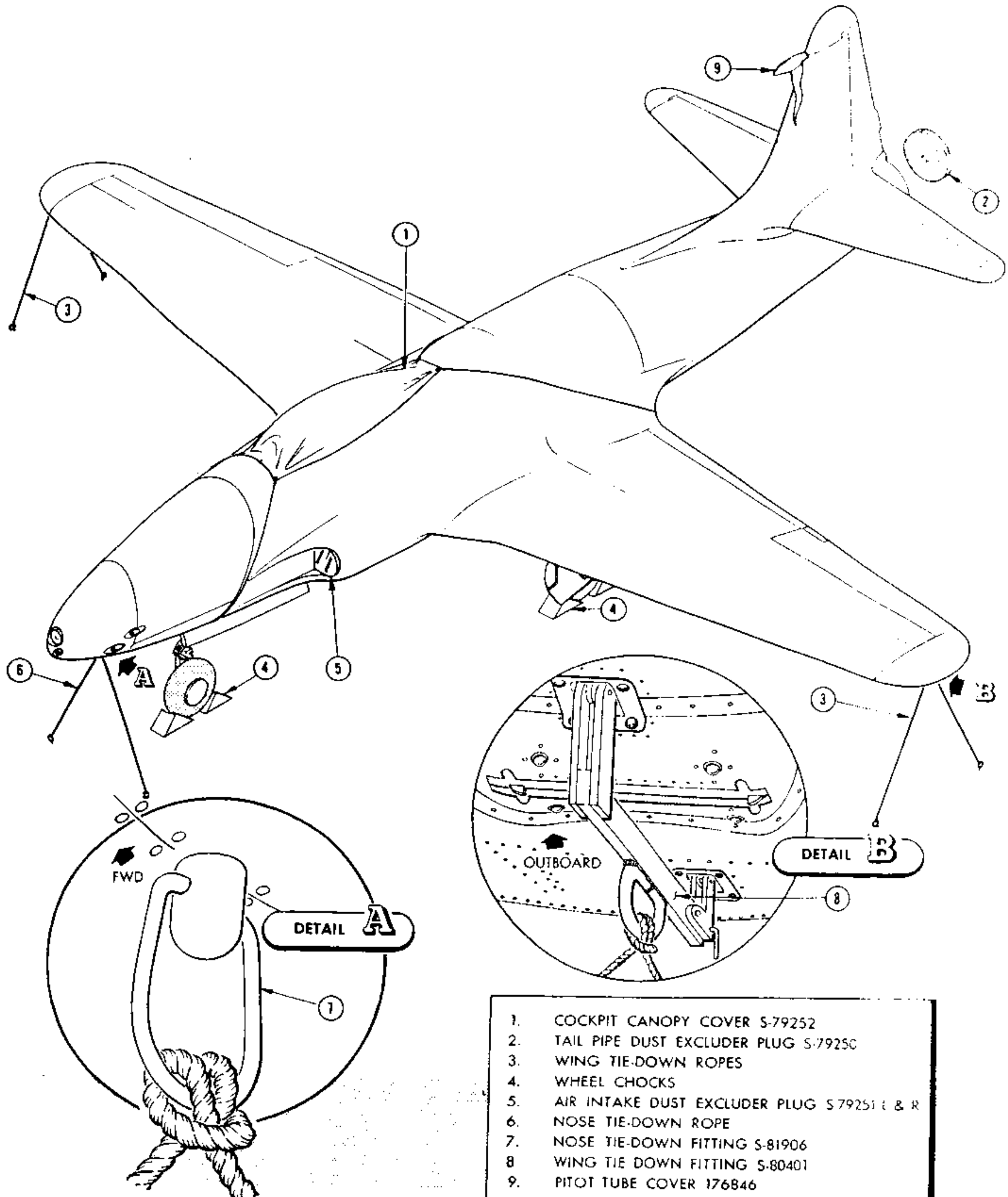



*Figure 19 — Mooring*

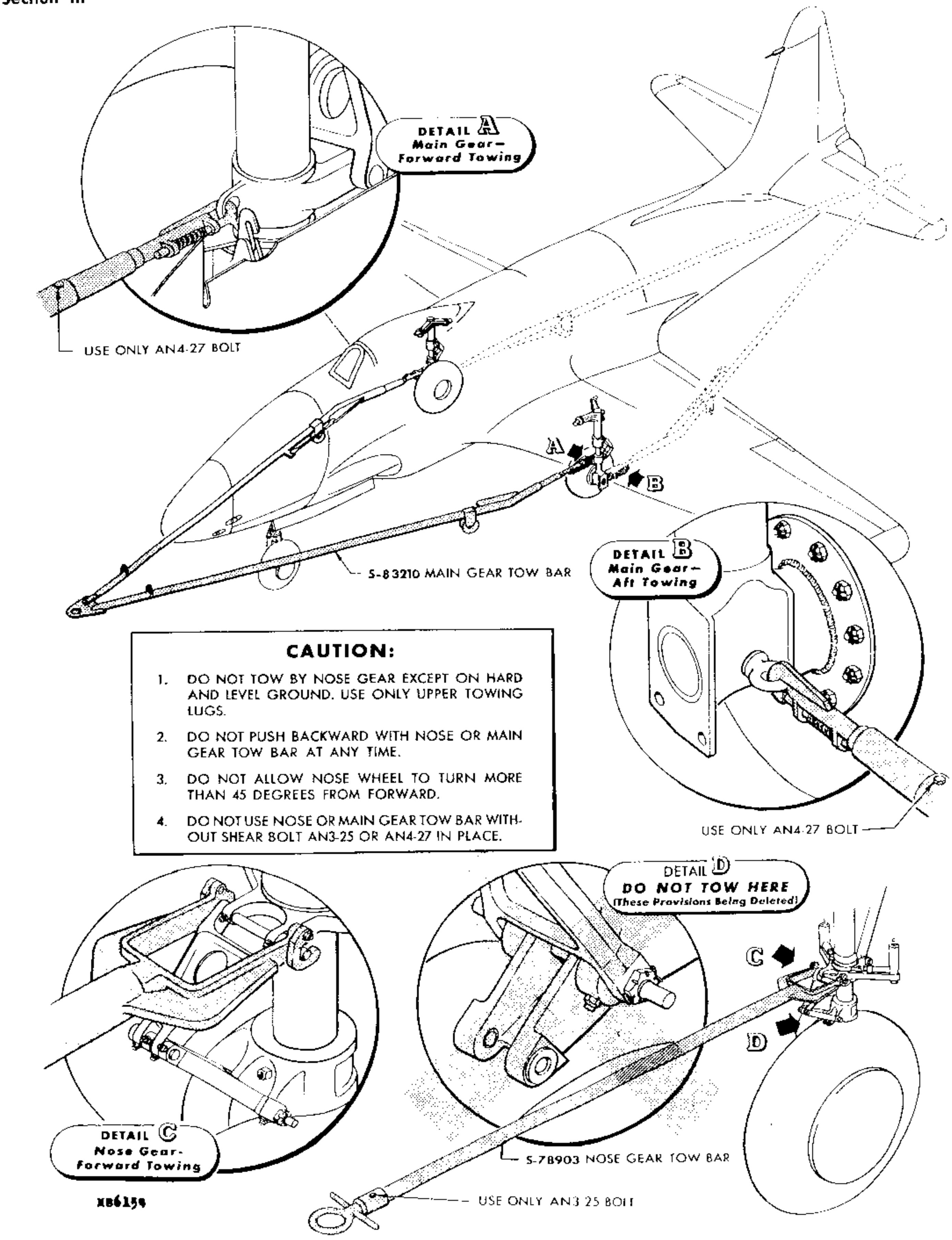



*Figure 20 — Towing*

On later airplanes, additional provisions for plumb line attachment are located in each main-gear wheel well. These points are readily accessible and clearly marked "F.S. 207.00 MEASURING POINT," and are to be used as reference points in taking forward and aft measurements when weighing the airplane to determine center of gravity. It is not necessary to use these points when leveling the airplane for boresighting.

For symmetry check of the airplane, refer to AN 01-75FJ-3, "Structural Repair Handbook."

*f.* PARKING AND MOORING. *(See figure 19.)*

(1) PARKING.—Set the parking brakes and lock the controls. (See paragraph *h* following, and section IV, paragraph 5*d*(2).)

**Note**

Do not set parking brakes at sub-freezing temperatures. Do not set parking brakes until they have cooled after use.

(2) WING TIE-DOWN.—Remove the two panels on the under side of the wing tips at the bomb hoist connection marked "MOOR HERE" and attach the wing tie-down fitting No. S-80401. Attach the fixed arm of the tie-down fitting to the outboard bomb hoist hook and the swinging arm to the inboard hook. Be sure that the locating pin for the swinging arm of the tie-down fitting is locked in position. Tie the wing down with ropes secured through the eyes of the fittings and to stakes or mooring rods driven into the ground.

**Note**

Droppable tanks must be removed in order to attach the wing tie-down fittings.

(3) NOSE TIE-DOWN.—On the under side of the fuselage nose at the point marked "ATTACH JACK PAD HERE," screw nose jack pad and tie-down fitting No. S-81906 into the tapped hole. Tie the nose down with a rope secured through the ring in the fitting and to stakes or mooring rods driven into the ground.

(4) COVERS.

*(a)* Cover canopy with cover No. S-79252.

*(b)* Cover pitot tube with LAC No. 176846 on F-80A-1, F-80A-5, RF-80A-5, and RF-80A-10 airplanes only. Cover pitot tube on all F-80A-10 airplanes with cover LAC No. 179379.

*(c)* Whenever airplane is to be moored, install plugs No. S-79251 L/R in air-intake duct openings, and plug No. S-79250 in the tail pipe opening.

*(d)* When operating under arctic conditions, protect aircraft surfaces with wing and empennage covers. (See applicable technical orders.)

*g.* TOWING. *(See figure 20.)*

(1) GENERAL. — Provisions are made on the alighting gears for use of two types of tow bars for handling the airplane on the ground.

If tow bars are not available, the airplane may be towed by ropes. Each tow rope should be at least 27 feet long, especially when towing is being done over soft or rough ground. Station a man in the cockpit to maintain control of the airplane by use of the brakes.

(2) NOSE GEAR TOWING.—Tow the airplane by nose gear bar No. S-78903, attached to the towing lugs at the bottom of the upper torque scissors.

**CAUTION**

Use only towing lugs at bottom of upper torque scissors. Do not use towing lugs nor AAF tow bar adapter provided on upper scissors. Use of upper towing lugs may result in damage to landing light bracket.

(3) MAIN GEAR TOWING.—The airplane may be towed by the towing and steering main gear bar No. S-83210. Towing eyes are provided on the main gear for forward or aft towing. The eye for forward towing is located at the lower end of the alighting gear shock strut and on the side opposite to the torque arm attachment. The eye for aft towing is located on the shock strut axle between the wheel and the inner door segment.

(4) GENERAL PRECAUTIONS.

*(a)* Do not allow the nose wheel to turn more than 45 degrees from forward position when towing with either the nose gear or main gear tow bars.

*(b)* Do not push backward with the main gear tow bar attached to the forward towing eye.

*(c)* Do not push backward with the nose gear tow bar at any time.

*(d)* Use the nose gear tow bar for towing only when the airplane is on hard, level ground.

*(e)* Do not use the nose or main gear tow bars without the shear bolts AN3-25 and AN4-27 in place as shown in figure 20. The failure of these bolts is a warning that a load has been applied which would endanger the structure of the airplane.

*(f)* If handling the airplane by hand, do not push on the aileron, empennage, wing-tip plastic housings, or on the fuselage-nose plastic housing.

*h.* PARKING BRAKES AND CONTROL LOCKS.

(1) PARKING BRAKES. *(See figures 139 and 140.)*—Refer to section IV, paragraph 5*d*(2) for description and operation of parking brakes. Use wheel chocks (figure 19) as extra braking precautions.

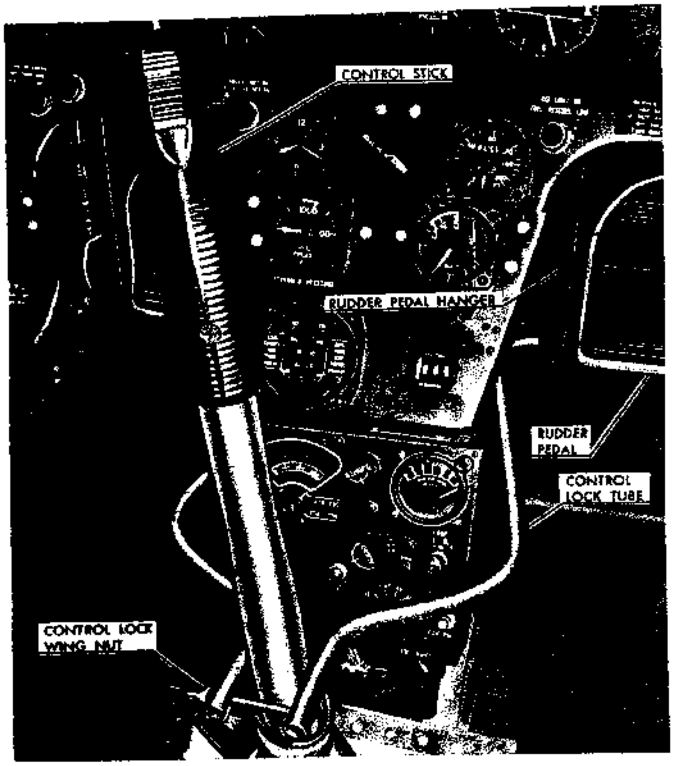



*Figure 21 — Surface Controls Lock, Cockpit*

(2) LOCKING THE SURFACE CONTROLS. *(See figure 21.)*

*(a)* A surface controls lock is provided to lock the rudder, aileron, and elevator in neutral when the airplane is moored or parked. Install as follows:

*1.* Place rudder pedal adjustment in aft position.

*2.* Insert tubes in inboard holes of rudder pedals.

*3.* Insert pins in holes of control stick.

*4.* Clamp lock to control stick by tightening wing nut.

*(b)* Additional precautions may be taken to secure the control surfaces when the airplane is to be stored or transported, by blocks clamped at the trailing edges. The blocks should be carefully shaped to the contour of these surfaces and pads placed between the blocks and skin surfaces to prevent injury.

(3) LOCKING THE ALIGHTING GEARS. *(See figure 22.)* The nose and main alighting gears may be locked in the down position with the alighting gear down lock clamp No. S85204. The clamp is attached

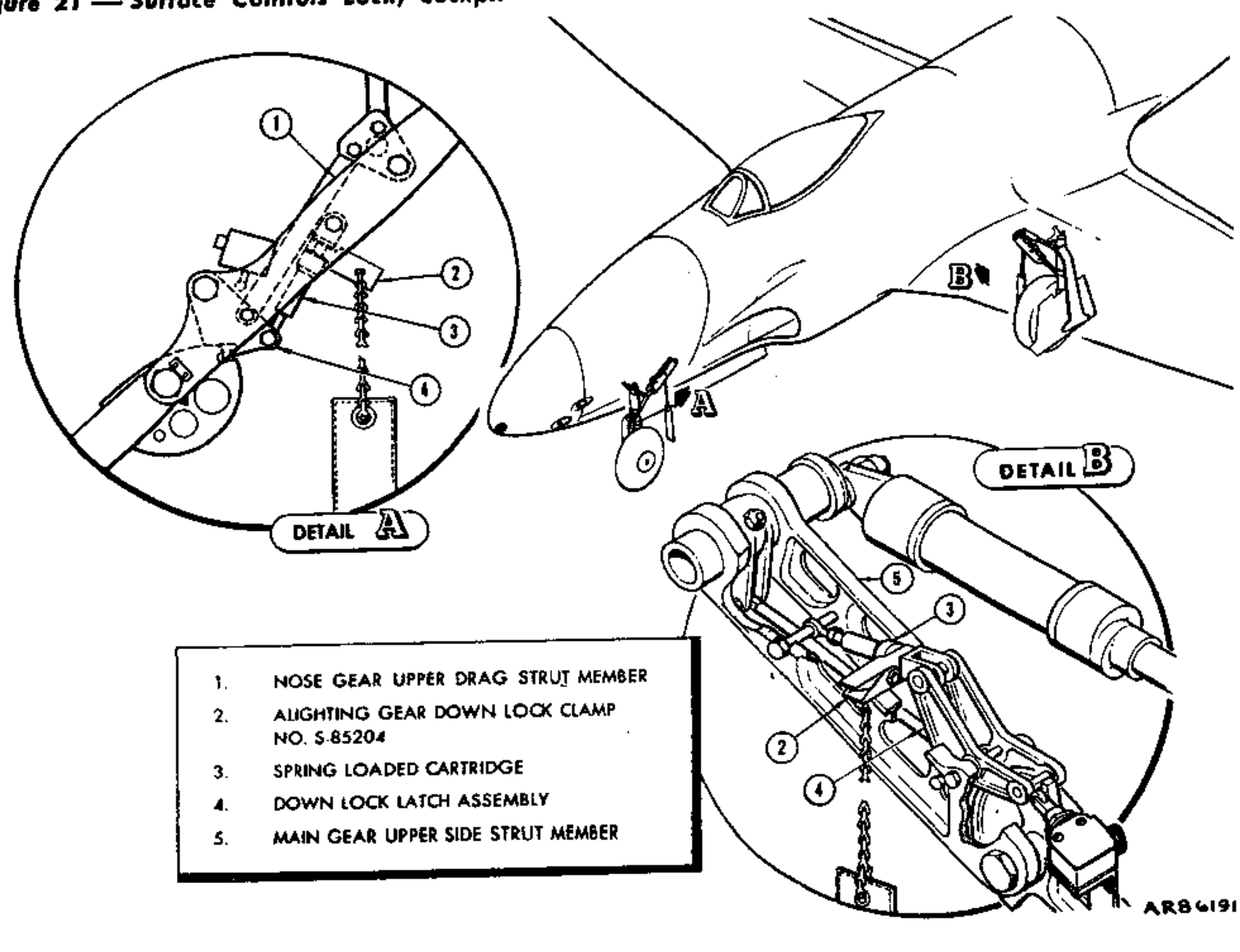



*Figure 22 — Installation of Alighting Gear Safety Clamp*

on each main gear to the spring-loaded cartridge rod between the upper side strut members. The clamp is attached on the nose gear to the spring-loaded cartridge rod between the upper drag strut members.

**CAUTION**

Remove all locking devices before the airplane is to be flown.

## 3. SERVICE.

*a.* Refer to figure 24 showing confined walkways to be used while servicing equipment in the cockpit and wing fuel tanks. See figure 31 for equipment used to facilitate servicing operations.

*b.* SERVICING THE FUEL SYSTEM. In all possible cases, aircraft will be serviced with "cold soaked" fuel (fuel which has attained temperature stabilization essentially the same as the ambient temperature).

(1) Service aircraft as soon as possible after landing.

(2) Before removing fuel cap, ground fuel hose nozzle to airplane structure through grounding jacks located near filler caps.

(3) Check quantity of fuel in tank and fill to desired level.

(4) Install filler cap and check for security.

*c.* COLD WEATHER FUEL SERVICING. It is important that the following additional fuel servicing instructions be observed during cold weather fueling to prevent fuel contamination from water:

(1) Remove all snow, water, ice, and mud from fuel filler caps, filler wells, and servicing nozzles.

(2) Remove only one filler cap at a time and replace immediately after filling.

(3) Drain water from fuel tanks, filter cases, and pumps 15 minutes after each servicing:

**WARNING**

Overflowing tanks are a serious fire hazard and should be avoided. Immediately wipe up spilled fuel. Aircraft will be grounded to dissipate static electricity prior to fueling, defueling, tank purging, and tank repair operation. A hazard exists due to the electrical charge imparted to metal articles within the vicinity of operating radar or high frequency radio transmitting equipment. Fuel servicing will not be accomplished within 100 feet of aircraft operating radar or high frequency radio transmitting equipment.

*d.* See figure 25 for locations of filler valves and openings for fuel, air, oil, hydraulic fluid, and oxygen.

## 4. TIRE INFLATION.

*a.* Inflate nose gear 8-ply tire to 80 psi (6-ply tire to 60 psi) for all weight conditions. See figure 23 for main gear tire pressures versus airplanes gross weight.

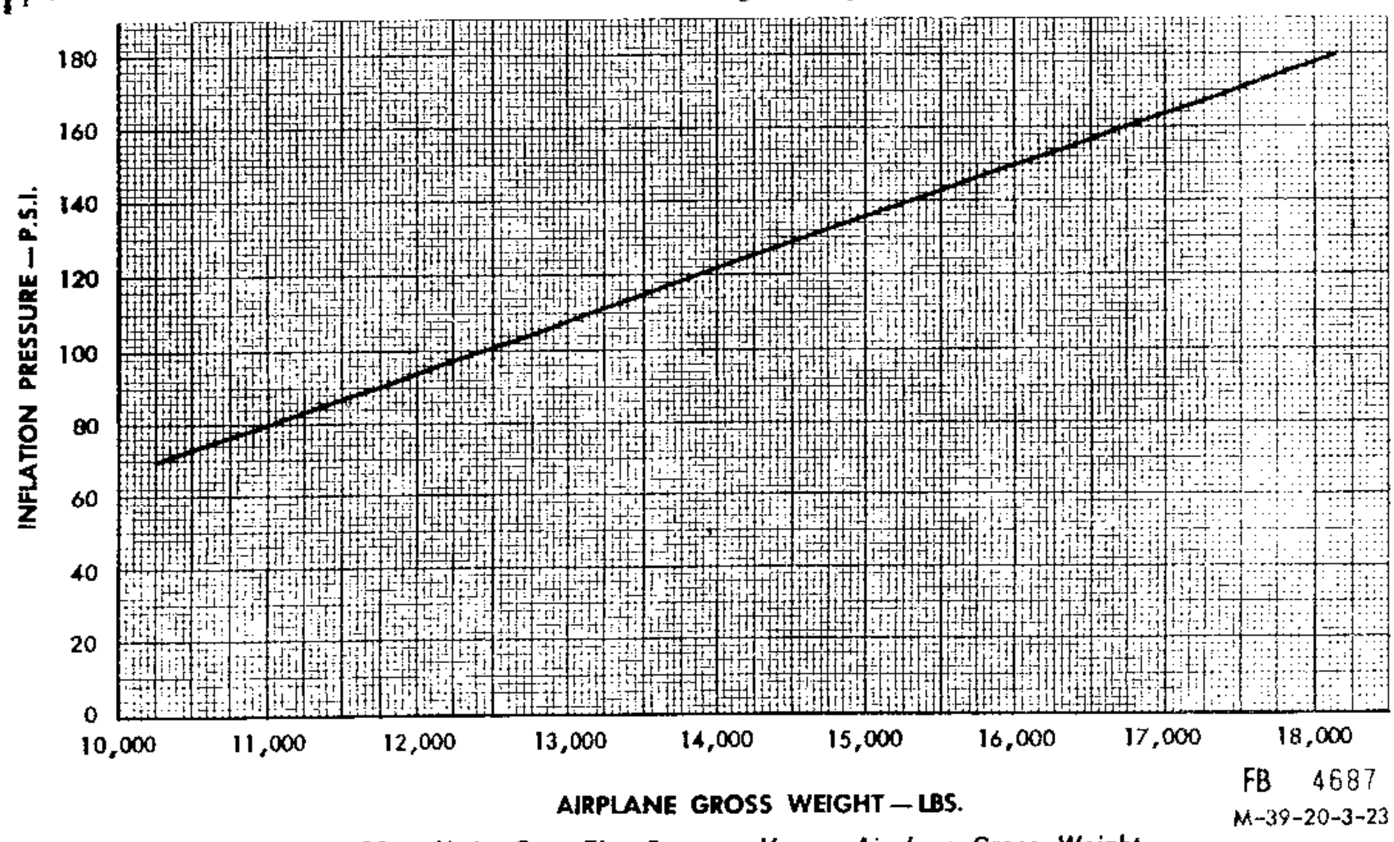



*Figure 23 — Main Gear Tire Pressure Versus Airplane Gross Weight*

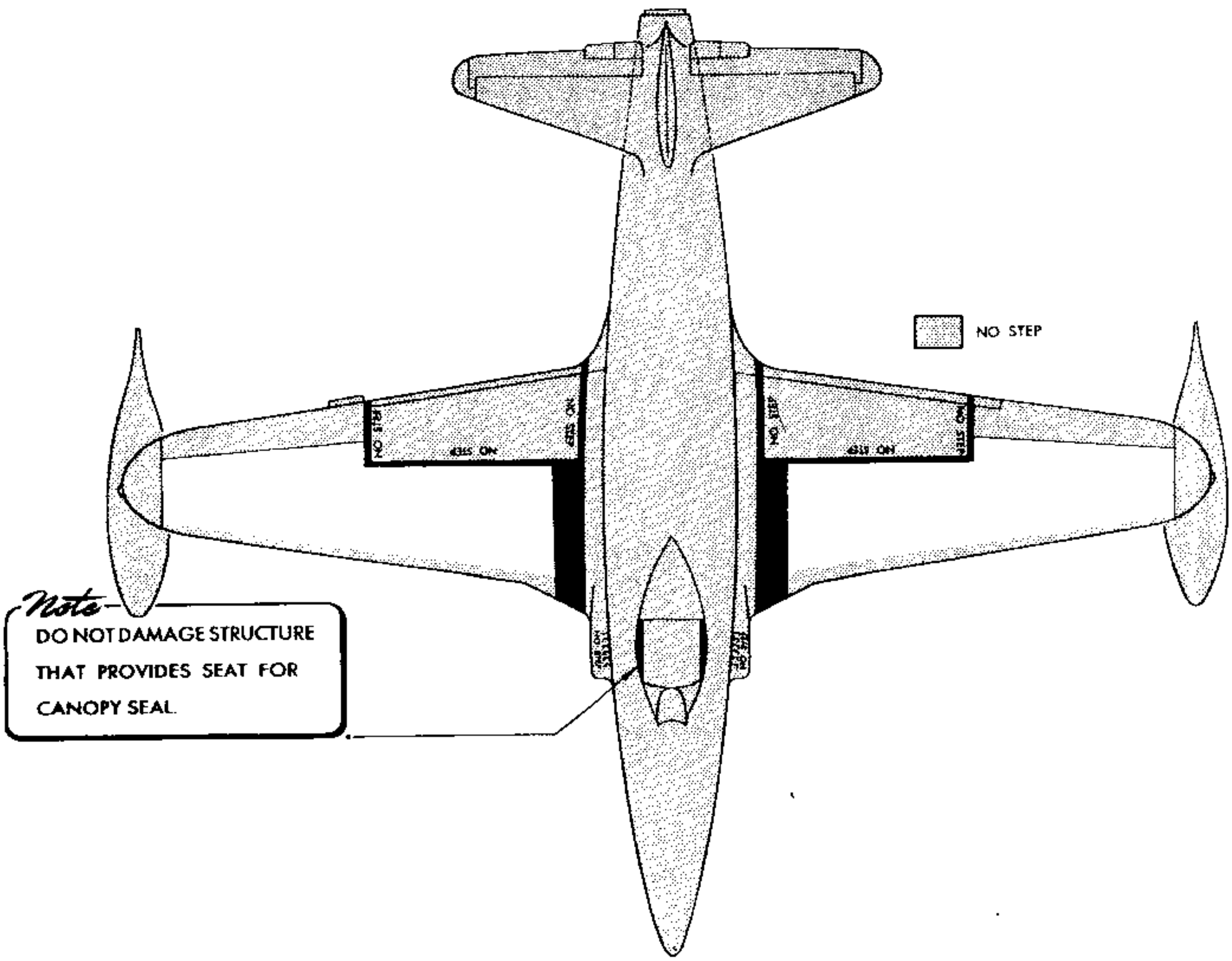
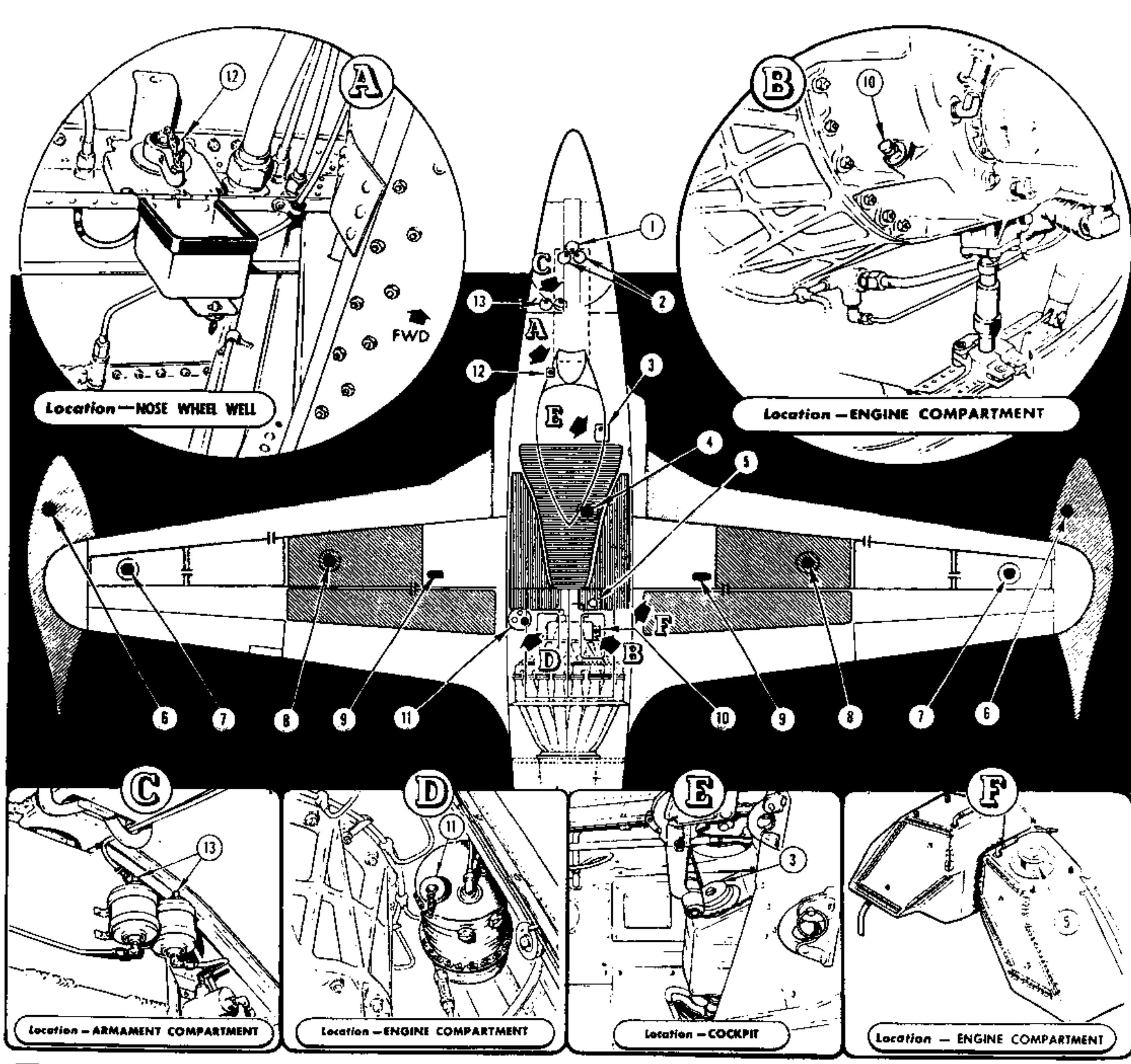



*Figure 24 — No Step Diagram*




DROP TANKS FILLED AT NO 6 FILLER CAPS

LEADING EDGE AND OUTBOARD WING TANKS FILLED AT NO. 7 FILLER CAPS

INBOARD WING TANKS FILLED AT NO. 8 FILLER CAPS

FUSELAGE TANK FILLED AT NO. 4 FILLER CAP

FLUID INJECTION TANKS FILLED AT NO 5 FILLER CAP

1. NOSE GEAR SHOCK STRUT AIR-OIL FILLER VALVE--FILL WITH HYDRAULIC FLUID, SPECIFICATION MIL-0-5606.
2. NOSE GEAR SHIMMY DAMPER RESERVOIR--FILL WITH HYDRAULIC FLUID, SPECIFICATION MIL-0-5606.
3. EMERGENCY HYDRAULIC SYSTEM RESERVOIR--FILL WITH HYDRAULIC FLUID, SPECIFICATION MIL-0-5606 ON LATER AIRPLANES FILL FROM OUTSIDE AIRPLANE PANEL 77, SEE FIGURE 7.
4. FUSELAGE TANK—207 U.S. (172 IMPERIAL) GALLONS CAPACITY, SPECIFICATION MIL-F-5616, GRADE JP-1.
5. FLUID INJECTION TANKS--60 U.S. (51 IMPERIAL) GALLONS CAPACITY; 67% DISTILLED WATER WITH 33% ALCOHOL, SPECIFICATION AN-A-18.

   FUEL DE-ICING TANK--30 U.S. (24.9 IMPERIAL) GALLONS CAPACITY. MINIMUM: 5 U.S. (4.15 IMPERIAL) GALLONS. SPECIFICATION MIL-A-6091 ALCOHOL.
6. DROP TANKS--330 U.S. (274 IMPERIAL) GALLONS CAPACITY, SPECIFICATION MIL-F-5616, GRADE JP-1.
7. LEADING EDGE AND OUTBOARD WING TANKS--88 U.S. (73 IMPERIAL) GALLONS CAPACITY, SPECIFICATION MIL-F-5616, GRADE JP-1, (44 U.S. (36.5 IMPERIAL) GALLONS CAPACITY, SPECIFICATION MIL-F-5572 GRADE 100/130 IN LEFT TANK AND 44 U.S. (36.5 IMPERIAL) GALLONS CAPACITY, SPECIFICATION MIL-F-5616 GRADE JP-1, IN RIGHT TANK ON F-80A-10 WINTERIZED AIRPLANES.)
8. INBOARD WING TANKS--130 U.S. (108 IMPERIAL) GALLONS CAPACITY, SPECIFICATION MIL-F-5616, GRADE JP-1.
9. MAIN GEAR SHOCK STRUT AIR-OIL FILLER VALVE--FILL WITH HYDRAULIC FLUID, SPECIFICATION MIL-0-5606.
10. ENGINE--3 U.S. (2.5 IMPERIAL) GALLONS LOW TEMPERATURE LUBRICATING OIL, SPECIFICATION MIL-0-6081. USE GRADE 1010 FOR TEMPERATURE ABOVE +20° F (-6.7° C), EITHER GRADE 1010 OR GRADE 1005 FOR TEMPERATURES BETWEEN +20° F (-6.7° C) AND -20° F (-28.9° C), AND GRADE 1005 FOR TEMPERATURES BELOW -20° F (-28.9° C).
11. MAIN HYDRAULIC SYSTEM RESERVOIR--ON EARLY AIRPLANES FILL TO LEVEL OF UPPER SIGHT; ON LATER AIRPLANES FILL TO FULL MARK ON SIGHT GAGE WITH HYDRAULIC FLUID, SPECIFICATION MIL-0-5606.
12. OXYGEN SYSTEM--425 (±25) PSI.
13. BRAKE RESERVOIRS--FILL TO 1/2 INCH BELOW FILLER HOLE WITH HYDRAULIC FLUID, SPECIFICATION MIL-0-5606.

NOTE: REFER TO SECTION IV FOR SPECIAL PRECAUTIONS AND PROCEDURES WHEN SERVICING ABOVE ITEMS. WARNING: GROUND AIRPLANE BEFORE REPLENISHING FUEL TANKS.

M17-21-3-15 F86234

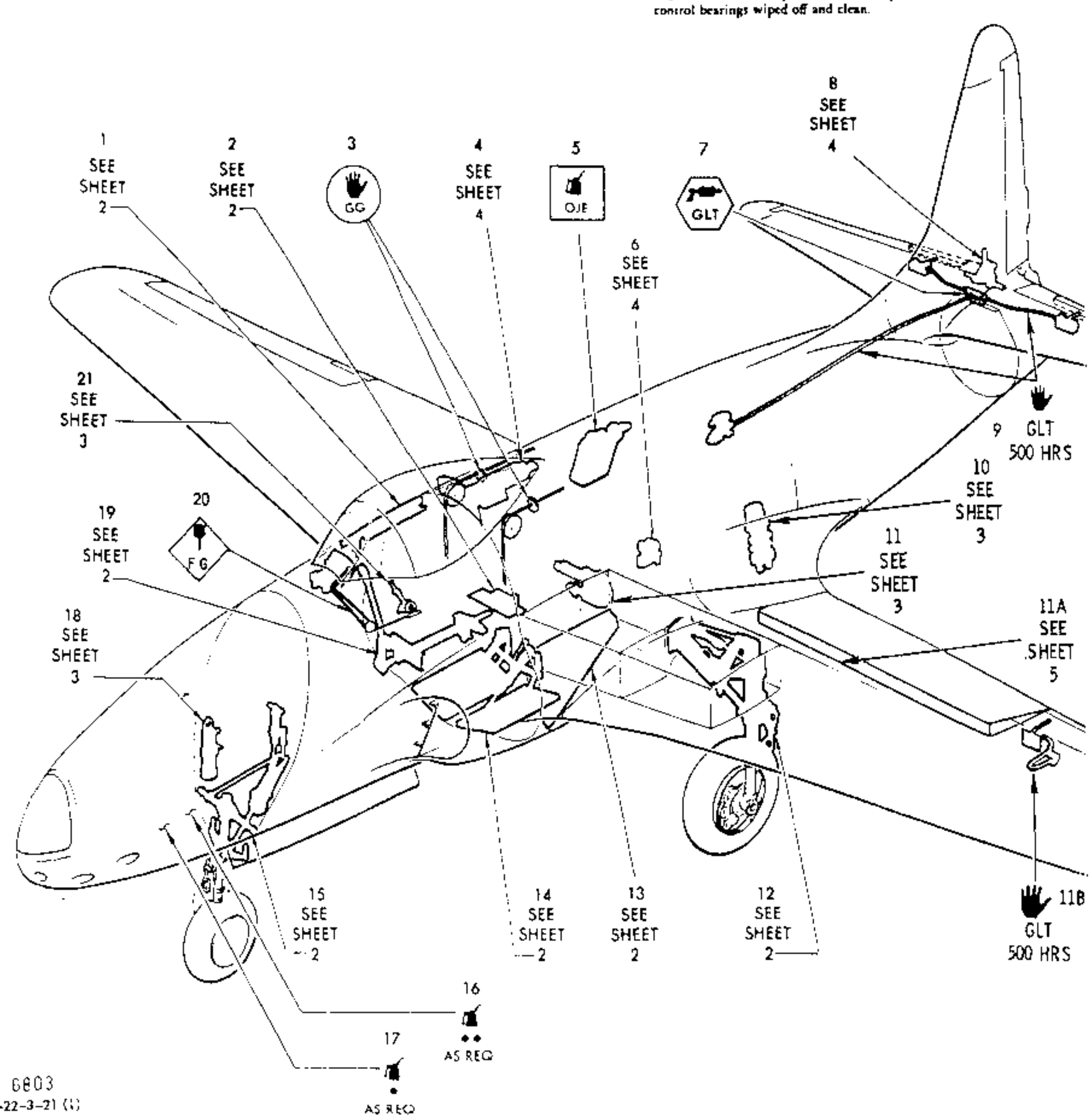
*Figure 25 — Replenishing Diagram*

## SPECIAL SERVICE NOTES

**FITTINGS** — Clean all fittings before lubricating. Lubricate through fittings until new grease appears at the part being lubricated.

**PIANO TYPE HINGES** — Lubricate all piano type hinges only upon replacement. Use AN-G-24 (Symbol FG). Do not use oil or grease.

**CONTROL SYSTEM BEARINGS** — These ball bearings are lubricated with AN-G-3 (Symbol GL) and sealed. They do not require relubrication. At overhaul, clean and replace AN-G-3 with AN-G-25 (Symbol GLT). Keep all control bearings wiped off and clean.




## TABLE OF LUBRICANTS

| Identification Letter | Base Specification | Type of Lubricant |
|---|---|---|
| GH | AN-G-5 | Grease, High Temperature, Water Resistant |
| GG | AN-G-6 | Grease, Lubricating, Graphite |
| GB | AN-G-15 | Grease, High Melting Point, General Purpose |
| FG | AN-G-24 | Graphite, Powdered |
| GLT | AN-G-25 | Grease, Low Temperature |
| OGR | AN-O-3 | Oil, Low Temperature, Lubricating, Gear |
| OGP | AN-O-6 | Oil, Low Temperature Lubricating, General Purpose |
| OJE | AN-O-9 Grade 1010 | Oil, Low Temperature Lubricating |
| OHA | AN-O-366 | Hydraulic Fluid |
| ● | USA Spec 2-120 | Oil, Lubricating, Preservative |
| ●● | USA Spec 2-36D | Oil, Recoil, *Medium* |

## FREQUENCY SYMBOLS

Daily — 25/30 Hrs. — 50/60 Hrs. — 100/120 Hrs. — Overhaul

## APPLICATION SYMBOLS

Zerk or Alemite Gun — Oil Can — Brush — Hand

## PARTS NOMENCLATURE KEY

1. Canopy Track Assembly
2. Engine Control Valve Pressure Seal
3. Cable Seals (Rubber)
4. Electric Canopy Screw Jack and Actuator
5. Turbine and Cooler
6. Wing Flap "H" Gear Box
7. Elevator Tab Tee Drive Assembly
8. Elevator Spring Tab Bungee
9. Elevator Tab Power Unit Flexible Shafts
10. Emergency Fuel Pump
11. Aileron Debooster Spring
11A. Wing Flap Operating Links
11B. Aileron Tab Power Unit Flexible Shaft
12. Main Alighting Gear Assembly
13. Main Alighting Gear Up Lock Assembly
14. Dive Flap Assembly
15. Nose Alighting Gear Assembly
16. Machine Gun Buffers (6)
17. Machine Guns (6)
18. Case Ejection Door Actuating Cylinder
19. Aileron-Elevator Control Assembly
20. Gun-Sight Control Cable
21. Gun Sight Control Handle

*Figure 26 — Lubrication Diagram (Sheet 1 of 5 Sheets)*

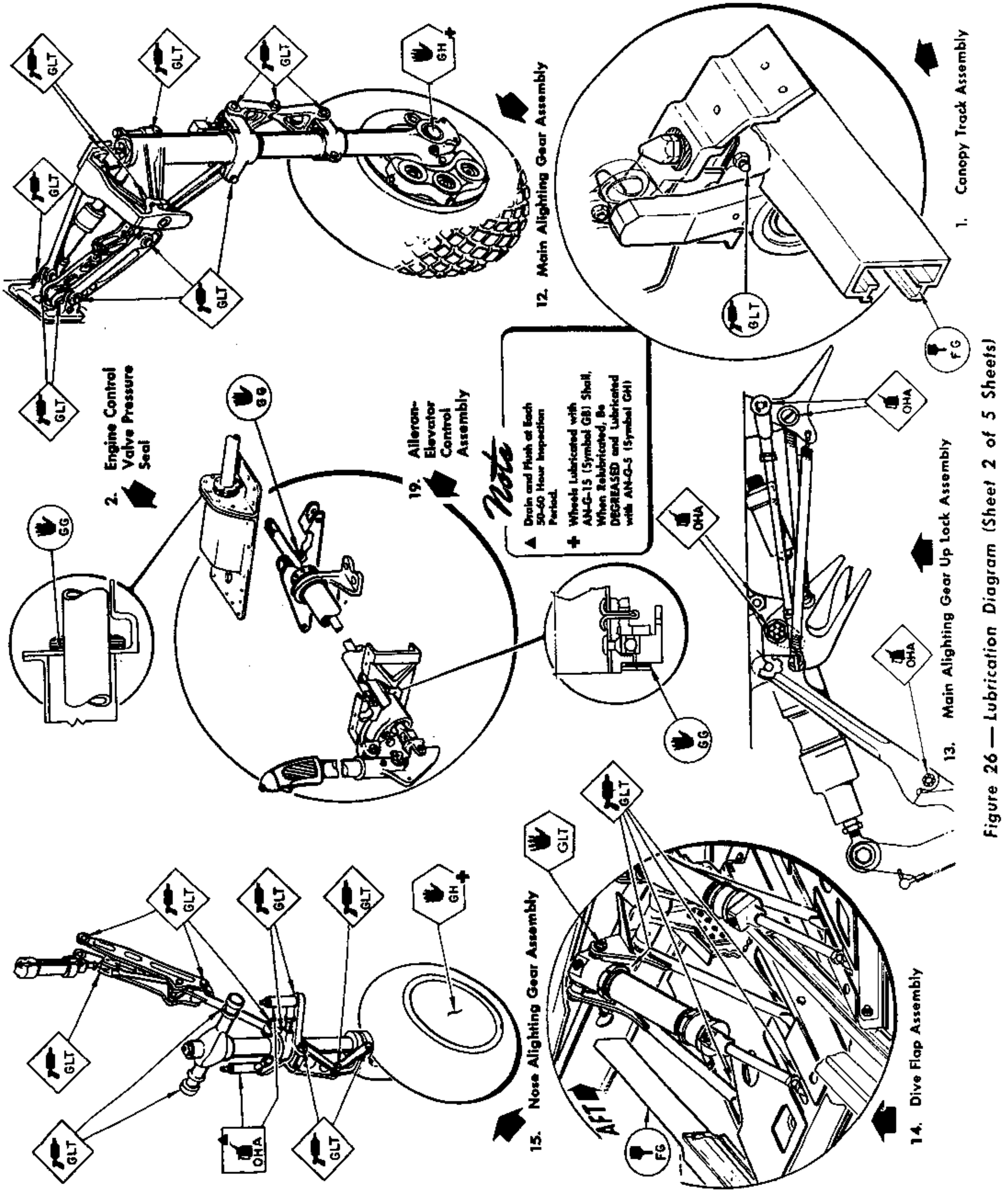



Figure 26 — Lubrication Diagram (Sheet 2 of 5 Sheets)

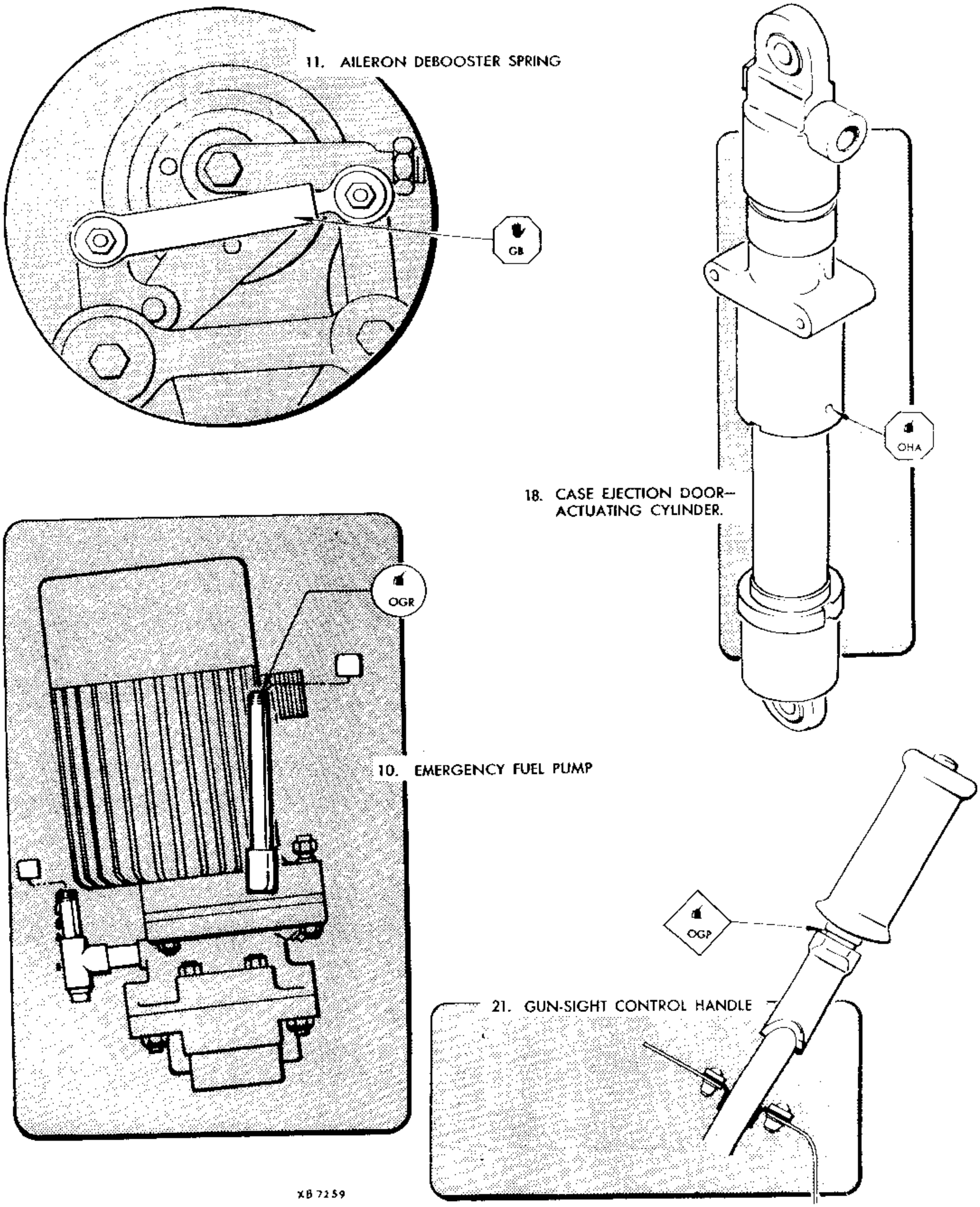



*Figure 26 — Lubrication Diagram (Sheet 3 of 5 Sheets)*

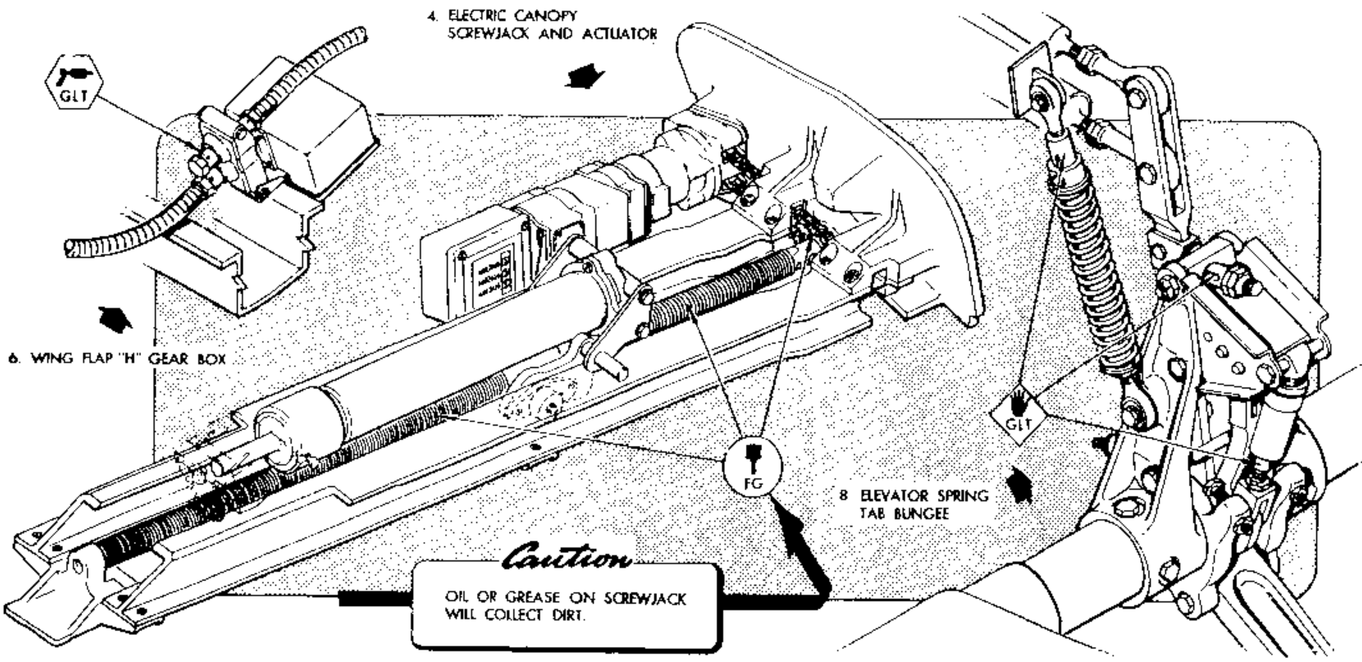
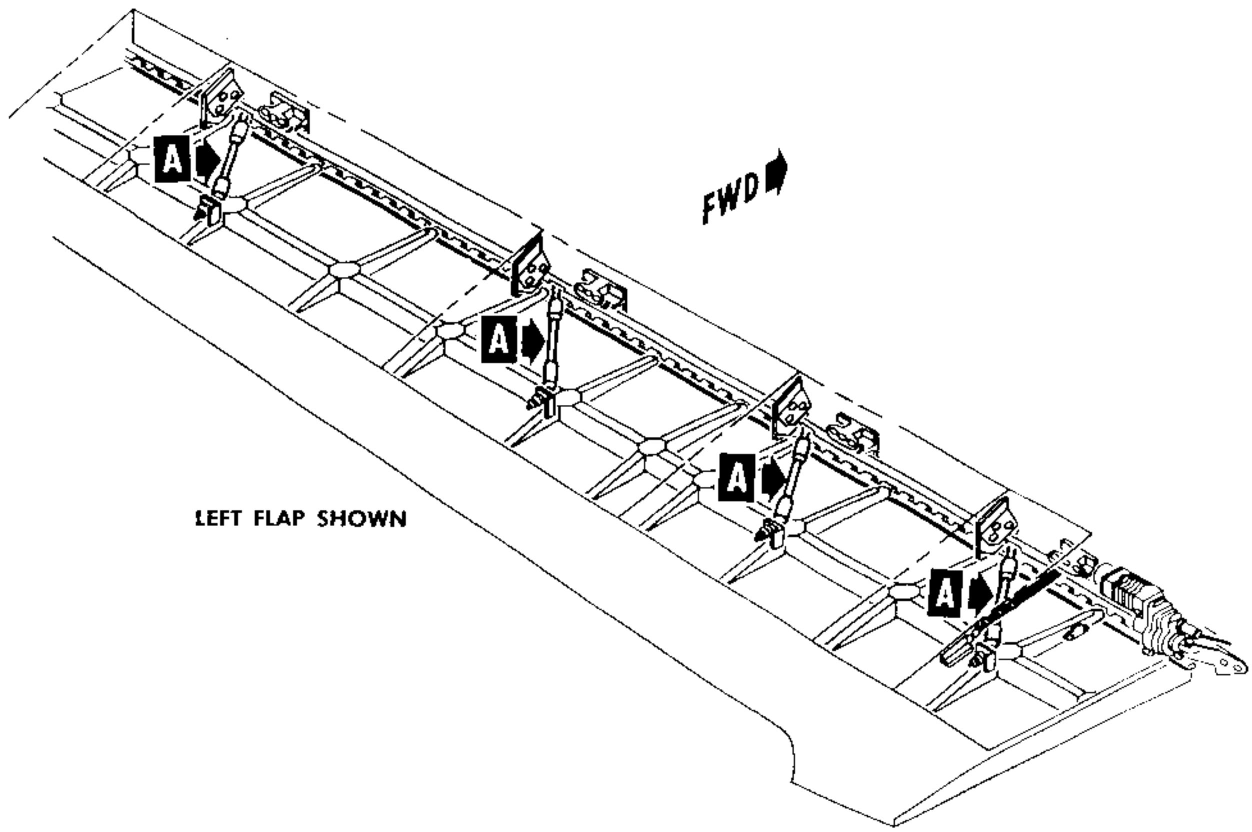
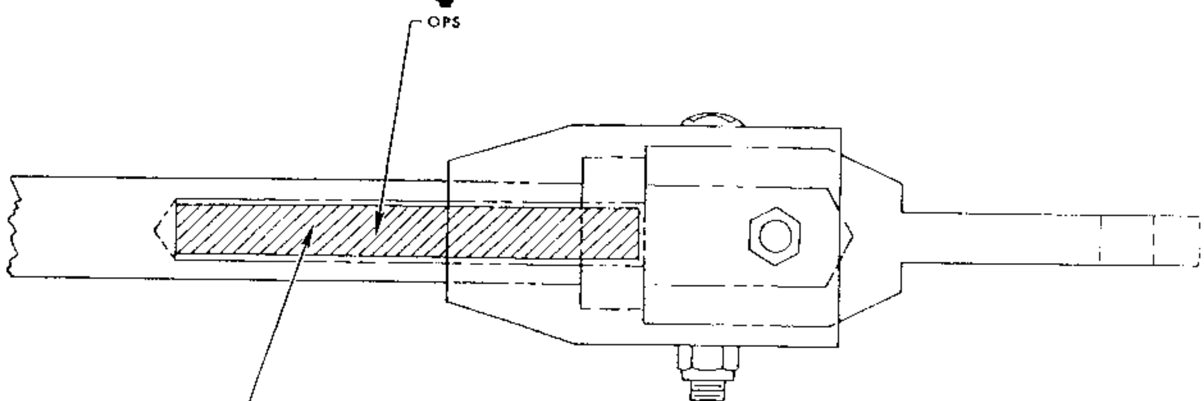



Figure 26 — Lubrication Diagram (Sheet 4 of 5 Sheets)




LEFT FLAP SHOWN

11A. WING FLAP OPERATING LINK




OPERATING LINK

DETAIL A

FB 461F
M39-20-3-76 (5)

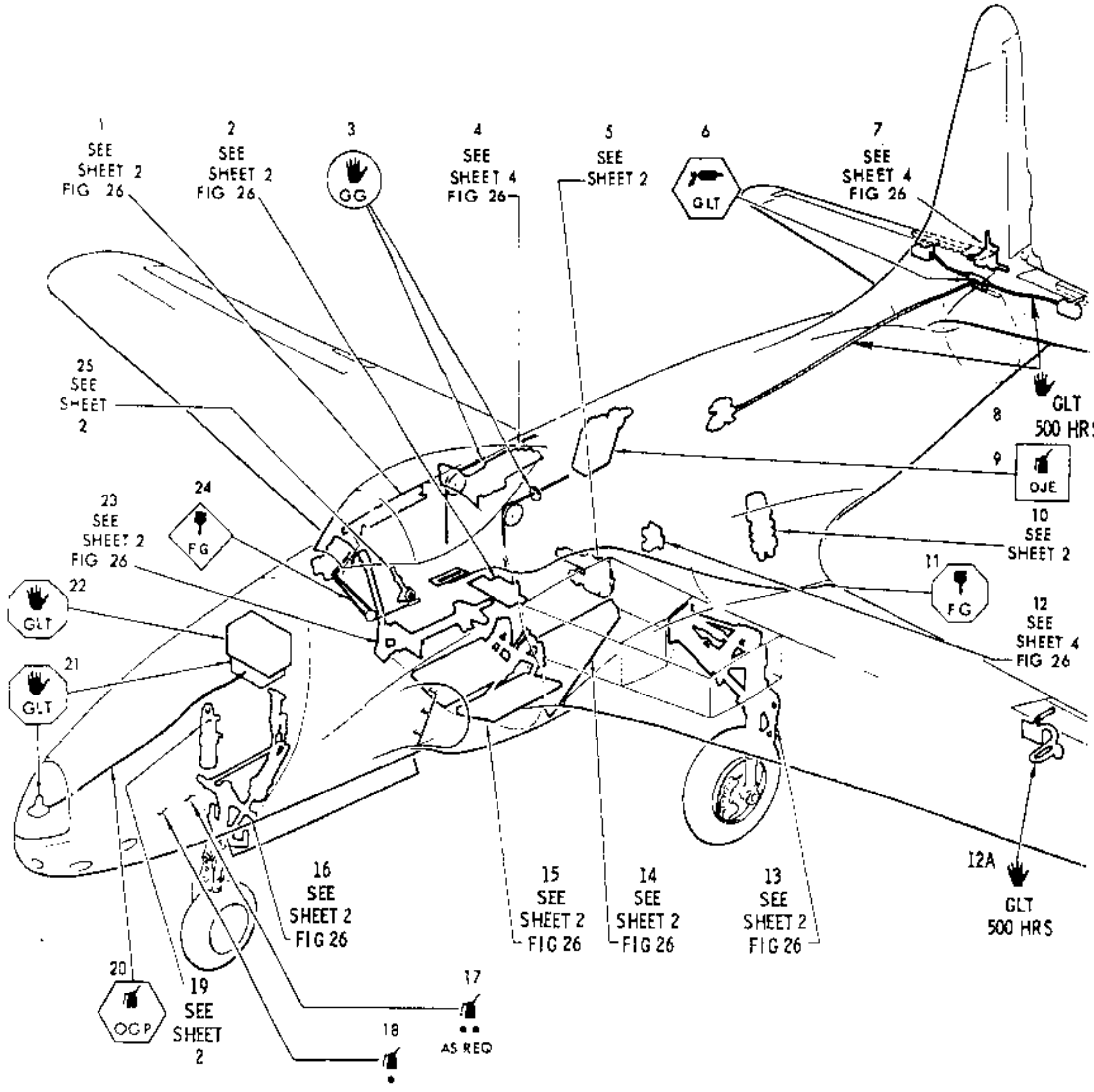
*Figure 26 — Lubrication Diagram (Sheet 5 of 5 Sheets)*

## SPECIAL SERVICE NOTES

FITTINGS — Clean all fittings before lubricating. Lubricate through fittings until new grease appears at the part being lubricated.

PIANO TYPE HINGES — Lubricate all piano type hinges only upon replacement. Use AN-G-24 (Symbol FG). Do not use oil or grease.

CONTROL SYSTEM BEARINGS — These ball bearings are lubricated with AN-G-3 (Symbol GLT) and sealed. They do not require relubrication. At overhaul, clean and replace AN-G-3 with AN-G-25 (Symbol GLT). Keep all control bearings wiped off and clean.




FB 68C5
M39-22-3-26A (1)

## TABLE OF LUBRICANTS

| Identification Letter | Boss Specification | Type of Lubricant |
|---|---|---|
| GH | AN-G-5 | Grease, High Temperature, Lubricating |
| GG | AN-G-6 | Grease, Lubricating, Graphite |
| FG | AN-G-24 | Graphite, Powdered |
| GLT | AN-G-25 | Grease, Low Temperature |
| OGR | AN-O-3 | Oil, Low Temperature, Lubricating, Gear |
| OGP | AN-O-6 | Oil, Low Temperature, Lubricating, General Purpose |
| OJE | AN-O-9 Grade 1010 | Oil, Low Temperature, Lubricating |
| OHA | AN-O-366 | Hydraulic Fluid |
| ● | USA Spec 2-120 | Oil, Lubricating, Preservative |
| ●● | USA Spec 2-36D | Oil, Recoil, *Light* |

## FREQUENCY SYMBOLS

Daily — 25/30 Hrs. — 50/60 Hrs — 100/120 Hrs — Over ...

## APPLICATION SYMBOLS

Zerk or Alemite Gun — Oil Can — Brush — Hand

## PARTS NOMENCLATURE KEY

1. Canopy Track Assembly
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3. Cable Seals (Rubber)
4. Electric Canopy Screw Jack and Actuator
5. Aileron Debooster Spring
6. Elevator Tab Tee Drive Assembly
7. Elevator Spring Tab Bungee
8. Elevator Tab Power Unit Flexible Shafts
9. Turbine and Cooler
10. Emergency Fuel Pump
11. Flap Position Indicator Cable
12. Wing Flap "H" Gear Box
12A. Aileron Tab Power Unit Flexible Shaft
13. Main Alighting Gear Assembly
14. Main Alighting Gear Up Lock Assembly
15. Dive Flap Assembly
16. Nose Alighting Gear Assembly
17. Machine Gun Buffers (6)
18. Machine Guns (6)
19. Case Ejection Door Actuating Cylinder
20. Tuning Shaft AN/ARN-6 Radio Compass
21. Couplings AN/ARN-6 Radio Compass
22. Dynamotor, Transmitter, Receiver AN/ARC-3 Radio
23. Aileron-Elevator Control Assembly
24. Gun-Sight Control Cable
25. Gun-Sight Control Handle

Figure 26A (Sheet 1 of 2 Sheets) — Lubrication Diagram, F-80A-10 Winterized Airplanes

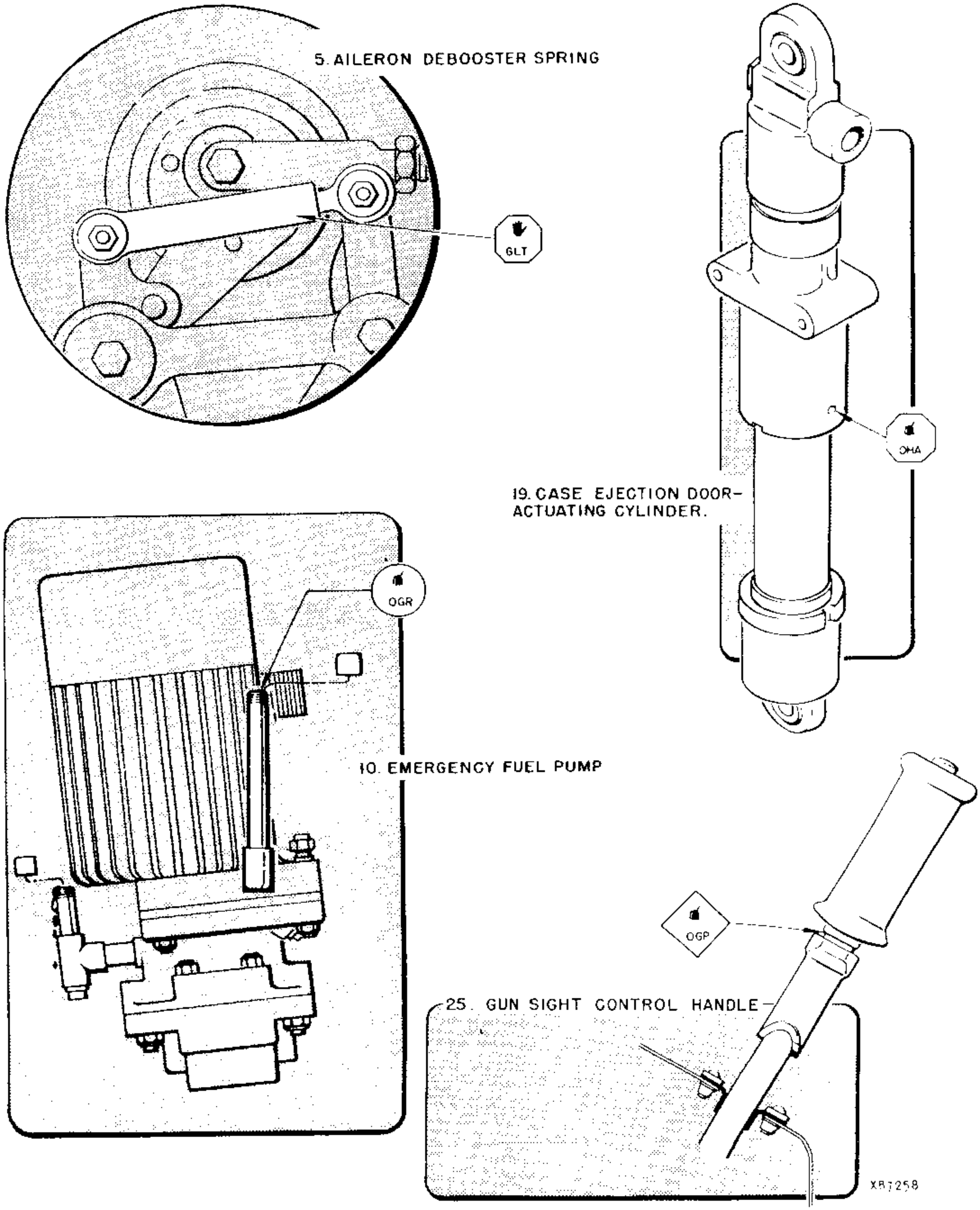



*Figure 26A (Sheet 2 of 2 Sheets) — Lubrication Diagram, F-80A-10 Winterized Airplanes*

| Part No. | Ref. Fig. | Description |
|---|---|---|
| 176846 | 19 | Pitot Tube Cover (Fin) |
| 179379 | Not Shown | Pitot Tube Cover (Nose) |
| 205824 | Not Shown | Canopy Bungee Safety Pin |
| S-10404 | 30, Sh. 1 | Slide Hammer |
| S-10406 | 31 | Aft Fuselage Mating Spreader Bar |
| S-10802 | 30, Sh. 1; 243 | Oil Buffer Spring Release Pin |
| S-13201 | Not Shown | Booster Bypass Piston Wrench |
| S-20406-35 | | Accumulator Retainer "U" Spanner Wrench |
| S-20410-31 | | Torque Tube Seal Retainer "U" Spanner Wrench |
| S-20411-29 | | Nose Gear Strut Upper Bearing "U" Spanner Wrench |
| S-20413-46 | | Main Gear Strut Piston Bearing "U" Spanner Wrench |
| S-20424-36 | | Nose Gear Strut Lock Nut Bearing "U" Spanner Wrench |
| S-20608-6 | 29 | Main Gear Door Cylinder Cap Lock Nut Hook Spanner Wrench |
| S-20612-20 | | Booster Cylinder Lock Nut Hook Spanner Wrench |
| S-20614-20 | | Main Gear Cylinder Cap Lock Nut Hook Spanner Wrench |
| S-20617-21 | | Nose Gear Actuating Cylinder Lock Nut Hook Spanner Wrench |
| S-20618-20 | | Dive Flap and Main Gear Actuating Cylinder Barrel Lock Nut Hook Spanner Wrench |
| S-31201 | Not Shown | Nose Gear Up Lock Cylinder Spanner Wrench |
| S-32550 | 28 | Main Gear Fulcrum Nut Spanner Wrench |
| S-34102 | 30, Sh. 1; 243 | Gun Adjusting Wrench |
| S-34103 | 30, Sh. 1; 243 | Rear Post Adjusting Short Wrench |
| S-34105 | 243 | Gun Rear Post Adjusting Wrench (Later Airplanes) |
| S-34802 | | Aileron and Elevator Hinge Pin Puller |
| S-35703 | | Flap Jack-shaft Spline Male Adapter |
| S-35704 | | Flap Jack-shaft Spline Female Adapter |
| S-37325 | 30, Sh. 1 | Forward Wing Mating Alignment Pin |
| S-37326 | | Aft Wing Mating Alignment Pin |
| S-37403 | | Fuselage Longeron Fitting Insert Wrench |
| S-38405 | | Nose Gear Strut Lower Bearing Spanner Wrench |
| S-38406 | | Main Gear Strut Lower Bearing Spanner Wrench |
| S-38505 | 28 | Nose Gear Strut Cam Installing Spanner Wrench |
| S-40704 | | Nose and Main Gear Strut Plunger Tube Spanner Wrench |
| S-40750 | | Battery Puller |
| S-40751 | Not Shown | Engine and Hydraulic Reservoir Funnel |
| S-40752 | | Battery Lift |
| S-78903 | 20 | Towing and Steering Bar, Nose Gear |
| S-79249 | | Wing and Stabilizer Cover |
| S-79250 | | Tail Pipe Dust Plug |
| S-79251 L/R | 19 | Duct Dust Plug |
| S-79252 | | Canopy Cover |
| S-80401 | | Wing Tie-down Fitting |
| S-80503 | 12 | Wing Hoisting Sling |
| S-81906 | 17, 19 | Nose Tie-down and Jack Pad |
| S-81907 | 17 | Wing Jack Pad |
| S-83210 | 20 | Towing and Steering Bar, Main Gear |
| S-84402 | 11 | Aft Fuselage Section Sling |
| S-84403 | 9 | Airplane Sling |
| S-84702 | 13 | Fuselage Aft Section Transport and Mating Cradle |
| S-84704 | 14 | Wing Dolly |
| S-84706 | 15 | Fuselage Nose and Mid Section Dolly |
| S-85204 | 22 | Alighting Gear Down Lock Clamp |
| S-88501 | | Auxiliary Electric Starting Cart |
| S-89801 L/R | 31 | Wing Protection Walkway |
| S-91825 | | Aileron Setting Gage |
| S-91826 | 30, Sh. 2 | Elevator Setting Gage |
| S-91827 | | Rudder Setting Gage |
| S-97701 | 31 | Cockpit Ladder |
| S-99851 | | Operational Squadron Tool Container |
| S-99853 | | Service Squadron and Major Overhaul Tool Container |

*Figure 27 — Special Tools List*

## 5. LUBRICATION.

Refer to figures 26 and 26A for lubrication points and requirements.

## 6. SPECIAL TOOLS AND EQUIPMENT.

*a.* Refer to figure 27 for list of special tools used for service and maintenance of the airplane.

*b.* Refer to figure 28 for alighting gear tools necessary to service the airplane.

*c.* Refer to figure 29 for the universal type tools necessary to service the airplane.

*d.* Refer to figure 30 for miscellaneous tools necessary to service the airplane.

*e.* Refer to figure 31 for miscellaneous ground handling equipment used to facilitate service and maintenance of the airplane.

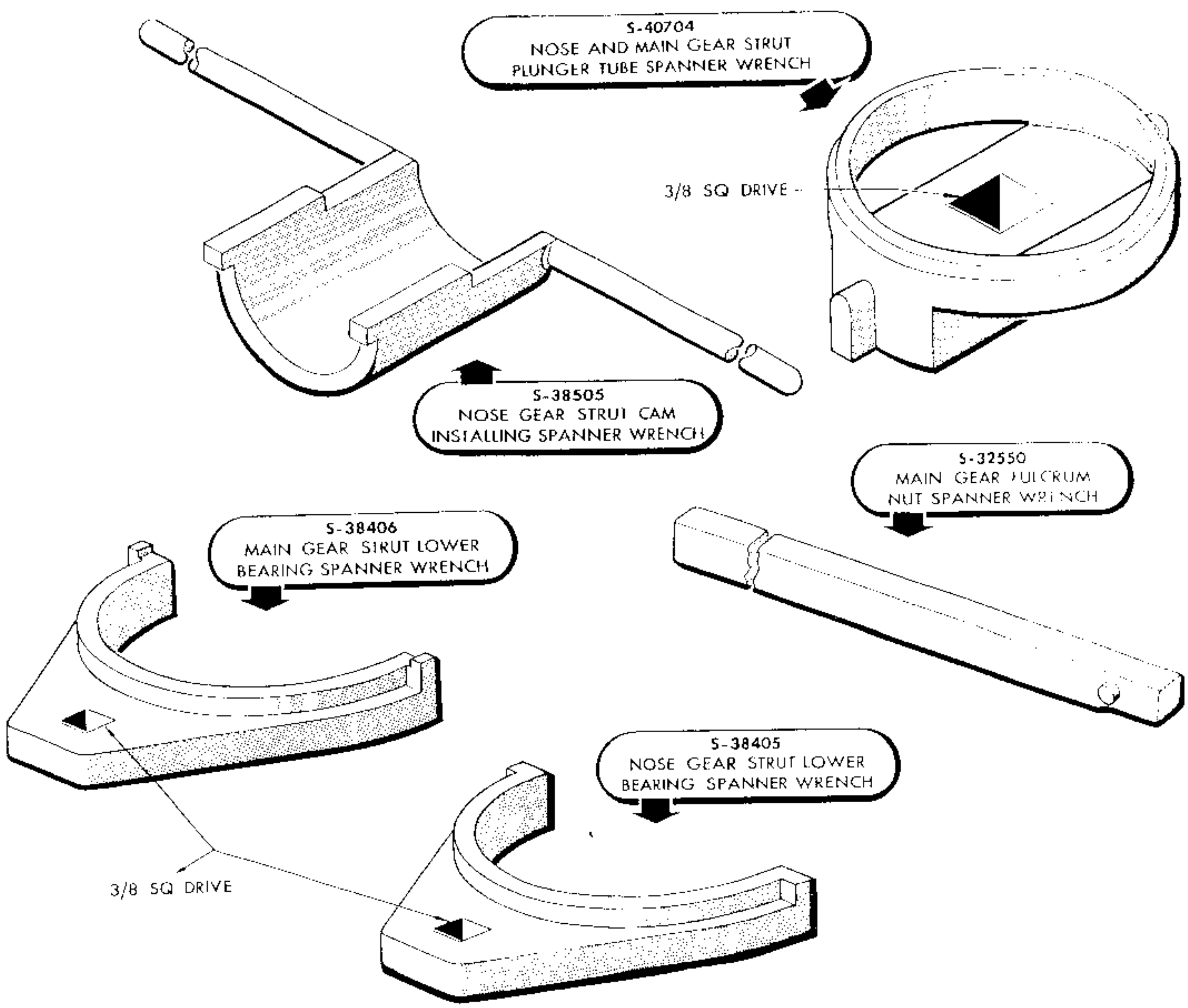
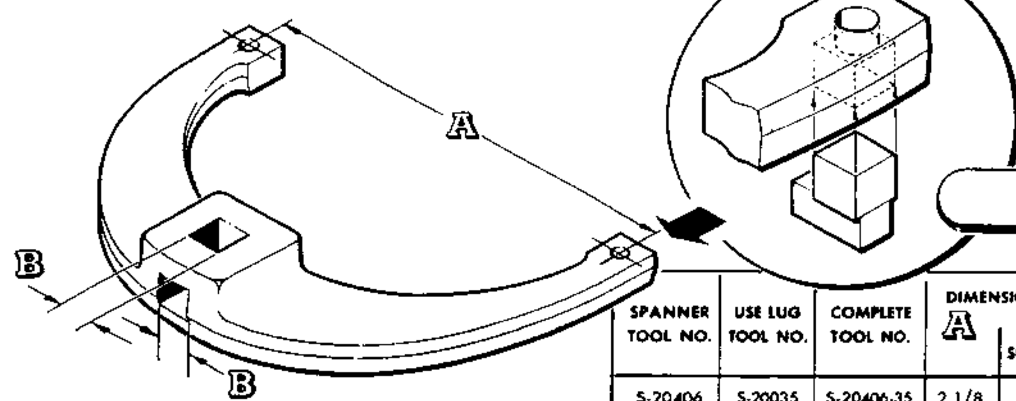


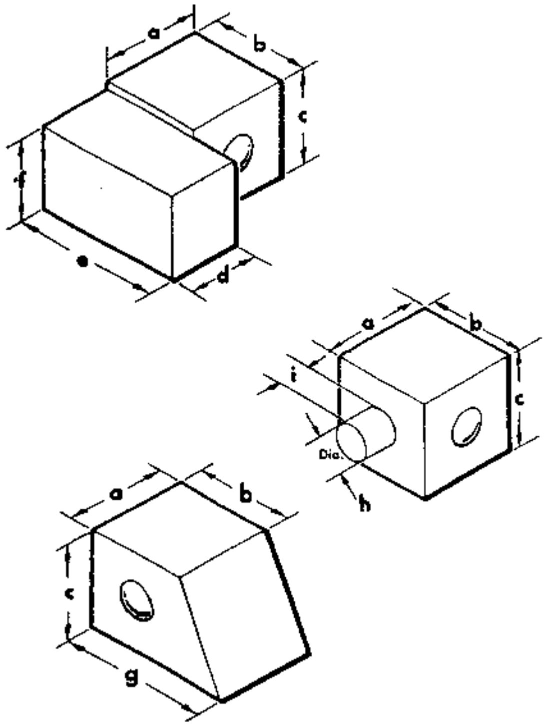

*Figure 28 — Alighting Gear Tools*




S-20400 SERIES

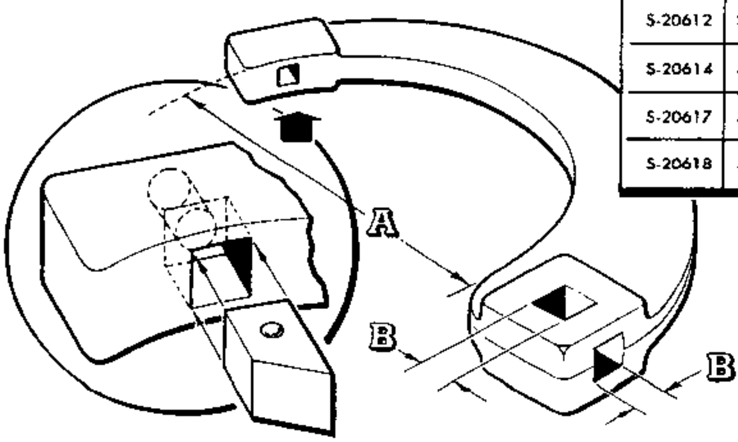
"U" SPANNER

| SPANNER TOOL NO. | USE LUG TOOL NO. | COMPLETE TOOL NO. | DIMENSIONS A | DIMENSIONS B SQ DR | USED ON |
|---|---|---|---|---|---|
| S-20406 | S-20035 | S-20406-35 | 2 1/8 | 3/8 | ACCUMULATOR RETAINER |
| S-20410 | S-20031 | S-20410-31 | 2 5/8 | 3/8 | TORQUE TUBE SEAL RETAINER |
| S-20411 | S-20029 | S-20411-29 | 2 3/4 | 3/8 | NOSE GEAR STRUT UPPER BEARING |
| S-20413 | S-20046 | S-20413-46 | 3 | 3/8 | MAIN GEAR STRUT PISTON BEARING |
| S-20424 | S-20036 | S-20424-36 | 4 3/8 | 3/8 | NOSE GEAR STRUT LOCK NUT |




| LUG NO. | DIMENSIONS a | b | c | d | e | f | g | h | i |
|---|---|---|---|---|---|---|---|---|---|
| S-20006 | 1/4 | 1/4 | 1/4 | | | | | 3/16 | 1/8 |
| S-20020 | 1/4 | 1/4 | 1/4 | | | | 5/16 | | |
| S-20021 | 1/4 | 1/4 | 1/4 | | | | 3/8 | | |
| S-20029 | 1/4 | 1/4 | 1/4 | 1/8 | 3/8 | 3/16 | | | |
| S-20031 | 1/4 | 1/4 | 1/4 | 1/8 | 3/8 | 1/4 | | | |
| S-20035 | 1/4 | 1/4 | 1/4 | 3/16 | 3/8 | 7/32 | | | |
| S-20036 | 1/4 | 1/4 | 1/4 | 3/16 | 3/8 | 1/4 | | | |
| S-20046 | 1/4 | 1/4 | 1/4 | 1/8 | 3/8 | 5/16 | | | |

| SPANNER TOOL NO. | USE LUG TOOL NO. | COMPLETE TOOL NO. | DIMENSIONS A | DIMENSIONS B SQ DR | USED ON |
|---|---|---|---|---|---|
| S-20608 | S-20006 | S-20608-6 | 1 7/8 | 3/8 | Main Gear Door Actuating Cylinder Cap Lock Nut |
| S-20612 | S-20020 | S-20612-20 | 2 3/8 | 3/8 | Booster Cylinder Lock Nut |
| S-20614 | S-20020 | S-20614-20 | 2 5/8 | 3/8 | Main Gear Actuating Cylinder Cap Lock Nut |
| S-20617 | S-20021 | S-20617-21 | 3 | 3/8 | Nose Gear Actuating Cylinder Lock Nut |
| S-20618 | S-20020 | S-20618-20 | 3 1/8 | 3/8 | Dive Flap Actuating Cylinder Barrel Lock Nut |




S-20600 SERIES

HOOK SPANNER

*Figure 29 — Universal Type Tools*

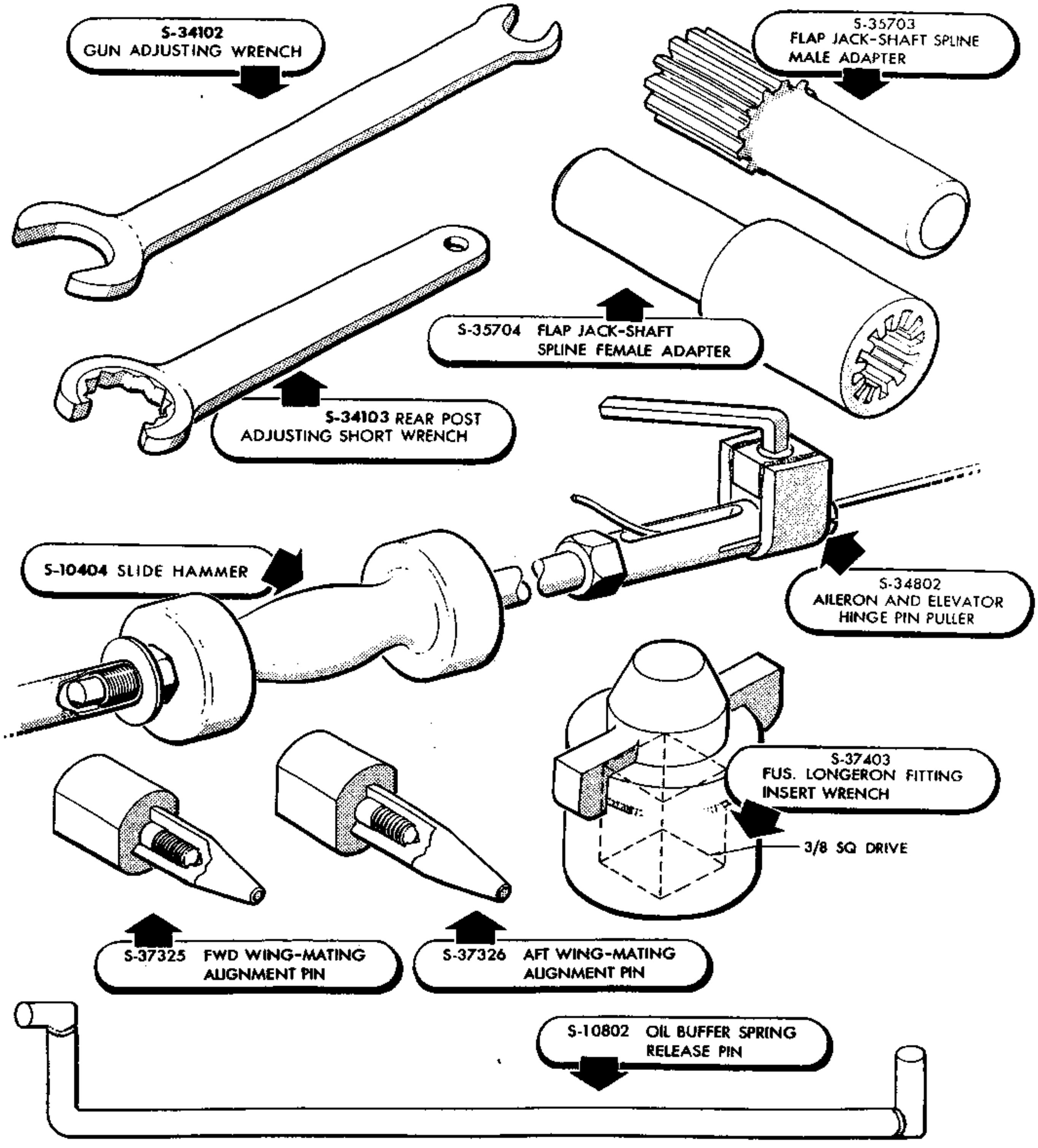



*Figure 30 (Sheet 1 of 2 Sheets)—Miscellaneous Tools*

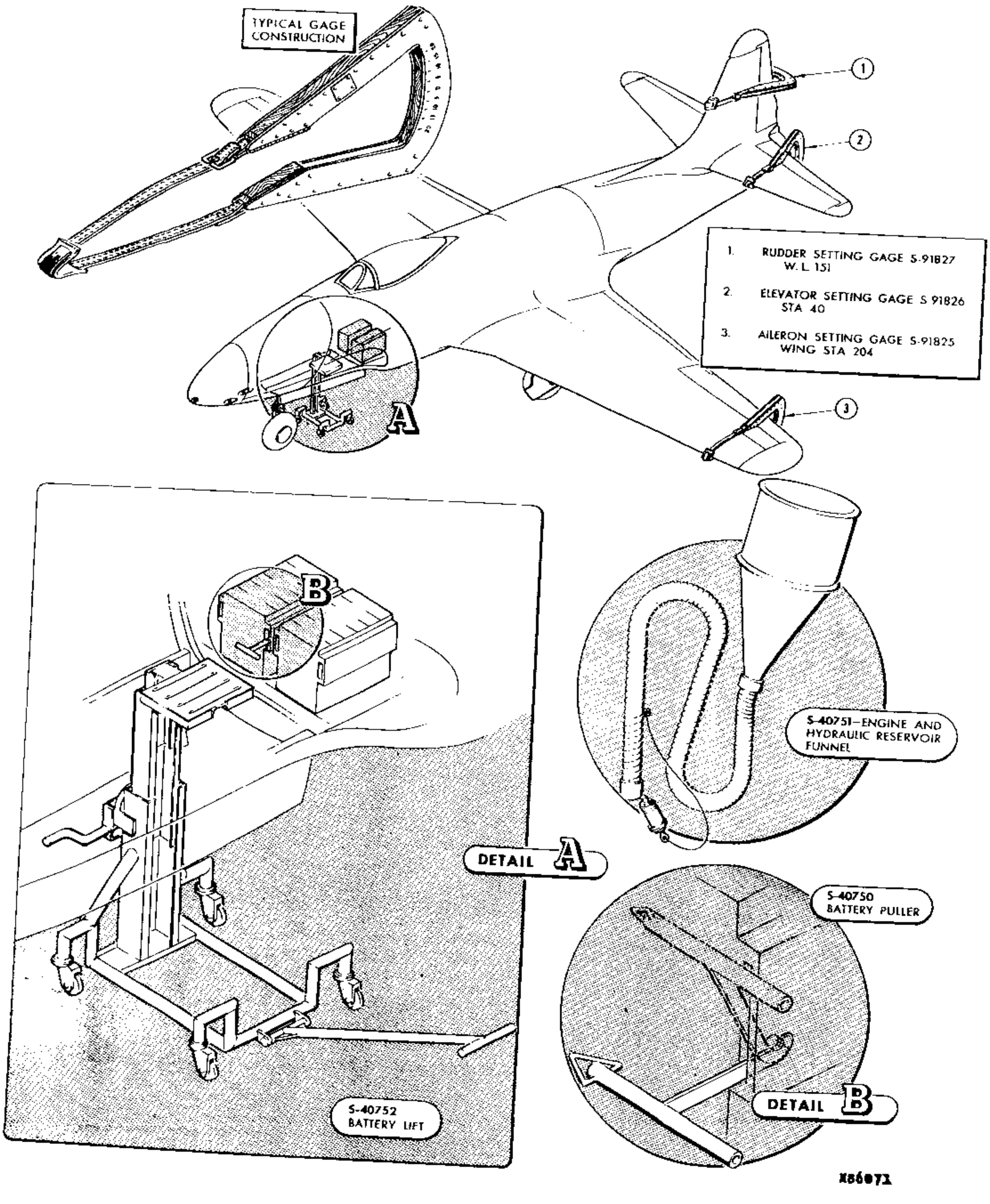



*Figure 30 (Sheet 2 of 2 Sheets) — Miscellaneous Tools*

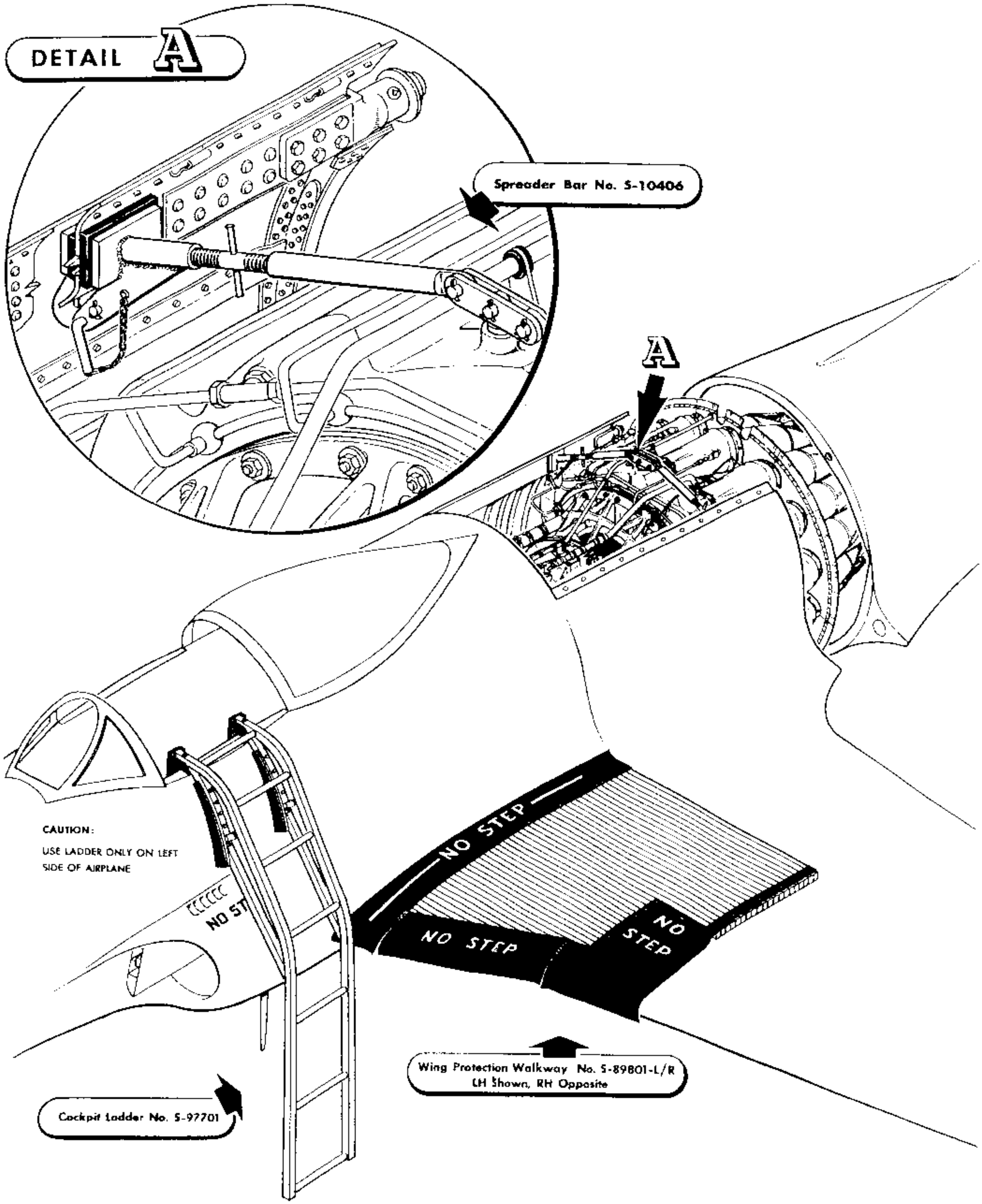
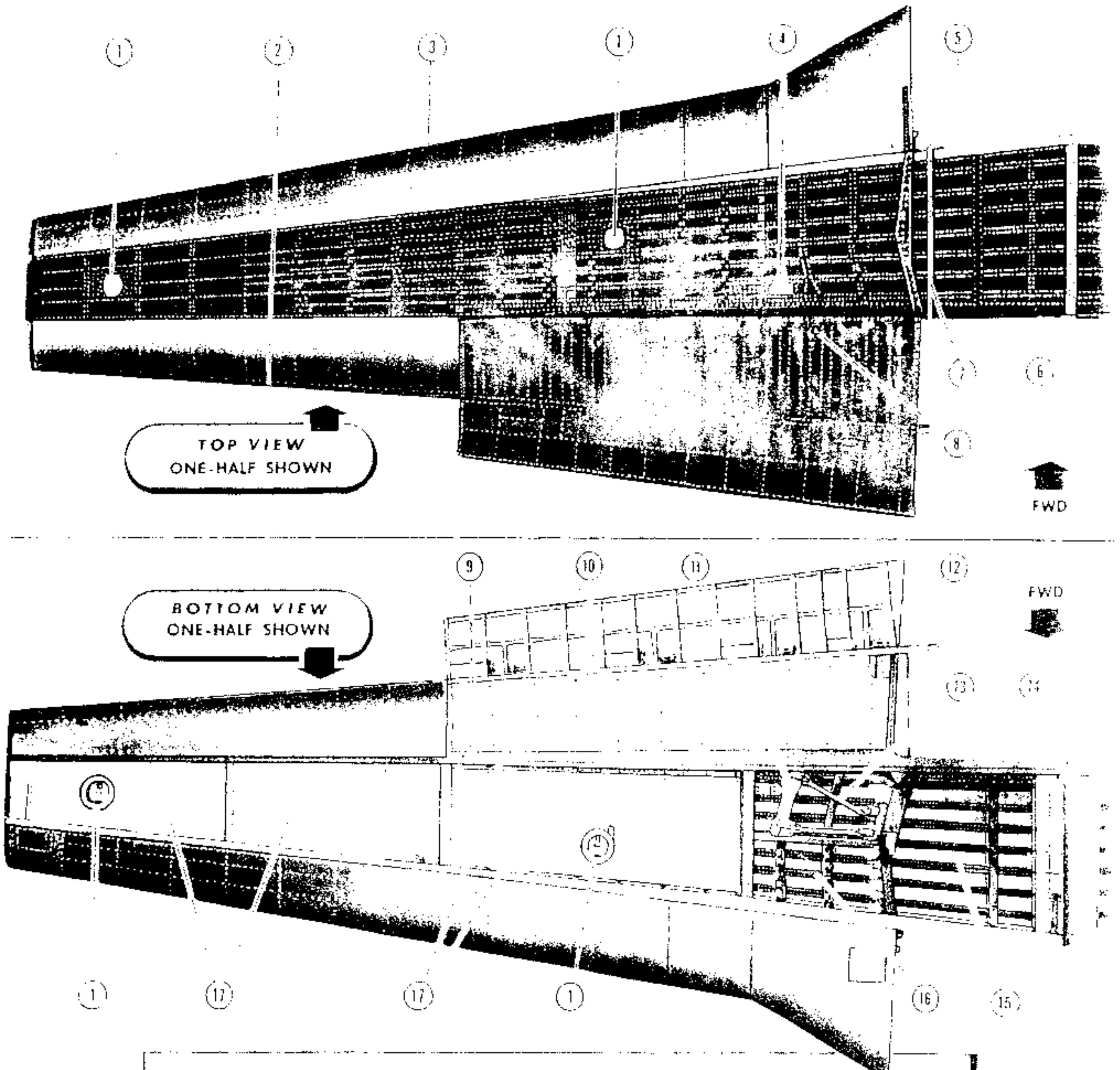



*Figure 31 — Miscellaneous Ground Handling Equipment*




1. FILLER WELLS
2. AILERON HINGE
3. LEADING EDGE SECTION
4. ACCESS DOOR SHOCK STRUT SERVICING
5. FRONT BEAM
6. REAR BEAM
7. SERRATED PLATE
8. LIFTING [illegible]
9. AUXILIARY BEAM
10. WING FLAP HINGE
11. ALIGHTING GEAR FULCRUM BEARING SUPPORT
12. WING FLAP PUSH-PULL TUBE ROLLERS
13. ALIGHTING GEAR TRUSS MEMBER
14. WING CENTER RIB
15. ALIGHTING GEAR WHEEL WELL
16. OXYGEN CYLINDER COMPARTMENT
17. FUEL TANK COMPARTMENTS

*Figure 32 — Wing Panel*

# SECTION IV

# MAJOR COMPONENT PARTS AND INSTALLATIONS

## 1. WING.

*(See figure 32.)*

*a.* GENERAL DESCRIPTION.—The wing is a full cantilever, stressed-skin structure of aged 24S-T aluminum alloy. (See AN 01-75FJ-3, "Handbook of Structural Repair Instructions.") The wing is made as one unit except for the detachable leading edges, wing tips, ailerons, and flaps. The leading edge sections of early airplanes are constructed of stringers along the length of the section, and ribs across the section. Compartments are provided aft of the leading edge sections for four self-sealing fuel tanks (two on each side) on these airplanes. On later airplanes the leading edge sections are more readily removable than on the early airplanes. Also in the later airplanes, each leading edge section contains a self-sealing fuel tank which extends the entire length of the section. On later airplanes, compartments are provided aft of the leading edge for eight self-sealing fuel tanks (four on each side). Removable stressed panels on the wing lower surface give access to the fuel tanks aft of the leading edge section on all airplanes. All self-sealing tanks are protected from excessive bullet rupture by .030 laminated glass cloth sheets.

Lifting lugs are at wing stations 52.1 right and left. (See figure 9.) Each wing tip structure is composed of one large casting which acts as a former for the skin, and contains the shackle, plumbing, and electrical wiring for droppable fuel tanks, bombs, and chemical tanks. A navigation light is in each wing tip.

Retractable rocket launching posts are mounted under each wing on the inboard wing tank panel. (See paragraph 20A.) A gun camera pod is located on each wing outboard leading edge section. (See paragraph 20*e*.)

There are provisions in the wing for an S-1 or S-2 bomb rack to be carried in an under-the-wing pylon on those airplanes incorporating T.O. 01-75F-42. (See paragraph 19*d*(5).)

An electrically operated trim tab is located on the inboard end of the left aileron. A split flap is mounted inboard of each aileron. The flaps form the aft lower surface and the upper trailing edge of the wing.

A wing-to-fuselage attachment fitting is located on the inboard end of each leading edge section, and two fittings are on the aft side of the wing rear beam. Two serrated plates are on the top surface of the wing, one on each side of the center line. Contoured angles on the fuselage mate with these serrated plates and are held against them by 13 bolts on each side.

The rib at wing station 0 has two fuselage attachment fittings at the lower forward and aft points of the rib. The fittings mate with the lower longeron fittings of the fuselage, and have threaded inserts which are removable with tool No. S-37403 (figure 30) after insert attaching bolts have been removed. (See figure 60.)

*b.* WING PANEL.

(1) REMOVAL. *(See figure 33.)*—Special tools required: Two S-37325 wing mating pins, two S-37326 wing mating pins, S-84403 fuselage sling, two S-84704 wing dollies, and S-84706 mid-section storage stand.

**Note**

These removal instructions apply only to the fighter airplane, since a fuselage nose and mid section storage stand and airplane sling are not available for the photographic airplane.

*(a)* Remove batteries. (See paragraph 17*c*(5)*(c)*, this section.)

*(b)* Drain all fuel.

*(c)* Drain hydraulic fluid from reservoir by removing plug in bottom of reservoir.

*(d)* Remove aft fuselage. (See paragraph 6*c*, this section.)

*(e)* Remove engine. (See paragraph 6*e*, this section.)

*(f)* Remove wing fillets and formers as follows (figure 34):

*1.* Remove upper middle and aft fillets.

*2.* Remove strap around leading edge, and remove upper leading edge fillet.

*3.* Remove lower leading-edge and aft fillets. Do not remove screws from the leading edge of the lower forward fillet. Splice plate will stay with this fillet.

*4.* Remove the lower leading-edge fillet former.

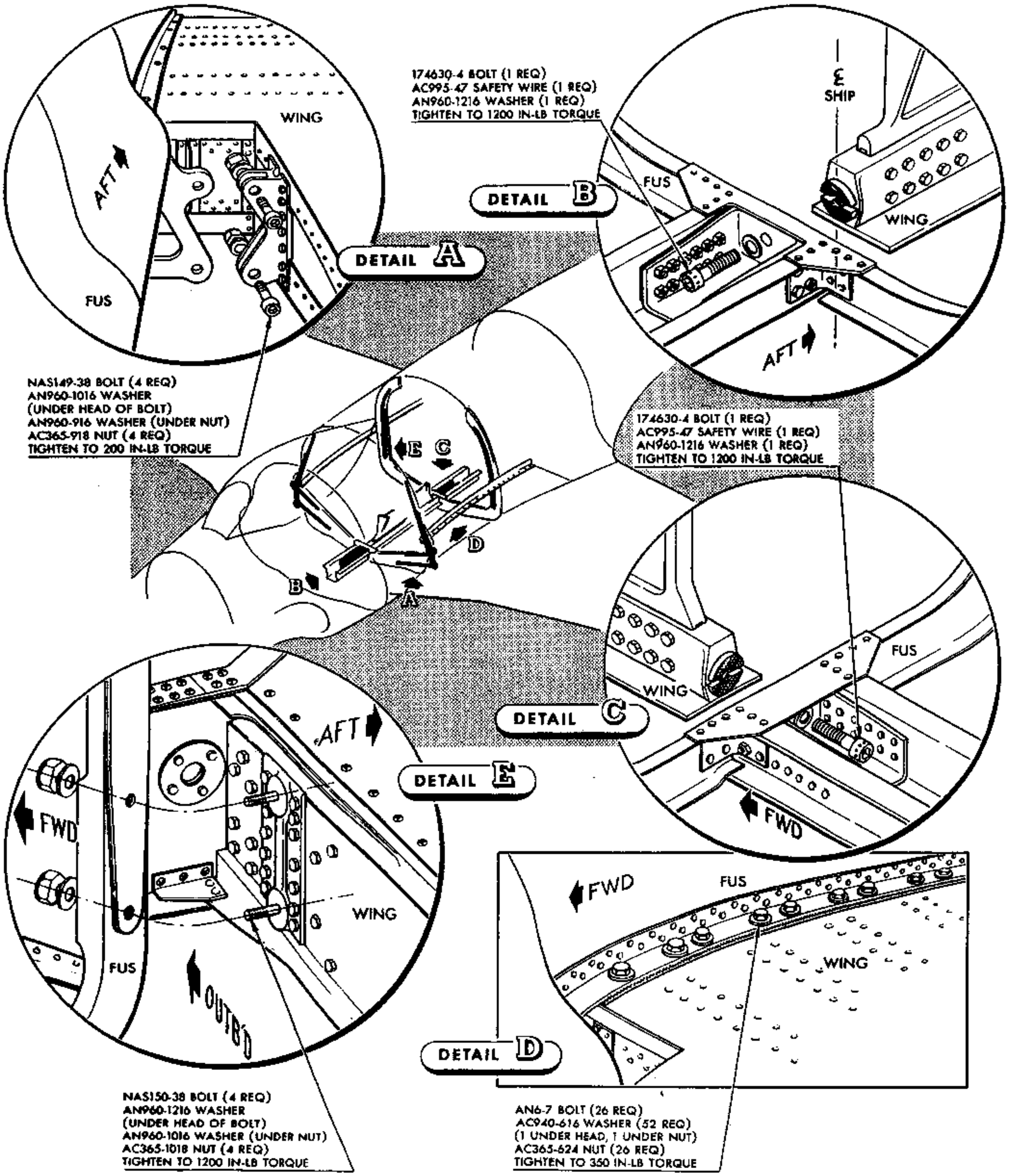



*Figure 33 — Wing to Fuselage Attachment*

(*g*) Disconnect wing flap position-indicator cable at inboard end of left flap. Loosen sheath from clips on wing and fasten sheath and cable to fuselage. (See figure 40.)

(*h*) Disconnect bomb release cable at cable connector in wing tip. From the cockpit, pull cable out of sheath until it clears the pulleys on the aft side of the fuselage fuel tank aft support panel. (See figures 49 and 50.) Disconnect the sheaths that go out the wing from the pulley bracket. Coil the sheaths in the wing.

(*hA*) In left wheel well, disconnect cable from hydraulic fuse by removing pin from clevis on end of cable. Remove casing from all clamps in wing. Disconnect pulley from its bracket. Coil cable and pulley in fuselage hydraulic compartment.

(*hB*) Disconnect jato cable in engine compartment by removing bolt from bridle. Remove cable clips in engine compartment and in wing. Coil cable in fuselage hydraulic compartment.

(*i*) Remove the dive flaps and the flap actuator support assembly. (See paragraphs 3*c*(6)(*c*), this section.) It is not necessary to remove the actuator from the support assembly.

(*j*) Remove electrical equipment as follows:

*1.* Disconnect and remove flap motors. (See paragraph *g*(4)(*b*) following.)

*2.* Disconnect all wires on terminal strips located in right-hand hydraulic compartment. Replace nuts and washers.

*3.* Release left- and right-hand electrical wires from their strap clips. Coil and stow wires in the wing.

*4.* Disconnect all electrical plugs and cables from the engine-compartment seal below the wing rear beam. Loosen straps and pull wires, cables, and receptacles through front beam and stow them in the hydraulic compartment.

*5.* Disconnect all electrical fittings from engine-compartment seal below wing rear beam.

(*k*) Disconnect plumbing as follows:

**Note**

Upon removal, immediately cap all plumbing lines.

*1.* Disconnect droppable-tank air pressure line, droppable-tank fuel line, and wing leading-edge tank vent line from inboard ends of wing leading edges. (See figure 35.) On airplanes without leading edge tanks, remove short tube with hose connection between leading edge and vent line "Y" fitting. On airplanes having the self-sealing tanks in the wing leading edge, remove hose at this point.

*2.* Disconnect vent lines from "Y" fitting at the wing front beam in the left and right main wheel wells. Remove "Y" fittings.

*3.* On airplanes with wing leading edge tanks, disconnect plumbing on the left and right leading-edge tank booster pump. Remove screws attaching pump and its adapter from the wing leading edge. Remove strap from the pump-support bracket. Remove pump and adapter. Replace strap on bracket.

*4.* Disconnect air lines from droppable-tank air pressure control valves.

*5.* Detach air-pressure control valves and brackets from front face of wing front beam by removing the attaching bolts.

*6.* Discharge oxygen system slowly by turning the regulator control to "SAFETY." (See paragraph 21, this section, for information on the oxygen system.)

## WARNING

Do not discharge oxygen system in the presence of oil, grease, an open flame, or an electric arc.

*7.* Disconnect all plumbing lines from the front face of the wing front beam, and cap all bulkhead fittings.

*8.* Disconnect cockpit hot and cold air pressure lines from aft side of the wing front beam and forward side of the wing rear beam. Remove tubes. Remove bulkhead fittings for these two lines from the front beam.

*9.* Disconnect the two fuel hoses forward of the wing front beam. Remove the drain cock from the fuel hose in the left main wheel well, and disconnect this hose aft of the wing rear beam. Remove the hose, and reinstall the drain cock. Disconnect the fuel hose from the filter in the right main wheel well, and remove the hose.

*10.* Remove hose fitting from valve at forward connection of right-hand hose.

*11.* On the aft side of the wing rear beam, disconnect all plumbing lines which go through the rear beam. (See figure 49.)

*12.* From the main-gear wheel wells, disconnect all plumbing that goes through the wing rear beam.

*13.* Remove all bulkhead fittings from the wing rear beam.

*14.* Disconnect aileron booster shut-off valve from the aft face of the wing rear beam.

*15.* Disconnect inboard fuel-tank hoses from wing. Stow hoses in engine compartment.

(*l*) Disconnect aileron cables from aileron booster and push cables into wing until they clear the fuselage.

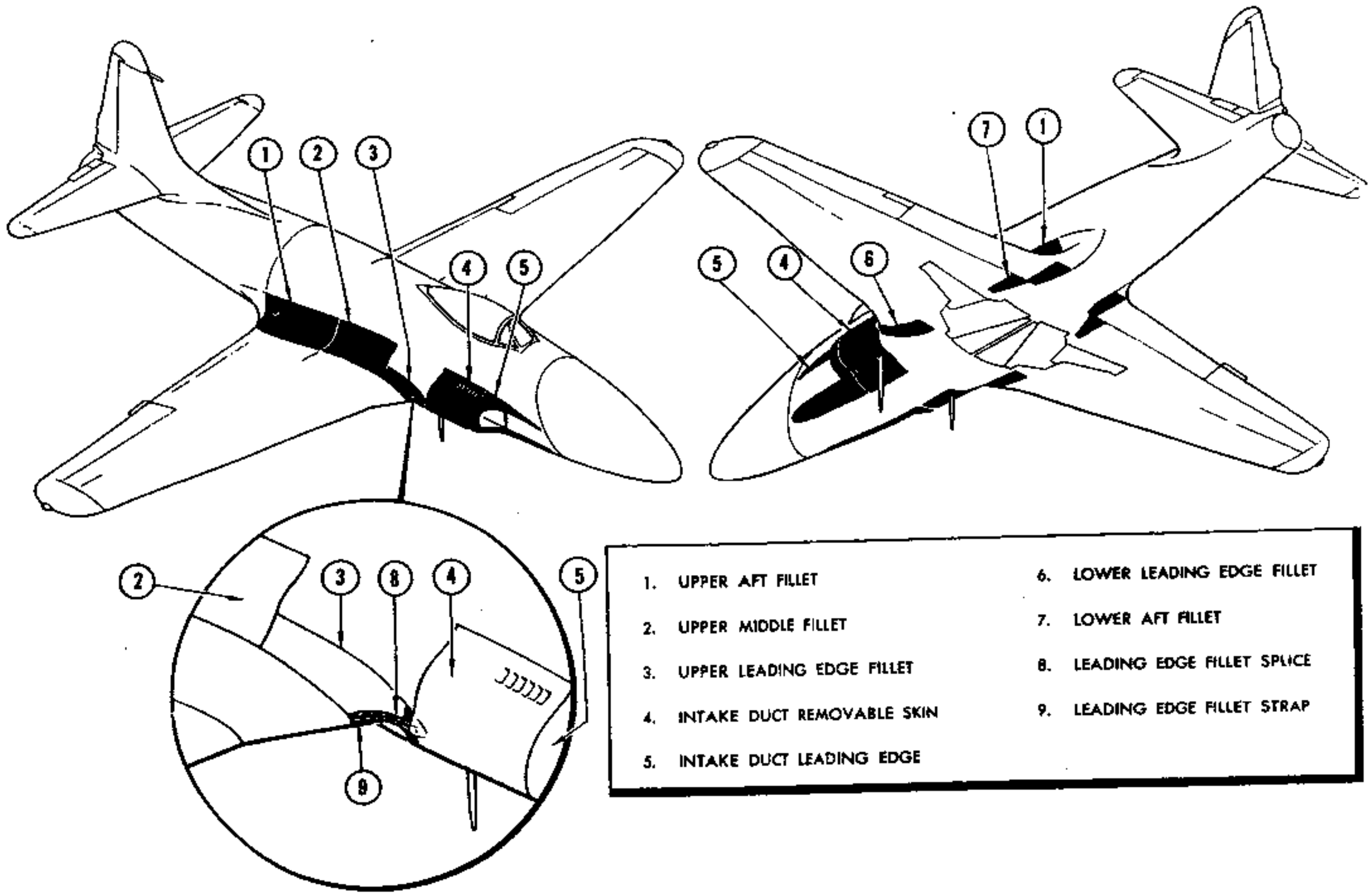



*Figure 34 — Wing Joint Fillets*

*(m)* Remove aileron booster. (See paragraph 15*c*(3)*(d)*, this section.)

*(n)* Remove aileron torque shaft. (See paragraph 15*c*(2)*(3)*2f, this section.)

*(o)* In main wheel wells, remove bolt from lever on inboard door-closing mechanism. (See figure 70, reference 12.)

*(p)* Remove canopy. (See paragraph 3*c*(3)*(f)*, this section.)

*(q)* Support wing on stands. (See section III, paragraph 2*c*(2) and figure 14.)

*(r)* Attach sling No. S-84403 to fuselage nose and mid section. (See section III, paragraph 2*b*(3) and figure 9.)

*(s)* Remove 13 bolts from wing-to-fuselage attaching angle through serrated plate on each side of the fuselage in the upper surface of the wing.

*(t)* From within the fuselage, remove forward and aft bolts attaching bottom of wing center rib to the fuselage.

*(u)* Lift sling enough to take the load off the eight bolts (four on each side) which attach fuselage to front and rear main spars.

*(v)* Remove the four lower bolts, and replace the two in the front beam with wing mating pin No. S-37325 (figure 30); replace the two lower aft bolts with wing mating pins No. S-37326 (figure 30).

*(w)* Remove the four upper bolts from the wing beam, then remove the adapters from the wing mating pins and drive the pins through.

**CAUTION**

Make final check to be sure that all electrical, hydraulic, and fuel connections, and all control cables are clear.

*(x)* Hoist fuselage slowly straight up from the wing. Fuselage nose and mid sections may be stored in mid-section storage stand S-84706. (See figure 15.)

(2) INSTALLATION. *(See figure 33.)* — Special tools required: Two S-37325 and two S-37326 wing mating pins, S-84403 fuselage sling, two S-84704 wing dollies, and S-84706 fuselage and mid-section storage stand.

*(a)* Support wing with wing dolly S-84704 (figure 14) at wing station 126.25 directly under rib.

*(b)* Use sling No. S-84403 to hoist fuselage nose and mid sections over wing. (See section III, paragraph 2*b*(3) and figure 9.) Lower fuselage onto wing slowly. Be careful not to damage plumbing fittings on wing front beam. Use two pieces of .012 aluminum sheet approximately 2 x 2 inches, to protect the faces of the lower center attachment from the serrated face of the wing station 0 rib attachment. (See figure 33, details B and C.) Remove the pieces of aluminum sheet when the fuselage is in place. Support the fuselage nose section with a jack. (See section III, paragraph 2*d*(2) *(b)*.)

**Note**

Tighten all structural bolts to torque limits specified in section IX, "Wrench Torque Table," except as noted in the following instructions.

*(3)* Install the eight wing main-beams-to-fuselage bolts as follows:

*1.* Drive wing mating pin No. S-37325 through the lower bolt holes of the forward wing-fuselage attachment points.

*2.* Drive wing mating pin No. S-37326 through the lower bolt holes of the aft wing-fuselage attachment points.

*3.* Insert a bolt in the holes above each pin. Tighten the forward bolts to 200 inch-pounds maximum torque. These forward bolts must be tightened only enough to take up slack. Approximately 1½ threads through the nut will be sufficient.

*4.* Remove wing mating pins and insert bolts. If holes do not line up, drive a wing mating pin, without the adapter, through the hole ahead of the bolt.

*(d)* Install forward and aft center bolts.

*(e)* Install 13 bolts on each side of the fuselage to secure attaching angle to serrated plate on upper surface of wing. Use AN940-616 washers under bolt heads. Tighten these bolts to 350 inch-pounds torque.

*(f)* Lower the alighting gear.

*(g)* Jack the nose of the airplane. (See section III, paragraph 2*d*(2)*(b)*.)

*(h)* Support the wing on two wing dollies No. S-84704. (See figure 14.) Remove the sling .

*(i)* Install aileron torque shaft.

*(j)* Install aileron booster.

(k) Connect cables to aileron booster and adjust system. (See paragraph 15*c*(4)*(c)*, this section.)

(l) In the main wheel wells, install bolt through lever in inboard door-closing mechanism. (See figure 70.)

(m) To install plumbing, reverse removal procedure given in paragraph *b*(1)*(k)*, preceding.

*(n)* To install electrical equipment, reverse removal procedure given in paragraph *b*(1)*(j)* preceding.

*(o)* Attach emergency bomb-release cable sheath to pulley bracket on aft side of the main fuel-tank aft support panel (figure 49 and 50) and push cable out of sheath to wing tip. Fasten the cable at the wing tip connector to the wing tip cable. Take up all slack in the cable in the wing tip connector.

*(p)* With the wing flap in the down position, connect the flap position indicator cable. For adjustment, see paragraph *g*(4)*(e)*, following. Attach sheath to wing with clips. (See figure 40.)

*(q)* Install flap motors. (See paragraph *g*(4)*(d)* and *(e)*, following.

*(r)* To install wing fillets, reverse removal procedure given in paragraph *b*(1)*(f)*, preceding. (See figure 34.)

*(s)* Install the engine and fuselage aft section. (See paragraph 6*f*, this section.)

*(t)* Replenish the hydraulic system. (See figure 25.)

*(u)* Install batteries.

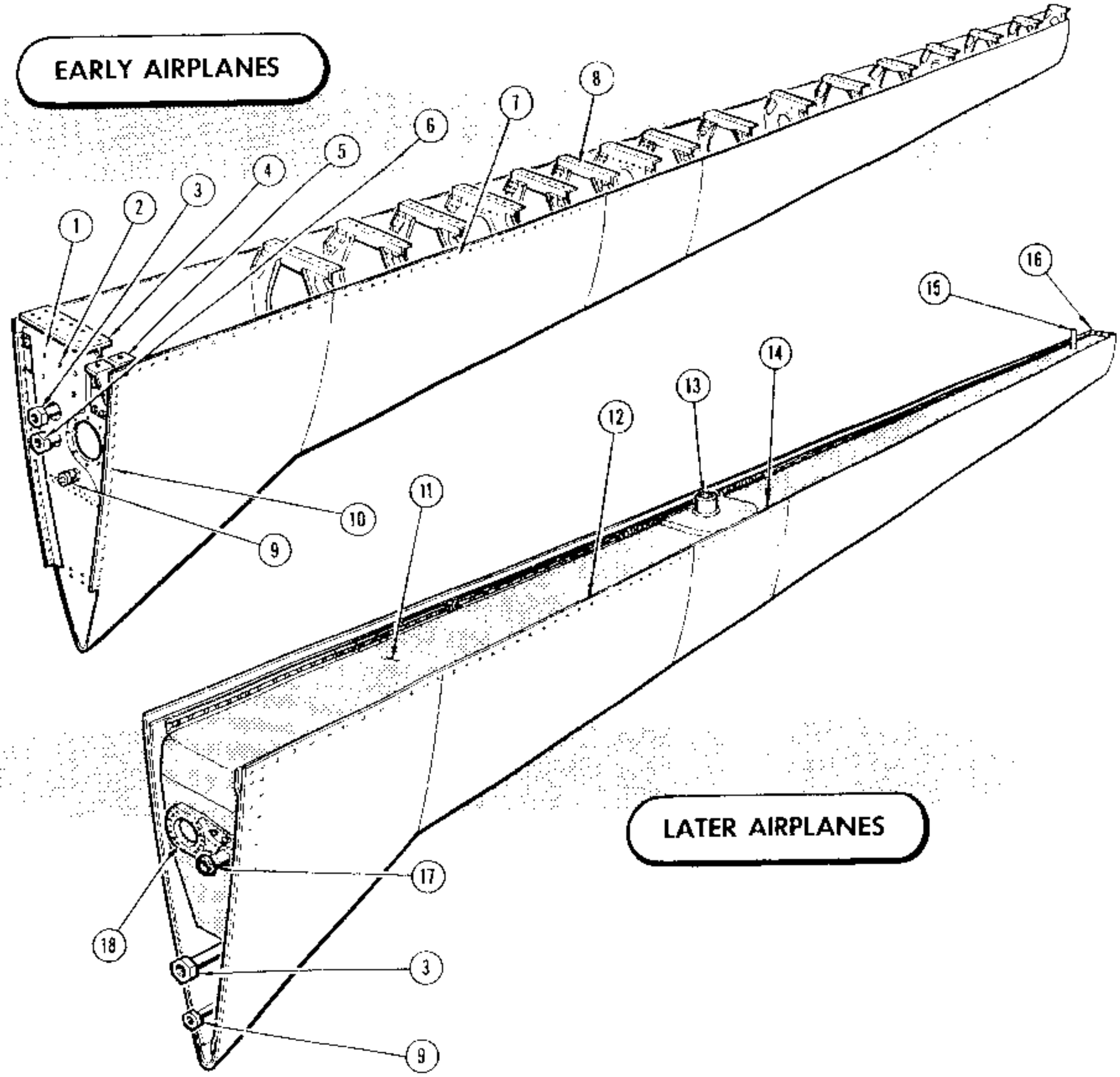
*(v)* Make operational check of aileron controls, wing flap, bomb manual release, alighting gear, and fuel, hydraulic, and electrical systems.

*(w)* Install canopy. (See paragraphs 3*c*(3)*(g)*, this section.)

*(x)* Lower airplane onto alighting gear.

**Note**

The installation of used spare leading edges, panels, door assemblies and stress plates with a maximum skin gap of ¼-inch, is authorized provided that: Minimum edge distance of all holes is not less than that specified on the drawings. A 3/16-inch minimum lap on all lands and overlaps is maintained. Trim does not adversely affect required weather sealing.




| | | | |
|---|---|---|---|
| 1. | AN4A BOLT (3 REQ)<br>AC365-428 NUT (3 REQ) | 9. | DROPPABLE TANK AIR PRESSURE |
| 2 | AN6A BOLT (3 REQ)<br>AC365-624 NUT (3 REQ) | 10. | LS577 SCREWS (14 REQ) |
| 3. | DROPPABLE TANK FUEL LINE | 11. | SELF-SEALING FUEL TANK |
| 4 | AN4A BOLT (14 REQ)<br>AC365-428 NUT (14 REQ) | 12. | NAS205 SCREWS<br>(190 REQ TOP, 191 REQ BOTTOM) |
| 5 | AN5-33A BOLT (2 REQ)<br>AC365-524 NUT (2 REQ) | 13. | FUEL INLET FROM OUTBOARD TANKS |
| 6. | VENT LINE | 14. | REMOVABLE PANEL |
| 7. | LS577 SCREWS, 1.0 INCH CENTER TO CENTER THROUGH UPPER AND LOWER JOINTS | 15. | VENT LINE FROM OUTBOARD TANKS |
| 8 | LS560 SCREWS (94 REQ) | 16. | NAS205 SCREWS (3 REQ) |
| | | 17 | LEADING EDGE TANK VENT |
| | | 18 | LEADING EDGE TANK FUEL OUTLET |

*Figure 35 — Attachment of Wing Leading Edge*

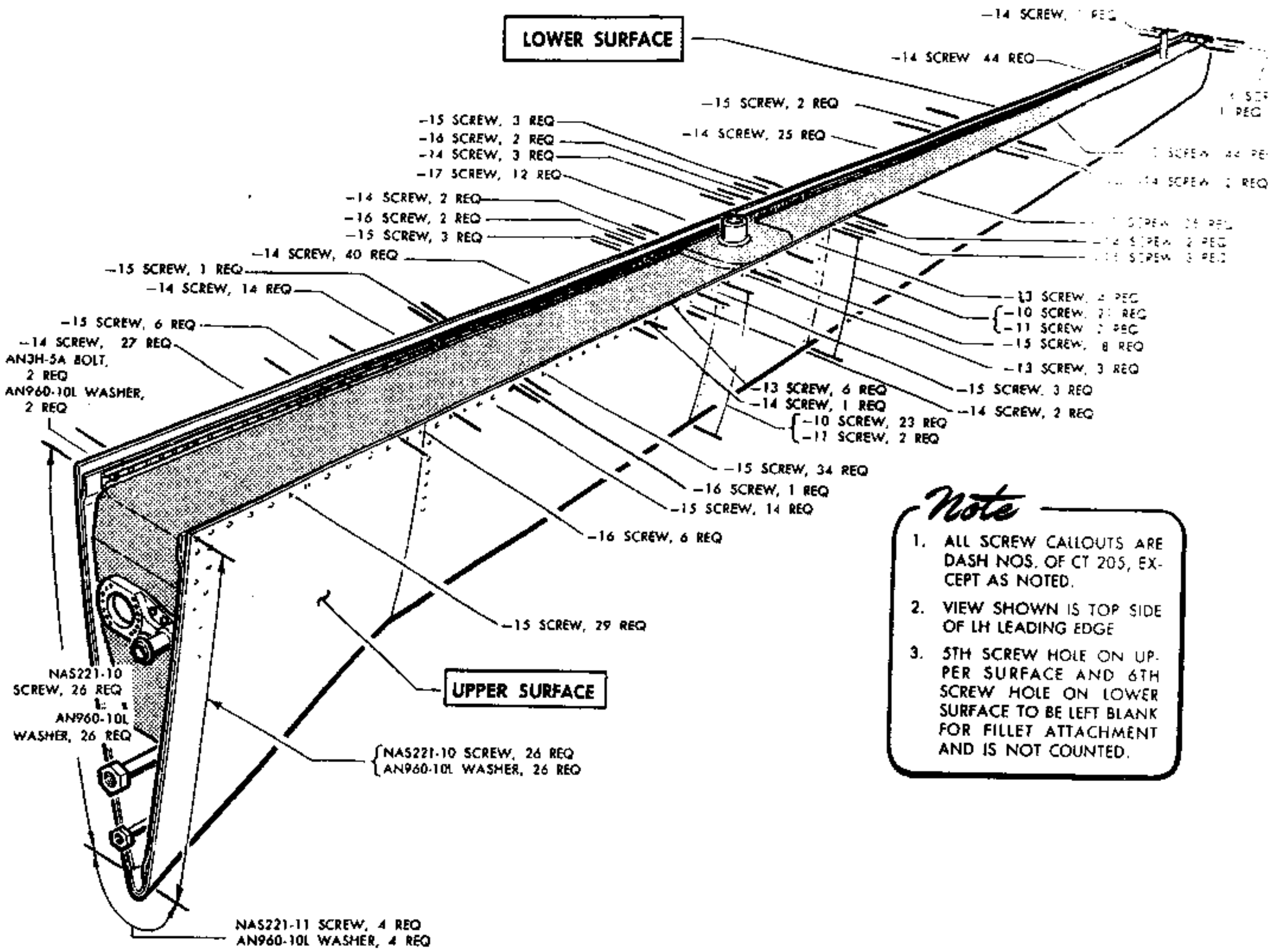



*Figure 36 — Installation of Replacement Leading Edge*

*c.* LEADING EDGE SECTIONS. *(See figure 35.)*

(1) DESCRIPTION. — The leading edge sections extend from the engine air intake scoops to the wing tips. They are attached to the wing by screws through the leading edge skin to flanges of the extruded spar caps (on airplanes without leading edge tanks by screws through the spar web into angles riveted to the leading edge ribs) and by bolts through fittings at the inboard leading edge ribs. Fuel and air pressure lines for the droppable tanks are routed through the leading edge sections.

The leading edge sections of airplanes serial Nos. AF44-85013 and subsequent contain self-sealing tanks extending the entire length of the sections. Each of these tanks is connected to the two outboard fuel tanks. Corrugations are used under the skin instead of the rib and stringer construction on other P-80A airplanes. A fuel drain is located in the lower skin, toward the inboard end. The leading edge sections that contain self-sealing fuel tanks are lined with laminated glass cloth.

A removable panel located midway between the outboard and inboard ends of the leading-edge section and extending around the section, gives access to the tube connecting the leading-edge tanks to the outboard tanks. Removal of the panel also exposes a manhole in the tank, through which access is gained to the clamp holding the tube in place.

(2) REMOVAL.

*(a)* AIRPLANES WITH LEADING EDGE INTEGRAL TANKS.

*1.* Remove wing tip. (See paragraph *d*(2) following.)

*2.* Remove upper and lower leading-edge fillets. (See paragraph *b*(1)*(f)2* and *3* preceding, and figure 34.)

*3.* Drain and remove wing fuel tanks between main wing spars for access to screws which attach leading edge ribs to front main spar. Remove the screws.

*4.* Detach wing-to-fuselage forward attachment fittings from leading edge inboard rib by removing all bolts which extend through rib.

**Note**

Do not remove the two large bolts which secure fitting to fuselage.

*5.* Remove bolts which attach leading edge outboard rib to main spar.

*5A.* Working at gun camera pod, proceed as follows:

a. Remove four screws around aft end of pod nose, and slide pod nose forward; remove pod nose.

b. Disconnect wiring at cameras.

c. Remove four screws, two upper and two lower from aft end of pod, and remove pod.

*6.* Remove screws which attach leading edge lower skin to main spar cap.

*7.* Disconnect all plumbing attached to the leading edge.

*8.* Support leading edge and remove screws which attach upper skin to main spar cap.

*9.* To remove leading edge, pull outboard end away from wing, and then move leading edge outboard.

*(b)* AIRPLANES WITH LEADING-EDGE SELF-SEALING TANKS.

*1.* Remove wing tip. (See paragraph *d* (3) following.)

*2.* Remove upper and lower leading-edge fillets. (See paragraph *b*(1)*(f)2* and 3 preceding, and figure 34.)

*3.* Drain fuel from leading-edge tank and from both outboard tanks.

*4.* Remove screws which attach outboard tank drain fitting to outboard tank panel.

*5.* Remove outboard tank panel.

*6.* Remove outboard-tank handhole cover and disconnect fuel and vent line connections to leading edge tank.

*7.* Disconnect all plumbing from the inboard end of the wing leading edge.

*8.* Remove leading-edge-tank fuel pump and its adapter. (See paragraph *b*(1)*(j)3* preceding.)

*9.* Remove 28 screws which attach the leading-edge lower skin to the inboard rib, and screws which attach the leading-edge upper skin to the inboard rib.

*10.* Remove three screws attaching outboard rib to wing front beam.

*10A.* Working at gun camera pod, proceed as follows:

a. Remove four screws around aft end of pod nose, and slide pod nose forward; remove pod nose.

b. Disconnect wiring at cameras.

c. Remove four screws, two upper and two lower from aft end of pod, and remove pod.

*11.* Remove all screws which attach the leading edge lower skin to the wing front spar cap.

*12.* Support leading edge section and remove screws from the upper skin to front spar cap attachment.

*13.* To remove leading edge, pull forward on outboard end until plumbing to outboard tanks is clear, then pull section outboard to clear fittings from inboard rib.

*14.* Remove three screws from leading-edge tank drain in lower skin near inboard end.

*15.* Remove leading edge tank. Lift the outboard end out first.

(3) INSTALLATION.—When installing original leading-edge section, reverse removal procedure.

**Note**

To facilitate installation of tank, coat outside of tanks with talc, U.S. Army Specification 4-33. Moisten tank fittings with water to facilitate installation of piping.

When replacing tank fittings or hand hole covers, bring parts to the best possible alignment so that the screws or bolts can be started with minimum torque. Tighten all screws as much as possible with the fingers, as this may indicate any threads in poor condition. Replace screws which have burred threads. Fittings with burred threads may be retapped with the same size tap. Tighten screws alternately on opposite sides of fitting or cover. Tighten all screws to three-fourths of the maximum required torque. Finally, tighten all screws to a torque of 20 to 30 inch-pounds.

(4) INSTALLATION OF REPLACEMENT LEADING EDGE. *(See figure 36.)*

*(a)* Install new, untrimmed leading-edge section without tank. Put in 10 percent of the screws to hold the section in place.

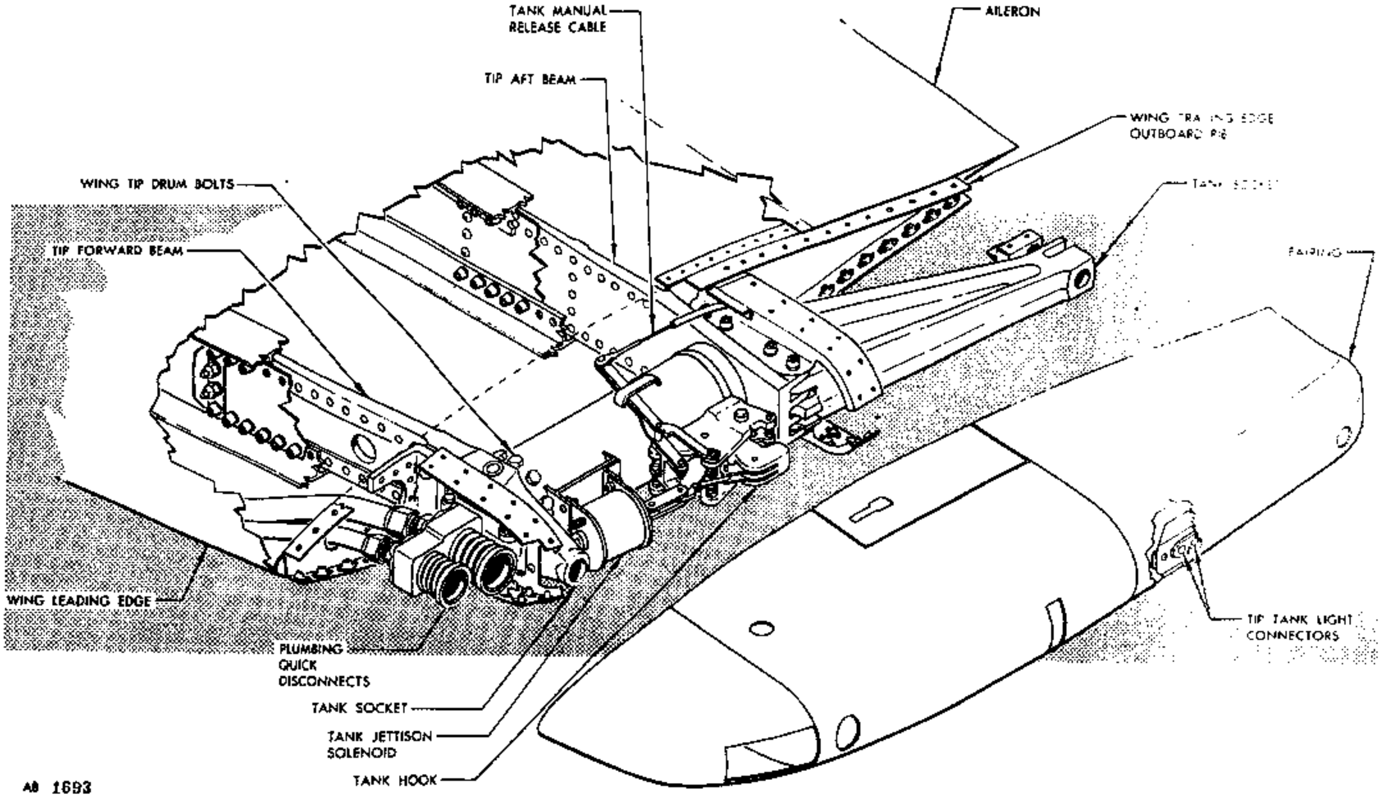



*Figure 36A — Wing Tip Attachment on Airplanes Incorporating T.O. 01-75F-42 (Centerline Droppable Tanks)*

*(b)* With a butt transfer scribe, scribe a trim line around the new leading edge.

*(c)* Remove the leading-edge section.

*(d)* Trim leading-edge section to scribed line.

*(e)* Install leading-edge tank.

**Note**

To facilitate installation, coat outside of tank with talc, U.S. Army Specification 4-33. Moisten tank fittings with water to facilitate installation of piping.

*(f)* Attach tank to drain fittings in lower inboard end of leading-edge section with three NAS 205-11 screws.

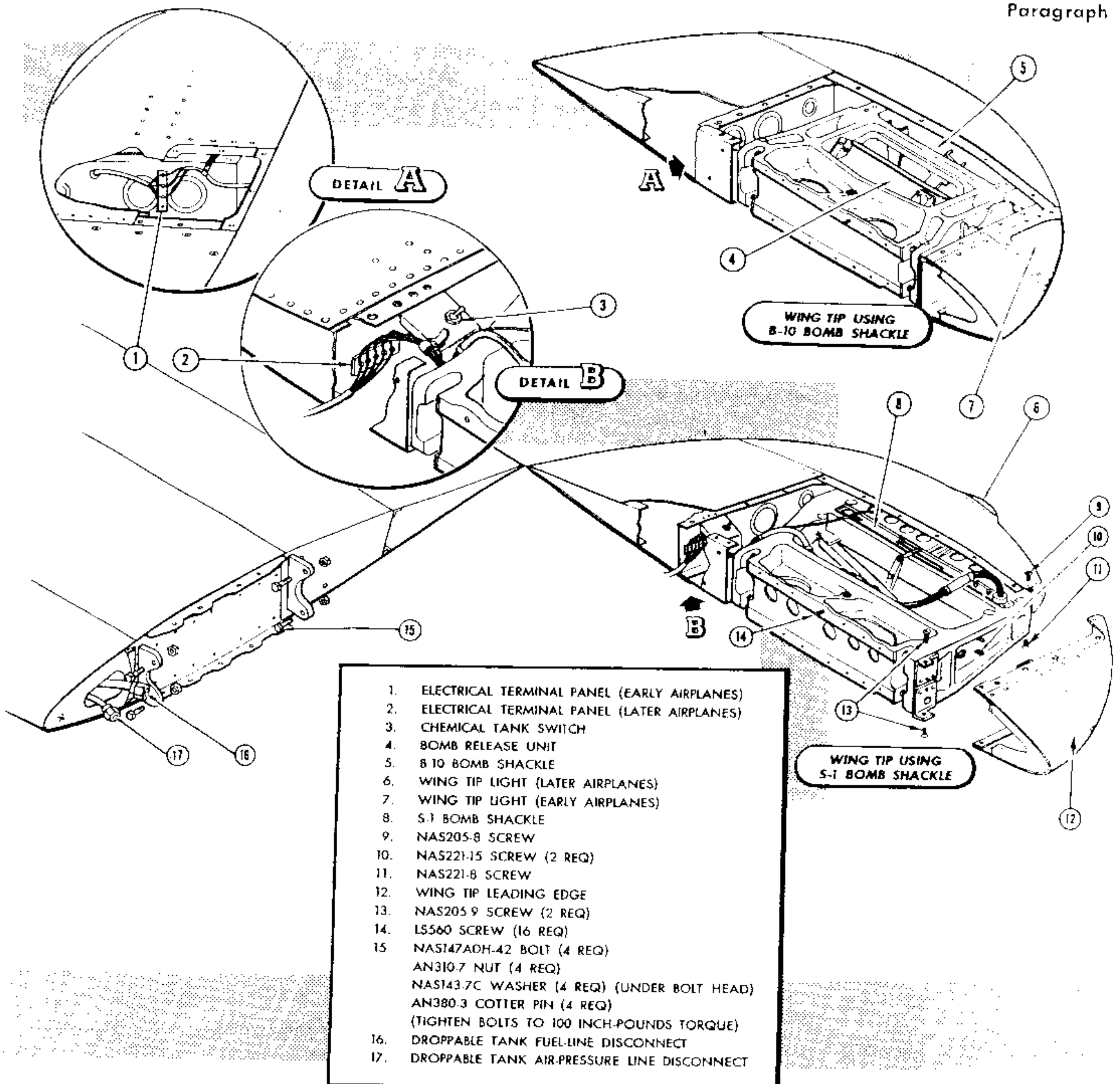



*Figure 37 — Wing Tip Attachment*

**Note**

It may be necessary to use a longer screw at first to draw the tank up to the drain fitting. Install the two NAS 205-11 screws, remove the long screw, and replace it with an NAS205-11 screw.

*(g)* Replace leading-edge section on wing and attach it with about 10 percent of the screws.

*(h)* Countersink balance of the screw holes with a 100-degree countersinking tool, to the mean depth of the screw heads. Install screws and bolts as shown in figure 36.

**Note**

If the two AN3-10 bolts at the lower inboard end are replaced, file approximately two threads from the new bolts. After installation, lock wire the two bolts together.

*(i)* Remove the screws originally installed, countersink the holes, and reinstall screws as shown in figure 36.

*(j)* Install gun camera pod and wiring.

*d.* WING TIPS. *(See figures 36A, 37, 232, and 233.)*

(1) DESCRIPTION.—The wing tips, attached to the wing at station 216 with screws and bolts, contain the droppable fuel-tank or bomb-shackle release and sway brace mechanism. Hoisting hooks for tanks or bombs are also provided which are designed to receive two bomb hoists, type AN-MK7, used in conjunction with a type A-2 bomb hoist sling. An internally mounted position light is located in each wing tip. On early airplanes a type B-10 bomb shackle is mounted in the tip. This tip has a navigation light faired into the leading edge. Later airplanes use a type S-1 bomb shackle in the wing tip with the navigation light located in a blister on the outboard edge. The wing tips utilize castings as the internal supporting structure. In those airplanes incorporating T.O. 01-75F-42, the tips are integral parts of the wing, and consist of steel fittings bolted to the wing beams, with fairings screwed to the fittings. A solenoid and a droppable-tank hook are fastened to each fitting. A switch in the tank aft socket is installed to change from the wing navigation lights to the tip tank lights whenever the tank is installed. Connectors for wires to these lights are in the outboard edge of the tip.

(2) REMOVAL OF TIPS WITH TYPE B-10 BOMB SHACKLE. *(See figures 37 and 232.)*

*(a)* Remove bomb shackle fairing and inspection plates.

*(b)* Remove wing-tip leading edge by removing one screw from each end of upper and lower inspection-plate supports.

*(c)* Pull wing-tip leading edge out far enough to remove electrical disconnect plug, then remove leading edge. Do not damage plastic window over the light.

*(d)* Disconnect bomb manual release by loosening the screw in the cable connector.

*(e)* Through access panel, remove wires leading to wing from terminal panel, and remove two screws extending into the wing.

*(f)* Disconnect two hydraulic lines.

*(g)* Remove 15 screws attaching bomb-support casting to wing.

*(h)* Remove two bolts from wing lower joint.

*(i)* Support tip, and remove two bolts from tip upper joint. This allows wing tip to be pulled outboard.

(3) REMOVAL OF TIPS WITH TYPE S-1 BOMB SHACKLE. *(See figures 37 and 233.)*

*(a)* Remove bomb-shackle fairing and all inspection plates. (See figure 7.)

*(b)* Remove wing-tip leading edge by removing six screws, and pulling leading-edge forward.

*(c)* Disconnect plumbing at unions exposed by removal of tip leading edge.

*(d)* Disconnect wiring at terminal panel aft of casting.

*(e)* Disconnect bomb manual release at cable connector in wing tip.

*(f)* Remove two screws from tip-to-wing attachment. Screws are located aft of casting.

*(g)* Remove 15 screws attaching bomb-support casting to wing.

*(h)* Remove two bolts from wing-to-tip lower joint.

*(i)* Support tip, and remove two bolts from tip upper joint. This allows tip to be pulled outboard.

(4) INSTALLATION. — Reverse removal procedure.

**CAUTION**

Tighten bolts in tip upper joint (steps *(h)* and *(i)* preceding) to 100 inch-pounds torque.

*e.* AILERONS. *(See figure 38.)*

(1) DESCRIPTION.—The two ailerons, one located at each end of the wing between the flap and wing tip, are mounted on full-length continuous hinges. Three stainless steel hinge pins attach each aileron to the wing structure. Each aileron is balanced by seven lead weights attached to brackets at the forward edge of the aileron. A cut-out for the electric trim tab is provided at the inboard end of the left aileron only. A bend tab is located on the inboard end of the right aileron. The tab extends one inch beyond the trailing edge of the aileron.

(2) REMOVAL. — Special tools required: Slide hammer No. S-10404 and hinge-pin puller No. S-34802.

*(a)* Disconnect bonding jumper.

*(aA)* Remove access panel No. 19 (figure 7) and disconnect tab flexible drive shaft at motor.

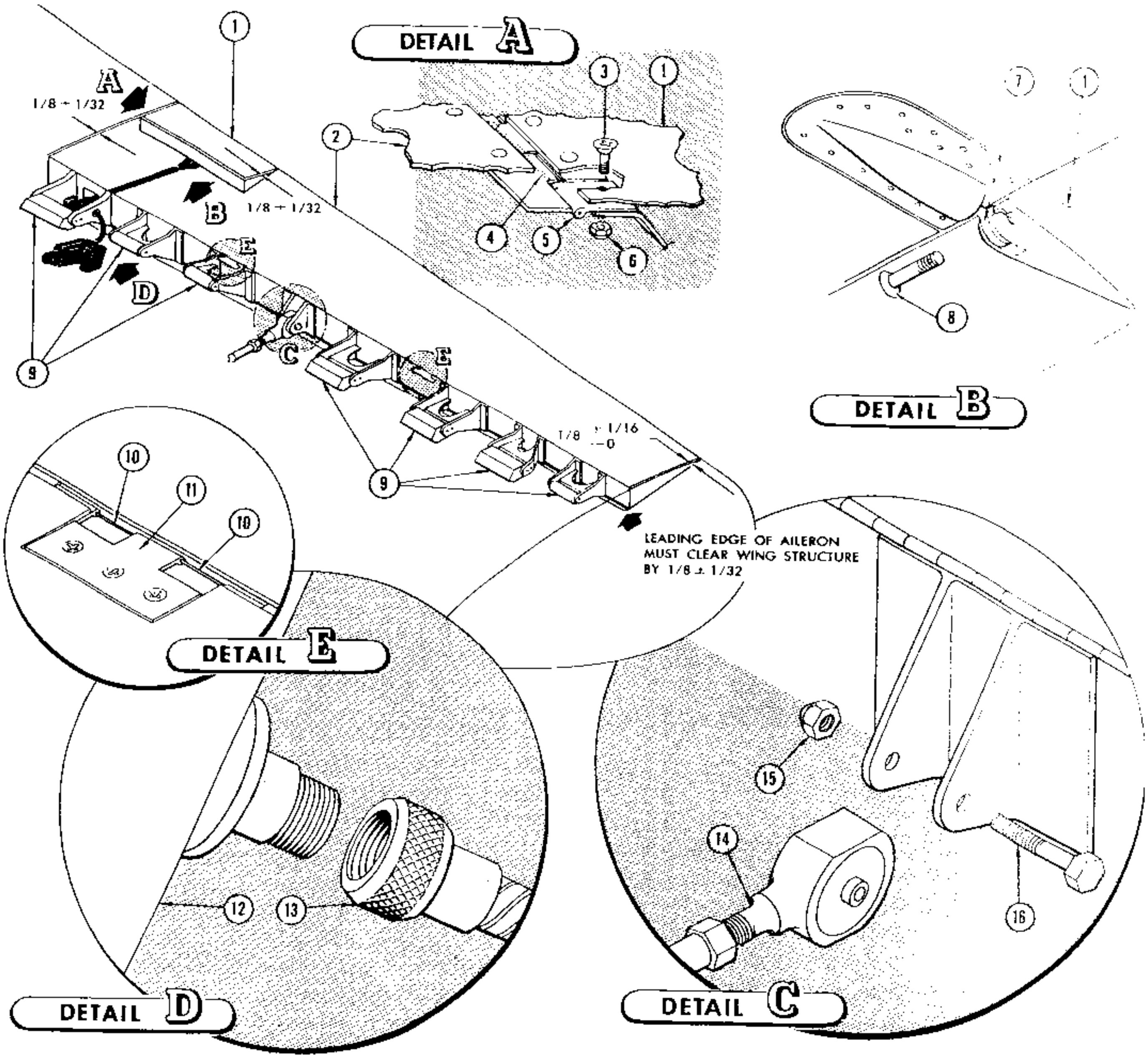
*(b)* Place aileron in up position and disconnect actuating rod at the aileron.

*(c)* Remove the two hinge-pin cover plates located on top surface of the hinge.

*(d)* Support aileron and pull out the three hinge pins as follows:

*1.* Attach hinge-pin puller No. S-34802 to the slide hammer, No. S-10404. (See figure 30.)

2. Clamp hinge-pin puller to hinge pin and operate the slide hammer by striking the slide against nut on end of the hammer opposite the pin puller. At the same time, pull on the knurled handle of the hammer to keep slack out of the hinge pin.




1. AILERON TAB
2. AILERON
3. NAS200-632-4 SCREW
4. TAB HINGE PIN
5. HINGE PIN LOCKING CLIP
6. AC364-632 NUT
7. TAB ACTUATING ARM
8. 175841 SCREW
9. AILERON COUNTERBALANCES
10. AILERON HINGE PIN
11. HINGE PIN CLIP
12. AILERON TAB ACTUATOR
13. FLEXIBLE SHAFT DISCONNECT
14. AILERON ACTUATING ARM
15. AC365-624 NUT
16. NAS56A-22 BOLT

*Figure 38 — Aileron and Tab Installation*

cut-outs in the fuselage skin into the wing. The actuators are interconnected by flexible shafts and an "H" drive assembly. The actuator circuit is controlled by a switch in the cockpit and by limit switches mounted on the "H" drive assembly. A mechanical position indicator is provided which consists of a Bowden cable connected to linkage at the inboard end of the left flap, and to an indicator on the cockpit left shelf. (See figure 40.)

(2) OPERATION. — Operation of the actuator motor to extend the flaps pulls the flap push-pull tube inboard forcing the links aft and down extending the flaps. Maximum up and down travel of the flaps is determined by the limit switches, however, the flaps may be stopped in any intermediate position by releasing the control switch.

**CAUTION**

The wing flap actuators are designed for intermittent duty only. Do not operate through more than one cycle without a one minute cooling period.

(3) REMOVAL OF WING FLAPS.—Special tools required: Slide hammer S-10404 and hinge pin puller S-34802.

*(a)* Lower flap to full down position.

*(b)* Detach position indicator cable at inboard end of the left flap.

*(c)* Disconnect link rods either at the flap or at the push-pull tubes.

**Note**

Each link is adjusted to the length required for its location on the flap. If links are to be removed, mark each to identify its location.

*(d)* Remove two bonding jumpers between flap and wing. One jumper is just inboard of the outboard link rod. The other jumper is just inboard of second link rod from the inboard end of the flap.

*(e)* Remove hinge-pin locking clip at center of flap.

*(f)* Support flap at both ends. Using slide hammer S-10404 and hinge-pin puller S-34802 (figure 30), withdraw the two hinge pins and remove the flap.

(4) INSTALLATION OF WING FLAPS.—Support the flap at both ends and drive both hinge pins with a hand drill motor or slide hammer S-10404 and hinge-pin puller S-34802. Lubricate hinge pins with oil, Spec. MIL-L-644a. Wipe off excess oil. Inboard end of flap must have a structure clearance of 0.12 to 0.18 inch. For clearance between flap and aileron, see figure 39. Reverse removal procedure for flap installation, and check operation and adjustment.

**CAUTION**

Clearance is to be measured through the entire section to prevent binding.

(5) REMOVAL OF WING FLAP PUSH-PULL TUBE.

*(a)* Perform procedure as outlined in paragraph (7) steps *(a)* through *(d)*.

*(b)* If left push-pull tube is to be removed detach position indicator cable at inboard end of left flap.

*(c)* Disconnect link rods at push-pull tube.

**Note**

Do not change length of links.

*(d)* Remove ailerons. See paragraph e (2) preceding.

*(e)* Pull push-pull tube outboard through lightening hole in aileron-to-wing flap joint rib.

(6) INSTALLATION OF WING FLAP PUSH-PULL TUBE.—Reverse removal procedure.

**Note**

With "H" drive in same position as when push-pull tube was removed, extend actuator to length measured prior to push-pull tube removal.

(7) REMOVAL OF WING FLAP ACTUATOR.

*(a)* Lower flaps to approximately full down position.

**Note**

Flaps must be lowered enough to remove push-pull-tube-to-jackshaft attachment bolt.

*(b)* Open actuator boot.

*(c)* Measure distance along actuator jackshaft between center of bolt at jackshaft-to-push-pull-tube attachment and point where jackshaft torque-tube enters actuator gear housing. Record this measurement.

*(d)* Remove cotter pin, nut, and bolt attaching actuator jackshaft and dust shield to push-pull tube.

*(e)* Detach push-pull tube from actuator jackshaft and dust shield by raising flap slightly, forcing push-pull tube outboard.

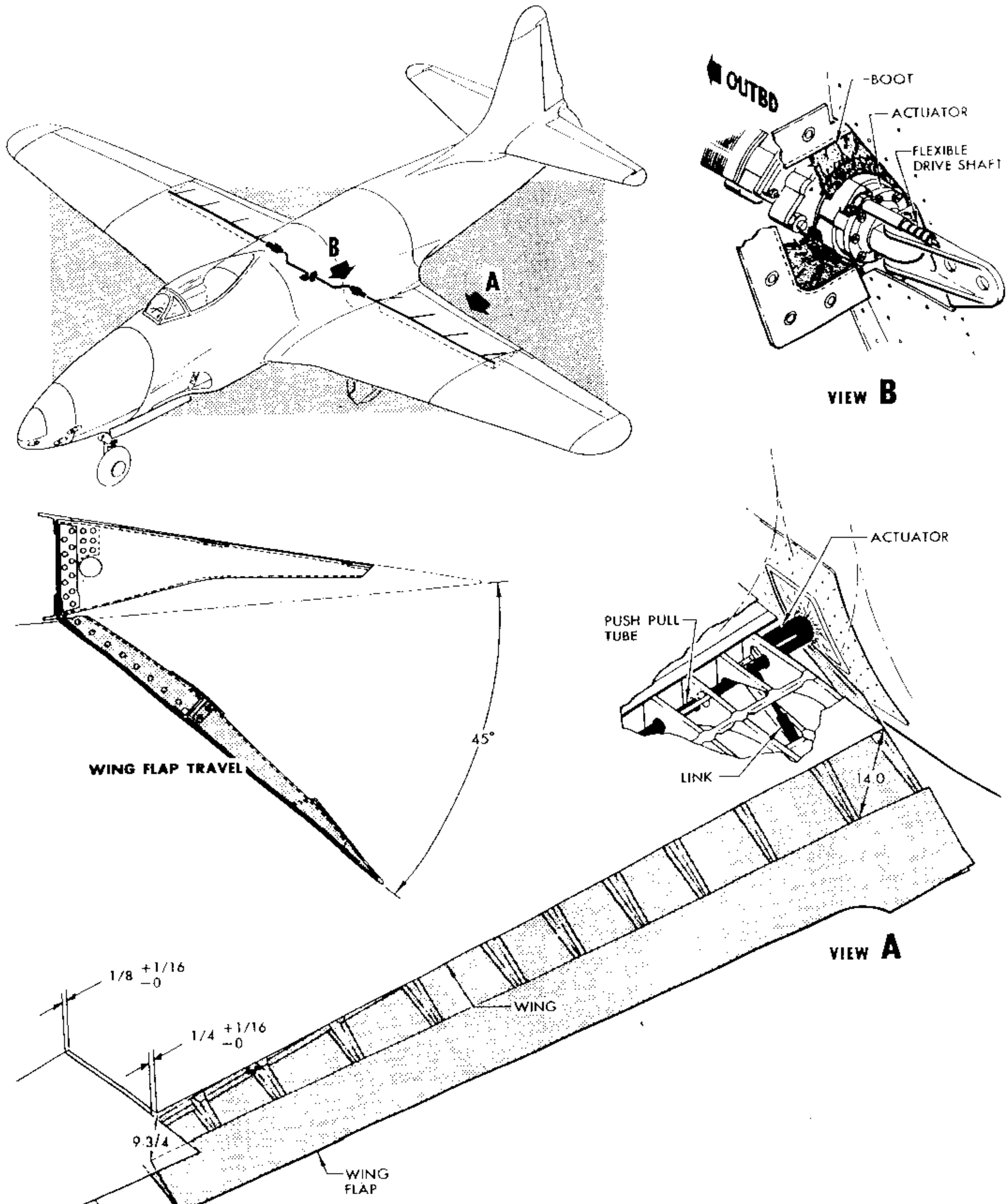



Figure 39 (Sheet 1 of 3 Sheets) — Wing Flap Installation

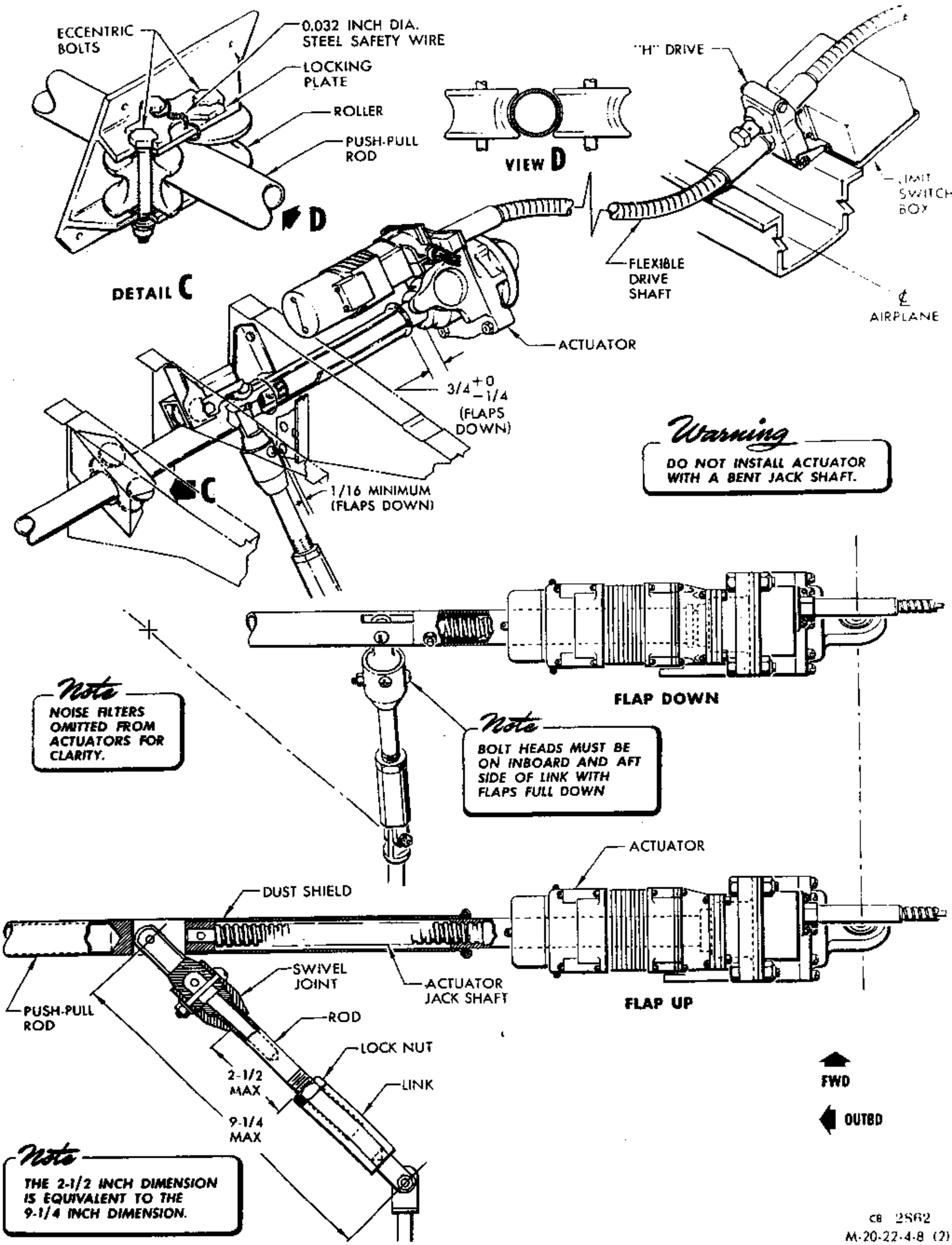



*Figure 39 (Sheet 2 of 3 Sheets) — Wing Flap Installation*

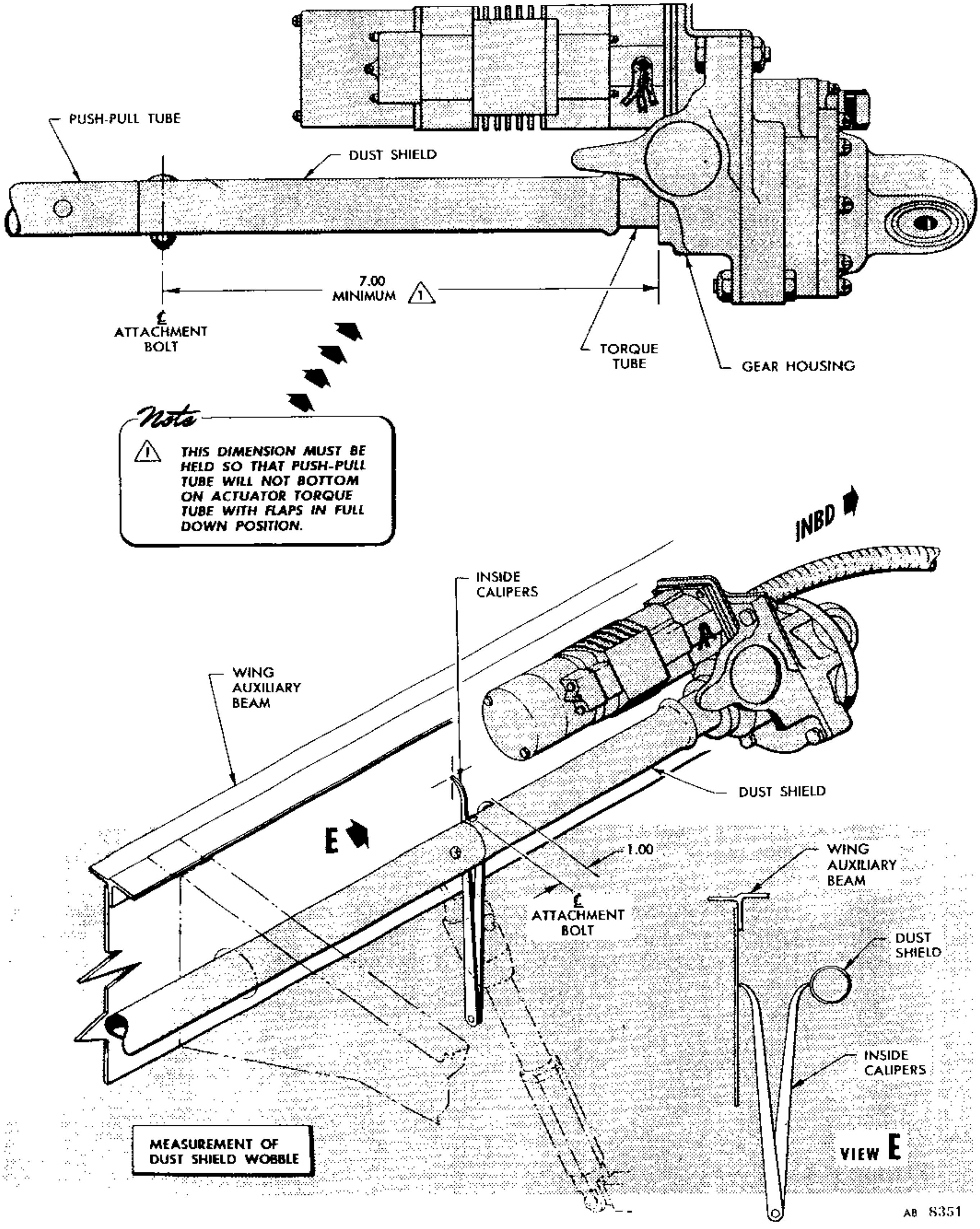



*Figure 39 (Sheet 3 of 3 Sheets) — Wing Flap Installation*

*(f)* Disconnect three wires from filter terminals on actuator.

*(g)* Disconnect actuator - to - fuselage bonding jumper at actuator.

*(h)* Disconnect flexible drive shaft from actuator.

*(i)* Remove nut, washer, and bolt attaching actuator to fuselage bracket and pull actuator outboard to remove.

**Note**

Raise flap slightly so that push-pull tube will be clear of actuator as actuator is removed.

(8) CLEANING AND INSPECTION OF WING FLAP ACTUATING MECHANISM.

*(a)* Remove all dust and grease from working parts.

*(b)* Inspect push-pull tube rollers to see that they are in alignment with tube. Check that they move freely and are not worn excessively. Measure wear of micarta rollers by attempting to insert a $\frac{1}{16}$-inch diameter wire between rear roller and tube while pressing tube against front roller. If wire will go between roller and tube, adjust rollers.

*(c)* Inspect push-pull tube to be sure that it is straight and aligned with actuator jackshaft.

*(d)* Remove jackshaft attaching bolt, disconnect push-pull tube from jackshaft and, without disturbing jackshaft adjustment, slide back dust shield and clean and inspect end of jackshaft for cracks and elongation of attachment hole.

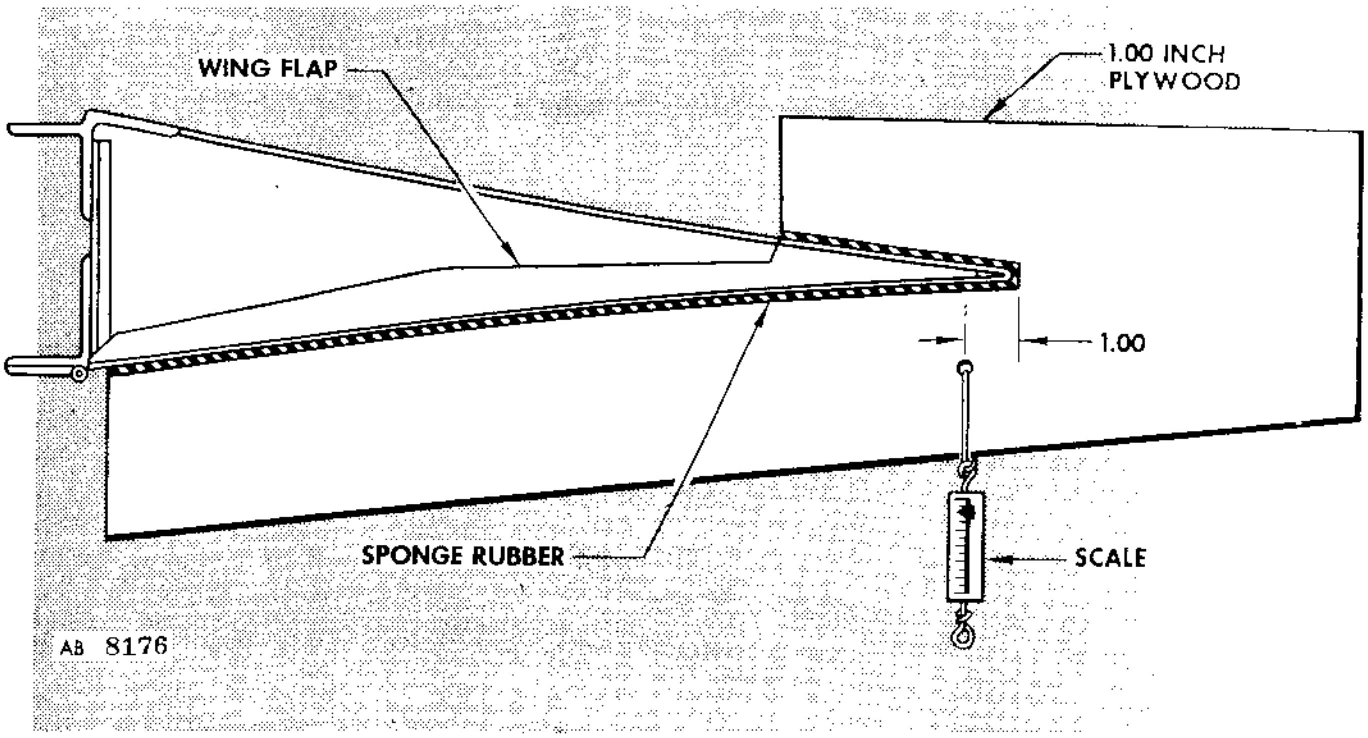



*Figure 39A — Wing Flap Loading*

**CAUTION**

Do not allow jackshaft to turn during this inspection.

(*e*) If actuator is removed, wash threaded portion of actuator jackshaft with solvent, Federal Spec P-S-661. Inspect for bent or cracked shaft and for elongation of attachment hole.

**Note**

After completion of inspection, lubricate threaded portion of jackshaft with grease, Spec MIL-G-7118.

**CAUTION**

Exercise caution when using grease, Spec MIL-G-7118, to see that it does not come in contact with and soften paint, natural rubber, neoprene and electrical insulating materials.

(*f*) Inspect flexible shafts for kinks or worn spots.

(9) WING FLAP "H" DRIVE.—This unit, mounted on the fuselage lower longeron is connected to each flap actuator with a flexible shaft. Limit switches are included as a part of the assembly.

(10) REMOVAL OF WING FLAP "H" DRIVE.

(*a*) Open access door No. 38 (figure 7), and remove electrical receptacle from limit switch box.

(*b*) Disconnect both flexible shafts from the "H" drive.

(*c*) Remove two bolts that attach "H" drive to its mounting bracket and remove "H" drive.

**Note**

When "H" drive is installed, flap actuators and limit switches must be properly synchronized and adjusted. (See paragraph (12.)

(11) INSTALLATION AND ADJUSTMENT OF REPLACEMENT WING FLAP ACTUATOR. - Special tools required: Bubble protractor and inside calipers.

(*a*) With dust shield on actuator, mount replacement actuator in fuselage bracket and, working through access door No. 39 (figure 7), bolt actuator in place.

**CAUTION**

Be sure actuator jackshaft is fully retracted before installing actuator to prevent jackshaft from hitting push-pull tube and damaging jackshaft of push-pull tube.

Install only actuators with a predrilled attachment hole in the jackshaft. Exercise caution during installation and adjustment of actuator to avoid bending jackshaft. If shaft is bent during installation or adjustment, replace actuator with serviceable unit.

*(b)* Turn actuator jackshaft by hand to obtain length as measured in paragraph (7), step *(c)*.

*(c)* With jackshaft in this position, slide dust shield over jackshaft and carefully slide push-pull tube into place over end of jackshaft.

**CAUTION**

Jackshaft and push-pull tube must be in alignment to prevent bending jackshaft. Refer to paragraph (12), step *(l)* for alignment procedure.

*(d)* With hole in push-pull tube aligned with hole in dust shield and hole in jackshaft, install bolt, nut, and cotter pin securing push-pull tube to jackshaft.

**CAUTION**

Bolt should slide into place easily. Do not drive bolt.

*(e)* Connect flexible shaft from "H" drive to replacement actuator and safety wire shaft attaching nut to structure.

*(f)* Connect bonding jumper between actuator and structure. Pull draw string on actuator boot.

*(g)* Connect three wires to filter terminals on actuator. (See figures 200 and 200A.) A decal near actuator shows correct wiring.

*(h)* Using control switch, retract flaps fully and be sure they contact wing trailing edge simultaneously. Extend flaps and check for proper angle.

*(i)* Check actuator jackshaft for wobble. (See paragraph (12), step *(x)*.)

(12) INSTALLATION AND ADJUSTMENT OF WING FLAP ACTUATING MECHANISM. — *(See figures 39 and 40.)* Special tools required: Male spline adapter S-35703, special male spline adapter, female spline adapter S-35704, bubble protractor, and inside calipers.

**CAUTION**

Never use hand drill motor for driving the spline adapter. Use only hand drill or wrench.

**Note**

This procedure applies to airplanes that require a complete wing flap installation and adjustment.

The special male spline adapter may be made by welding the correct size drive socket to male spline adapter S-35703 so that a torque wrench may be applied to the adapter.

*(a)* With ailerons removed, insert push-pull tubes through lightening holes in aileron-to-wing flap joint ribs and guide tubes through rollers.

*(b)* Install wing flaps (paragraph (4)) but do not connect link rods.

*(c)* Connect bonding jumpers between flap and wing.

*(d)* Set inboard link to a length of approximately 9.13 inches (9.25 inches maximum) by turning clevis in or out. Measure length from center to center of attachment holes. Inspect links for bent eyebolts, elongated holes, or other signs of damage. See that eyebolts are free to rotate in their bushings. Replace defective eyebolts with serviceable parts. Install inboard link rod on push-pull tube.

**Note**

Distance between top of link-rod lock nut and bottom of clevis should be approximately 2 7/16 inches, but never more than 2½ inches.

*(e)* Adjust remaining links to same lengths as inboard link and connect to push-pull tube, but not to flap.

*(f)* With dust shields on actuators, mount actuators on fuselage bracket and working through access doors Nos. 38 and 39 (figure 7), bolt actuators in place. Connect three wires to filter terminals on actuator. (See figures 200 and 200A.) Decal near actuator shows correct wiring.

**CAUTION**

Be sure actuator jackshaft is fully retracted before installing actuator to prevent jackshaft from hitting push-pull tube and damaging jackshaft or push-pull tube.

Install only actuators with a predrilled attachment hole in actuator jackshaft. Exercise exercise extreme caution during installation and adjustment of actuator to avoid bending actuator jackshaft. If jackshaft is bent during installation or adjustment, replace actuator with serviceable unit.

*(g)* Connect link rods to flap. Back off attaching nuts so that rods are just free to rotate.

*(h)* Lift flap up slightly and extend actuator jackshaft by hand until there is approximately 1¾ inches between jackshaft-to-push-pull tube attachment hole and outboard end of dust shield with dust shield

pushed inboard. Lower flap until hole in end of push-pull tube lines up with hole in end of jackshaft.

**CAUTION**

Do not force tube into jackshaft. If properly aligned, jackshaft and tube should mate easily.

*(i)* Connect jackshaft and dust shield to push-pull tube with bolt, nut and cotter pin.

**CAUTION**

Do not drive bolt. If holes are properly aligned, bolt shold slide into place without forcing.

*(j)* Install "H" drive assembly including limit switch box.

*(k)* Connect flexible shaft to actuator and insert male spline adapter S-35703 in end of flexible shaft. Driving adapter with a hand drill or wrench, lower flap until centerline of jackshaft attachment bolt is approximately in line with wing trailing edge inboard rib.

**Note**

Distance from center line of actuator jackshaft attachment bolt to point where jackshaft torque tube enters actuator gear housing should be an absolute minimum of 7 inches.

*(l)* Adjust rollers so that they are snug against tubes, but not binding, with tubes straight and in alignment with actuator jackshafts. Adjust rollers as follows:

*1.* Working at outboard metal-roller bracket (bracket on wing beam) loosen locking plate attaching bolt and raise locking plate clear of roller eccentric bolts. Adjust rollers by turning eccentric bolts until rollers are contacting but not binding the tube.

**Note**

Position of eccentric bolt can be determined by location of two small dots on head of bolt.

*2.* Replace locking plate and attach it with locking-plate attaching bolt.

*3.* Working at outboard micarta-roller bracket (bracket on rib) loosen roller eccentric bolt-nuts and push bolts up so that bolt head clears locking plate. Adjust rollers by turning eccentric bolts until rollers are contacting but not binding the tube. Push down on bolts until bolt head is in locking plate, and tighten nuts.

**Note**

Adjust forward roller first.

Be sure that locking-plate attaching bolt is safe-tied to locking plate with 0.032-inch diameter steel (cadmium plated) safety wire.

*4.* Adjust rollers on remaining brackets.

*(m)* Insert male spline adapter S-35703 in end of flexible shaft, and driving adapter with a hand drill or wrench, raise flap until it nearly contacts wing trailing edge, noting any misalignment between wing trailing edge and flap.

**CAUTION**

When retracting flap with hand drill, use extreme caution when flap nears wing trailing edge. Do not retract flap tightly against wing when using drill.

*(n)* If misalignment exists, extend flap and adjust links so that flap fairs evenly with wing trailing edge along the entire flap length. Adjust links by loosening lock nuts and turning threaded rods.

**Note**

Do not readjust inboard actuating link to more than 9¼ inches measured from center to center of attaching holes.

*(o)* After links are properly adjusted, extend flap to approximately 3 inches below wing trailing edge.

*(p)* Insert special male spline adapter into end of flexible shaft and using a suitable torque wrench on adapter, raise flap noting maximum torque required to turn flexible shaft.

**CAUTION**

If maximum torque required to drive the system exceeds 15 inch-pounds applied at the flexible shaft, misalignment or distortion of the push-pull tube, binding of the rollers or a bent jack-shaft is indicated. Cause of the excessive torque must be located and corrected before proceeding with adjustment of system.

*(q)* Continue raising flap until it is against wing trailing edge. Load flap against wing by turning flexible shaft to a torque of 4.0 ($\pm$1.0) inch-pounds more than that observed in step *(p)*. Remove adapter and torque wrench.

**Note**

If torque wrench is not available, rig a spring scale (figure 39A) one inch forward of trailing edge, one inch outboard of the second rib from the inboard end of the wing flap. Pull down on scale and check force required to just break the flap from the wing. Required pull should be between 10 and 20 pounds. If less than 10 pounds, increase the flap loading against wing; if more than 20 pounds, decrease flap loading against wing.

*(r)* Repeat steps *(l)* through *(q)* for other flap.

*(s)* Insert female spline adapter S-35704 into "H" drive. Slowly turning the adapter by hand, turn "H" drive in the "up" direction until up limit switch "clicks" open. Stop turning immediately when "click" is heard.

**Note**

The "click" means that the up limit switch has opened. If the up limit switch is already open, back "H" drive off slightly, then turn adapter slowly until limit switch is heard to "click."

*(t)* Connect flexible shafts from both actuators to "H" drive.

*(u)* Extend flaps to full down position being careful not to allow actuator to bottom out in flaps down position. Adjust down limit switch (bottom switch in "B" on figure 202) so that with flap full down the distance from center line of actuator jackshaft attachment bolt to point where jackshaft torque tube enters actuator gear housing is an absolute minimum of 7 inches and flap angle is 45 (+2, —5) degrees (13.00 to 14.62 inches measured lineally near inboard end of flap as shown in figure 39). Adjust limit switch by turning adjustment screw with Allen wrench which is mounted in limit switch box. Rotate screw clockwise to decrease flap angle or counterclockwise to increase flap angle.

**Note**

Both flaps must be at same angle at all times.

*(v)* Check adjustment of down limit switch by retracting flaps about half way and then extending them to full down position. Check flap angle and jackshaft position as shown in step *(u)*.

**Note**

With flaps in full down position, distance between bolt head on the inboard actuating link and wing trailing edge inboard rib should be a minimum of $1/16$ inch.

*(w)* Apply "Glyptal" sealing compound, manufactured by General Electric Company, Lockheed Aircraft Corp., Spec 1-214, to the limit switch adjustment screws to insure better locking in position, and to indicate any change in setting.

*(x)* Retract flaps fully and be sure they contact wing trailing edge simultaneously. While raising flaps, check actuator jackshaft for wobble. If no wobble is apparent, the installation is satisfactory. If any wobble is apparent, check wobble as follows:

*1.* Using control switch, lower flaps to full down position.

2. Insert inside calipers, or equivalent, between the aft face of the wing auxiliary beam and the forward side of the dust shield one inch inboard of the actuator-jackshaft-to-push-pull tube attachment point.

3. Using control switch, raise flap until jackshaft torque tube rotates at least two revolutions. Take calipers out of airplane and place on linear scale. Record this minimum distance between auxiliary beam and dust shield.

4. Insert calipers between auxiliary beam and dust shield at same wing station as above.

5. Using control switch, raise flap a little at a time until maximum distance between beam and dust shield is obtained. Record this distance.

6. The second dimension less the first dimension will be the maximum wobble of the dust shield. Maximum permissible wobble is 0.040 inch. If wobble is greater than 0.040 inch, replace actuator with a serviceable unit.

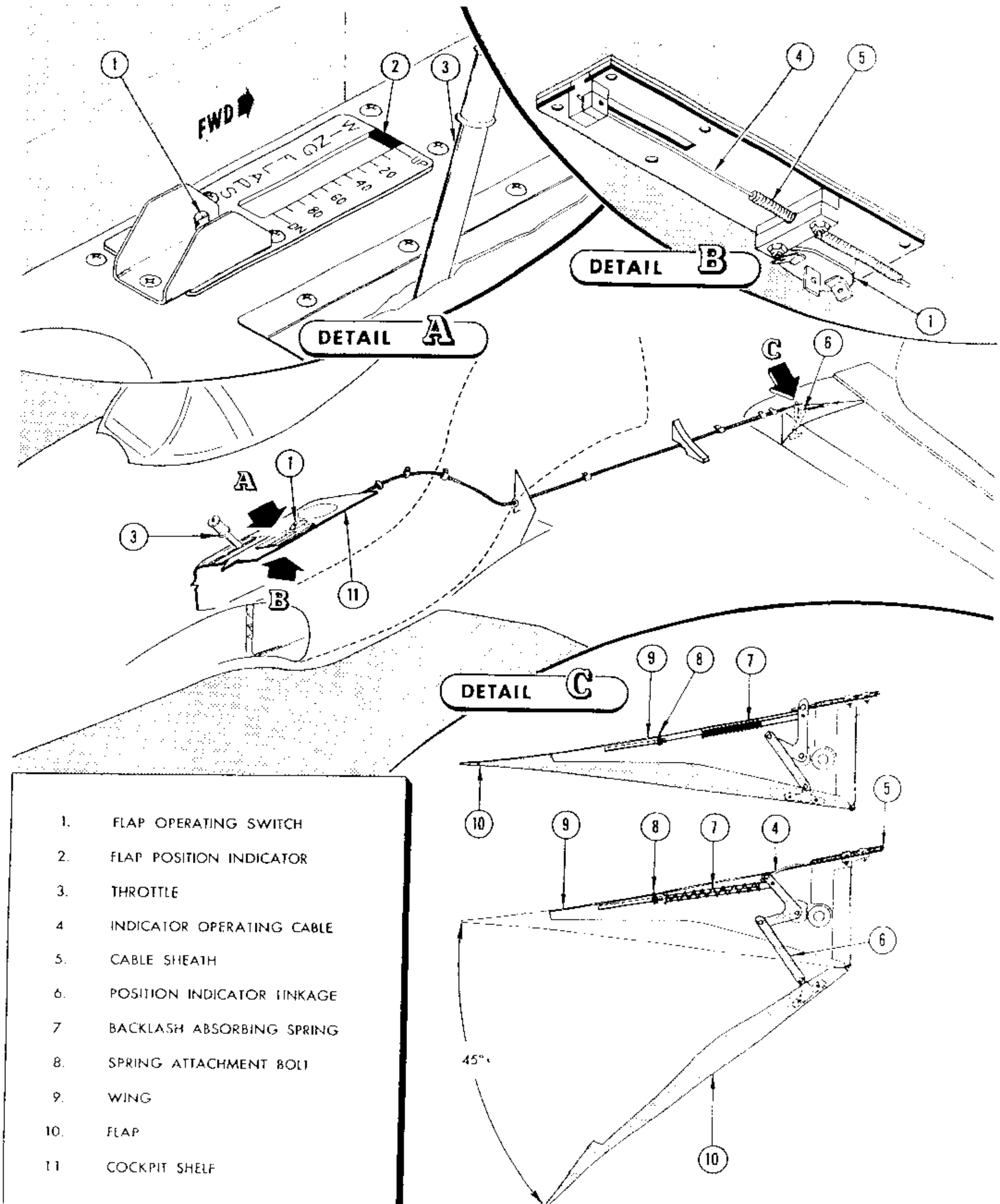
*(y)* Set Bowden cable on position indicator so that indicator will read zero at full up flap position. Check indicator by operating flaps. (See paragraph 14B (26).)

*(z)* Secure draw string on actuator boot.

*(aa)* Install ailerons. (See paragraph e (3) preceding.)

**CAUTION**

During adjustment do not operate flaps through more than one cycle without a cooling period of at least one minute.




1. FLAP OPERATING SWITCH
2. FLAP POSITION INDICATOR
3. THROTTLE
4. INDICATOR OPERATING CABLE
5. CABLE SHEATH
6. POSITION INDICATOR LINKAGE
7. BACKLASH ABSORBING SPRING
8. SPRING ATTACHMENT BOLT
9. WING
10. FLAP
11. COCKPIT SHELF

*Figure 40 — Wing Flap Position Indicator*

## 2. EMPENNAGE.

*(See figure 41.)*

*a.* COMPLETE EMPENNAGE.

(1) DESCRIPTION.—The empennage consists of a horizontal stabilizer, two elevators with their tabs, a vertical fin, and a rudder. Attachment to the fuselage aft section is by four shear type fittings, two mounted on the stabilizer front spar and two on the stabilizer rear spar. These fittings mate with similar fittings bolted to the upper portions of fuselage bulkhead rings, two at fuselage station 376 bulkhead and two at fuselage station 400 bulkhead. Smooth contours are provided by fillets riveted to the structure on early airplanes. On later airplanes, the fin-to-stabilizer center fillets are fastened to the structure with screws to facilitate fin and stabilizer removal. Access to the empennage-to-fuselage attaching bolts is gained either by removing the horizontal stabilizer fillets or through the interior of the aft fuselage after the tail pipe has been removed.

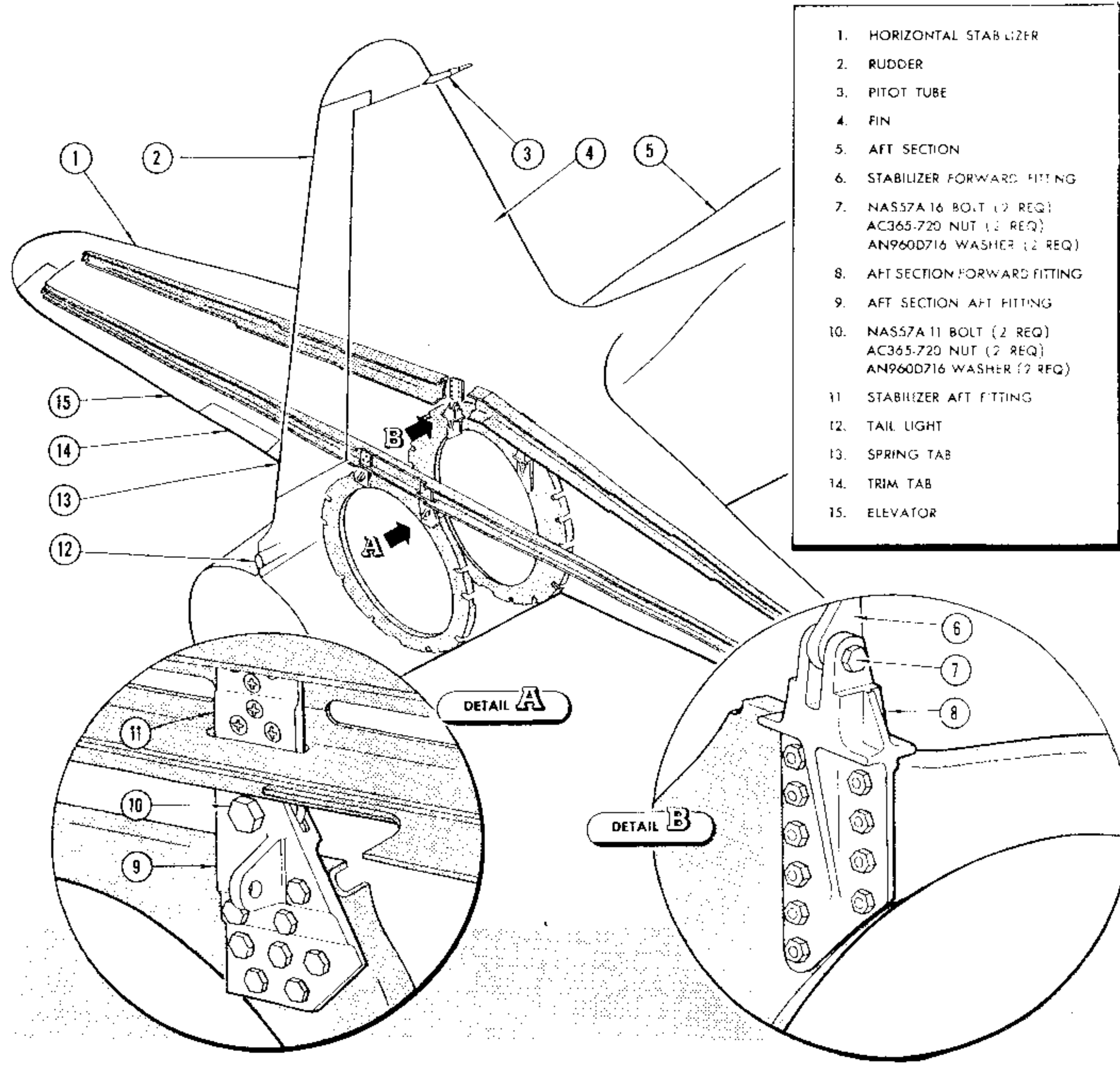
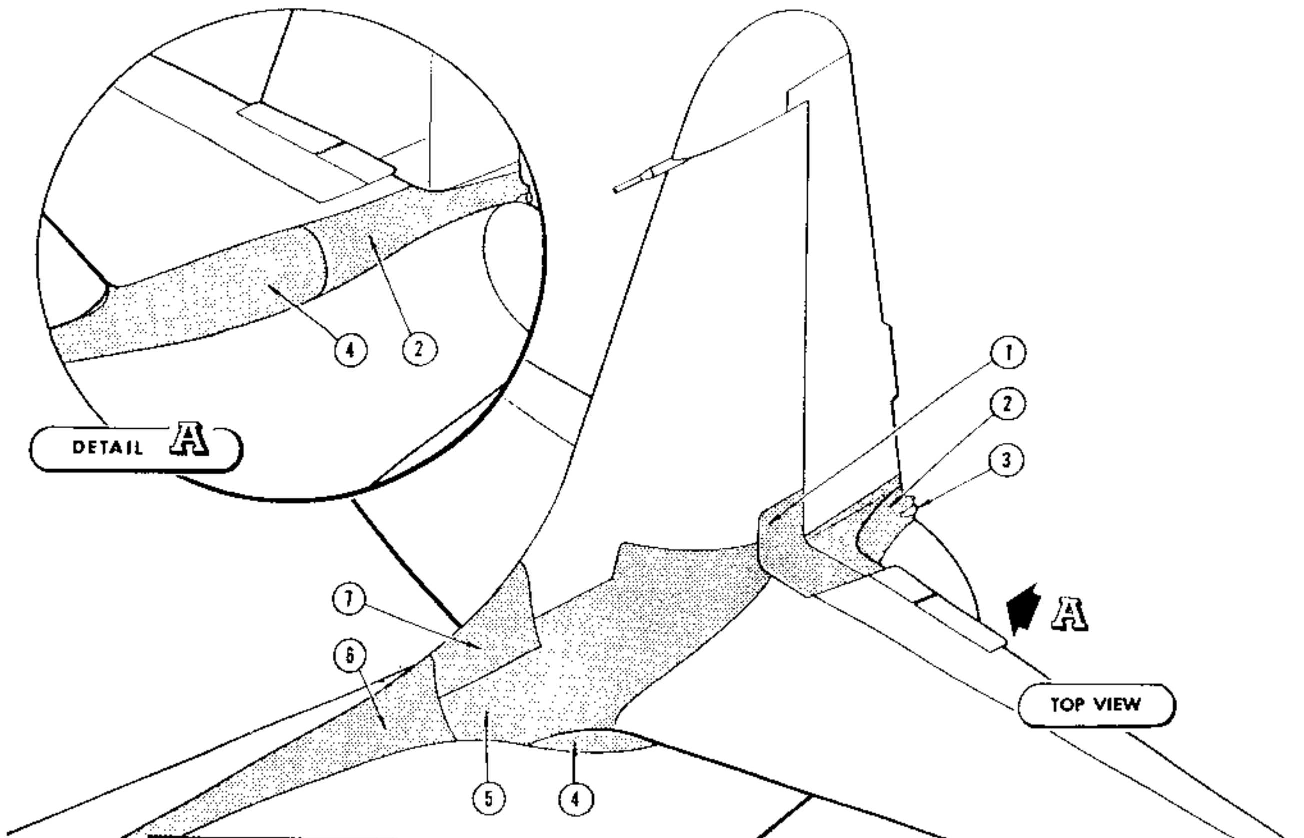



*Figure 41 — Empennage Installation*




| | |
|---|---|
| 1. INSPECTION PANEL NO. 34 | 5. UPPER FILLET |
| 2. EMPENNAGE AFT FAIRING | 6. DORSAL FIN |
| 3. TAIL LIGHT | 7. INSPECTION PANEL NO. 33 |
| 4. LOWER FILLET | |

*Figure 42 — Empennage Fillets*

(2) REMOVAL.

*(a)* Remove the aft section. (See paragraph *6e*, this section.)

*(b)* Remove the tail pipe. (See paragraph 10*b*(2), this section.

*(c)* On early airplanes, remove the rivets which attach the lower fillets to the horizontal stabilizer, and the upper fillets to the dorsal fin just aft of the inspection door No. 33 (figure 7). Remove rivets which attach the upper fillet to the lower fillet; leave the splice attached to the upper fillet. On later airplanes, remove screws attaching fillets to the stabilizer. (See figure 42.)

*(d)* Through access panels Nos. 33 and 34 (figure 7) remove elevator control rods which extend through fin.

*(e)* Disconnect the rudder cables at the rudder actuating arm at the base of the rudder torque tube. (See figure 44.)

*(f)* Disconnect the elevator tab flexible drive shaft at the "T" coupling located under the stabilizer rear spar.

*(g)* Under inspection panel No. 33 (figure 7) disconnect and immediately cap the pitot pressure line at the bulkhead fitting in the fuselage. On later airplanes, disconnect the antenna coaxial cable.

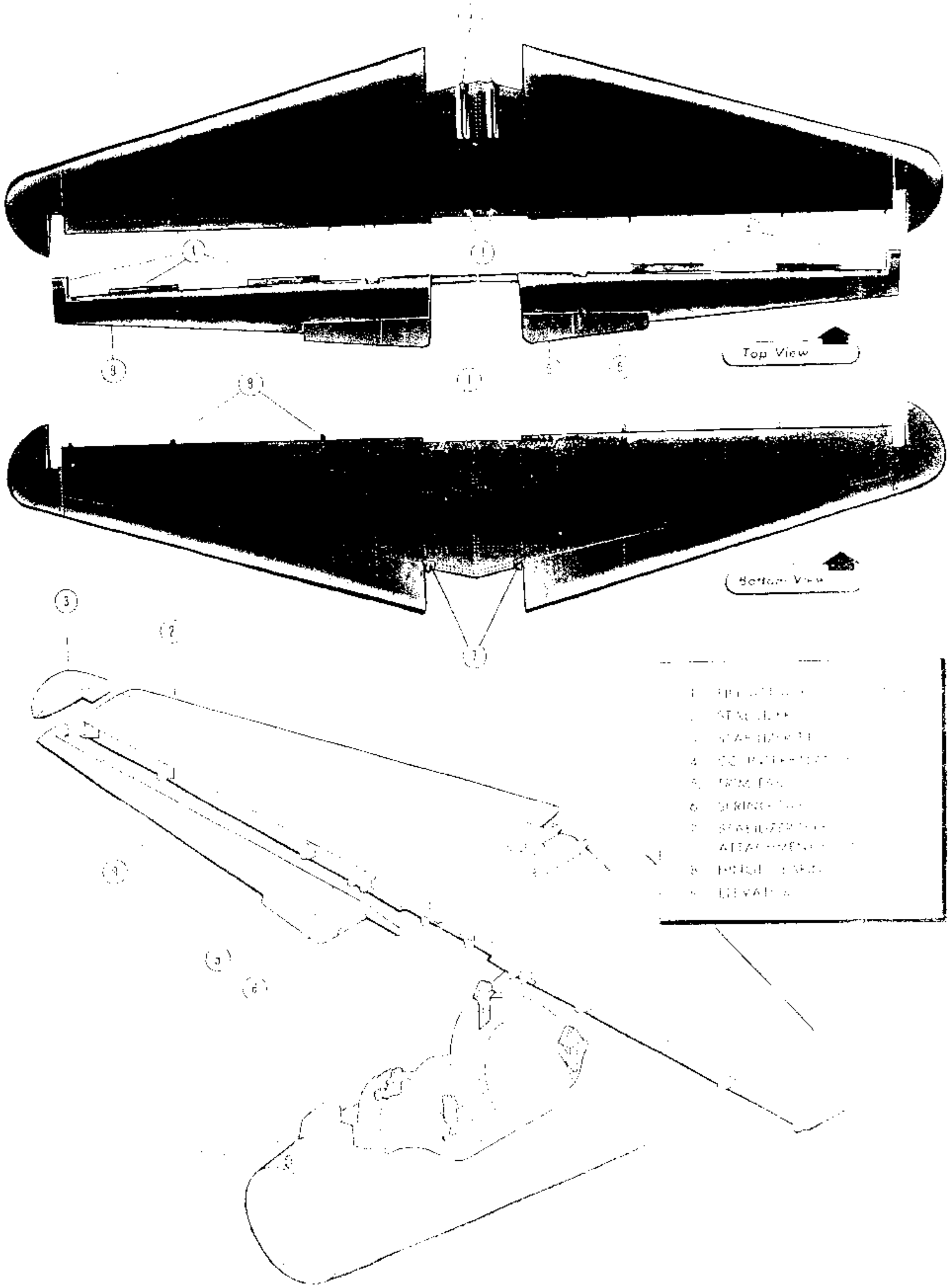
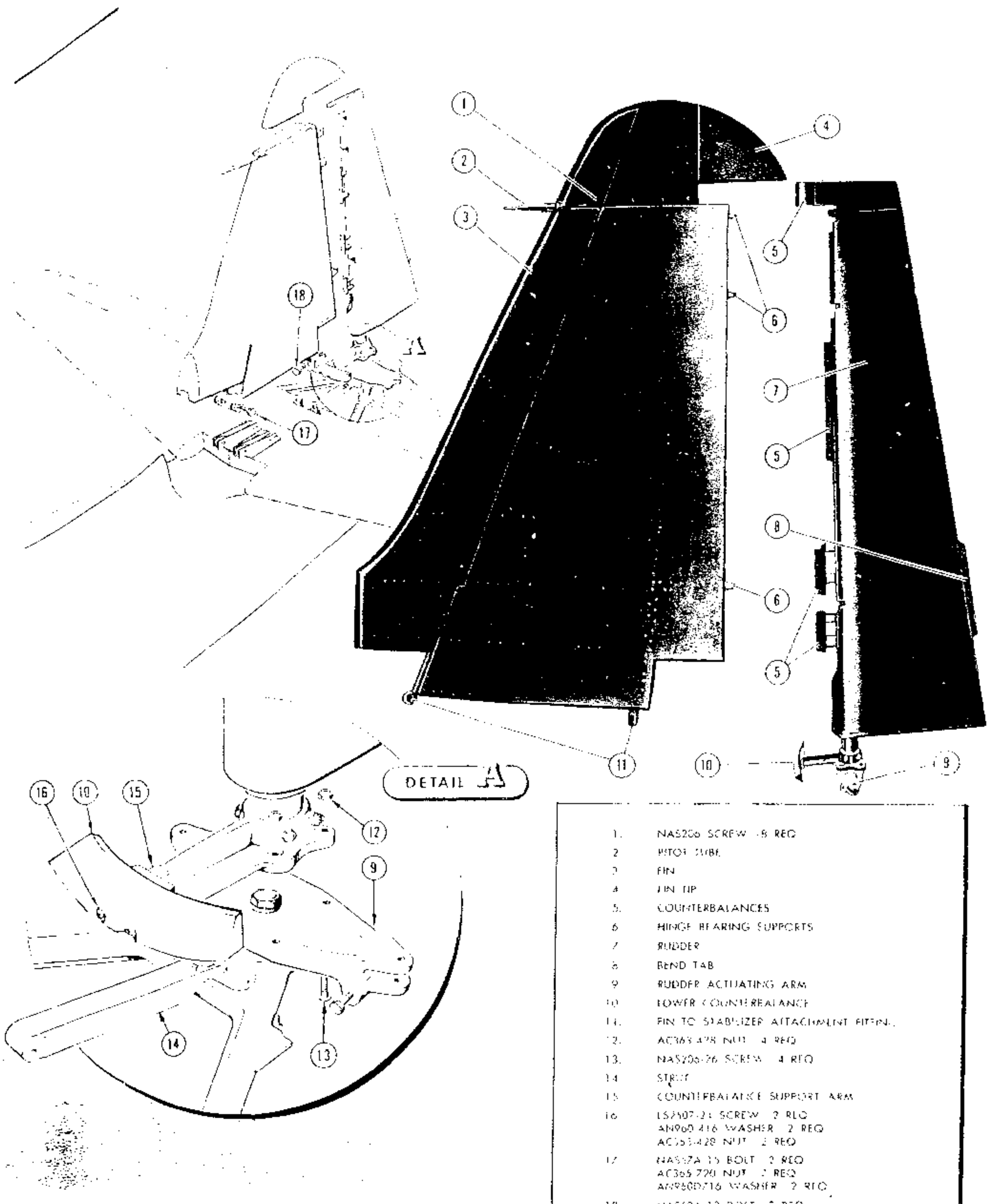



*Figure 43 — Elevator and Stabilizer*




| | |
|---|---|
| 1. | NAS206 SCREW 8 REQ |
| 2 | PITOT TUBE |
| 3 | FIN |
| 4 | FIN TIP |
| 5. | COUNTERBALANCES |
| 6 | HINGE BEARING SUPPORTS |
| 7 | RUDDER |
| 8 | BEND TAB |
| 9 | RUDDER ACTUATING ARM |
| 10 | LOWER COUNTERBALANCE |
| 11. | FIN TO STABILIZER ATTACHMENT FITTIN[illegible] |
| 12. | AC363-428 NUT 4 REQ |
| 13. | NAS206-26 SCREW 4 REQ |
| 14 | STRUT |
| 15 | COUNTERBALANCE SUPPORT ARM |
| 16 | LS7507-21 SCREW 2 REQ<br>AN960-416 WASHER 2 REQ<br>AC553-428 NUT 2 REQ |
| 17 | NAS57A-15 BOLT 2 REQ<br>AC365-720 NUT 2 REQ<br>AN960D716 WASHER 2 REQ |
| 18 | NAS58A-13 BOLT 2 REQ<br>AC365-820 NUT 2 REQ<br>AN960D816 WASHER 2 REQ |

*Figure 44 — Fin and Rudder Removal*

*(h)* Disconnect wiring from the connector panel in fairing under the rudder.

*(i)* Disconnect the radio antenna at the fin.

*(j)* Support the empennage, and from within the fuselage remove the four attaching bolts, two at the stabilizer front spar and two at the stabilizer rear spar.

*(k)* Remove the empennage by lifting it clear of the fuselage aft section. Weight is approximately 210 pounds.

(3) INSTALLATION. — Reverse removal procedure. Use Cherry blind self-plugging rivets where necessary for reinstallation of fillets. Be sure that pitot pressure line is airtight.

*b.* EMPENNAGE COMPONENTS.

(1) STABILIZER.

(a) DESCRIPTION. *(See figure 43.)*—The horizontal stabilizer is constructed as one unit with detachable tips. The left and right tips are interchangeabe. The structure consists of a front spar and a rear spar interconnected by ribs, and extruded stringers which extend spanwise at the upper and lower surfaces. Support castings for hinging the elevators, and brackets for mounting the elevator tab jack screws are bolted to the rear spar.

*(b)* REMOVAL.—The stabilizer may be removed with the entire empennage as described in paragraph *a* (2), preceding, or it may be detached from the fuselage aft section after the rudder, fin, and elevators have been detached. (See paragraphs *b*(2), (4), and (5), following, for removal of elevator, fin, and rudder.) The tips may be removed by unscrewing eight screws.

(2) ELEVATORS. *(See figure 43.)*

*(a)* DESCRIPTION. — The two elevators are joined at their inboard ends by torque tubes and a control horn assembly, and operate as a single unit. They are hinged on sealed, anti-friction bearings which are housed in brackets attached to the stabilizer rear spar. One external and two internal counterbalance weights are provided at the forward edge of each elevator.

*(b)* REMOVAL.

*1.* Disconnect bonding jumper.

*1A.* Using the elevator tab switch on the control stick (figure 212) set the trim tabs in neutral position.

*2.* Remove the stabilizer tips by removing eight screws attaching each tip to the stabilizer.

*3.* At the location of the trim tab jack screw, remove the screws attaching the inboard and outboard mounting brackets to the stabilizer rear spar. Trim tab jack screw assembly is mounted on the stabilizer rear spar, but is removed with the elevator.

*4.* Remove access panel No. 34 (figure 7). Work through this opening to perform the following operations:

a. Disconnect elevator-tab flexible drive shaft at "T" drive coupling under the stabilizer rear spar.

b. Support the elevator, and remove four screws which attach elevator outer torque tube to control horn. (See figure 137.)

*5.* With the elevator in the down position, strike outboard on the external counterbalance with a shot bag. At the same time, tap the elevator spring tab mechanism inboard occasionally when the elevator pulls it out of line. Work the elevator outboard to free the hinge pins from the bearings, torque tube from the control horn, and inner spring-tab torque tube from its horn. At the same time, guide the trim-tab jack screw clear of its inboard mounting by shifting it with a screw driver.

**CAUTION**

Do not pry on elevator hinges with a screw driver or sharp instrument, as hinge pin bearings are easily damaged.

*6.* When hinge pins, torque tube, and jack screw have been freed, remove the elevator by moving it outboard until the torque tube has cleared the hole in the tail fillet.

*(c)* INSTALLATION.—Reverse removal procedure. Be sure that the elevators, spring tabs, and the elevator control unit are all in neutral when the splines on the spring tab torque tube engage the splined horn. Be sure that elevator trim tabs, power unit, and drive mechanisms are in neutral before connecting the flexible drive shaft at the "T" drive coupling.

**Note**

Check tolerance of elevator hinge pins, maximum diameter of 0.3117 inch and a minimum diameter of 0.3112 inch. Check tolerance of elevator hinge fitting hole, maximum diameter of 0.3134 inch and a minimum diameter of 0.3123 inch. Replace parts worn beyond these tolerances.

After elevator assembly has been installed, check elevators for alignment. Misalignment should not exceed ½ degree difference between elevators. If either elevator exceeds ½ degree, remove and replace elevator with a serviceable item.

*(d)* ADJUSTMENT. — Refer to paragraph 15*d* (6), this section.

(3) ELEVATOR TABS. *(See figure [illegible])*

*(a)* DESCRIPTION.—The elevator tabs consist of two electrically operated trim tabs and two spring controlled servo tabs. The tabs, mounted on continuous hinges, are on the inboard end of each elevator. The innermost tab of each pair is the spring tab. The tabs extend one inch beyond the trailing edge of the elevator.

*(b)* REMOVAL.—Special tools required: S-34802 hinge pin puller, and S-10404 slide hammer.

*1.* Remove screws which attach actuating arms to streamline fittings on lower surface of tabs.

*2.* Remove hinge-pin locking clip at inboard end of spring tab.

*3.* Remove hinge pin. Use hinge-pin puller S-34802 and slide hammer S-10404. (See figure 30.)

*4.* Remove tabs by pulling them aft.

**Note**

Do not rotate trim-tab jack screw after tab has been removed, as rotation will alter tab rigging.

*(c)* INSTALLATION.—Refer to paragraph 1*e* (3), this section.

*(d)* ADJUSTMENTS.—Refer to paragraph 15*d* (6), this section.

(4) FIN. *(See figure 44.)*

*(a)* DESCRIPTION.—The fin is attached to the stabilizer upper surface with four shear pin fittings, two at the fin front spar and two at the rear spar. These fittings mate with similar fittings on the stabilizer front and rear spars. Two rudder hinge brackets, having sealed anti-friction bearings, are mounted in the rib structure at the aft edge. The removable leading edge section is attached with screws, and incorporates a radio antenna attachment at the upper forward edge. On the F-80A-1, F-80A-5, RF-80A-5, and RF-80A-10 airplanes, the air-speed pitot head is secured to the uppermost fin rib. A fin tip is attached to the upper end of the fin with eight screws. The tip is removable without disturbing the pitot head support tube. Airplanes serial Nos. AF-44-85407 and subsequent and prior airplanes incorporating T.O. No. 1F-80A-23, have plastic fin tips which house the command radio antenna. To remove the antenna, remove the fin tip. Displace the antenna sufficiently to gain access to the electrical disconnect plug. Remove the plug and then remove the antenna. If the plastic fin tip becomes rain-eroded, it should be coated with neoprene cement in accordance with paragraphs (4)*(c)* through (4)*(f)*.

*(b)* REMOVAL.

*1.* Remove the rudder. (See paragraph (5)*(b)*, following.)

*2.* Remove the fillets at the base of the fin, and remove access panels Nos. 33 and 34 (figure 7).

*3.* Remove elevator control rods which extend through the fin.

*4.* Disconnect antenna at the leading edge section. (See figure 229.)

*5.* Disconnect air-speed pitot line, and on some airplanes, disconnect the antenna coaxial cable on the fuselage forward of the fin.

*6.* Disconnect the wire from the pitot tube heater at the terminal panel in the fairing under the rudder. Detach wires from the clip which holds them to the horizontal stabilizer.

*7.* Support the fin and remove the four bolts attaching the fin to the stabilizer.

*8.* Remove the fin by lifting it straight up.

*(c)* ALLOWABLE REPAIR OF LAMINATED GLASS FABRIC ANTENNA HOUSING. — Repairs should be limited to the following:

*1.* Surface erosion only, with no penetration through any reinforcing layer: an unlimited area.

*2.* Erosion through only the first layer of reinforcing fabric: not more than a total area of one square inch within an area enclosed by a six-inch circle.

*3.* Pits extending through two or more layers of reinforcing fabric: individual pits not more than 1/4-inch wide, and total area pitted not more than one square inch within an area enclosed by a six-inch circle.

*4.* Long, narrow, eroded areas: not more than 1/4-inch wide, no penetration through more than the first layer of reinforcing fabric, no longer than 25% of the over-all dimension of the part, measured parallel to the eroded area.

*5.* For more extensive damage, or for damage which is considered dangerous to flight, replace the damaged part immediately.

*(d)* REPAIR OF LAMINATED GLASS FABRIC ANTENNA HOUSING.

**Note**

Repairs must be accomplished in a sheltered area protected from dust and weather, and at a temperature not lower than 15.5°C (60°F).

*1.* Trim loose or delaminated pieces, and sand to a smooth surface using No. 180 grit emery cloth or equivalent.

*2.* Clean the sanded surface with a dry-cleaning grade of trichlorethylene, Federal Specification O-T-634, to remove oil or grease.

*3.* Apply filler, Filaplast No. P-24 manufactured by the Brooklyn Varnish Manufacturing Company, to the depressions of the eroded area, using a spatula or knife to spread smoothly, and allow filler to dry for *b.* EMPENNAGE COMPONENTS.

(1) STABILIZER.

(a) DESCRIPTION. *(See figure 43.)*—The horizontal stabilizer is constructed as one unit with detachable tips. The left and right tips are interchangeabe. The structure consists of a front spar and a rear spar interconnected by ribs, and extruded stringers which extend spanwise at the upper and lower surfaces. Support castings for hinging the elevators, and brackets for mounting the elevator tab jack screws are bolted to the rear spar.

*(b)* REMOVAL.—The stabilizer may be removed with the entire empennage as described in paragraph *a* (2), preceding, or it may be detached from the fuselage aft section after the rudder, fin, and elevators have been detached. (See paragraphs *b*(2), (4), and (5), following, for removal of elevator, fin, and rudder.) The tips may be removed by unscrewing eight screws.

(2) ELEVATORS. *(See figure 43.)*

*(a)* DESCRIPTION. — The two elevators are joined at their inboard ends by torque tubes and a control horn assembly, and operate as a single unit. They are hinged on sealed, anti-friction bearings which are housed in brackets attached to the stabilizer rear spar. One external and two internal counterbalance weights are provided at the forward edge of each elevator.

*(b)* REMOVAL.

*1.* Disconnect bonding jumper.

*1A.* Using the elevator tab switch on the control stick (figure 212) set the trim tabs in neutral position.

*2.* Remove the stabilizer tips by removing eight screws attaching each tip to the stabilizer.

*3.* At the location of the trim tab jack screw, remove the screws attaching the inboard and outboard mounting brackets to the stabilizer rear spar. Trim tab jack screw assembly is mounted on the stabilizer rear spar, but is removed with the elevator.

*4.* Remove access panel No. 34 (figure 7). Work through this opening to perform the following operations:

a. Disconnect elevator-tab flexible drive shaft at "T" drive coupling under the stabilizer rear spar.

b. Support the elevator, and remove four screws which attach elevator outer torque tube to control horn. (See figure 137.)

*5.* With the elevator in the down position, strike outboard on the external counterbalance with a shot bag. At the same time, tap the elevator spring tab mechanism inboard occasionally when the elevator pulls it out of line. Work the elevator outboard to free the hinge pins from the bearings, torque tube from the control horn, and inner spring-tab torque tube from its horn. At the same time, guide the trim-tab jack screw clear of its inboard mounting by shifting it with a screw driver.

**CAUTION**

Do not pry on elevator hinges with a screw driver or sharp instrument, as hinge pin bearings are easily damaged.

*6.* When hinge pins, torque tube, and jack screw have been freed, remove the elevator by moving it outboard until the torque tube has cleared the hole in the tail fillet.

*(c)* INSTALLATION.—Reverse removal procedure. Be sure that the elevators, spring tabs, and the elevator control unit are all in neutral when the splines on the spring tab torque tube engage the splined horn. Be sure that elevator trim tabs, power unit, and drive mechanisms are in neutral before connecting the flexible drive shaft at the "T" drive coupling.

**Note**

Check tolerance of elevator hinge pins, maximum diameter of 0.3117 inch and a minimum diameter of 0.3112 inch. Check tolerance of elevator hinge fitting hole, maximum diameter of 0.3134 inch and a minimum diameter of 0.3123 inch. Replace parts worn beyond these tolerances.

After elevator assembly has been installed, check elevators for alignment. Misalignment should not exceed ½ degree difference between elevators. If either elevator exceeds ½ degree, remove and replace elevator with a serviceable item.

*(d)* ADJUSTMENT. — Refer to paragraph 15*d* (6), this section.

(3) ELEVATOR TABS. *(See figure 43.)*

*(a)* DESCRIPTION.—The elevator tabs consist of two electrically operated trim tabs and two spring controlled servo tabs. The tabs, mounted on continuous hinges, are on the inboard end of each elevator. The innermost tab of each pair is the spring tab. The tabs extend one inch beyond the trailing edge of the elevator.

one hour. If sink marks show in the filled-in areas, repeat the operation. Xylene, Federal Specification TT-X-916, grade B, may be used for thinning.

*4.* Remove excess filler by sanding. The prepared surface must have a dull appearance, and any glossy finish must be removed by sanding lightly. Remove dust by wiping with a clean lint-free cloth, and wash surface with toluene, Federal Specification TT-T-548.

*(e)* REFINISHING LAMINATED GLASS FABRIC ANTENNA HOUSING.

*1.* Apply, by brush or spray, one or more coats of priming cement, Bostik No. 1007, manufactured by the B. B. Chemical Company, to provide a coating from 0.001 to 0.002 inch thick. The cement may be thinned with methyl-ethyl-ketone, Federal Specification TT-M-261. The priming coat must be evenly distributed, and must be allowed to dry a minimum of 20 minutes before further processing.

2. Prepare neoprene coating, No. 23-56S, manufactured by the Goodyear Tire and Rubber Company, by adding 80 milliliters of accelerator (provided with neoprene coating) to one kilogram of neoprene coating, and then thinning with a mixture of 7 parts toluene, Federal Specification TT-T-548, 8½ parts xylene, Federal Specification TT-X-916, grade B, and 4 parts cyclohexanone, commercial grade, by volume.

**CAUTION**

Do not prepare quantities in excess of requirements, since material will jell in approximately 8 hours.

*3.* Apply neoprene coating by spraying successive coats until total thickness (including priming coat) is 0.007 to 0.008 inch thick. Allow 15 to 30 minutes drying time between coats.

**Note**

It is recommended that the thickness of each coat not exceed 0.001 inch to facilitiate drying.

**CAUTION**

Close the cover on the container of prepared coating material between applications. Scrape off any jelled material, and do not attempt to thin this jelled material for subsequent use.

*4.* Allow coating to set for a minimum of 12 hours at room temperature after application of the last coat before handling, and 24 hours before checking the coating thickness. Allow a minimum of seven days before the part is used in flight.

*(f)* REPAIR OF NEOPRENE COATING. When the cured coating is blistered, or a localized failure of the coating occurs, repairs may be made as follows:

*1.* Trim loose coating, and sand open area of laminated part to a smooth surface, using No. 180 grit emery cloth or equivalent. Wipe free from dust.

2. Apply primer, Bostik No. 1007, and neoprene cement properly catalyzed, and cure as previously described.

**Note**

Avoid applying repair coating much beyond edge of area to be repaired, as adhesion to existing coating is only fair. Avoid a build-up of thicknesses of repair coating beyond that specified above, since the electrical transmission properties may be critically affected.

(5) RUDDER. *(See figure 44.)*

*(a)* DESCRIPTION.—The rudder is hinged at four points, three along the rudder front spar, and one at the lower end of the torque tube. The lower hinge fitting is an integral part of the control quadrant which is attached to the torque tube. The bearing which supports the lower hinge fitting is contained in a cast truss assembly attached to the fuselage and stabilizer structures. The rudder is balanced to one external and three internal weights attached to the leading edge, and one internal weight attached to the lower end of the torque tube. A bend-type tab is attached to the trailing edge.

*(b)* REMOVAL.

*1.* Disconnect bonding jumper.

*1A.* Through access panel No. 30 (figure 7) disconnect the rudder cables at the quick disconnect. (See 4, figure 138.)

*2.* Remove the eight screws around the fin tip and remove the tip. On some airplanes, remove the antenna under the fin tip by disconnecting the cable under the antenna.

*3.* Remove access panel No. 34 (figure 7).

*4.* Remove two screws attaching the lower counterbalance to counterbalance support arm.

*5.* Remove four screws attaching the lower counterbalance support arm to the rudder actuating arm. If work is being done with the tail pipe installed an offset screw driver must be used to hold the screw heads under the rudder actuating arm.

*6.* Swing the rudder either way to clear the elevator mechanism; lift the rudder to clear the hinge pins, and pull it aft to remove it.

*(c)* INSTALLATION.

*1*. Reverse removal procedure.

*2*. Check clearance between rudder and vertical fin. Trim as required to provide clearance of .125 ±.031 inch.

*3*. Check clearance between rudder and empennage. Trim as required to provide minimum clearance of 0.1562 (5/32) inch. Excessive trimming should not be necessary, and the edge distance from rivet pattern center line to rudder skin bottom must not be less than 0.2187 (7/32) inch.

*(d)* ADJUSTMENTS.—Refer to paragraph 15*e* (4), this section.

## 3. FUSELAGE.

*a.* DESCRIPTION. *(See figure 3.)*—The semi-monocoque fuselage is constructed in three main sections, nose, mid, and aft sections. Bolted attachment enables removal of the nose section for repairs or replacement. The aft section is connected to the mid section with three quickly detachable tension fittings to permit removal of the engine. (See figure 60.) Attachment bolts used in the tension fittings are the internal wrenching type, and screw into threaded inserts which are removable for replacement. Drain holes to prevent accumulation of fuel and water are drilled in the bottom of the mid and aft sections. These holes must be kept open.

*b.* FUSELAGE NOSE SECTION.

(1) FIGHTER TYPE AIRPLANE NOSE.

*(a)* DESCRIPTION.—The fuselage nose section is attached to the mid section at station 81 sloping bulkhead with tension bolts through fittings of bulkhead and nose section, and with shear bolts through fittings of longerons in nose wheel well. Upper attachment is made with screws and bolts at armament door support. The nose section of P-80A-1 and some P-80A-5 airplanes contains a landing light, oxygen cylinder, gunnery equipment, armament junction box, and command radio set. The nose of later P-80A-5 and all P-80A-10 airplanes contains, in place of the landing light and oxygen cylinder, a radio compass loop antenna. The radio compass unit is mounted on the radio rack. On P-80A-10 airplanes the pitot mast is on the lower center line of the airplane nose, forward of the case ejection door. A data case is at the left aft end of the armament compartment, and a ballast box is behind the forward ammunition tray. Two doors enclose the armament compartment. An electrically operated machine-gun-case ejection door is on the lower aft portion of the nose section.

*(b)* REMOVAL. *(See figure 45.)*

*1.* Support fuselage aft section with cradle.

*2.* Remove armament compartment doors.

*3.* Remove all radio equipment, all wires leading into cockpit, and all gunnery equipment.

*4.* On airplanes with nose landing light, disconnect landing light control. Loosen nut in top of light support bracket, releasing cable (figure 211), and remove cable through cockpit. Disconnect cable casing by loosening nut on ferrule at station 103 bulkhead. (See figure 49.)

*5.* Discharge and disconnect the oxygen cylinder. (See paragraph 21*j*, this section.)

*6.* Disconnect static pressure line at station 103 bulkhead.

*7.* Unsnap the canvas dust shield from its aft fasteners.

*8.* Remove two shear bolts and five flush screws from the top longeron.

*9.* Remove eight shear bolts attaching the armament compartment floor to station 103 bulkhead. Remove eight additional shear bolts (four on each side) which attach the armament compartment floor to the side stringers.

*10.* Remove two tension bolts from the longeron fittings under the floor on each side. Remove the nose section by pulling it forward to clear the radio shelves.

*(c)* BALLAST BOX. *(See figure 237.)*

*1.* DESCRIPTION.—On early airplanes, a ballast box with a capacity for 85 pounds of ballast, is attached to the left side of the forward ammunition tray supports. Later airplanes have the ballast box attached to the right side of the No. 2 ammunition tray supports. To open the box, remove the top hinge pin and swing the door down. The lower hinge pin may be removed to remove the door.

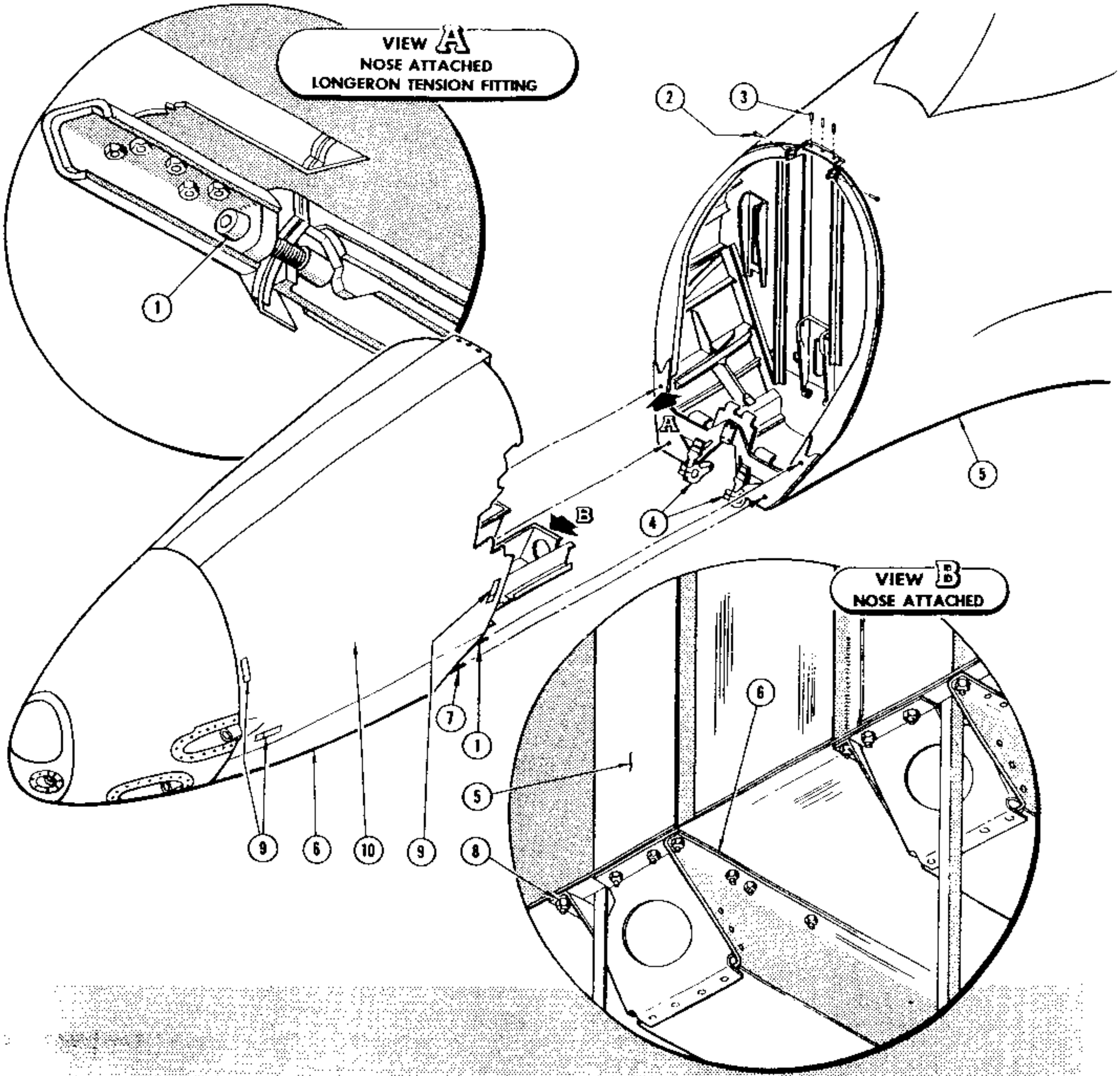
*2.* REMOVAL.—Remove two screws, one from each upper side clip. Remove four flush screws from the lower support behind the box.

*(d)* ARMAMENT COMPARTMENT DOOR. *(See figure 237.)*—Two doors enclose the armament compartment. The doors are hung on three sealed-bearing hinges, and are held closed by three latches. To open the doors, insert a screw driver in the slot of the small segment of the latch and push, then pull out the long segment. Raise the door, and insert the support arm in the clip mounted on the ammunition tray support members. When closing the doors, press in on the long segment of the latch until it is caught and held in place by the short segment. If the doors do not fit flush, move the pin on which the latch catches. To do this, loosen the bolt holding the serrated plate on which the pin is mounted, move it as necessary, and tighten the bolt.

To remove the doors, support them in the open position. Do not use the support arm. Remove the bolts from each of the three hinge pins, and remove the doors. The hinge-pin bolts are held by plate nuts.

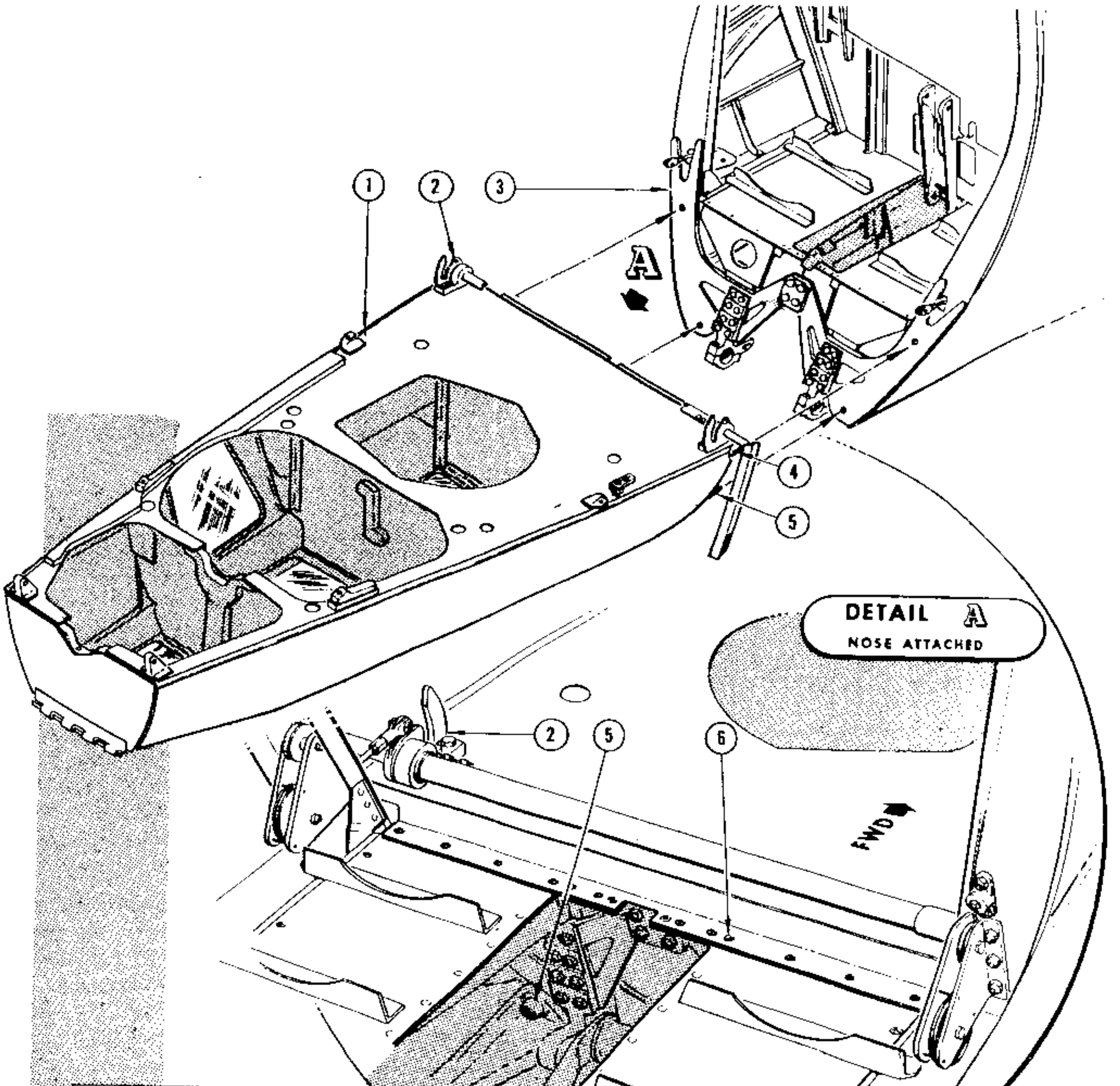
(2) PHOTOGRAPHIC AIRPLANE NOSE.

(a) DESCRIPTION.—The FP-80A-5 and the FP-80A-10 photographic airplanes are essentially P-80A-5 or P-80A-10 airplanes, except that the entire nose section forward of the canted bulkhead at station 81 has been exchanged for one suitable for carrying photographic equipment. The nose section consists of the structure, the camera compartment hood, and a removable window frame on the under side of the nose structure.




| | | | |
|---|---|---|---|
| 1. | NAS148-44 BOLT (2 REQ) | 6. | FUSELAGE NOSE SECTION |
| | 12B-080 ELASTIC STOP NUT (2 REQ) | 7. | NAS149-52 BOLT (2 REQ) |
| 2. | AN4 BOLT (2 REQ) | | 12B-098 ELASTIC STOP NUT (2 REQ) |
| 3. | NAS206-11 SCREW (3 REQ) | 8. | LS560 SCREWS (16 REQ) |
| | AC364-428 NUT (3 REQ) | | AC365-1032 NUT (16 REQ) |
| | AN960D416 WASHER | 9. | ARMAMENT COMPARTMENT DOOR LATCHES |
| 4. | ALIGHTING GEAR ATTACHMENT FITTINGS | 10. | ARMAMENT COMPARTMENT DOOR |
| 5. | FUSELAGE MID SECTION | | |

*Figure 45 — Fuselage Nose to Mid Section Attachment — P-80A*




1. FUSELAGE NOSE SECTION
2. HOOD LATCH ASSEMBLY
3. FUSELAGE MID SECTION
4. NAS148-44 BOLT (2 REQ)
   12B-080 ELASTIC STOP NUT (2 REQ)
5. NAS149-52 BOLT (2 REQ)
   12B-098 ELASTIC STOP NUT (2 REQ)
6. LS560 SCREW (14 REQ)
   AC365 NUT (8 REQ)

*Figure 46 — Fuselage Nose to Mid Section Attachment — FP-80A*

The nose section contains two oxygen cylinders, photographic equipment, command radio, radio compass unit, vacuum pumps, the heat control thermostat, and temperature bulb. The camera junction box and radio junction box are mounted on the front of the radio rack. The radio compass loop antenna, a case for spare window glasses, and the nose ballast are mounted in the hood. The lower nose section and the camera compartment hood are insulated to assist in the maintenance of an even temperature in the camera compartment. The parting surfaces of the hood are sealed with rubber strips attached with screws.

*(b)* REMOVAL. *(See figure 46.)*

*1.* Support the fuselage aft section with a cradle.

*2.* Remove the camera compartment hood. (See paragraph *(c)2,* following.)

*3.* Disconnect all electrical cables and vacuum system tubing from the cameras, and remove the cameras. (See figures 223, 260, and 261.)

*4.* Disconnect the static pressure line at the station 103 bulkhead.

*5.* Remove the camera and radio junction boxes.

*6.* Remove the oxygen cylinders. (See paragraph 21*i*(2)*(d),* this section.)

*7.* Remove the 14 bolts from the "Z" section attaching nose section floor to floor in forward part of the fuselage mid section.

*8.* Disconnect sheave operating rods (9) from latching hooks (8). (See figure 48.)

*9.* Remove two tension bolts from the longeron under the floor on each side. Remove the nose section by pulling it forward.

*(c)* CAMERA COMPARTMENT HOOD. *(See figure 47.)*

*1.* DESCRIPTION.—The camera compartment hood structure consists of an aluminum alloy outer skin reinforced with a beaded aluminum alloy inner skin. The two skins are fastened together with rivets. A continuous hinge (21) provides attachment between the hood and the nose structure at fuselage station 31. The hood is held closed by three latch tie-down fittings (1 and 28) on the aft edge. Dowel pins (27) on the lower right and left edges of the hood mate with fittings (17) on the nose section lower structure to provide additional rigidity. A 328-pound lead weight (22) is installed in the lower forward end of the hood to maintain proper balance of the airplane. The hood is held open by hold-open mechanisms (19). A glass window is installed in the lower left side of the hood to provide a view opening for an oblique camera in the mid bay. A small spring-loaded door near the lower left edge of the hood provides a hand hold for opening and closing the hood.

2. REMOVAL.

a. Remove the hold-open mechanisms as directed in paragraph 4c, following.

b. Remove the hood hinge guard (20). This is a rubber guard, cemented in place, and will come loose with a steady pull.

c. Remove the cloth tape (23) from the hinge line.

d. Attach a chain fall or hoist to the top center latch fitting of the hood, and lift just enough to relieve the weight on the hinge.

e. Remove hinge pin clip (24), and pull out the hood hinge pin.

f. Pull hood forward to free it.

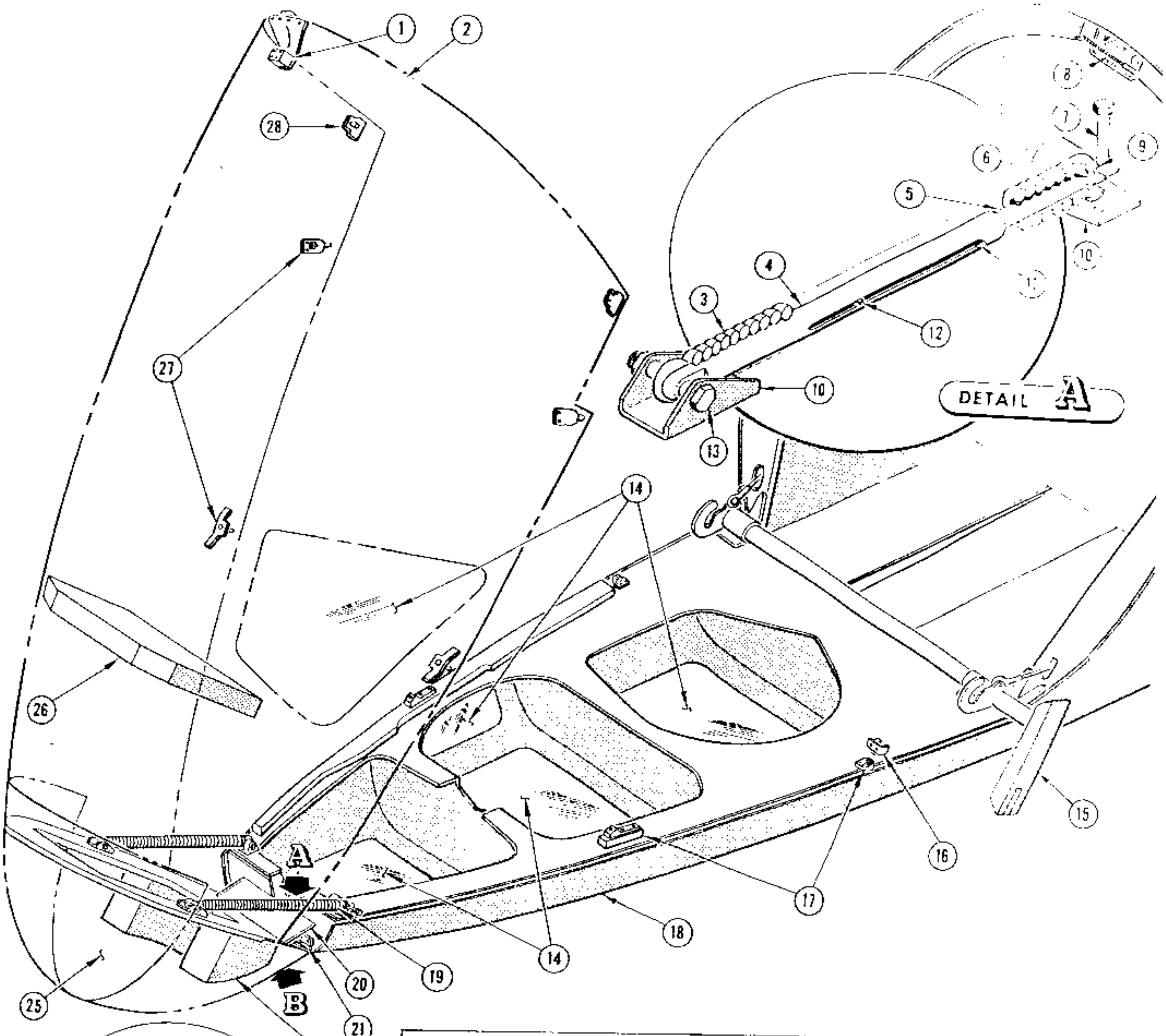
3. HOOD LATCH. *(See figure 48.)* — The camera hood is secured in the closed position by a latch mechanism on the aft end of the fuselage nose structure and the canted bulkhead of the fuselage mid section.

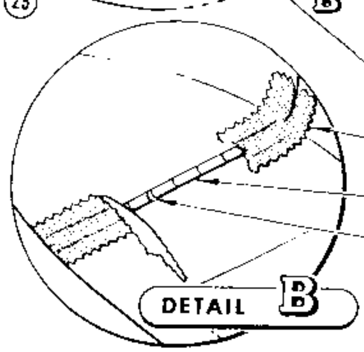
a. OPERATION.

*(1)* TO OPEN THE HOOD.—Push the trigger (18) on the forward end of handle (12). The handle will snap out of its recess. Push the forward end of the handle down until the hood is released. Then pull the hood upward and forward until it is fully open and the hold-open mechanism (19, figure 47) is engaged.

Pushing the trigger in forces catch (19, figure 48) out of its slot in the handle. When the catch releases the handle, the spring (7) in the latch tube forces the handle out of its recess. Two bolts through tube (13) into the handle hub limit the travel of the hub. Rotating the handle (12) counterclockwise moves tube (13) and latching hooks (8) in the same direction. This causes the hooks to disengage from the bolts in the hood latch lower fitting (25). As the hooks are displaced, sheaves (17) are rotated by rods (9) to operate the cable system that releases the upper latch. The cable extends around the aft circumference of the canted bulkhead through several guide pulleys (21), and is anchored at each end to the sheaves by a lock screw (27). The left sheave pulls the cable to disengage pin (2) from the upper latch.

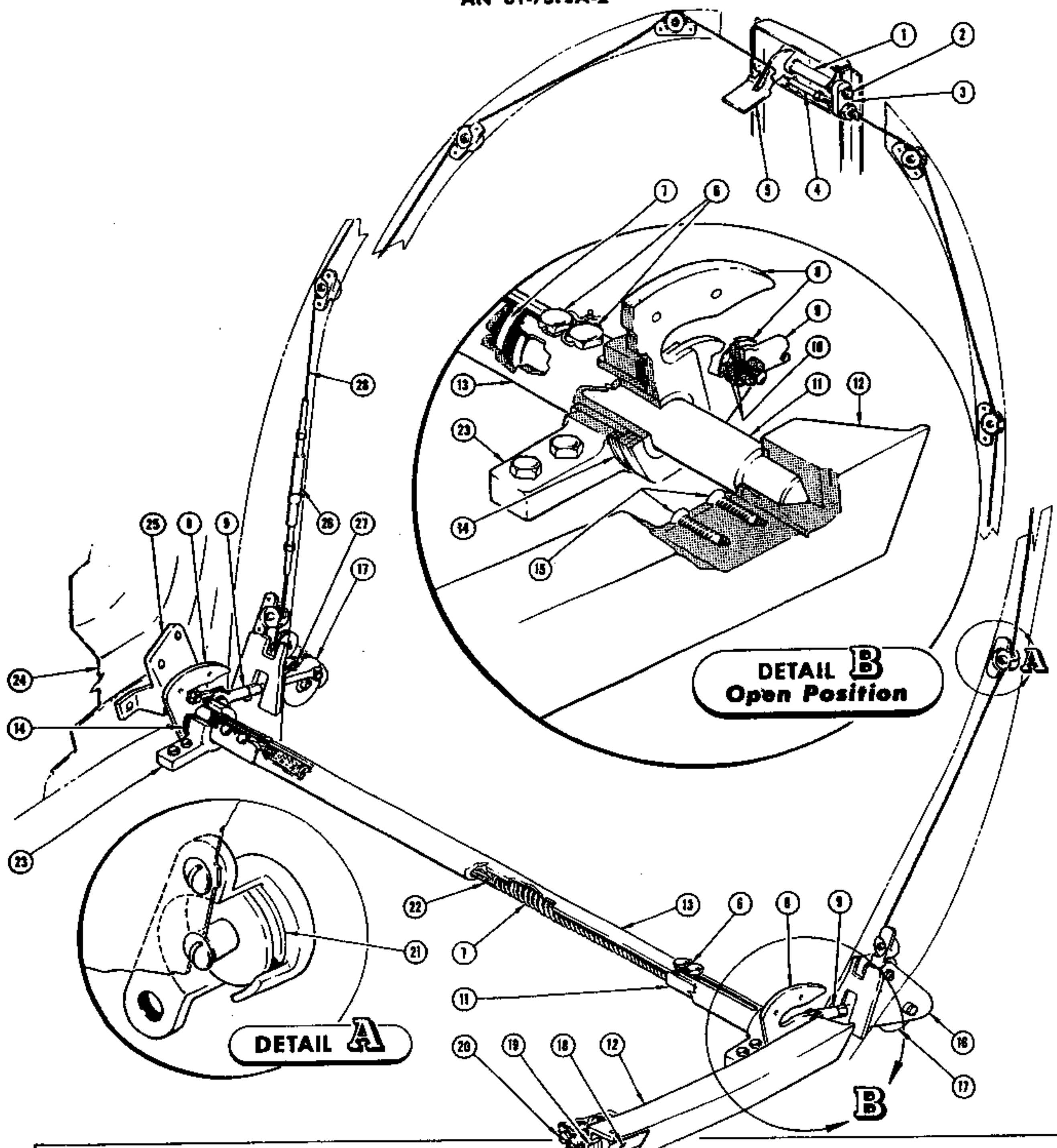
*(2)* TO CLOSE THE HOOD. — Release the safety lock of the hold-open mechanism (paragraph 4b, following) and pull the hood closed. Rotate the handle clockwise until it is in the horizontal position. Then push the handle into its recess. Be sure the catch engages and holds the handle securely. The latching process is




1. HOOD LATCH FITTING—UPPER
2. CAMERA COMPARTMENT HOOD
3. SPRING
4. TUBE
5. ROD
6. SLOTTED PIN
7. HOLD-OPEN MECHANISM HANDLE
8. FUSELAGE-HOOD LATCH FITTING
9. PIN
10. HOLD OPEN MECHANISM ATTACHMENT FITTING
11. RETAINING SLOT
12. RETAINING PIN
13. ATTACHMENT BOLT
14. CAMERA WINDOWS
15. HOOD LATCH HANDLE
16. HANDLE CATCH
17. HOOD DOWEL PIN SOCKETS
18. FUSELAGE NOSE STRUCTURE
19. HOOD HOLD OPEN MECHANISM
20. CAMERA HOOD HINGE GUARD
21. CAMERA HOOD HINGE
22. LEAD WEIGHT
23. CLOTH TAPE
24. HINGE PIN LOCKING CLIP
25. PLASTIC ANTENNA COVER
26. SPARE WINDOW GLASS CONTAINER
27. HOOD DOWEL PINS
28. HOOD LATCH FITTING LOWER

*Figure 47 — Installation of Camera Compartment Hood*




| | | |
|---|---|---|
| 1. FUSELAGE-HOOD-LATCH FITTING—UPPER | 11. HUB | 21. PULLEY |
| 2. HOOD LATCHING PIN | 12. HOOD LATCH OPERATING HANDLE | 22. WOOD DOWEL |
| 3. PIN OPERATING LUG | 13. LATCH—OUTER TUBE | 23. BEARING |
| 4. LUG ATTACHING SLEEVE | 14. SHIMS | 24. HOOD |
| 5. HOOD LATCH FITTING—UPPER | 15. HUB ATTACHING SCREWS | 25. HOOD LATCH FITTING—LOWER |
| 6. TUBE-TO-HUB ATTACHING BOLTS | 16. SHEAVE BRACKET | 26. TURNBUCKLE |
| 7. HANDLE THROWOUT SPRING | 17. SHEAVE | 27. CABLE LOCKING SCREW |
| 8. HOOD LATCHING HOOK | 18. OPERATING HANDLE TRIGGER | 28. UPPER HOOD LATCH OPERATING CABLE |
| 9. SHEAVE OPERATING ROD | 19. HANDLE CATCH | |
| 10. SPACER | 20. ADJUSTING SCREWS | |

*Figure 48 — Installation of Camera Compartment Hood Latch*

essentially the reverse of unlatching except that the right sheave pulls the cable to engage pin (2) with the upper latch.

b. REMOVAL.

*(1)* Open the hood until the hold-open mechanism engages.

*(2)* Remove screws holding the camera and radio junction boxes so that boxes may be moved aside.

*(3)* Remove bolts (6) and take off handle.

*(4)* Remove two bolts attaching latch tube (13) to the right hook.

*(5)* Remove both hooks and the latch tube. Note the number of shims (14) at each end, and record the number for reinstallation.

*(6)* Remove the vacuum pump bracket.

*(7)* Remove the oxygen cylinders. (See paragraph 21*i*, this section.)

*(8)* Release tension of the latch cable by loosening the turnbuckle on the right side of the cable.

*(9)* Disconnect the sheave operating rods at the hooks.

*(10)* Remove pulleys (21).

*(11)* Remove cable lock screws from sheave and remove the cable assembly.

c. INSTALLATION. — Reverse removal procedure. When attaching sheave operating rods to hood latching hooks, fit the fork of the rod over the tongue of the hook and line up the holes. Insert the spacers (10), one in each side of each fork. Then insert and tighten the bolts. (See B, figure 48.)

Install shims (14) as necessary (paragraph b*(5)*, preceding) to position the hood latching hooks so that they will engage the bolt in the latch lower fittings (25). For adjustment of guides on this bolt see paragraph c*(5)*, preceding.

d. ADJUSTMENTS.

*(1)* Rig latch cable to a tension of 30 to 35 pounds with the turnbuckle (26).

*(2)* Adjust latch pin (2) by turning it in or out of lug (3). If additional travel is needed, it may be obtained by moving the lug back or forth on the sheave. This is accomplished by changing the positions of the sleeve nuts.

*(3)* If the handle is not in line with its recess when the hood is closed and completely latched, adjust the sheave operating rods.

*(4)* If the handle is not held by catch (19), or is allowed to extend outboard beyond the contour of the hood, move the catch inboard or outboard until the handle is flush with the hood contour. The catch has serrations on its aft side which match serrations in the attachment fitting, permitting movement inboard or outboard by loosening adjusting screws (20).

*(5)* To align the guides on the bolts of the latch lower fitting (25) with the hooks (8), use a total of six washers on each bolt. If only three are necessary between the guide and the fitting, then place the other three between the guide and the nut. Run the nut onto the bolt finger-tight against the washers, then back it off one-quarter turn. Lock it in place with a cotter pin.

4. HOLD-OPEN MECHANISM.

*(See figure 47.)*

a. DESCRIPTION. — A hood hold-open mechanism (19) is located on each side of the fuselage at station 30. The left mechanism automatically locks the hood in the full open position. The right mechanism is identical to the one on the left, except that there is no retaining slot or handle.

b. OPERATION.—When the hood reaches the full open position, the left hold-open mechanism automatically locks. As the hood is opened, rod (5) and retaining pin (12) are pulled through tube (4) against the tension of spring (3) until the retaining pin is forced into retaining slot (11) in the aft end of the tube. The hood is locked open when handle (7) is in a horizontal position. To unlock the mechanism, rotate the handle to the vertical position.

c. REMOVAL.

*(1)* Open the camera compartment hood, and tie a rope between the top center latch fitting on the hood and the fuselage. This must be done to prevent the hood from falling forward when the hold-open mechanisms are removed.

*(2)* Remove pin (9).

*(3)* Close the hood as much as possible and yet leave room to work. This reduces tension of the spring.

*(4)* Drive out slotted pin (6). Allow hood to tilt open, being sure to maintain control so that it will not fall forward and break the retaining rope.

*(5)* Remove bolt (13) from attaching fitting on the phenolic resin bulkhead, and remove the hold-open mechanisms.

5. BALLAST.

a. DESCRIPTION.—To compensate for the difference in weight between the photographic airplane nose and the fighter airplane nose, a 328-pound lead weight is installed in the front of the camera compartment hood. The airplane can be flown without cameras, provided no droppable tanks are installed.

## WARNING

Fifty pounds of ballast per bay, or one camera per bay must be installed when the photographic airplane is flown with droppable fuel tanks.

b. REMOVAL.

*(1)* Remove the plastic nose cover by taking out the screws around it.

*(2)* Remove loop antenna or forward shooting camera.

*(3)* Take out the bolts which secure the lead weight.

*(4)* Install lift bolts in the threaded sleeves in the upper face of the weight.

*(5)* Attach a hoist or chain fall to the lift bolts, and hoist the weight clear of the airplane.

6. INSULATION. — A laminated fiberglas blanket is attached to the inside of the hood and to the nose structure to insulate the camera compartment against cold. This blanket consists of the following laminations, starting from the inside: Hlavity No. 5454 trim cloth, fiberglas 1/2 inch, XAA-PF aluminite vinylite septum, fiberglas 1/2 inch and No. 20-12 cheesecloth. The blanket is quilted with a loop stitch approximately 4 inches center to center. It is attached to the inner skin of the hood by cement, and to the inner-skin beads by sheet metal screws and large washers. If replacement of this insulation is necessary and this material is not available, a plain blanket of fiberglas or comparable material one inch thick and attached in a similar manner may be used.

*(d)* NOSE STRUCTURE.—The nose structure of the photographic airplane is a cantilever structure attached to the fuselage at station 81. It serves as a base for the camera mounts. The windows for the vertical cameras are installed in a removable frame which is attached to the bottom of the nose section by Airloc fasteners.

*(e)* WINDOWS.

*1.* GENERAL.—The side and nose windows are made from 1/4-inch photo glass, U. S. Army Specification 75-357, type II. The bottom windows are made from 1/4-inch photo glass, U. S. Army Specification 75-357, type V, class F. If replacement is necessary, any approved adhesive compound will be satisfactory for attaching the rubber seals. A wooden box is installed in the hood to carry spare window glasses.

*2.* CLEANING. — Use great care in cleaning the glass of the camera windows, to prevent scratching. The simplest and best method of cleaning is to dip the fingers in dry powdered pumice or Bon Ami and rub on the glass with a rotary motion, using light pressure. When the glass is clean, polish with the heel of the hand. Use soft paper tissue to remove excess powder from the corners. Do not use any water with this method. The hands must be absolutely clean and free from anything of an abrasive nature. If the windows are dusty or spattered with mud, wash them with a stream of water under low pressure, and allow them to dry completely. Then apply the preceding cleaning method.

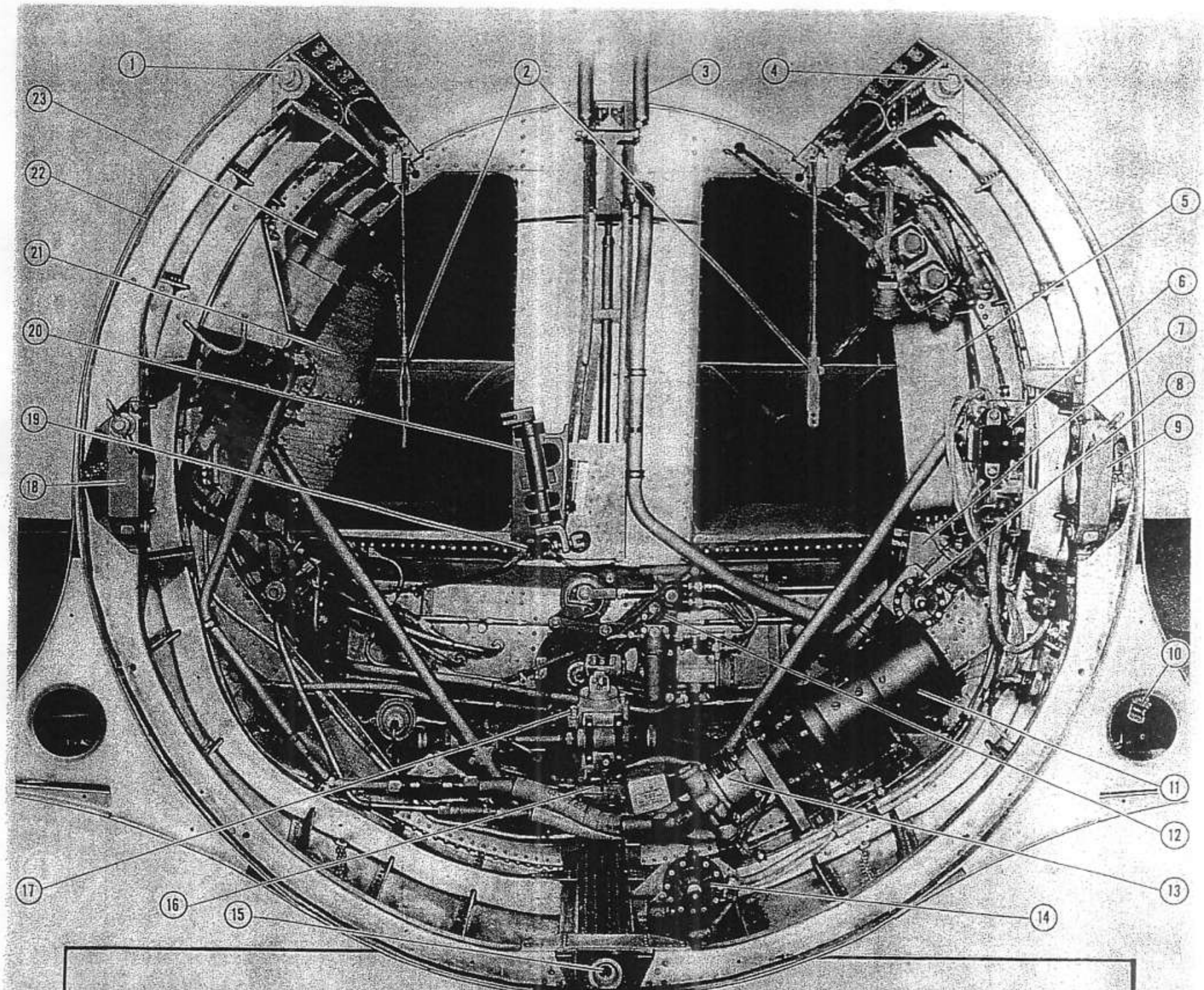
To clean the inner surface of the right oblique window, it will be necessary to remove both cameras from the mid bay. Cleaning of the inner surface of the window for the forward-aiming camera will necessitate removal of the camera or loop antenna. To clean the inner surface of the bottom windows, detach the removable frame on the under side of the nose structure.

*c.* FUSELAGE MID SECTION.
*(See figures 49 and 50.)*

(1) DESCRIPTION.—The fuselage mid section extends from station 81 to station 277. The wing is attached to this section. The cockpit is located in the upper forward structure, a fuel-tank compartment in the center, and the engine compartment in the aft end. The space beneath the floor of the cockpit is termed the "sub-cockpit compartment."

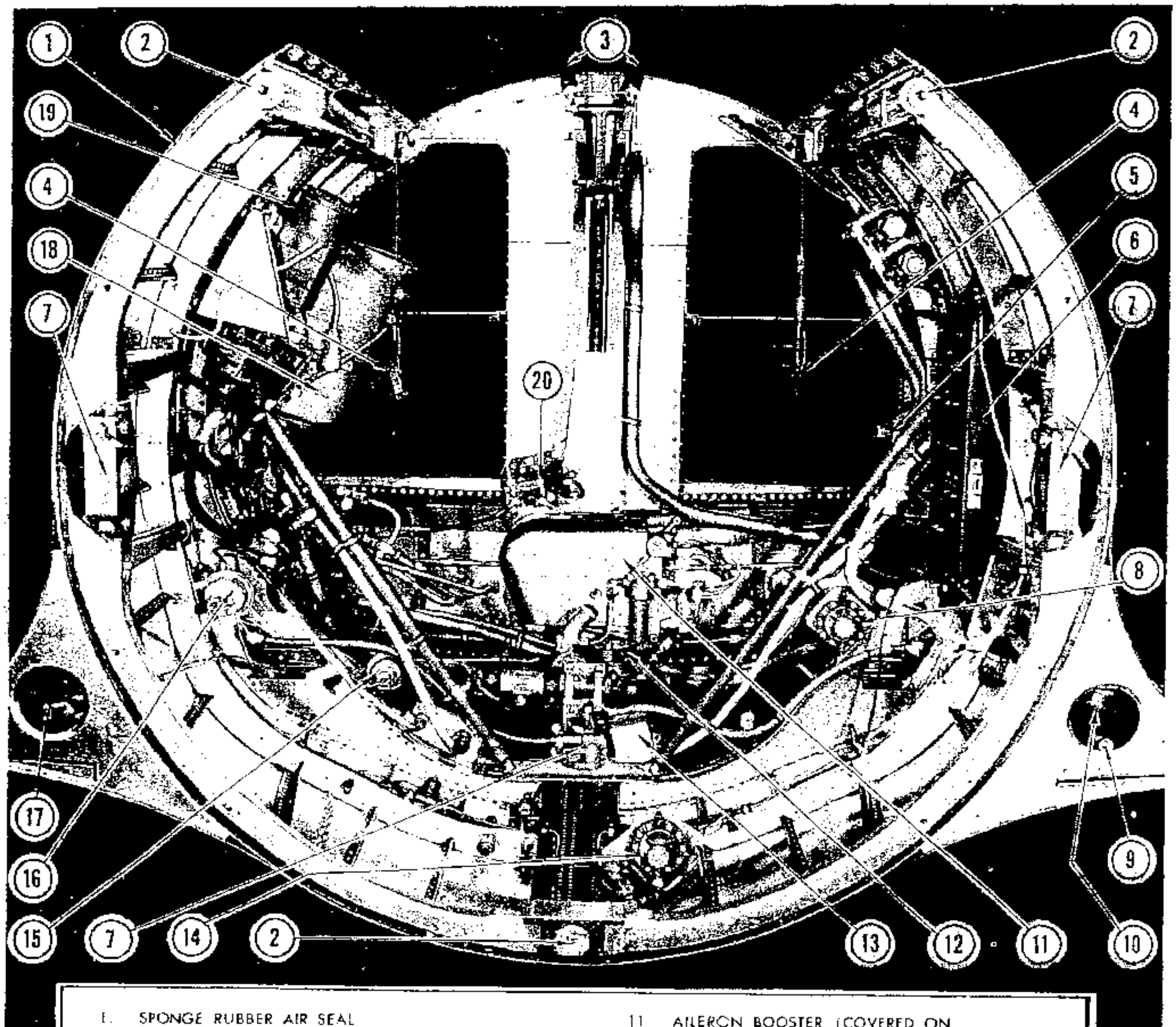
The structure consists of bulkhead rings and segments, reinforced where loads are highly concentrated, stringers extending longitudinally at the fore and aft sections, and longerons on each side of larger cut-out areas. A channel-shaped longeron also extends along the bottom center line and attaches to the wing center rib. The bulkheads on each side of the wing cut-out incorporate fittings for attachment of the wing front and rear spars. Bulkheads on each side at the forward end of the fuel-tank compartment are shaped to receive the engine air-intake ducts. The air ducts extend along both sides of the fuselage, with the openings just forward of the cockpit. A scoop on the inboard side of each opening bleeds off the boundary air. (See figure 94.) Tanks for water-alcohol fluid are located, one on each side of the fuselage fuel tank, directly above the air ducts.

A wheel well for the nose alighting gear is provided in the lower forward structure. Two doors enclose the well when the gear is retracted. For detailed instructions and description of the nose gear doors, see paragraph 4*j*, this section. Mountings for the batteries and




1. ATTACHMENT BOLTS AND FITTINGS
2. RUDDER CABLE DISCONNECT FITTING
3. ELEVATOR PUSH-PULL TUBES
4. ATTACHMENT BOLTS AND FITTINGS
5. ENGINE JUNCTION BOX
6. ENGINE ACCESSORY PANEL
7. STARTER RELAY BOX
8. OIL PRESSURE TRANSMITTER
9. ENGINE MOUNTS
10. PITOT PRESSURE LINE DISCONNECT
11. HYDRAULIC PUMP MOTOR
12. AILERON BOOSTER UNIT
13. HYDRAULIC PUMP
14. FUEL PRESSURE TRANSMITTER
15. ATTACHMENT BOLTS AND FITTINGS
16. ENGINE MOUNTS
17. FUEL FLOWMETER
18. ENGINE MOUNTS
19. BOMB MANUAL RELEASE CABLES
20. THROTTLE CONTROL SHAFT
21. MAIN HYDRAULIC RESERVOIR
22. SPONGE RUBBER AIR SEAL
23. EMERGENCY FUEL PUMP

*Figure 49 — Interior of Mid Section — P-80A-1 Airplanes*



1. SPONGE RUBBER AIR SEAL
2. ATTACHMENT BOLTS AND FITTINGS
3. ELEVATOR PUSH PULL TUBES
4. RUDDER CABLE DISCONNECT FITTINGS
5. STARTER RELAY BOX
6. ENGINE JUNCTION BOX (LATER AIRPLANES)
7. ENGINE MOUNTS
8. OIL PRESSURE TRANSMITTER
9. COMMAND RADIO ANTENNA, COAXIAL CABLE DISCONNECT (LATER AIRPLANES)
10. PITOT PRESSURE LINE DISCONNECT
11. AILERON BOOSTER (COVERED ON LATER AIRPLANES)
12. FUEL FLOWMETER
13. FLAP ACTUATOR LIMIT SWITCH BOX
14. FUEL PRESSURE TRANSMITTER
15. WING TANK FUEL PRESSURE SWITCH
16. EMERGENCY FUEL SYSTEM PRESSURE SWITCH
17. VOLTAGE REGULATOR (LATER AIRPLANES)
18. MAIN HYDRAULIC RESERVOIR
19. EMERGENCY FUEL TANK
20. ENGINE CONTROL BELL CRANK

*Figure 50 — Interior of Mid Section — P-80A-5 and FP-80A-5 Airplanes*

the identification radio are in the sub-cockpit compartment immediately aft of the nose wheel well. The two dive flaps are forward of the main gear doors, one on each side of the airplane center line.

On the bottom of the mid section are access doors to the engine compartment, one on each side of the airplane center line. The three recognition lights are mounted in the left-hand doors.

Three ball socket-type fittings for mounting the engine are located one on the left and one on the right side of station 277 bulkhead, and one at the bottom of station 252 bulkhead.

Access doors and panels aft of fuselage station 48.0 with ¼-inch skin gaps are satisfactory, providing they are flush with aircraft contours, a minimum of 3/16-inch overlap is maintained and weather sealing is not adversely affected.

Fillets screwed and riveted to the fuselage and wing form smooth contours at the intersections of these main structural components. (See figure 34.)

Three tension fittings attach the aft fuselage section to the mid section. Two of the fittings are bolted to the ends of the two upper longerons on the mid section. Each fitting contains an insert nut to hold the attachment bolt. (See figure 60.) The insert nut is screwed into the fitting and locked in place with a screw. The third tension fitting is on the fuselage aft section and mates with a bathtub fitting which is riveted to the lower longeron of the mid section. For removal of the fuselage mid section from the wing, see paragraph 1*b*(1), this section. The three bolts are chained to the airplane structure to prevent their loss.

(2) COCKPIT. *(See figures 3 and 246.)*

*(a)* DESCRIPTION.—The cockpit is sealed for pressurization, and extends from the forward pressure bulkhead, station 103, to the aft pressure bulkhead, station 163.9. The structure provides mountings for the canopy and windshield, instrument panel, pilot's seat, and all power plant, radio, and flight controls. Flooring is ⅜-inch five-ply fir or spruce with poplar core (Specification AN-NN-P-551), and is tunneled in the center to accommodate the aileron-elevator control assembly.

*(b)* PRESSURE SEALING. (See figure 51.)

*1.* GENERAL.—The cockpit structure is sealed at all joints and seams to withstand an internal pressure of 4 psi. When the canopy is closed, it is sealed to the structure by rubber tubes installed in the canopy rail and windshield frame. These two tubes are inflated by pressure from the engine compressor. Formed rubber strips seal the windshield glass into the frame. The joints between the cockpit structure and the flight-surface controls are sealed as shown in figure 51. Pressure-tight connector plugs permit routing electrical wiring through the cockpit area.

See paragraph *(b)3*, following, for details of structural sealing.

2. MATERIALS.

a. Sealer, General Purpose, Synthetic Rubber Base, Minnesota Mining & Mfg. Co., EC612.

b. Bostick 1007 primer S/N 7300-78020 (C1 07).

c. Cable sealing and control rod grease Spec. 3607.

d. Cement, General Purpose, Synthetic Rubber Base, Spec. 26609.

3. PROCEDURE.

a. Inspect rubber and leather seals in bulkhead fittings and replace any defective seals.

b. Lubricate all controls which move in these seals. (See figure 26.)

c. Apply sealing primer, Bostick 1007 primer, with a brush over all rivet patterns, seams, joints and joggles. Take care to cover thoroughly all rivets, screws, and plate nuts. Allow the sealing primer to dry for one hour.

d. Apply sealing putty EC612 with the fingers at joggles, corners, and gaps. Apply the putty in such a way that it will produce a smooth coat approximately ¼ inch thick. Allow the putty to dry for one hour.

a. Seal all seams with EC612 seam sealer. Apply the seam sealer with a pressure pot and a booster pump having an airmotor drive. A high-pressure hose with a flow gun having a 0.040-inch diameter orifice is attached to the pump. Flow a bead of from 1/16 to ⅛ inch diameter along the edges of all angles, channels, flooring, clips, bulkheads, or other type of fittings to be sealed in the cockpit area. Flow a bead around the edge of all applied putty. The width of the bead will depend on the speed with which the flow gun is moved, and the pressure in the pressuer pot. The bead must be applied continuously. Hold the gun stationary at start and finish. Allow the seam sealer to dry for four hours before pressure testing.

**Note**

Do not apply sealing tapes or compounds to the faying surfaces of the seams or joints. Accomplish all sealing after parts have been assembled. Apply all sealing compound on the cockpit side of the structure.

f. After the sealing compound is thoroughly dry (a minimum of four hours), close all openings in the cockpit, connect an air pressure line, a flowmeter, an

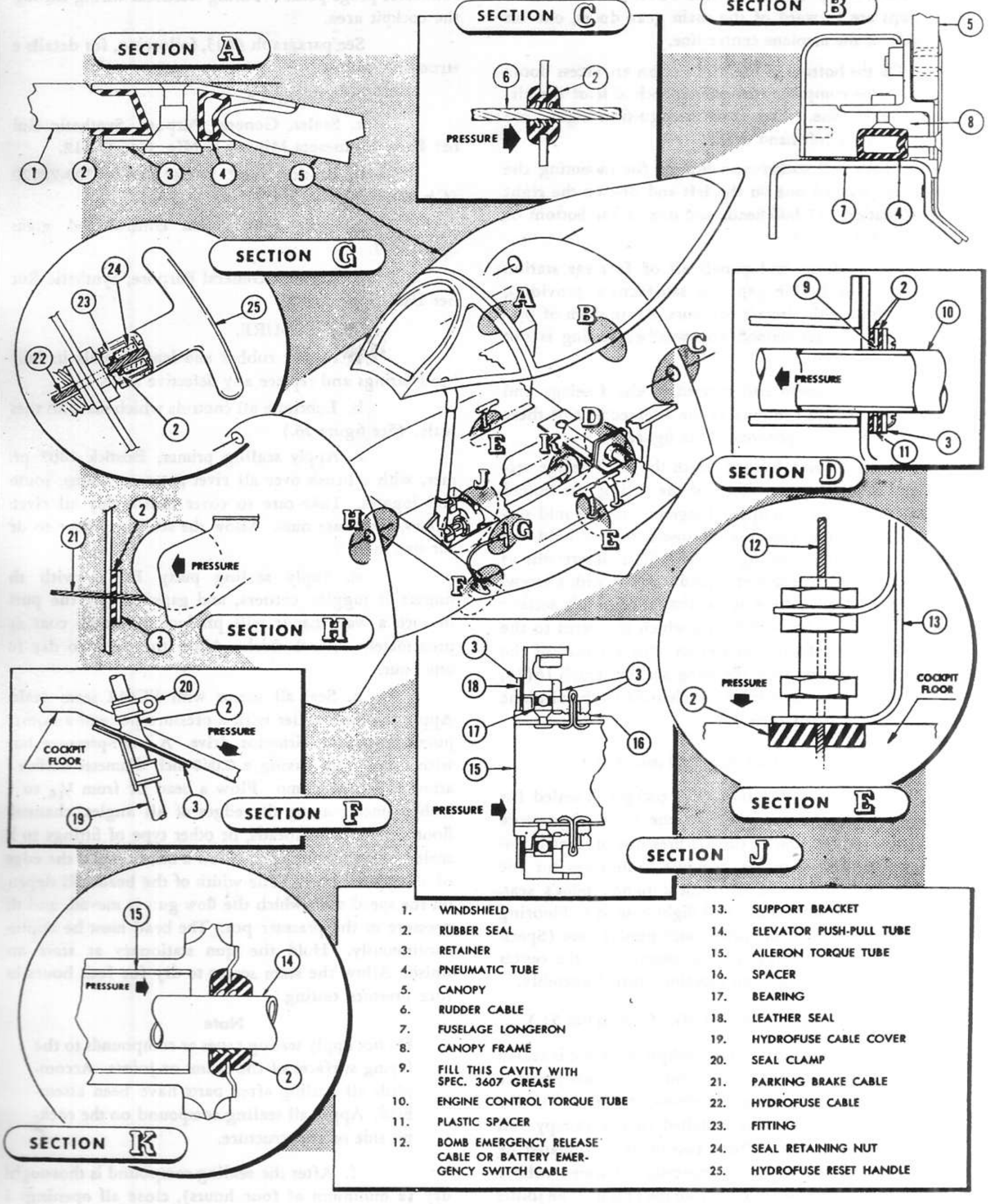



*Figure 51 — Cockpit Pressurization Seals*

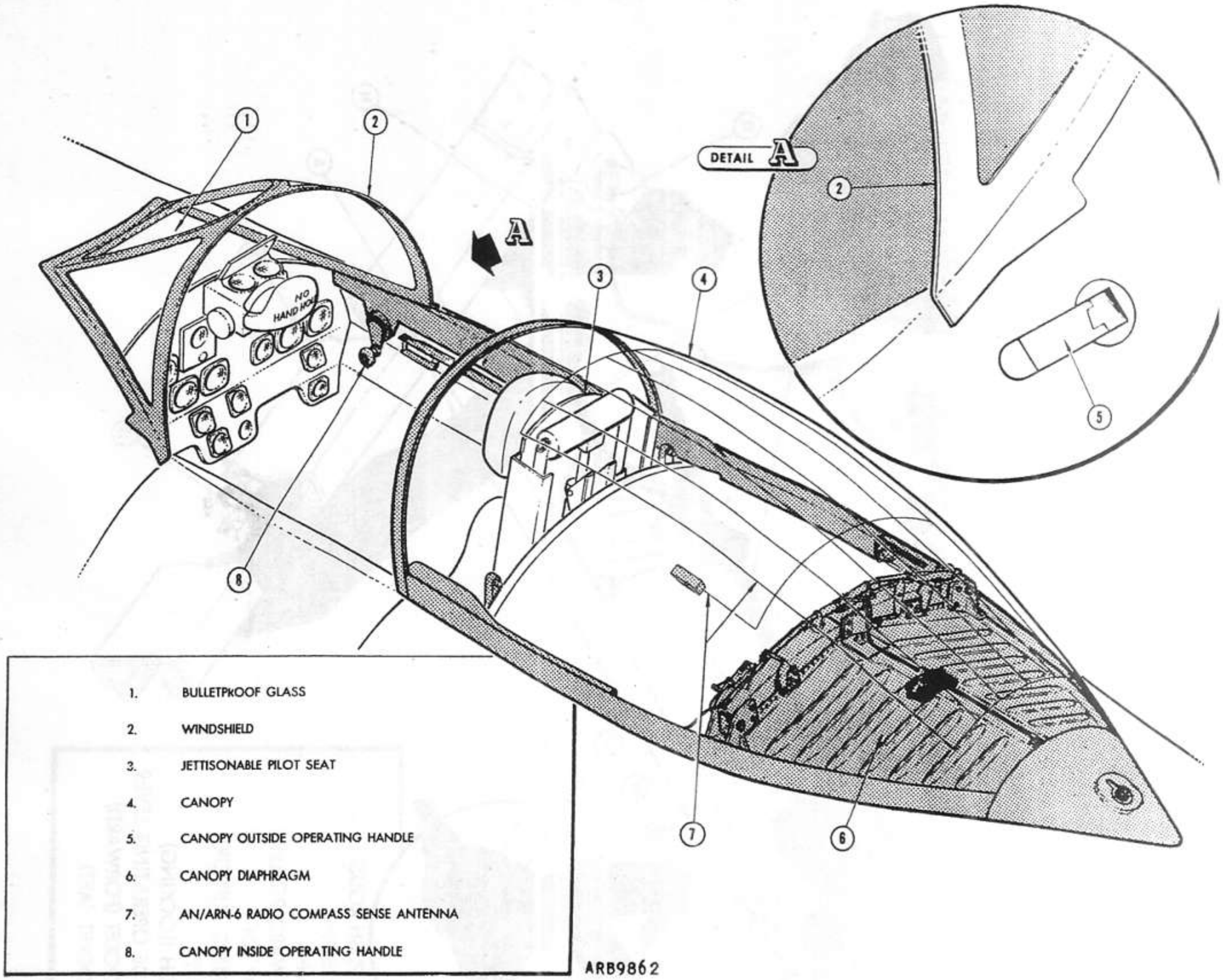



***Figure 52 — Windshield and Canopy***

a manometer to the cockpit and conduct a pressure test. (See paragraph 23*i*, this section.) If pressure test shows leakage in excess of allowable tolerances, locate points of leakage using a solution of mild soap and water. Repair leaks and repeat pressure test.

(3) COCKPIT CANOPY. *(See figures 52, 53, and 57A.)*

(*a*) DESCRIPTION.—The canopy on unmodified airplanes is normally operated by either internal or external hand cranks, and may be jettisoned manually. All airplanes are currently being modified to have electrically operated canopies and explosive removers for jettisoning the canopy. (Refer to Lockheed Service Bulletin F-80/SB-44A.) The electrically controlled canopy may also be operated manually. External normal operating controls are located in a well on the right side of the fuselage just below the aft corner of the windshield. The internal electrical controls are on the cockpit forward right sill, just above the location of the canopy-operating hand crank on unmodified airplanes.

(*b*) MANUALLY OPERATED CANOPY

*1.* REMOVAL.—Do not jettison the canop for normal removal. Remove as follows:

a. Disconnect antenna at the fin and betwee the spring and insulator in the canopy. (See figure 231. Coil and store antenna with the canopy.

b. Open the canopy far enough to disengag the aft support links.

c. Release the forward latches (15, figure 56 by pressing aft on release cams with the fingers. Cam are located under the forward ends of the canopy fram Aft latches are disengaged when the canopy is raisec

d. Lift forward end of the canopy up t clear the windshield, and pull the canopy forward unti the aft track is free from its rollers.

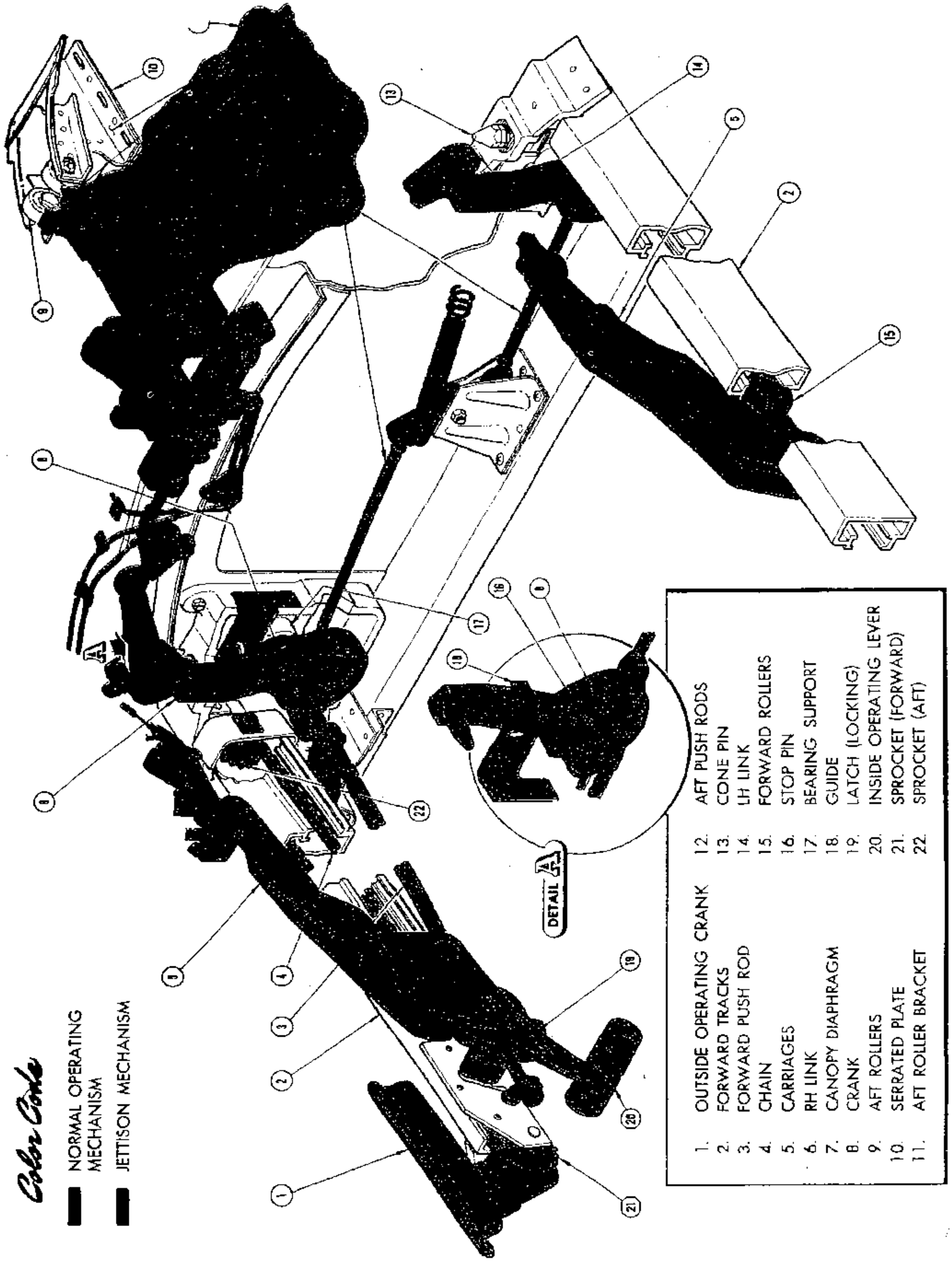
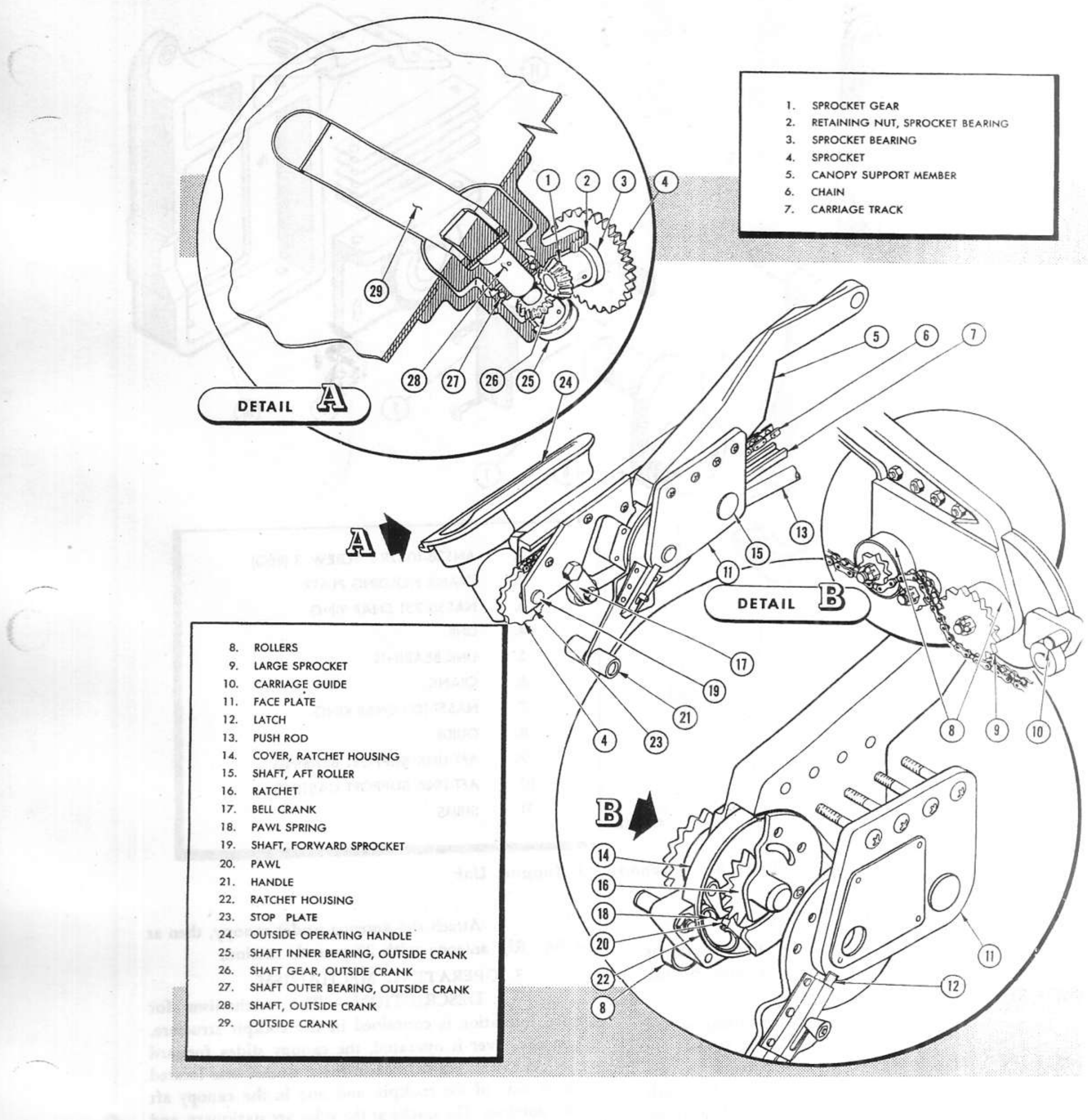
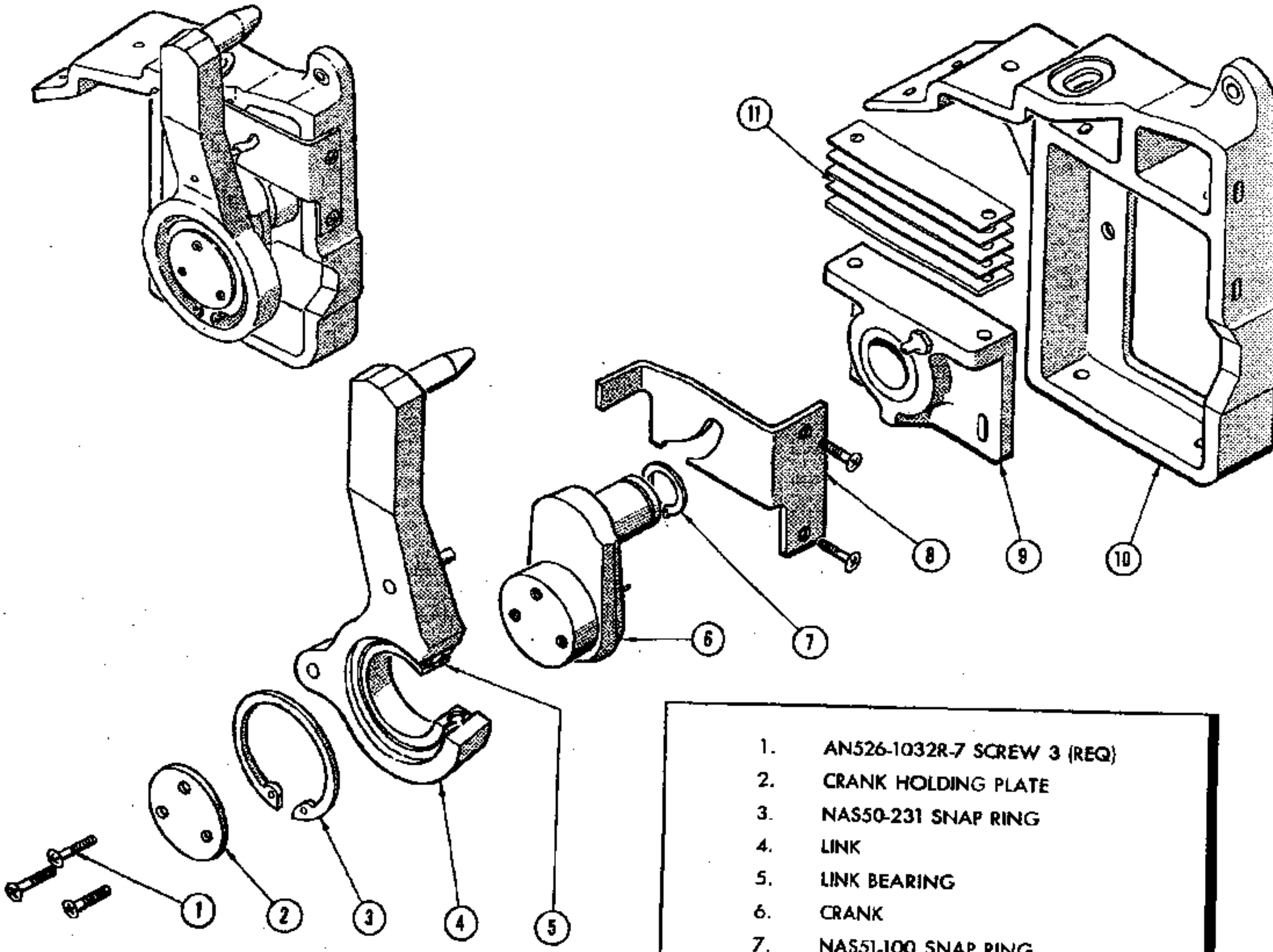



*Figure 53 — Canopy Normal Operating Mechanism*




1. SPROCKET GEAR
2. RETAINING NUT, SPROCKET BEARING
3. SPROCKET BEARING
4. SPROCKET
5. CANOPY SUPPORT MEMBER
6. CHAIN
7. CARRIAGE TRACK
8. ROLLERS
9. LARGE SPROCKET
10. CARRIAGE GUIDE
11. FACE PLATE
12. LATCH
13. PUSH ROD
14. COVER, RATCHET HOUSING
15. SHAFT, AFT ROLLER
16. RATCHET
17. BELL CRANK
18. PAWL SPRING
19. SHAFT, FORWARD SPROCKET
20. PAWL
21. HANDLE
22. RATCHET HOUSING
23. STOP PLATE
24. OUTSIDE OPERATING HANDLE
25. SHAFT INNER BEARING, OUTSIDE CRANK
26. SHAFT GEAR, OUTSIDE CRANK
27. SHAFT OUTER BEARING, OUTSIDE CRANK
28. SHAFT, OUTSIDE CRANK
29. OUTSIDE CRANK

*Figure 54 — Canopy Outside and Inside Operating Handle Mechanism*




1. AN526-1032R-7 SCREW 3 (REQ)
2. CRANK HOLDING PLATE
3. NAS50-231 SNAP RING
4. LINK
5. LINK BEARING
6. CRANK
7. NAS51-100 SNAP RING
8. GUIDE
9. AFT LINK SUPPORT BEARING
10. AFT LINK SUPPORT CASTING
11. SHIMS

*Figure 55 — Canopy Aft Support Link*

2. INSTALLATION. *(See figure 56.)*

a. Engage the canopy aft track with its rollers on the fuselage, and lower the canopy into place over the cockpit.

b. Align forward latches with carriages, and push down on forward end of canopy until latches are engaged. If latches do not engage by pressure on the canopy, insert a screw driver in the hole over the latch and press down until latch "clicks" in engaged position.

**CAUTION**

Make visual check through the hole on inner side of the latch to see that forward release cam is positively engaged with roller of the latch.

c. Attach the antenna under canopy, then at the fin. Rig antenna with 20 pounds tension.

3. OPERATING MECHANISM.

a. DESCRIPTION. — The mechanism for normal operation is contained in the cockpit structure. When the lever is operated, the canopy slides forward or aft on rollers which ride in three tracks, one located on each side of the cockpit, and one in the canopy aft center portion. The tracks at the sides are stationary, and are fastened to the fuselage structure. Rollers for these tracks are attached to the canopy inside operating handle. At the aft end of the canopy, the rollers are attached to the fuselage fuel-tank access panel, and the track is attached to and moves with the canopy. The inside operating handle is on the right side, and moves with the canopy. (See figure 53.) Initial movement of the lever, when opening the canopy, actuates a series of rods and linkage which raises the canopy aft end slightly. The canopy is raised to break the seal and position the aft track for engagement with its rollers. When closing the canopy, a final forward movement of the lever creates a reverse action of the rods and linkage which pulls the canopy down tight against the cockpit structure.

Outside operation is effected by a flush crank which moves the canopy by means of a chain and sprocket mechanism. The crank is spring-loaded and is made accessible by a push-button release. (See figure 54.)

**CAUTION**

When closing the canopy from the outside, move the canopy forward only until it barely engages the windshield frame. Do not attempt to lock the canopy down by use of the outside operating handle.

b. REMOVAL. *(See figures 53 and 54.)*

*(1)* Open the canopy.

*(2)* Release left- and right-hand canopy support carriage from forward jettison latch by pressing aft on the bottom of the forward release cam. Release cams are located under the forward ends of the canopy frame.

*(3)* Remove inside operating handle and mechanism as follows:

(a) Disconnect forward push-rod from canopy-operating forward bell crank.

(b) Remove bolt from aft sprocket, and remove the sprocket.

(c) Remove canopy roller stop plate by removing the bolt which holds the forward bell crank and then removing three screws. Pull plate inboard.

(d) Remove two screws holding the removable section of track, and remove the section.

(e) Remove the lamp located at the forward end of the left-hand track.

(f) Roll canopy support carriage off the track.

(g) Disengage the chain from three sprockets of the support carriage.

*(4)* Remove canopy outside operating handle and mechanism as follows:

(a) Remove safety from sprocket-bearing retaining nut.

(b) Unscrew front sprocket-retainin nut and remove sprocket, shaft, nut, bearing, and gea in one unit.

(c) From the inside of the canopy, re move the snap-ring retainer from the outside-crank shaf

(d) Release outside operating crank.

(e) Lift out crank, shaft, upper shaf bearing, and gear as a unit.

*(5)* Remove balance of canopy normal operating mechanism as follows:

(a) Remove pilot's seat. (See paragrap 22*a*(2), this section.)

(b) Remove armor plate from cockpi rear bulkhead.

(c) Disconnect aft actuating rod fron canopy right-hand aft links.

(d) Unbolt aft bell crank assembly fron its bracket and remove forward push-rod, bell crank and aft actuating rod together.

(e) Remove canopy aft support link a follows (See figure 55):

Disconnect aft push rods from af support links.

Remove guide by unscrewing thre screws.

Remove aft link support bearing b removing two screws through bearing support castin from plate nuts in rear. Remove remaining two bolt and remove bearing.

To remove canopy aft support lin from its support bearing, remove snap ring from af end of link crank.

(f) Detach spring from left aft canop mechanism.

(g) Remove bell crank supportin bracket at center of yoke by unscrewing four screws. Re move bell crank from bracket by removing one bolt.

c. DISASSEMBLY OF CANOPY INSIDI OPERATING HANDLE. *(See figure 54.*

*(1)* Remove four screws from face plat through canopy support member.

*(2)* Remove cotter pin and nut from af roller shaft and remove sprocket, roller, and shaft.

*(3)* Remove face plate, three washers, han dle, and latch assembly in that order.

(4) With a gear puller, remove large sprocket from ratchet shaft. Retain the key.

(5) Remove snap ring from ratchet housing shaft.

(6) Remove ratchet housing from canopy support member. Retain roller and spacer at back of support member.

(7) Remove three screws and remove ratchet housing cover.

(8) Remove springs and pawls.

(9) Remove ratchet.

(10) Remove carriage guide from ratchet housing by removing nut from guide pin on ratchet housing, and remove roller from pin.

d. DISASSEMBLY OF CANOPY AFT SUPPORT LINK. *(See figure 55.)*

(1) Remove three screws attaching crank-holding plate to crank, and remove plate.

(2) Remove crank.

(3) Remove snap ring and take out bearing.

e. ADJUSTMENTS. *(See figure 53)*

(1) AFT TRACK ROLLERS. — Adjust roller bracket forward or aft until forward face of roller is approximately in line with track end plate. This djustment is made with the canopy full forward, but ot locked down. The bracket has slotted holes to per-nit adjustment fore and aft. Tighten the adjustment olts securely after adjustment is complete.

(2) PUSH ROD AND LINKAGE. *(See igure 53.)*—Adjust aft push rods which extend laterally ehind pilot's seat so that left-hand link stop pin is gainst the link support bearing when the right-hand in is against the link support bearing. Adjust the for-ard push rod on the right side of the cockpit so that oth links are held against the stops when the inside erating lever is in the full forward position (canopy cked down). A further check of this adjustment will necessary after additional adjustments have been made.

(3) LINK PIN ALIGNMENT. — With nopy latched to support carriages and engaged with the track rollers, slide the canopy forward until the aft k pins are just ready to engage the aft release ches. Adjust the aft links vertically so that the link s are aligned with the center of the notches in the release latches. Make this adjustment as follows:

(a) Remove the cone pins. Shim the link support bearing so that the cone pins are aligned. Nominal adjustment requires 1/8 inch of shims or one 174736-2 shim and four 174736-3 shims. Adjustment can be made ±1/8 inch by removal or addition of shims. Latch the canopy fully down (linkage against stops).

(b) Check clearance between the canopy frame and cockpit structure. Clearance must not exceed 3/32 inch around entire frame. The canopy must engage the channel in the windshield by at least 0.950 inch measured at the top of the windshield.

(c) If link pins do not align vertically after shimming bearing block, adjust upward travel of the links by shifting the guides.

(4) CONE PINS.—Install the cone pins and adjust fore or aft and vertically to fit the conical holes in the canopy yoke when the canopy is latched down. Tighten the nuts securely after completing the adjustments.

(5) CHAIN. — Regulate tension of the chain so that chain is taut. This adjustment is made by moving the aft idler sprocket forward or aft with mounting bolt through a serrated plate on each side of the sprocket support bracket. The hole for the bolt in the bracket is slotted to allow the serrated plate to move forward or backward.

4. JETTISON OPERATING MECHANISM. *(See figure 56.)*

a. DESCRIPTION.—The canopy may be jettisoned during flight when it is closed, open, or partially open. The mechanism is contained entirely in the canopy and employs five latches, all connected to a spring-loaded jettison trigger mechanism. (See figure 57.) The jettison trigger mechanism supplies the force required for simultaneous operation of all five latches. A lanyard, located on the right side of the cockpit, is pulled to operate the jettison trigger. During jettison operation, four of the latches disengage the canopy from the normal operating mechanism attached to the cockpit structure; the fifth latch, located in the canopy aft portion, disengages the aft track which is also jettisoned.

A ring-shaped operating handle at the canopy aft end can be operated from the outside of the airplane to jettison the canopy in case of emergency while the airplane is on the ground. The handle trips the jettison trigger mechanism in a manner similar to that of the inside jettisoning lever.

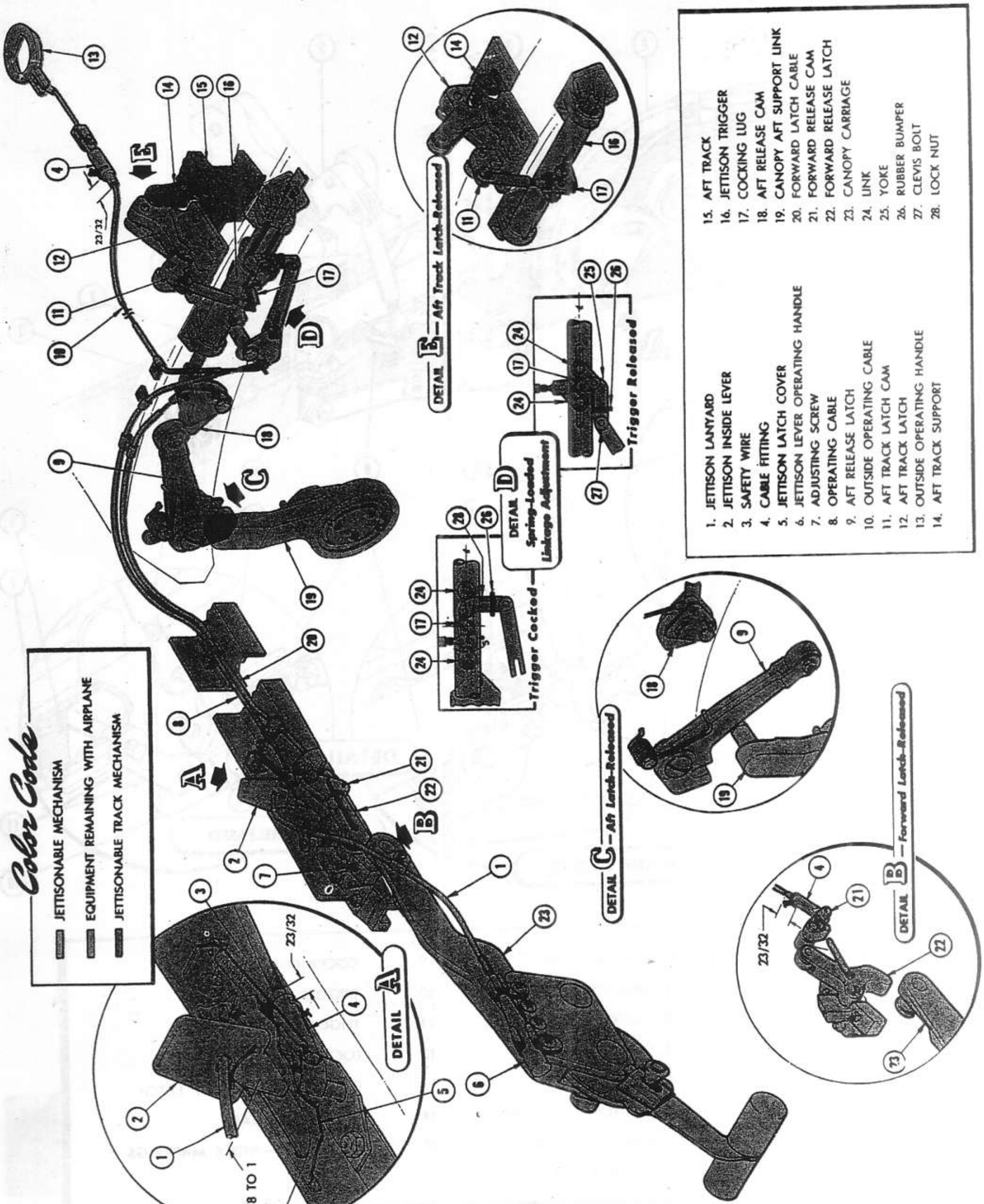



*Figure 56 — Canopy Jettison Mechanism*

b. ADJUSTMENTS. *(See figure 56.)*

*(1)* Adjust length of forward latch cables (20) at cable fitting (4, detail B) so that aft release latch is released by cam (18) before forward release latch is released by cam (21). Safety cable fitting by drilling a No. 50 hole through fitting and cable end, .71 ($^{23}/_{32}$) inch from end, and insert safety wire.

*(2)* Adjust clevis bolt (27) so that links (24) are approximately 5 degrees past dead-center position. End of the clevis bolt rests on bottom of jettison trigger cartridge. Turn bolt clockwise to increase the amount of link travel past dead center. (See detail D.)

*(3)* Adjust length of outside operating cable (10) at aft cable fitting (4) so that it has 0.12 (⅛) inch slack, and safety as in step *(1)* preceding.

*(4)* Adjust length of operating cable (8) so that mechanism trips when dimension between jettison inside lever (2) and forward end of cover slot is between ⅜ and 1.0 inch, measured in the plane of the cover. (See detail A.) This adjustment is made by turning forward cable fitting (4) to shorten or lengthen the cable. Safety jettison lever as shown in detail A, and safety the cable as in step *(1)* preceding.

c. OPERATIONAL CHECK.
*(See figures 56 and 57.)*

*(1)* Release jettison mechanism by inside jettison lever for operational check at periods specified in section X. When releasing, hold the aft track by hand, or secure it so it will not fall from the canopy. If it falls, the canopy must be removed to gain access to the track for installation and cocking of the release latch.

**Note**

Operational check for outside emergency jettisoning is not required, but inspection of outside operating cable (10, figure 56) must be made while the inside mechanism is released. Inspect cable for freedom of movement in guide tube by pulling aft end of cable.

*(2)* Place aft track in position under canopy diaphragm.

*(3)* Insert a screw driver (type used for recessed-head screws, ¼-inch shank) or equivalent tool in cocking lug (17, figure 56) of the jettison trigger mechanism. Cock the mechanism by rotating the lug approximately 90 degrees or until the mechanism has passed over-center position against the stops. While cocking, hold the aft-track latch in the engaged position.

*(4)* Reset release latches by hand to their cocked positions. If the canopy is off the airplane, leave the forward release latches disengaged, as they must be reset when the canopy is being installed. (See paragraph 2 preceding.)

**CAUTION**

Be sure that etched mark on aft release cam (14 and 15, figure 57) is indexed with arrow at roller on aft release latch (13). (See detail A.)

*(c)* ELECTRICALLY OPERATED CANOPY. *(See figure 57A.)*

*1.* REMOVAL.

a. Open canopy, and perform following steps from inside the cockpit:

**CAUTION**

Make certain that ground safety pin is installed in the jettison trigger mechanism.

b. Disconnect "sense" antenna at canopy.

c. Release aft latches by pressing on release lever. Latches may also be released by pulling the ring at aft end of canopy.

**Note**

Do not use lanyard attached to canopy shroud.

d. Release forward latches by pushing forward on forward triggers and pushing carriages away from canopy.

e. Slide canopy to aft end of tracks, and lift it off airplane.

## WARNING

As soon as canopy it off, install cotter pin in safety hole, and tape sear pin in canopy remover.

**Note**

As limit switches are operated by the carriages attached to forward end of canopy, extreme care should be taken when operating actuator motor with canopy removed.

*2.* INSTALLATION.

a. Cock jettison trigger bungee.

b. Be sure sear pin is in place in remover. Remove cotter pin and tape from sear pin.

c. Insert safety pin in jettison trigger.

d. Place canopy on aft tracks, and slide it forward far enough so that forward latches engage carriages.

e. Latch forward carriages to forward end of canopy. Check for vertical play. Any play must be taken out by turning the adjusting screw. Turn screw down tight, then back it off one-half turn.

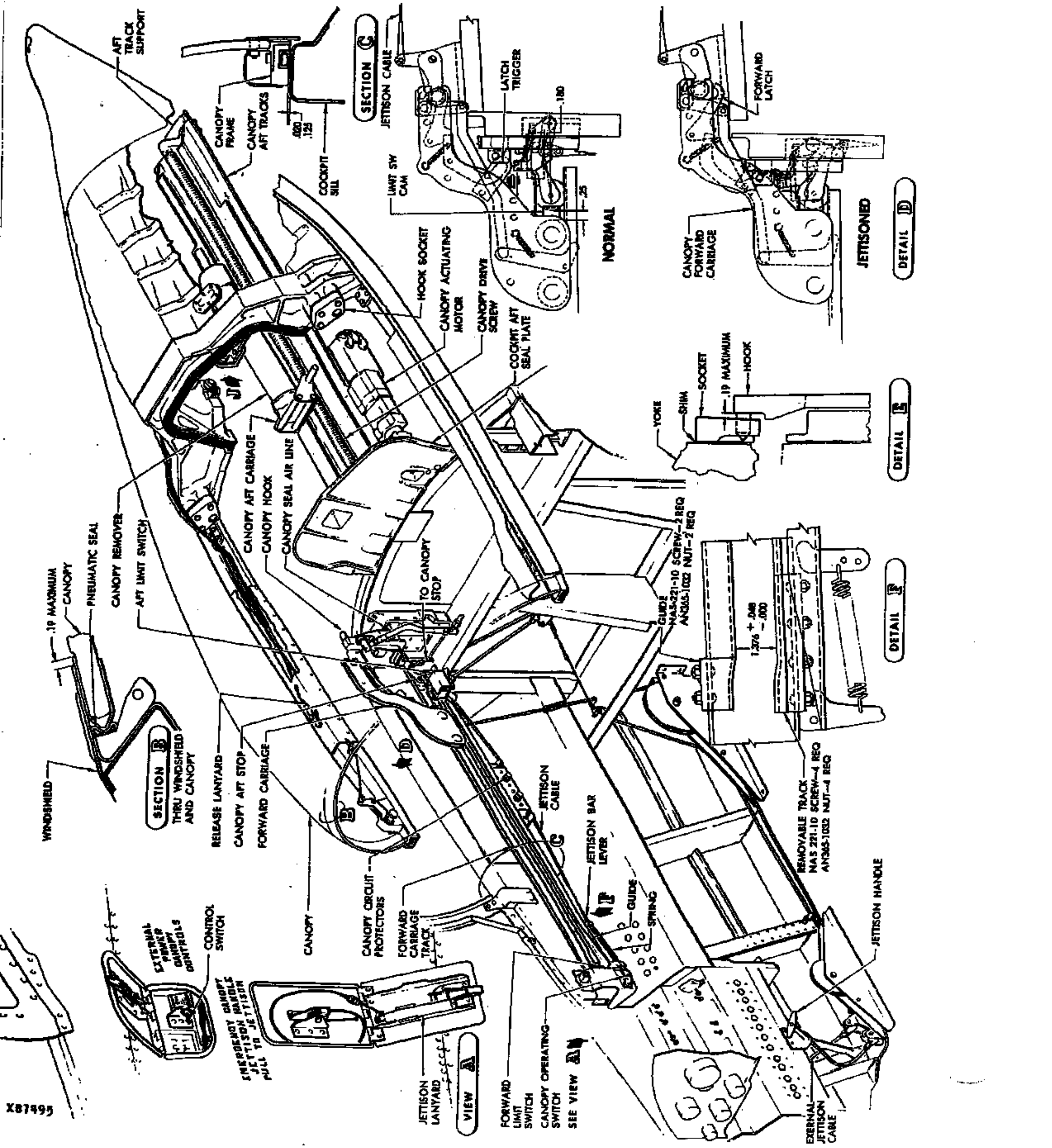



*Figure 57A (Sheet 1 of 3 Sheets)—Canopy Jettison and Electrical Operating Mechanism*

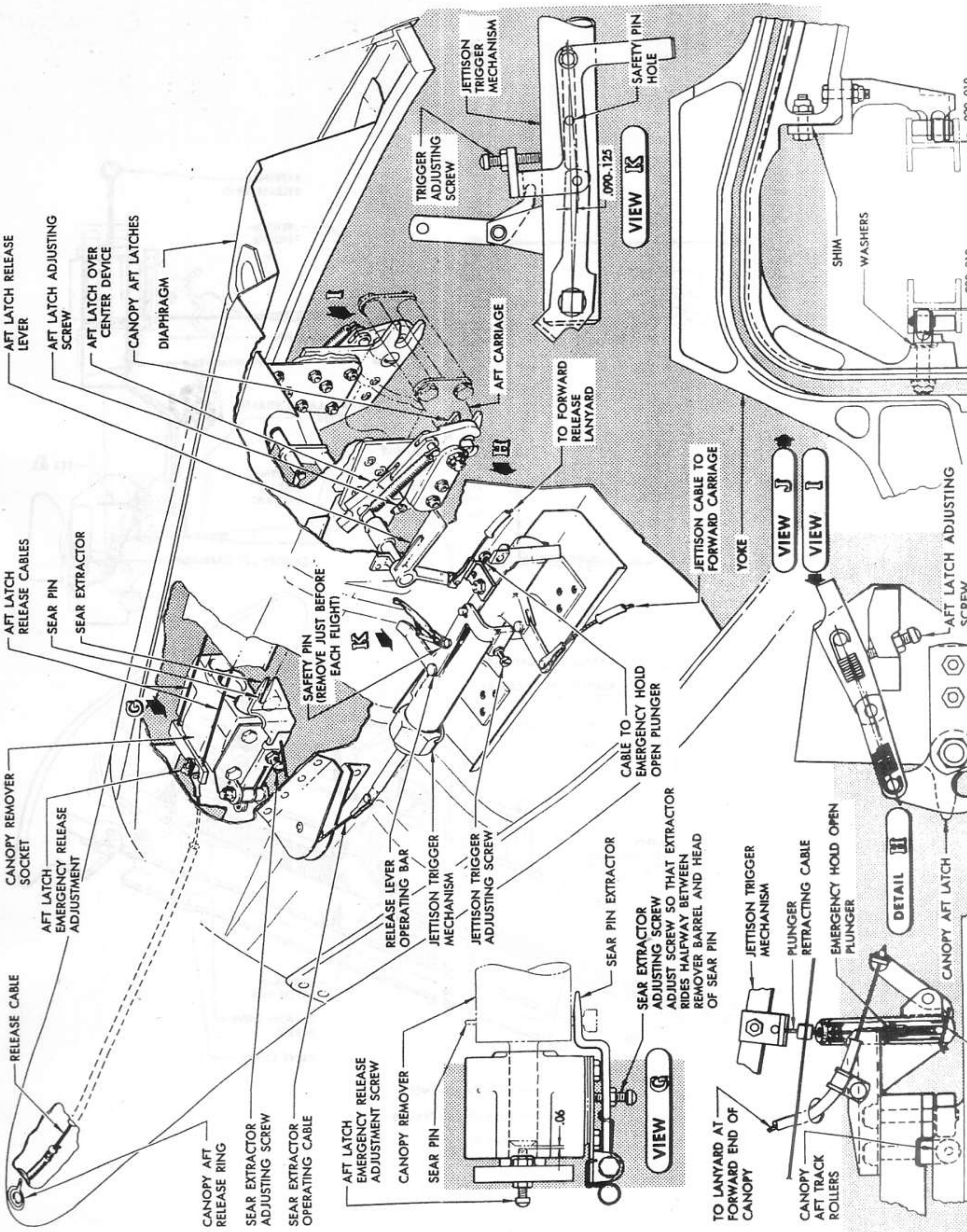



*Figure 57A (Sheet 2 of 3 Sheets) — Canopy Jettison and Electrical Operating Mechanism*

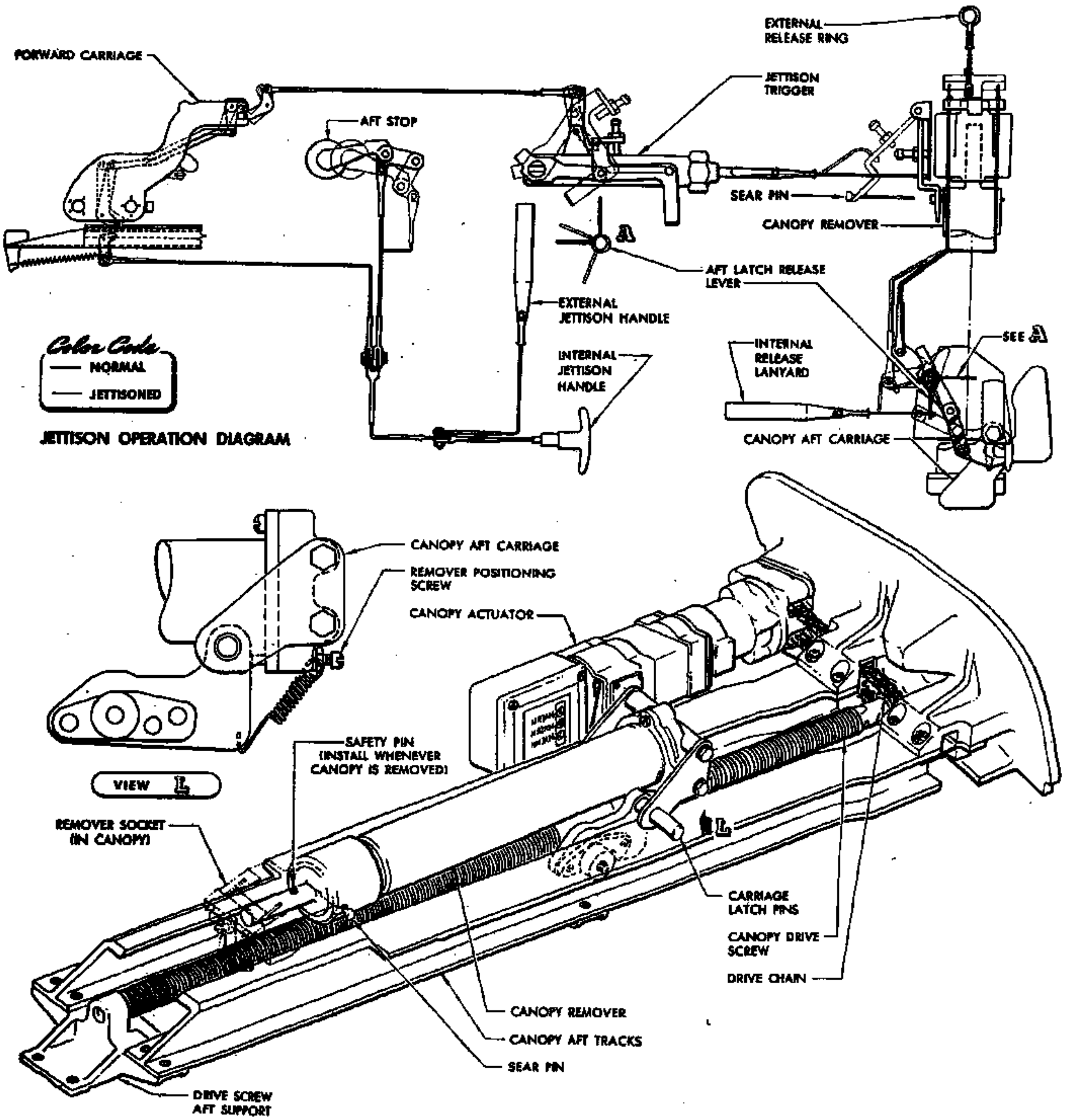



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Figure 57A (Sheet 3 of 3 Sheets) — Canopy Jettison and Electrical Operating Mechanism

f. Engage canopy with aft latches. Guide pin (on end of remover) into socket under canopy diaphragm.

g. Guide sear pin into sear pin extractor.

h. When canopy is fully engaged with rear carriage, push down canopy release lever to close aft carriage latches.

3. OPERATING MECHANISM.
*(See figure 57A.)*

a. DESCRIPTION.—An electrical actuator motor and gear box assembly mounted on the seal plate back of the pilot's head armor is connected by a sprocket chain to a jack-screw drive assembly. This mechanism positively controls the forward or aft position of the canopy. Vertical loads on the canopy are taken through the forward and aft carriages and also, when the canopy is closed, by two canopy hooks above the cockpit aft bulkhead. The aft carriage assembly travels on the drive screw, and is secured by two latches to the canopy. The forward end of the explosive canopy remover is attached to the aft carriage. The forward end of the canopy is secured by latches to the forward carriages. Two momentary contact switches control operation of the canopy. One switch is in the cockpit just below the forward end of the right sill; the other switch is similarly located but is accessible from outside the airplane through an access panel. A limit switch at each end of the right forward carriage track limits canopy travel.

**Note**

Allow one minute cooling period after each complete cycle of canopy operation.

The canopy may be operated manually in case of electrical failure by pulling the manual release lanyard. A hold-open device is provided to lock the canopy in the position. (See T.O. 01-75FJB-39.) It is operated when the internal manual release lanyard is pulled, and engages when the canopy is opened only 19½ inches from the windshield, making an exit from the cockpit difficult. It is possible to jettison the canopy manually after the lanyard has been pulled and the hold-open pin engaged. This is done by pulling the canopy jettison handle, which in this sequence of operation disengages the hold-open pin so that the pilot can push the canopy aft until it falls free from the airplane. To reset the hold-open device necessitates removal of the canopy from the airplane. (See paragraph 3*c*(3)*(c)*1.) Turn canopy over on a sling or similar support, and safety-wire hold-open device lever in place with 0.020 diameter cadmium plated copper wire. Make double turns of the wire through terminal holes. No more than two twists of the wire between terminal holes will be made. (Refer to T. O. No. 1F-80-75.)

**Note**

Do not pull internal release lanyard on ground except in emergency.

The manual operation from outside the airplane is done by pulling the aft latch release ring located at the aft end of the canopy, and pulling back on the canopy.

b. REMOVAL OF OPERATING MECHANISM.

*(1)* Remove canopy. (See paragraph 3*c*(3) *(c)1* preceding.)

**CAUTION**

Be sure to safety canopy remover.

*(2)* From under forward end of canopy aft tracks, remove two screws attaching seal plate to tank cover.

*(3)* Remove four screws attaching track center support to tank cover.

*(4)* Remove four screws attaching track aft support to tank cover.

*(5)* Lift mechanism off tank cover. Seal plate is sealed to tank cover and may stick slightly.

c. INSTALLATION OF OPERATING MECHANISM.

*(1)* Scrape old sealing compound off both seal plate and tank cover. Clean faying surfaces with methyl-ethyl-ketone, Federal Specification TT-M-261.

**CAUTION**

Methyl-ethyl ketone will damage the canopy if it comes in contact with the plastic bubble.

*(2)* Coat bottom of seal plate with sealing compound EC800 manufactured by the Minnesota Mining and Manufacturing Company.

*(3)* Place mechanism on tank cover and install 10 screws removed in steps *(2)*, *(3)*, and *(4)*, paragraph b, preceding.

*(4)* Install canopy. (See paragraph 3*c*(3) *(c)2*, preceding.)

d. REMOVAL OF CANOPY DRIVE SCREW.

*(1)* Remove canopy. (See paragraph 3*c* (3)*(c)1*, preceding.)

**CAUTION**

Be sure to safety the canopy remover.

*(2)* From the canopy aft-track support, remove the four screws that hold it to the fuselage tank support. These screws are in plate nuts.

*(3)* Remove four screws which attach the same support to the aft tracks. Leave support in place to protect canopy drive screw from bending.

*(4)* From the forward side of cockpit aft seal plate, remove nut from forward end of canopy drive screw.

*(5)* Slide drive screw and aft support aft. Sprocket on end of shaft will stay with chain. Retain sprocket and key.

*(6)* To remove actuator motor, remove from forward side of seal plate the three nuts which hold actuator motor in place.

*(7)* Disengage sprocket from chain and pull actuator aft.

*(8)* If chain is to be removed, disengege master link or remove left track.

e. REMOVAL OF FORWARD CARRIAGES.

*(1)* Remove bolts from removable section at forward end of each track.

*(2)* Move carriages forward and slide them off track.

f. INSTALLATION OF FORWARD CARRIAGES.

*(1)* Reverse removal procedure.

*(2)* Check distance between removable section of track and guide. Dimension must be 1.375 (+.048, —.000) inch. Add or remove .016 shims between guide and upper tracks to secure this dimension. (See figure 57A, detail F.)

g. ADJUSTMENTS.

*(1)* Adjust canopy aft track rollers on both sides to clear track by 0.030 (±.010) inch. Add or remove shims between roller support bracket and yoke casting (See figure 57A, view J). AN960-516C washers may be placed under right horizontal roller. Shim as necessary to center canopy over hooks.

*(2)* Add or remove shims under hooks (See figure 57A, detail E) to allow hooks to mate with sockets in canopy. Hooks must bottom on sockets, but must not bind.

*(3)* Add or remove shims between hook socket and canopy yoke to make 0.19 inch maximum clearance between front face of socket and aft face of hook.

*(4)* Rubber shims may be installed in canopy side frame under the pneumatic seal for a distance of not more than 12 inches from the forward end of the canopy. Install shim in a manner similar to installation of the pneumatic seal. (See paragraph 3*c*(3)*(e)* following.)

*(5)* Adjust aft limit switch so that when canopy is full open, there is a maximum of 0.12 inch clearance between the forward carriage aft roller and roller on forward cariage stop. (See figure 57A, detail D.)

*(6)* With canopy adjusted to stop as shown above, adjust striker bolt on canopy forward-latch trigger so that there is 0.25 inch clearance between it and the fitting against which it strikes when canopy is jetisoned.

*(7)* Adjust the over-center device on the aft stop of the forward carriage so that the joint is 0.180 inch over center. (See figure 57A, detail D.)

**Note**

Canopy frame must clear cockpit sills 0.020 to 0.10 inch.

*(8)* Canopy leading-edge channel must engage with windshield until maximum of 0.19 inch of channel is exposed. (See figure 57A, section B.)

*(9)* Particular attention must be given to the fit between the forward edge of the canopy and the windshield. The forward lip of the canopy should engage the rubber seal in the windshield frame in order to maintain sealing. There must not be any severe binding or pressure exerted between the windshield and the canopy. Whenever the canopy is closed, the canopy motor will overload during the last part of the travel. This may be determined by a definite difference in the sound of the motor operation. The overload sound should be of very short duration (one second), since severe overloading will ultimately result in canopy drive chain or sprocket failure.

4. JETTISON MECHANISM. *(See figure 57A.)*—The canopy is jettisoned by an explosive charge, and may be jettisoned from any position by pulling the internal or external jettison handle, unless the internal release lanyard has been pulled.

The external jettison handle is on the right side of the cockpit near the floor, below the canopy switch. The external jettison handle is mounted in a bracket, accessible on the right side of the airplane. The two handles are connected to the same cable which in turn operates two other cables. One cable trips the over-center device on the forward carriage aft stops, and disconnects the canopy seal air line; the other cable operates the jettison bar under the right forward carriage track. This operates, through the carriage, a cable which trips the jettison trigger mechanism. The trigger mechanism, through a cable and a hinged sear extractor lever, pulls the sear pin from the canopy remover, allowing it to fire. At the same time, the jettison trigger strikes a lever disconnecting the aft carriage from the canopy. The trigger mechanism pulls an additional cable which lifts the hold-open device. An emergency disconnect device is built into the canopy remover. The canopy, still connected to the forward carriages, will move aft until the bolt on the forward latch trigger strikes a fitting which permits the forward latches to disconnect.

A red-flagged safety pin is used to safety the jettison trigger mechanism. This pin must be removed prior to flight, and installed upon return of the airplane from flight.

5. CANOPY JETTISON REMOVER. — A standard type M-1 remover is installed to jettison the canopy in an emergency. It is provided with a safety cotter pin, part No. AN380-3-4, which is removed when the remover is installed in the airplane. A lead seal is affixed by a safety wire through a hole drilled in the firing head and the telescoping tube stop.

## WARNING

Loaded removers must be placed in shipping containers for storage, and stored and handled as live ammunition. Any remover showing any evidence of damage, or lacking the lead seal, should be safetied and turned over to the Base Ordnance Officer for disposition.

6. GENERAL MAINTENANCE OF TYPE M-1 REMOVER.

## WARNING

Be certain that safety cotter pin is installed in the head of the remover before sear pin is removed.

Dents, or any other visible damage to the remover are sufficient justification for removal and replacement of the remover. The sear pin must be lubricated with anti-seize compound, Spec AN-G-6A, AF Stock No. 7500-313650. If this is not available, use a mixture of 95% Spec AN-G-15, AF Stock No. 7500-249000 and 5% Spec AN-G-24, AF Stock No. 7500-229200.

7. ADJUSTMENT OF JETTISON MECHANISM. *(See figure 57A.)*

a. Adjust the aft carriage-latch over-center device so that when the latches are closed, an 0.030 feeler gage inserted under the adjusting screw will not open the latches, but an 0.040 feeler gage will open the latches. (See view I.)

b. Adjust the jettison trigger device so that when it is cocked, the center pivot is 0.090 to 0.125 inch past dead center. (See view K.)

c. Adjust set screw at aft end of canopy remover socket to clear canopy remover aft pin by 0.06 inch. (See view G.)

d. Adjust jettison cables so that when jettison handle is pulled, the forward carriage aft stop is actuated first.

e. Adjust sear pin extractor so that extractor fingers ride on sear pin half way between remover barrel and head of sear pin.

8. GROUND CHECK OF JETTISON MECHANISM. *(See figure 57A.)*

## WARNING

When performing ground check, be certain that safety pin is installed in head of remover.

a. Remove canopy. (See paragraph 3*c*(3)*(c)1*, preceding.)

b. Install canopy. Safety cotter pin must be left in head of remover. (See paragraph 3*c*(3)*(c)2*, preceding.)

c. Pull internal jettison handle, making certain that operation complies with step 7d preceding. Check to see that sear pin extractor pulls sear pin clear of remover. If sear pin is not pulled clear, check linkage and cables, readjusting as necessary.

d. Reinstall sear pin in remover, cock jettison trigger bungee, and perform step c using the external jettison handle.

e. Reinstall sear pin in remover, and cock jettison trigger.

f. Remove canopy, and remove safety cotter pin from head of remover.

g. Install canopy, making certain that flagged safety pin is installed in jettison trigger assembly.

## WARNING

Flagged safety pin must be installed in jettison trigger assembly as soon as airplane returns from flight, and removed just prior to flight.

*(d)* CANOPY SEALING. (See figure 51.)—A pneumatic tube seal, inflated by engine air pressure, is installed in the bottom of the frame for sealing between the cockpit structure and the canopy. The seal tubing is a one-piece rectangular section which extends along both sides of the canopy and crosses over at the canopy yoke. At the center of the yoke on the manually operated canopy, and to the right of the seal plate on the electrically operated canopy, an air pressure fitting is provided which mates with a fitting on the seal tube when the canopy is in the closed position. Air pressure is supplied to the seal tube only when the engine is in operation and the canopy is closed. Air is expelled from the manually operated canopy seal when the canopy aft end is raised. Air is expelled from the seal of the electrically operated canopy by means of a solenoid bypass valve in the air line. This bypass valve is operated when the canopy switch is held in either the open or closed position. Another pneumatic tube seal is in the windshield frame along the joint between the windshield and canopy. This tube seal is inflated in the same manner as the canopy seal.

The canopy frame is sealed at all seams, joggles, etc., with EC612 sealing compound and Bostick 1007 primer. (See paragraph (2)*(b)*(3) preceding.) The transparent enclosure is sealed to the frame with $\frac{1}{64}$-inch synthetic rubber strips installed between mating surfaces, and rubber bushings with metal spacers at the screw fastenings.

*(e)* INSTALLATION OF CANOPY PNEUMATIC SEAL.

*1.* Remove canopy and place it upside down on cradle or straps.

*2.* Coat bottom only of seal channel with cement AF Specification 26609. Do not use EC669.

*3.* Coat top of rubber seal with same cement.

*4.* Allow cement to dry until no longer tacky.

*5.* Dampen seal with methyl-ethyl ketone, Specification AN-M-5. This will lubricate seal and facilitate installation.

**CAUTION**

Methyl-ethyl ketone will damage the canopy if it comes in contact with the plastic bubble.

*6.* Install seal air fitting in slot in aft channel.

*7.* Install seal in aft corners. Press seal in place to about four inches away from corners in both directions.

*8.* Place forward ends of seal in position and press firmly in place for about four inches aft.

*9.* Press centers of remaining three loops of seal into channel.

*10.* Work remaining seal into channel.

*11.* Cut three hold-down pieces of S-T aluminum alloy approximately 0.081 inch thick, and long enough to cover the seal in the channel. Hold-down pieces must overlap seal about one inch on each side, and turn over on the forward ends to hold seal at that point. Clamp hold-down pieces in place over seal with "C" clamps every three or four inches.

*12.* Apply 12 to 15 psi air pressure to inside of seal for $1\frac{1}{2}$ hours.

*13.* Remove clamps and hold-down pieces.

*(f)* PRESSURE TESTING.—Refer to paragraph 23*i* this section.

(4) WINDSHIELD. *(See figure 52.)*

*(a)* DESCRIPTION.—The windshield is composed of three panels which are set in $\frac{1}{8}$-inch synthetic sponge rubber, and held in a corrosion-resistant steel frame by corrosion-resistant steel strips. The side panels are $\frac{3}{8}$-inch molded transparent acrylate base plastic. The center panel is $1\frac{1}{2}$-inch, three-ply bulletproof glass. Frame and retaining strips around the side panels are held together by screws and elastic stop nuts so that the edge of the glass and the rubber seal are squeezed between the frame and the retainer to make a pressure-tight joint. The retaining strips around the center panel are held together at the top and bottom by clamp assemblies. A channel in the aft edge of the windshield holds a pneumatic rubber tube which is automatically inflated when the canopy closes. This tube forms the forward pressure seal for the canopy.

*(b)* REMOVAL.

*1.* SIDE PANELS.—Remove screws from retaining strips and lift out the panels.

2. CENTER PANEL.

a. Remove defroster tube by disconnecting it below the windshield and removing one support clip from each side.

b. Remove pneumatic seal tube as follows:

*(1)* Remove windshield-frame attaching angle from aft end of canopy rim.

*(2)* At right end of windshield pneumatic seal, pry plug from hole in top longeron of cockpit.

*(3)* Pull pneumatic tube loose from the aft edge of the windshield. Do not damage the tube.

*(4)* Disconnect the air line under the cockpit top left longeron.

*(5)* Pull pneumatic tube fitting through hole in cockpit left top longeron. Remove pneumatic seal tube.

c. Remove all screws from windshield frame which go through mid section structure. Retain flush nuts on inside.

d. Lift windshield off airplane.

e. Remove strap from outside top of windshield by removing six screws.

f. Remove one bolt at top center of bullet-proof glass, and two bolts at bottom center.

g. Separate the two halves of the frame, being careful not to damage the rubber seal. Remove the bullet-proof glass.

*(c)* INSTALLATION.

*1.* SIDE PANEL.

**Note**

Trim side panel to fit in frame prior to installation.

a. Cement sealing strips to edges of plastic.

*(1)* Clean surfaces to be cemented. Be sure to remove all traces of grease, oil, or other foreign matter.

*(2)* Roughen all contact surfaces with emery cloth.

*(3)* Clean roughened surfaces with aromatic naphtha, Federal Specification TT-N-97, and allow to dry thoroughly.

*(4)* Spray or brush one thin coat (0.010 inch) of cement (Minnesota Mining and Manufacturing Co. EC-669; Lockheed Aircraft Corp. Specification 1-897) on both surfaces and allow cement to dry to a "tacky" condition.

*(5)* Bring tacky surfaces together and apply pressure with a hand roller. Be sure there are no air bubbles under the sealing strip, and that strip is free from wrinkles.

b. Push top edge of panel into the frame, and position the lower and aft edges. Tighten screws in the retaining strips.

**Note**

Be sure pneumatic tube is in place in the channel at aft edge of the windshield glass.

2. CENTER PANEL.

a. Cement sealing strips to edges of the glass. (See paragraph *(c)1*, preceding.)

b. Place glass in the frame. Be sure that 1/4 x 1/2 x 1.38-inch synthetic rubber seal is in place under extreme forward edge of glass.

c. Place 1/32-inch synthetic seals between mating surfaces of clamps, and reinstall bolts through the clamps.

d. Install the windshield frame on airplane.

e. Seal metal-to-metal joint between frame and fuselage with sealing compounds as directed in paragraph (3)*(d)*, preceding.

3. PNEUMATIC TUBE SEAL.

a. Install air fitting through hole in cockpit top left longeron and connect it to air line directly under the hole.

b. Press pneumatic tube into aft edge of windshield. If necessary to hold it in place, use rubber cement sparingly.

c. Press end fitting through hole in top right longeron.

d. Install angle brackets that cover ends of the pneumatic tube.

*(d)* PRESSURE TEST.—Refer to paragraph 23*i*, this section.

(5) MAINTENANCE OF PLASTIC AND GLASS.

*(a)* CLEANING.—Clean glass and plastic panels with soap and water applied with the bare hands or with a grit-free soft cloth, chamois, or sponge. Use kerosene, Federal Specification VV-K-211, or dry cleaning solvent, Federal Specification P-S-661, to remove grease or oil. Do not use acetone, benzene, lacquer thinner, jet engine fuels, or window-cleaning solvents on plastic, as these chemicals will soften or craze the surface. Never clean a dry panel with a dry cloth, as this tends to scratch the surface, and builds up an electrostatic charge which will attract dust particles. After any cleaning operation, blot the panel with a clean damp chamois to neutralize any such charge.

*(b)* REMOVAL OF SCRATCHES FROM PLASTIC.

**WARNING**

Replace panel when any nicks, cracks or crazing are present.

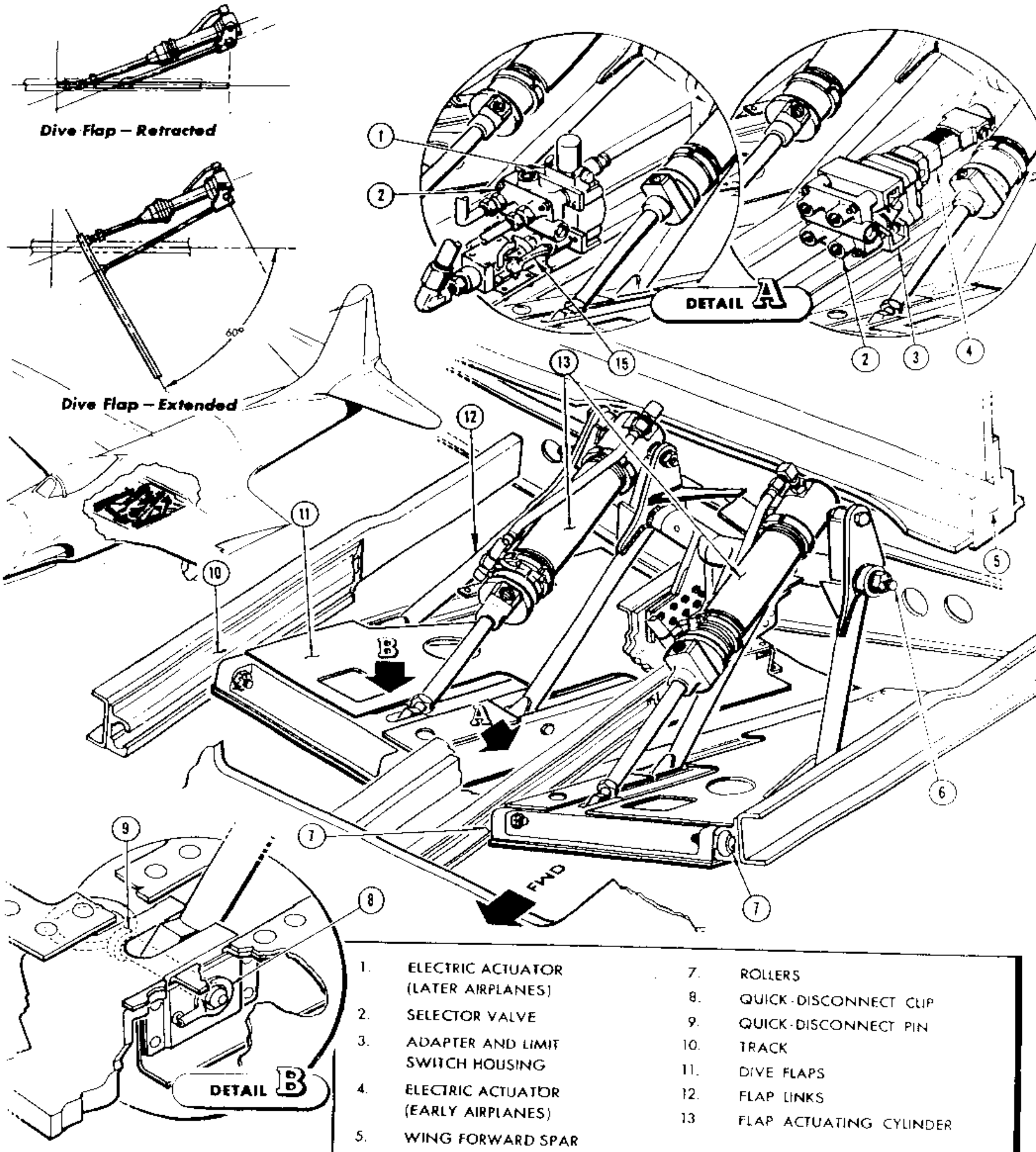
**Note**

Scratches may be buffed out only if they penetrate to a depth of less than 1/32 inch. If scratches are deeper than 1/32 inch, replace the panel.

*1.* Clean all dirt, grease, or foreign matter from the panel.

2. Sand area around scratch with coarse wet sandpaper (No. 280 or No. 320). Work deep scratches out over a large area to reduce distortion. Sand with light pressure to avoid burning plastic and to avoid scratches as deep or deeper than original. Wipe surface clean.

3. Finish-sand the surface with fine wet sandpaper (No. 400). Clean the surface.




| | | | |
|---|---|---|---|
| 1. | ELECTRIC ACTUATOR (LATER AIRPLANES) | 7. | ROLLERS |
| 2. | SELECTOR VALVE | 8. | QUICK-DISCONNECT CLIP |
| 3. | ADAPTER AND LIMIT SWITCH HOUSING | 9. | QUICK-DISCONNECT PIN |
| 4. | ELECTRIC ACTUATOR (EARLY AIRPLANES) | 10. | TRACK |
| 5. | WING FORWARD SPAR | 11. | DIVE FLAPS |
| 6. | AXLE | 12. | FLAP LINKS |
| | | 13 | FLAP ACTUATING CYLINDER |
| | | 15. | DIVE FLAP SHUT-OFF VALVE |

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*Figure 58 — Dive Flap Installation*

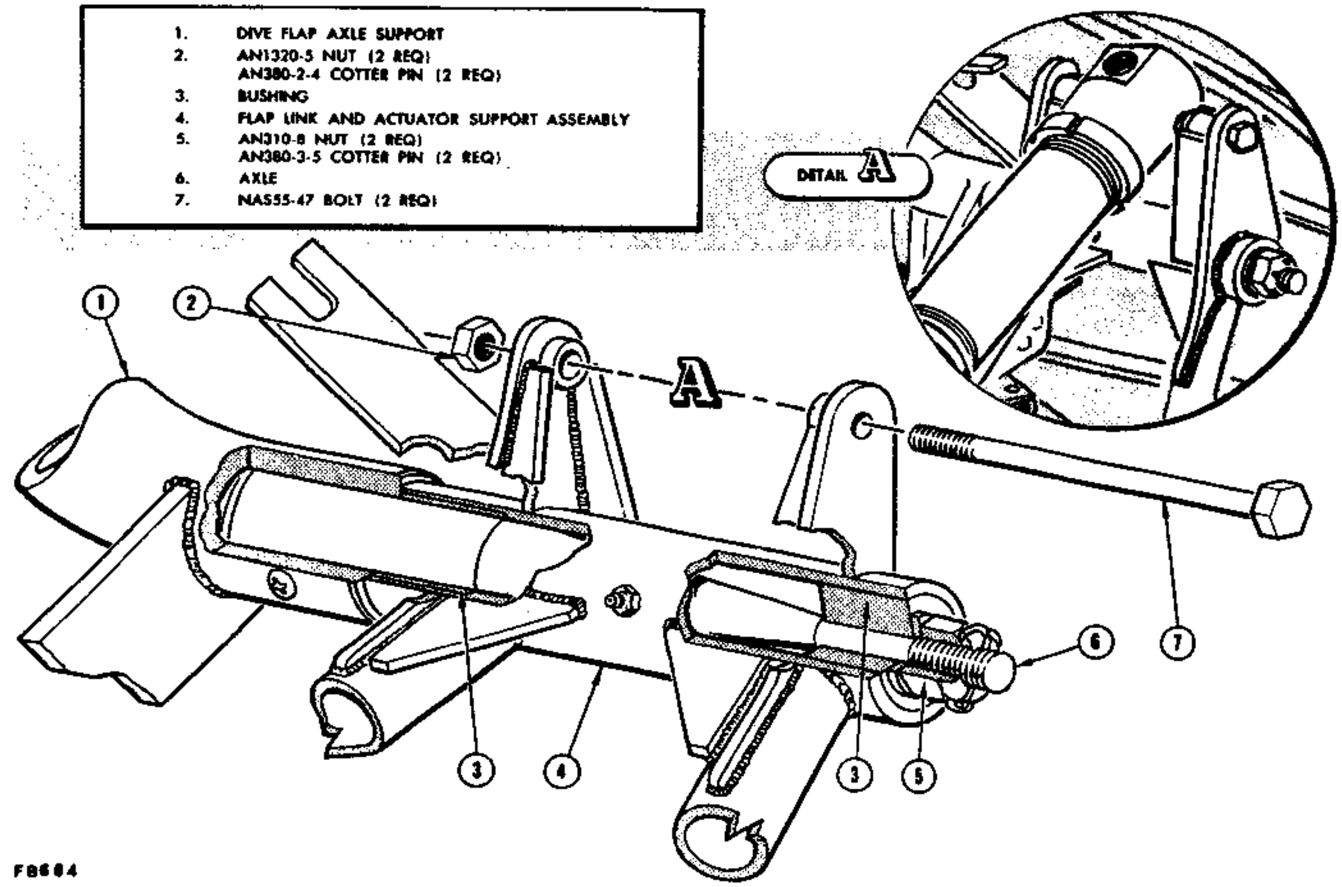



*Figure 59 — Dive Flap Axle Assembly*

*4.* Buff the sanded area with a cotton buffing wheel and buffing rouge. Keep the wheel moving over the surface to avoid burning the plastic or causing ridges. Whenever hand buffing is required, apply a small quantity of rouge to the plastic surface and rub with a clean soft cloth, preferably at right angles to the scratches. Clean off all buffing rouge.

*5.* Repeat the buffing procedure using a finer rouge if condition of surface requires it.

*6.* Clean the surface thoroughly and allow it to dry.

*7.* Apply a coat of paste wax and polish with a soft cloth.

(6) DIVE RECOVERY FLAPS. *(See figure 58.)*

*(a)* DESCRIPTION.—Two hydraulically actuated dive flaps are located one on each side of the airplane center line, between fuselage stations 163.38 and 190.5. The forward end of each flap pivots on rollers which run in tracks. Each flap is actuated by a hydraulic cylinder attached near the flap rollers. A combination link and actuator support is mounted on the dive-flap axle assembly. This support is mounted on a bathtub fitting in the lower longeron at the wing station 0 forward attaching point. (See figure 59.) The upper end of the flap-link and actuating-cylinder support has a bolt which passes through the end-cap bushings and mounts the actuating cylinder. (See figure 172.) The lower ends of the flap links are attached to the door about midway between the forward and aft ends. Access to the flap actuating mechanism is through the opening made by the flaps.

For hydraulic information on the dive-flap actuating cylinder, see paragraph 16*g*(5), this section.

## WARNING

When using the flap opening for access to the hydraulic compartment, shut off the hydraulic pressure to the dive-flap selector valve. Early airplanes do not have the shut-off valve. Accidental operation of flaps may cause injury to personnel.

*(b)* OPERATION. — The dive flaps are controlled by a switch in the cockpit, on the left side behind the throttle lever. The switch has only two positions, "UP," and "DOWN." The switch operates an

electric actuator, which in turn operates the hydraulic selector valve. (See figure 58.) When the flaps are being extended, the actuating-cylinder piston retracts, pulling aft on the forward ends of the flaps. The flap links are attached approximately two-thirds of the way down the flap, and so force the aft end of the flap down. The flap-link and actuating-cylinder support rotates around the axle (figure 59) and as the actuating cylinder pulls back on the front end of the dive flap, this rotation tips the cylinder forward. Retraction of the flaps is a reversal of the extension.

For information on the electrical actuator, see paragraph 17z, this section.

*(c)* REMOVAL. *(See figures 58 and 59.)*

*1.* Extend the dive flaps, and remove bolts from aft flap links at the flap.

*2.* Remove quick-disconnect pin from flap actuating cylinder arm at flap by pressing lever on quick-disconnect clip.

*3.* Slide flap aft until rollers disengage track.

*4.* To remove actuating cylinder, proceed as follows:

a. Relieve hydraulic pressure in the system by operating the aileron booster.

b. Disconnect and immediately cap all hydraulic lines at the actuator.

c. Remove from the actuator support the bolt, nut, and cotter pin which pass through the flap actuator.

*5.* To remove flap link and actuator support assemblies, remove nut and cotter pin from axle and slide the assemblies outboard off axle. Links must be rotated until they are inside the fuselage in order to clear the opening made by the dive flaps.

*6.* Remove the dive flap axle only if replacement is necessary. Remove one bolt from each axle. Remove axle.

*7.* Remove dive flap axle support by removing 16 bolts from the bathtub fitting; remove support and replace bolts.

*(d)* CLEANING AND INSPECTION.

*1.* Inspect flaps for cracks in skin, and distorted contour.

*2.* Inspect flap tracks for warping and cracks. See that the tracks do not contain dirt or foreign matter. Clean with unleaded gasoline.

**Note**

Do not lubricate flap tracks with grease or oil as these lubricants will collect dirt and grit.

*3.* Inspect welds on flap-link and dive-flap support assemblies for cracks. Inspect bushings for wear.

*4.* Inspect all bolts for tightness. (See "Wrench Torque Table" in section IX.)

*5.* Inspect fuselage lower longeron near actuating mechanism support and near tracks for possible cracks.

*(e)* ADJUSTMENT. *(See figure 172.)*

*1.* Remove one flap. (See paragraph 3c(6)(c).)

*2.* Extend flap to full open position and check angle of travel. If angle of travel is within dimensions given on figure 58, no further adjustment is necessary. If angle of travel is not within dimensions, proceed as follows:

Remove pip pin that attaches piston rod terminal to flap.

Loosen jam nut on piston rod terminal.

Adjust terminal until it mates with hole in flap when flap is in proper position.

*3.* Push cylinder up inside fuselage and extend piston hydraulically until piston is bottomed.

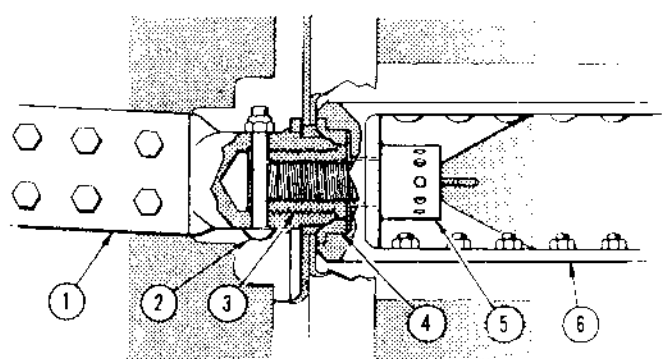
*4.* Hold flap up flush with fuselage contour and adjust cylinder forward end cap until hole in terminal mates with hole in flap.

*5.* Attach piston rod terminal to flap with pip pin. Tighten jam nut on piston rod terminal.

*6.* Adjust other flap in the same manner.

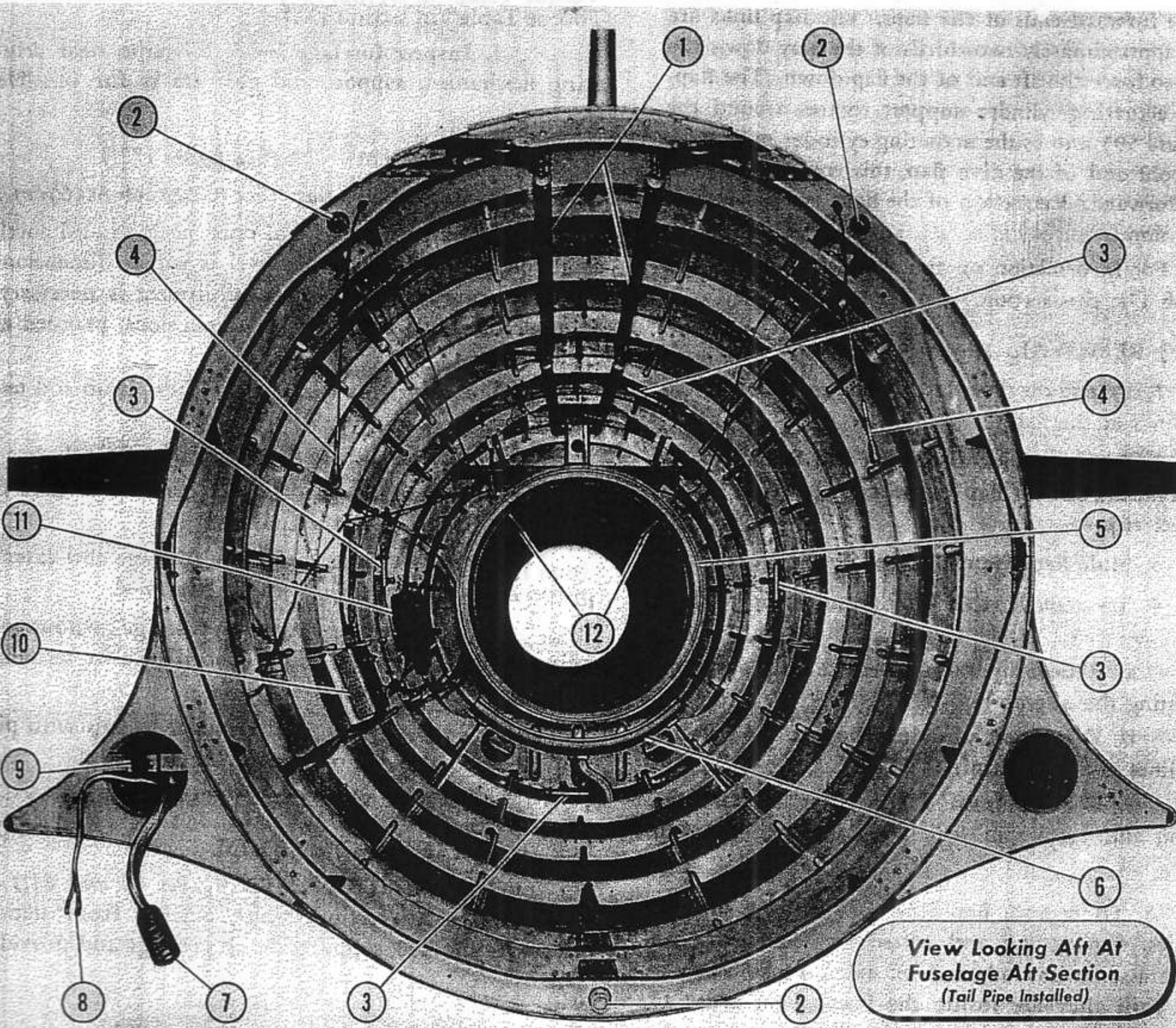
*d.* FUSELAGE AFT SECTION.

(1) DESCRIPTION. *(See figures 60 and 61.)* — The fuselage aft section, which extends from station 277 to station 430, supports the empennage and provides




1. ATTACHMENT FITTING
2. INSERT LOCKING SCREW
3. ATTACHMENT FITTING INSERT NUT
4. BATHTUB FITTING INSERT
5. ATTACHMENT BOLT
6. BATHTUB ATTACHMENT FITTING

*Figure 60 — Aft Section to Mid Section Attachment*




| | |
|---|---|
| 1. ELEVATOR PUSH RODS | 7. AFT SECTION ELECTRICAL DISCONNECT PLUG |
| 2. AFT SECTION ATTACHING POINTS | 8. TAIL PIPE THERMOCOUPLE DISCONNECT |
| 3. FIRE WARNING THERMAL SWITCHES | 9. PITOT PRESSURE LINE DISCONNECT |
| 4. RUDDER CABLES | 10. ELEVATOR TAB RHEOSTATS |
| 5. TAIL PIPE | 11. ELEVATOR TAB ACTUATOR |
| 6. TAIL PIPE SCUPPER | 12. THERMOCOUPLES |

*Figure 61 — Interior of Aft Section*

mounting for the aft end of the engine tail pipe. By removing the fuselage aft section, access is gained for removal of the engine and tail pipe. The internal structure is similar to that of the mid section, being mainly bulkhead rings and stringers. Three fittings on the forward end of this section attach with bolts to mating fittings on the fuselage mid section. The attaching bolts with eight tapered shear pins form the aft section to mid section attachment. Four fittings, two at station 376 bulkhead ring and two at station 400 bulkhead ring, provide attachment for the empennage. A compartment for the remote compass transmitter is located in the bottom, between stations 352 and 364. The elevator tab actuator is mounted on a shelf on the right side between fuselage stations 337 and 352, and is connected to the tab jack screws with a flexible drive. (See figure 41.) A tail pipe joint scupper is installed to drain overboard any fuel leakage from this joint. (See figure 97.) A fire warning system is provided in the fuselage aft section which consists of seven thermal switches connected to a red indicator light on the instrument sub-panel. For electrical information on this system, see paragraph 17*aa*, this section. Access to the interior of the aft section is gained by removing it from the mid section.

(2) REMOVAL.—See paragraph 6*e*, this section.

(3) INSPECTION AND REPLACEMENT.

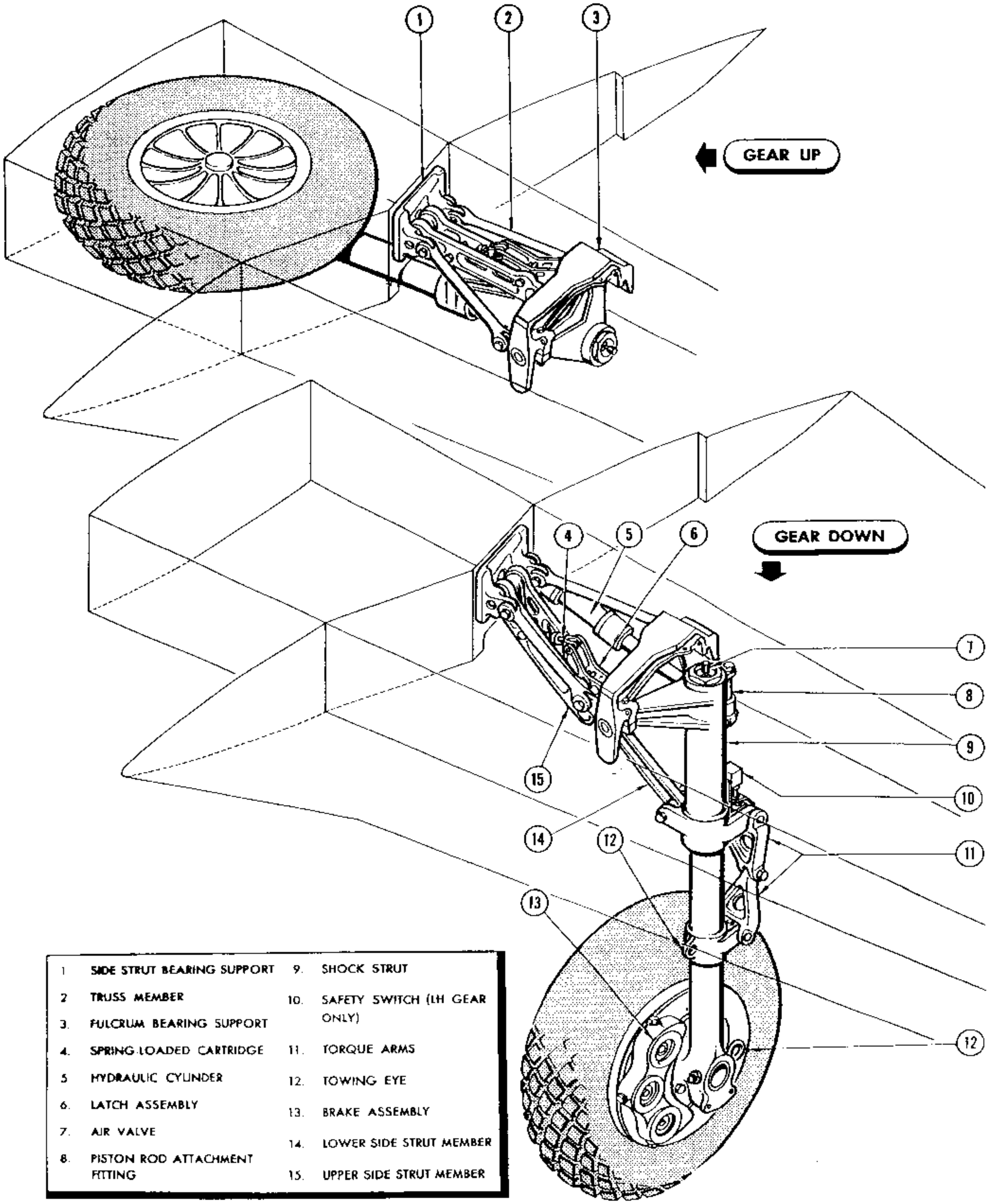
*(a)* Inspect the skin for burns. Annealed skin must be replaced.

*(b)* Inspect engine seal canted bulkhead for dents. This bulkhead must be smooth, as it forms part of the seal for the engine compartment.

*(c)* Inspect the attachment fitting insert nut and the attachment fitting (figure 60) as outlined under Fuselage in section X.

(4) INSTALLATION. — See paragraph 6*f*, this section.

(5) OPERATIONAL CHECK.—See paragraph 6*f*, this section.




| | | | |
|---|---|---|---|
| 1. | SIDE STRUT BEARING SUPPORT | 9. | SHOCK STRUT |
| 2. | TRUSS MEMBER | 10. | SAFETY SWITCH (LH GEAR ONLY) |
| 3. | FULCRUM BEARING SUPPORT | 11. | TORQUE ARMS |
| 4. | SPRING-LOADED CARTRIDGE | 12. | TOWING EYE |
| 5. | HYDRAULIC CYLINDER | 13. | BRAKE ASSEMBLY |
| 6. | LATCH ASSEMBLY | 14. | LOWER SIDE STRUT MEMBER |
| 7. | AIR VALVE | 15. | UPPER SIDE STRUT MEMBER |
| 8. | PISTON ROD ATTACHMENT FITTING | | |

*Figure 62 — Main Alighting Gear*

## 4. ALIGHTING GEAR.

*a.* GENERAL.—The airplane is equipped with hydraulically actuated fully retractable tricycle alighting gear. A single control on the left side of the cockpit provides control of the gear. The two main gears retract inboard into the wing, and the nose gear retracts aft into the fuselage mid section. When retracted, all gears are enclosed by flush doors, which are linked mechanically and hydraulically to the gears. Mechanical down locks are installed in each gear, and a spring-loaded hydraulically operated uplock is installed on the nose gear only. The heavily constructed enclosure doors serve to lock the main gears in the up position.

An emergency extension system operated from a hydraulic hand pump and controlled by a valve, is also provided. The valve and pump are located on the right side of the cockpit.

Three electrically operated safety devices are employed for alighting gear operation: a lock on the cockpit control lever, a green and a red indicator light on the instrument panel, and a warning horn in the cockpit.

For detailed information on hydraulic units and electrical systems which are related to the alighting gear, refer to paragraphs 16 and 17, this section, respectively.

*b.* MAIN ALIGHTING GEAR. *(See figure 62.)*

(1) GENERAL DESCRIPTION. — Each main alighting gear consists of an air-oil shock strut assembly, a side strut assembly with down lock mechanism, a hydraulic actuating cylinder, two torque arms, and a wheel and brake assembly. The gear is mounted by means of a fulcrum which is made integral with the shock strut cylinder. The fulcrum pivots in a bearing support attached to the wing structure. The lower side-strut member is connected to a crank and bearing support bolted to the wing structure at a point inboard from the fulcrum. Two truss members interconnect the fulcrum bearing support and the side-strut bearing supports to form a rigid structural assembly. The hydraulic actuating cylinder is connected between a fitting on the strut, just below the fulcrum, and a crank assembly on which the upper side strut is pivoted. The torque arms are connected between the shock-strut cylinder and piston to maintain alignment of these two units.

(2) OPERATION. When the alighting gear control lever in the cockpit is placed in the "UP" position, hydraulic pressure in the cylinder moves the piston rod inward. During initial movement of the piston rod, the gear does not move, as the side struts are on dead center. Instead, the force is transformed into rotation of the crank connected to the other end of the cylinder. The crank releases the down lock mechanism. After the down lock is released, additional force applied by the crank breaks the side struts from dead-center position, thus permitting retraction of the gear.

For further details on operation of the down lock, refer to paragraph *d*(2) following.

(3) REMOVAL AND DISASSEMBLY.- Special tools required: Spanner wrench No. S-32550.

*(a)* Jack airplane. (See section III, paragraph 2*c*.)

*(b)* If desired, remove the wheel assembly. (See paragraph 5*b*(2), this section.)

*(c)* Disconnect outer door segment at door actuator rod attached to shock strut. (See figure 63.)

*(d)* Relieve hydraulic system pressure by operating the aileron booster.

*(e)* Disconnect hydraulic lines at hydraulic cylinder. Remove cylinder by disconnecting piston rod fitting from shock strut and detaching upper cylinder end at crank assembly.

*(f)* Disconnect and immediately cap swing joint fitting of brake line at fulcrum.

*(g)* Disconnect electrical wiring leading to switches.

*(h)* Remove complete side strut assembly as follows:

*1.* Disconnect lower side strut members at shock strut.

*2.* Disconnect upper side strut member by removing bolt which extends through the arm, and pulling crank assembly aft. (See figure 64.)

**Note**

Side strut arm and washers will fall free as crank assembly is removed. Keep washers for reinstallation.

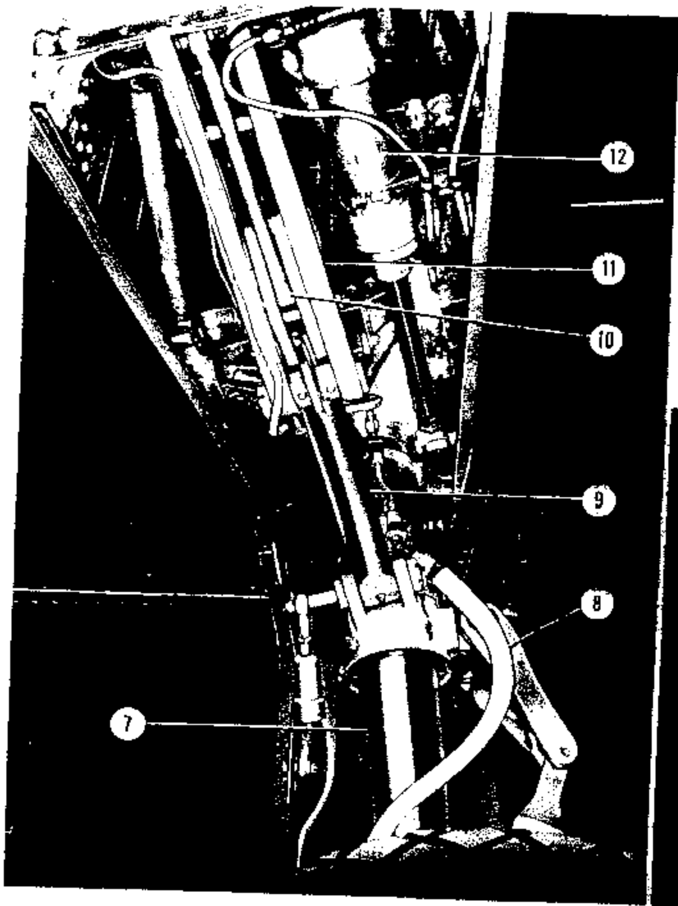
*(i)* Support gear and remove four bolts in bearing caps of fulcrum. (See figure 65.)

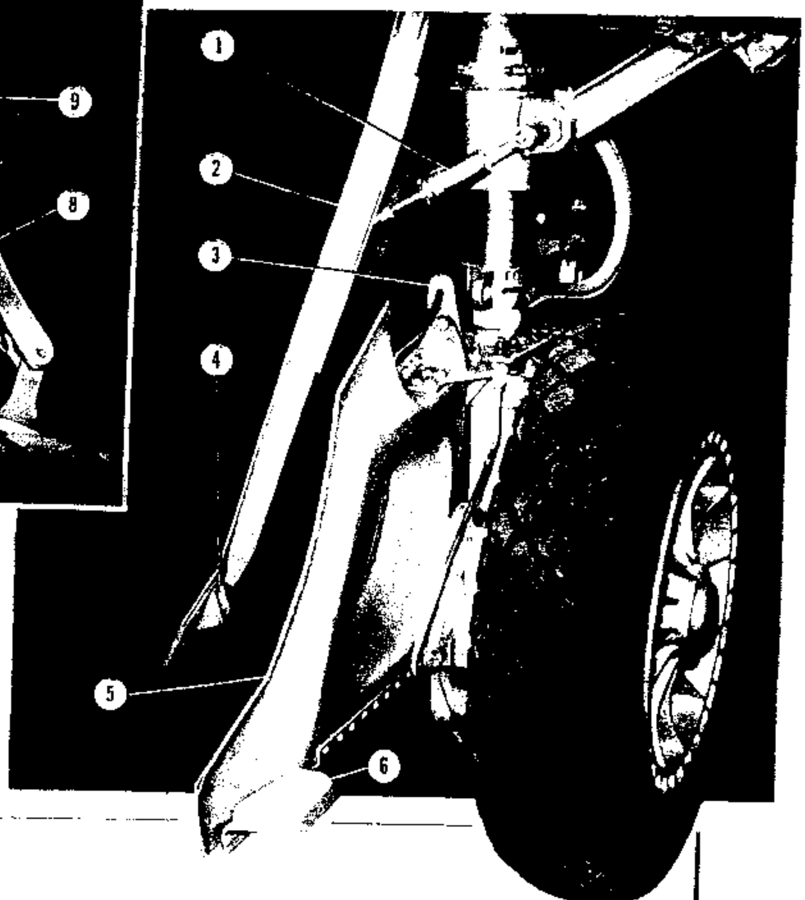
**Note**

Bearing caps and fulcrum assembly are line reamed and must be attached together upon disassembly.

*(j)* Remove bearing caps and lower the gear clear of the airplane.

*(k)* Disassemble bearings from fulcrum by removing lock ring, pin, and nut. Use spanner wrench No. S-32550 (figure 28) for removal of nut.




1. DOOR ACTUATOR ROD
2. OUTER DOOR SEGMENT
3. DOOR CONNECTOR HOOK
4. DOOR CONNECTOR FITTING
5. CENTER DOOR SEGMENT
6. DOOR MECHANISM BUMPER
7. SHOCK STRUT
8. BRAKE LINE
9. LOWER SIDE STRUT MEMBER
10. DOWN LOCK LATCH ASSEMBLY
11. UPPER SIDE STRUT MEMBER
12. ACTUATING CYLINDER

*Figure 63 — Main Alighting Gear Installation*

(4) CLEANING.—Wash parts with kerosene or solvent, Federal Spec P-S-661. Wipe parts dry with clean cloth.

(5) ASSEMBLY AND INSTALLATION. *(See figure 65.)* Special tool required: Wrench S-32550.

*(a)* Assemble bearings on fulcrum and secure with nut, pin, and lock ring. Insert crank in first bearing of side support far enough to retain first washer.

*(b)* Position the arm in the strut and insert strut and arm between the two support bearings. Push the crank through the strut, second washer, and remaining support arm.

*(c)* Align holes in arm and crank and install bolt.

*(d)* Lift gear into place and seat fulcrum firmly in support bearing.

**Note**

If end of aft fulcrum is not chromium plated, coat fulcrum end with grease, Specification MIL-L-3545, prior to spacer installation.

If bearings do not fit freely into support fitting, chill bearings prior to installation.

*(e)* Install bearing caps. On airplanes incorporating T.O. No. 1F-1-48, install spacer assembly in aft fulcrum. Install retaining bolts.

*(f)* Tighten bearing retaining nut on forward fulcrum with tool No. S-32550 to assure minimum side play and yet permit the gear to swing freely. Install pin and lock ring.

*(g)* On airplanes incorporating T.O. No. 1F-1-48, tighten bearing retaining nut on forward fulcrum with tool No. S-32550 to assure a minimum clearance of 0.010 inch between nut and bushing with aft end of fulcrum against spacer assembly. Install pin and lock ring.

*(h)* On airplanes incorporating T.O. No. 1F-1-48, with aft end of fulcrum against spacer assembly, clearance between forward fulcrum shoulder and bearing must be maintained at 0.006 inch. Peel shims off spacer assembly to maintain clearance.

*(i)* Connect lower side strut to shock strut.

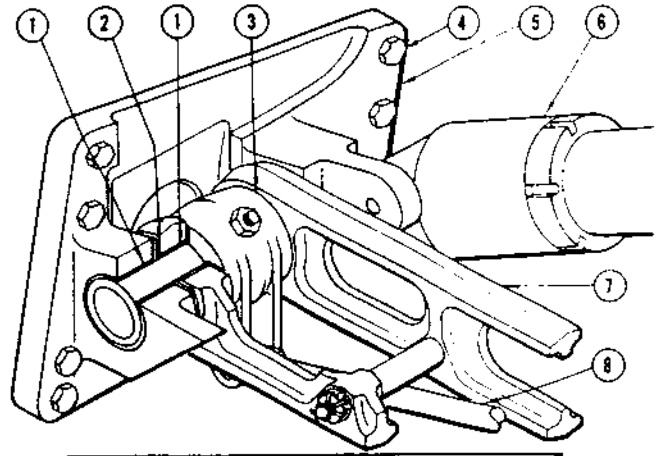
*(j)* Connect cylinder at crank and at shock-strut fitting. Connect hydraulic lines.

*(k)* Connect outer door segment to shock strut.

*(l)* Connect brake line and electrical wiring.

**CAUTION**

Be sure that brake line attachment fittings are positioned so that when the gear is retracted the brake line is not pinched between gear and wing structure.




1. BEARINGS
2. WASHER
3. CRANK ASSEMBLY
4. SIDE SUPPORT MOUNTING BOLTS
5. SIDE STRUT BEARING SUPPORT
6. ALIGHTING GEAR ACTUATING CYLINDER
7. UPPER SIDE STRUT MEMBER
8. DOWN LOCK LATCH ROD

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***Figure 64 — Main Gear Side Strut Upper Pivot***

*(m)* Lubricate affected parts. Bleed brakes. (Se paragraph 5*d*(7), this section.)

(6) ADJUSTMENTS.—The down position of th gear is controlled by the side strut and down loc mechanism. The up position is automatically determine by the center door segment (attached to the strut) whic acts as an up stop when it contacts the wing. The ge must be pulled up far enough to seat the door firml against the wing and must go down far enough to engag the down lock mechanism properly. Adjustment for bot positions is made at the gear actuating cylinder.

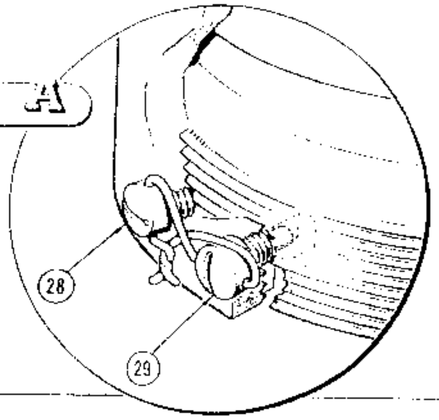
*(a)* GEAR UP POSITION ADJUSTMENT.

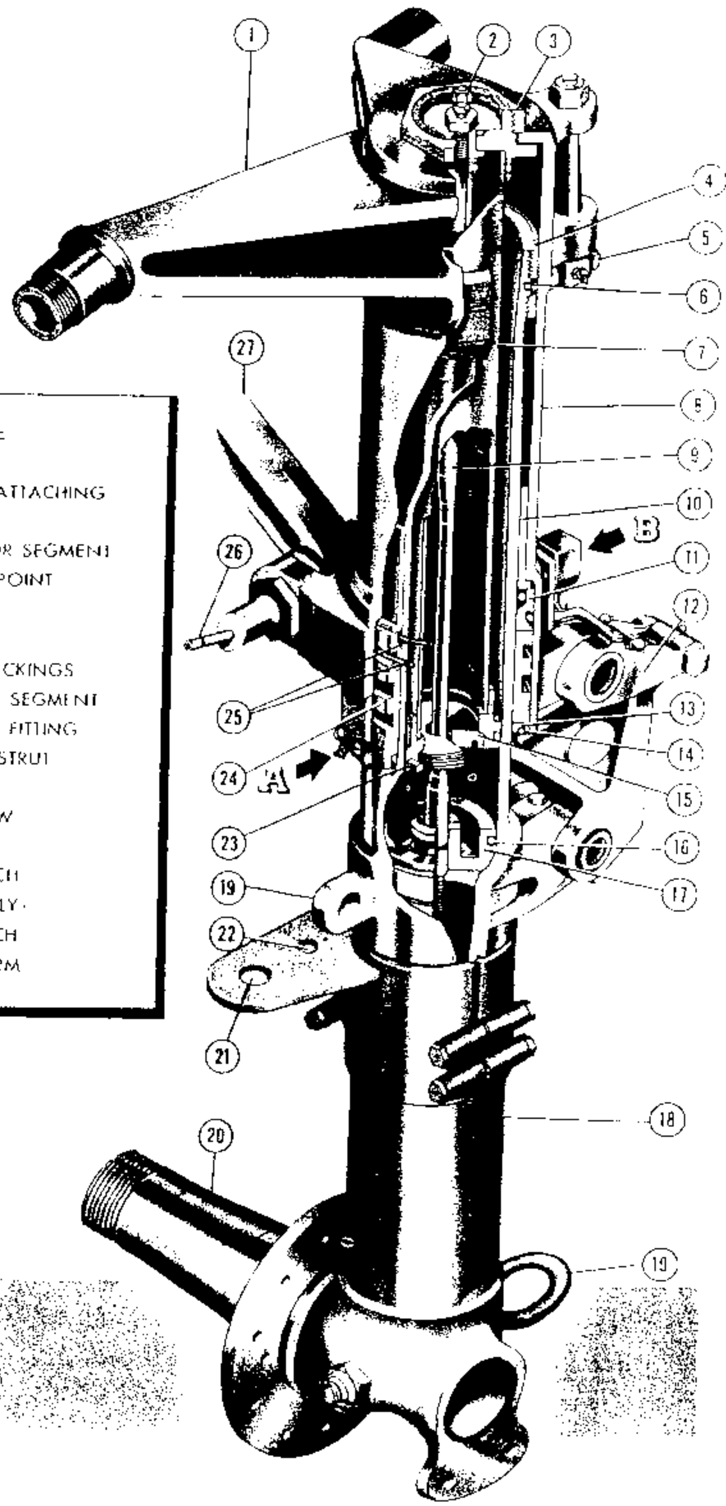
*1.* Retract gear and note whether door sea firmly.

*2.* If gear up travel is insufficient to seat th door, loosen hex jam nut and rotate piston tube suffi ciently to close the door.

*3.* Check and adjust travel until door mak firm contact.

*(b)* GEAR DOWN POSITION ADJUSTMEN There is no adjustment for dead-center position of th side strut. This position is automatically attained whe the down lock is engaged, thus the gear down-positio adjustment is actually an adjustment to insure prop engagement of the down-lock mechanism. Adjust th down lock as follows:




1. FULCRUM
2. AIR VALVE
3. NUT
4. BEARING
5. PISTON ROD ATTACHMENT FITTING
6. PINS
7. PLUNGER TUBE
8. CYLINDER
9. METERING PIN
10. STOP
11. ADAPTER
12. TORQUE ARMS
13. WIPER RING
14. LOCK RING
15. ORIFICE PLATE
16. "O" RING PACKING
17. SUPPORT
18. PISTON
19. TOWING EYE
20. WHEEL AXLE
21. BRAKE LINE ATTACHING POINT
22. CENTER DOOR SEGMENT ATTACHING POINT
23. PISTON RING
24. BEARING
25. "O" RING PACKINGS
26. OUTER DOOR SEGMENT ATTACHMENT FITTING
27. LOWER SIDE STRUT MEMBER
28. SAFETY SCREW
29. LOCK SCREW
30. SAFETY SWITCH (LH GEAR ONLY)
31. SAFETY SWITCH ACTUATOR ARM

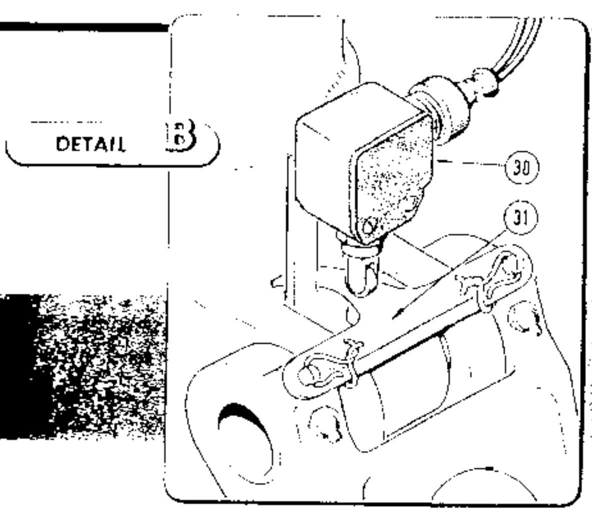



*Figure 66 — Main Gear Shock Strut*

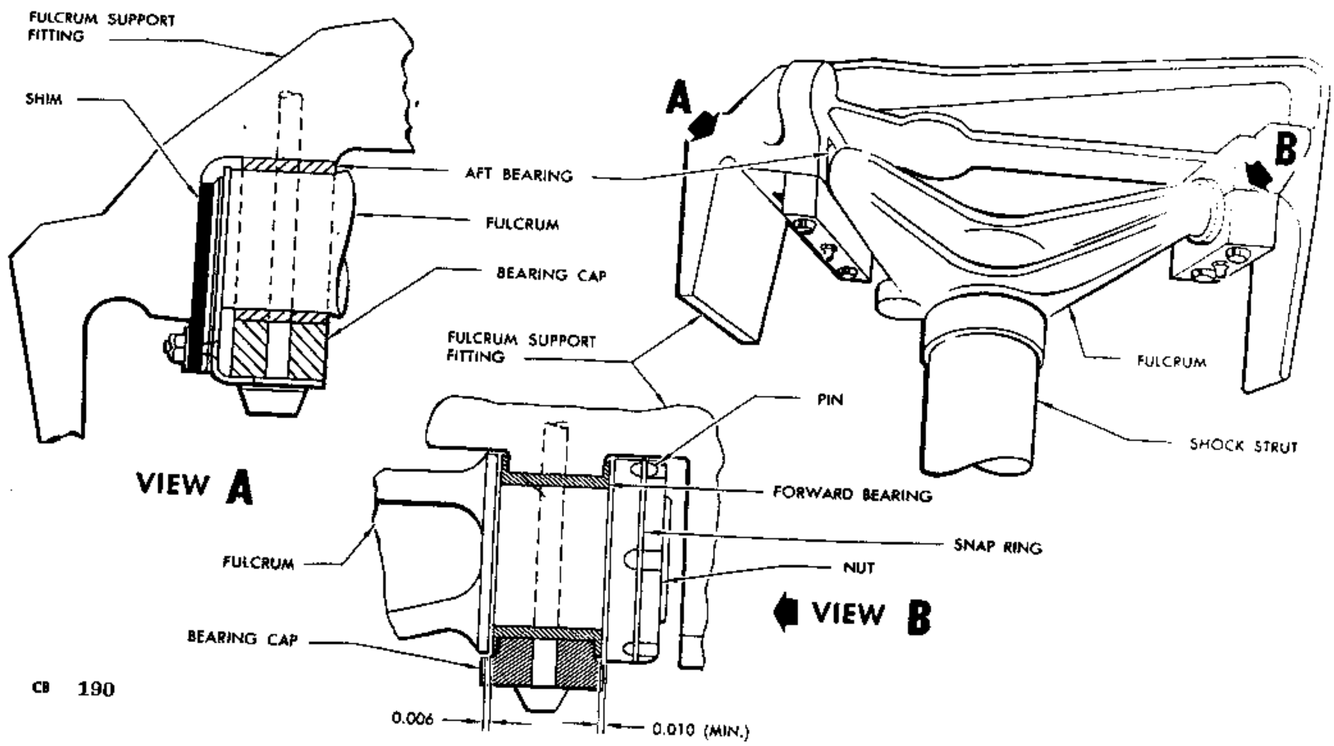



*Figure 65 — Main Gear Fulcrum Installation (Airplanes Incorporating T.O. 01-75F-48)*

*1.* With the gear in the down position, adjust the length of the cylinder so that the latch engages slot in cam 0.34 inch (±0.03 inch). This adjustment is made by unscrewing lower end cap to lengthen cylinder.

2. With gear partially retracted (less than half way) adjust the spring-loaded cartridge so that the latch block clears arc of cam from 0.03 to 0.06 inch.

*c.* SHOCK STRUT, MAIN ALIGHTING GEAR.

(1) DESCRIPTION. *(See figure 66.)*—The air-oil shock strut has a maximum stroke of 8 inches. The cylinder has a fulcrum at the upper end, and lugs at the lower end for attachment of the side strut and upper torque arm. The piston incorporates an axle and forward and aft towing eyes.

(2) OPERATION. — Landing loads force piston (18) into cylinder (8), forcing fluid through orifice (15) at a rate governed by the position of the metering pin (9).

(3) SERVICING.—The air valve and filler cap are accessible for servicing through a hinged access door in the wing upper surface.

*(a)* Release air pressure in strut by loosening valve assembly hex nut one-half to one complete turn.

## WARNING

Do not loosen valve assembly more than one complete turn until all air has escaped from strut to prevent injury to personnel.

*(b)* On F-80A-10 winterized airplanes, loosen ⅝-inch hex nut on air valve assembly one-half to one full turn and depress valve stem.

**CAUTION**

Do not loosen ⅝-inch hex nut more than one turn or valve stem and housing assembly may fall into cylinder.

*(c)* Compress strut completely.

*(d)* Fill to level of filler hole with hydraulic fluid, Specification MIL-O-5606.

*(e)* Check strut for installation of red bottoming tape, Specification L-T-101, Type III. Tape will be installed 0.03-inch from the end of packing nut, with strut in collapsed position.

*(f)* Prior to installing air valve assembly, install new aluminum gasket between valve assembly and shock strut.

*(g)* Inflate struts after airplane has been loaded. Rock airplane to overcome packing friction. With full fuel load less drop tanks, piston should extend 4 inches from red bottoming tape. With full drop tanks, pisto should extend 3 inches from red bottoming tape, or unti upper and lower torque-arm bolts are 6½ inches apart.

*(b)* On winterized airplanes, torque ⅝ hex nu on valve assembly to between 50 and 70 inch-pounds.

(4) MAINTENANCE.

*(a)* Wipe piston after each landing with clea cloth saturated with hydraulic fluid, Spec AN-O-366.

*(b)* If leakage is apparent, disassemble strut an install new packings.

(5) REMOVAL. — Shock strut is removed wit complete alighting gear. (See paragraph *b*(3) above.

1. DRAG STRUT ATTACHING POINT
2. BUSHING
3. PIN
4. SHOCK STRUT
5. BUSHING
6. LOWER TORQUE ARM
7. SAFETY SWITCH BRACKET SUPPORT
8. UPPER TORQUE ARM
9. SAFETY SWITCH BRACKET

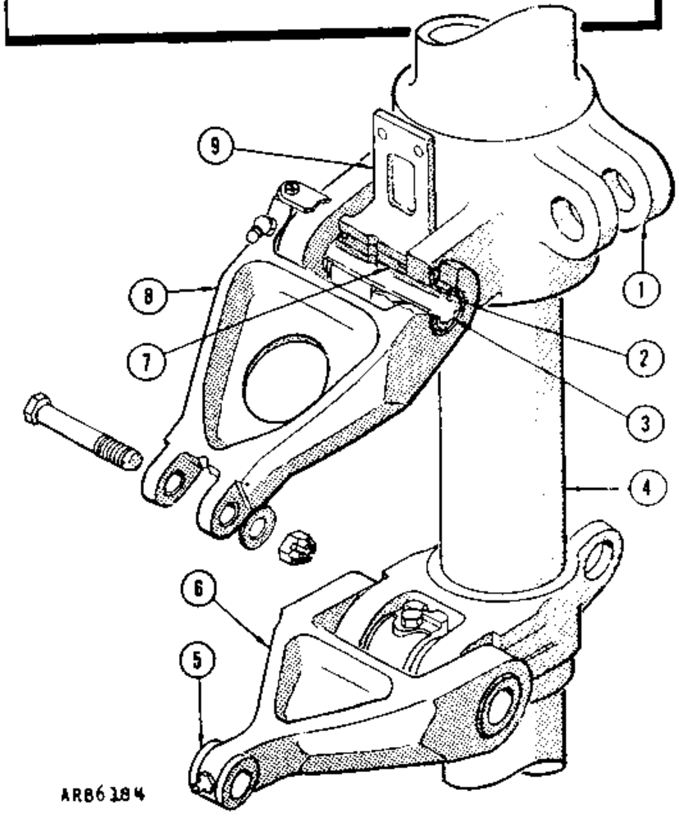



*Figure 67 — Main Gear Torque Arm Assembly*

(6) DISASSEMBLY.—Special tool required: Spanner wrench No. S-38406.

*(a)* Release air pressure in strut by depressing valve stem.

*(aA)* On F-80A-10 winterized airplanes, loosen ⅝-inch hex nut on air valve assembly one-half to one complete turn, and depress valve stem.

**CAUTION**

Do not loosen ⅝-inch hex nut more than one turn or valve stem and housing assembly may fall into cylinder.

**WARNING**

Failure to deflate strut before disassembly may cause serious bodily injury or damage to equipment.

*(b)* Remove filler plug and drain fluid from strut.

*(c)* Disconnect or remove torque arms. (See figure 67.)

*(d)* Remove lock ring (14) which secures wiper (13).

*(e)* Remove the two screws (28) and (29) which lock bearing (24) in place.

*(f)* With spanner wrench No. S-38406 (figure 28) unscrew the bearing from the cylinder.

*(g)* Pull piston assembly out of cylinder.

**Note**

Alternate jarring action when pulling out piston should dislodge stop (10), adapter (11), and "O"-ring packings (25) from the cylinder. If this method is not successful, inflate strut sufficiently to force piston and internal parts free. Two pins (6) secure bearing (4) to upper end of piston. The pins are free to fall out when piston is clear of cylinder, and bearing can be removed when pins are out.

*(h)* If there is leakage at "O"-ring packing (16), remove metering pin (9) and its support (17).

**Note**

Since there is no movement of the metering-pin support in relation to the piston wall, it is not expected that any trouble will develop with the "O"-ring packing. However, in the event that it is necessary to replace the packing, the axle will have to be removed. As the axle is pressed in place, do not remove it unless absolutely necessary. After removing the axle, a tool can be inserted in the piston to remove the nut on the bottom of the metering pin. The pin and support are then free to be removed by driving them out with a soft metal rod inserted from the bottom of the piston.

*(i)* Remove "O"-ring (16) from support.

*(j)* With pointed tool, remove piston ring (23) from bottom of plunger tube (7).

*(k)* Remove plunger tube by removing nut (3) at top of cylinder and withstanding plunger tube from bottom of cylinder.

*(l)* Remove "O"-ring packing from adapter (11).

(7) CLEANING — Wash all disassembled parts with either kerosene or unleaded gasoline. Wipe parts dry with clean cloth.

(8) INSPECTION.

*(a)* Visually inspect the entire outer surface of the cylinder assembly. Inspect inside of cylinder for corrosion, scoring and worn spots. Use magnifying glass to inspect the area approximately four inches below the top of the strut. Replace defective parts.

*(b)* Inspect piston for continuity of plating, and for pitted condition.

*(c)* Inspect piston-ring (23) groove at bottom of plunger tube for possible wear at sides of groove.

*(d)* Inspect metering pin orifice at bottom of plunger tube for wear caused by possible misalignment of metering pin.

**Note**

Do not attempt to remove orifice plate unless it is damaged, as attachment threads are seized by litharge process.

(9) REPLACEMENTS. — Whenever strut is disassembled, replace with new parts all "O"-ring packings, gasket at large retainer nut (3) on top of cylinder, gasket under filler cap, and valve core.

(10) ASSEMBLY. — Special tool required: Spanner wrench No. S-38406.

*(a)* Insert plunger tube in cylinder and secure with large nut (3) using new replacement gasket. Tighten firmly; gasket will seat in chamfer of cylinder head.

*(b)* Assemble the following parts on the piston: Lock ring (14); wiper (13) with sharp edge at bottom; bearing (24); adapter (11) with new replacement "O"-ring packings (25) (install adapter so widest edge is at bottom); slip one "O"-ring packing (25) down on piston until it is under lip of adapter; stop (10); upper bearing (4) and two pins (6).

*(c)* If metering pin support (17) has been removed, install new replacement "O"-ring packing on support. Press support in piston and replace nut on pin.

**Note**

Be sure that support is firmly seated and that metering pin is in true vertical alignment so it will center in orifice (15) of plunger tube.

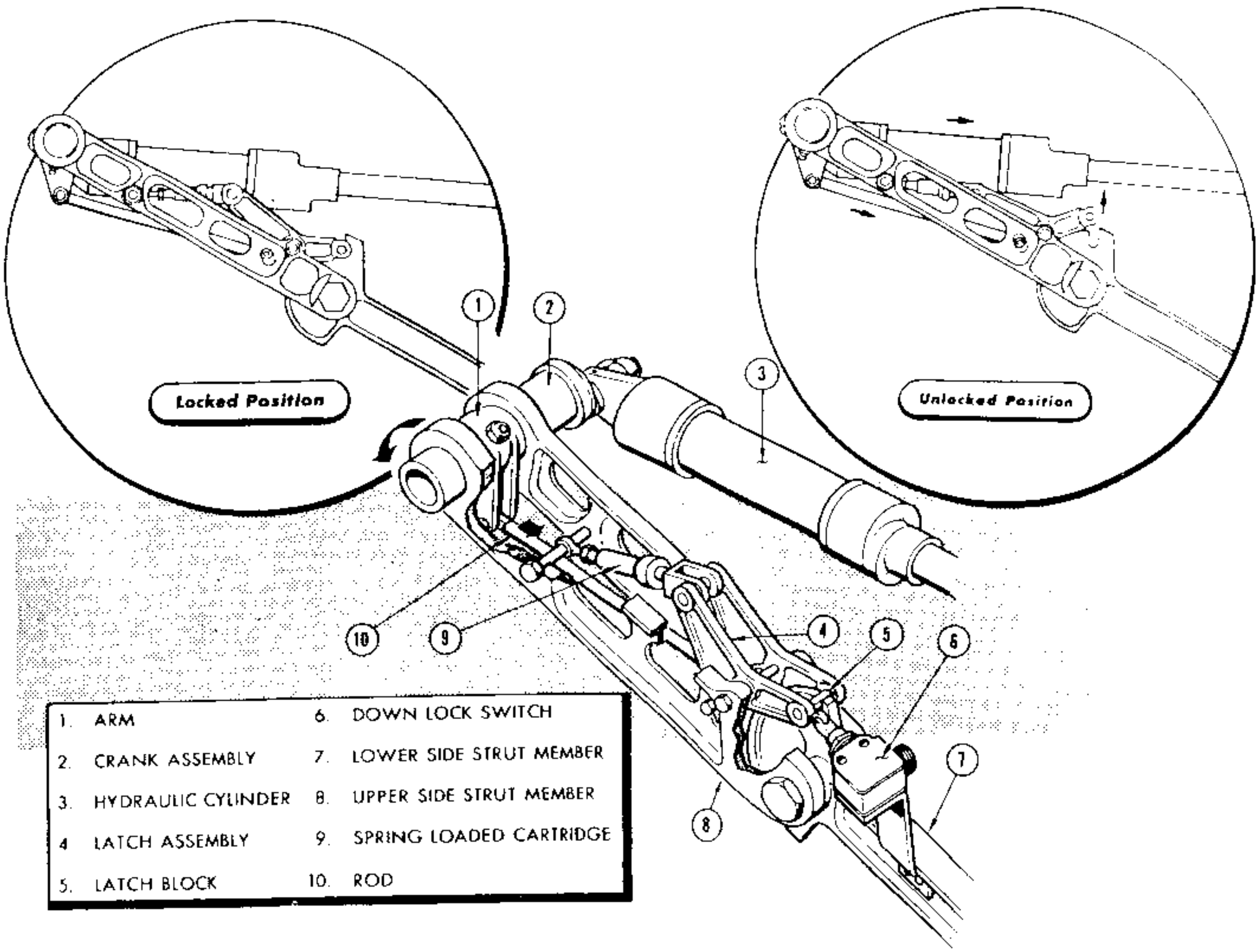



*Figure 68 — Main Gear Down Lock*

(*d*) Wet inside of cylinder and piston assembly with clean hydraulic fluid, Specification MIL-O-5606.

(*e*) Insert piston assembly in cylinder. Do not drop pins (6) from the assembly.

(*f*) Screw bearing (24 in place and tighten snugly with spanner wrench S38406 (figure 28). Bearing has six slots, spaced 60 degrees apart. Align one of the slots with either one of the two tapped holes for lock screw (29) and safety screw (28). Select slot with bearing in tightest possible position.

**Note**

One of the locking screws is an AC501-416-5 and does not safety the bearing. It is used only for the purpose of securing safety wire for the other screw (part No. 175126) which has an extended shank to penetrate the bearing slot. The screws are interchangeable in either tapped hole to provide greater range of adjustment.

(*g*) Install wiper in place and secure with lock ring.

(*h*) With strut fully compressed, fill to level of filler hole with hydraulic fluid, Specification MIL-O-5606.

(*i*) Work piston several times to eliminate trapped air.

(*j*) Install filler cap with new gasket and tighten securely.

(*k*) Install new valve core.

(*l*) Install torque arms.

(*m*) Inflate with air pressure to approximately 630 psi.

(*n*) On F-80A-10 winterized airplanes, following inflation of strut, tighten 5/8-inch hex nut on air valve assembly to a torque of from 50 to 70 inch-pounds.

(11) TEST.—Test with soapy water for air leakage around filler cap and valve core. Fluid seepage around other parts will indicate leakage.

(12) INSTALLATION.—Shock strut is installed with complete alighting gear. (See paragraph *b*(5) preceding.) After installing, and with weight of airplane on strut, regulate air pressure until piston is extended 4 inches from cylinder. Rock the airplane to overcome packing friction. For information on strut inflation see paragraph (3)*(d)*, preceding.

*d.* SIDE STRUT AND DOWN LOCK MECHANISM, MAIN GEAR.

(1) DESCRIPTION. *(See figures 62 and 68.)*—The side strut assembly includes two upper members and a lower member. The side strut upper members are attached to a crank and support assembly mounted on the wing structure. The lower member is attached to the shock strut. The down lock mechanism is located between the two upper members and consists of the crank, A cam on the end of the lower side strut member acts as arm, rod, spring-loaded cartridge, and latch assembly. A cam on the end of the lower side strut member acts as a guide for the latch assembly and provides a notch to receive the latch block in the locked position.

(2) OPERATION.—When the alighting gear is being retracted, the crank actuates the arm and the rod. The rod rotates the latch assembly and lifts the latch hook free of the notch in the cam. The spring-loaded cartridge functions as a stop for the latch assembly in the released position only.

In the extension of the alighting gear, the above operation is reversed, except that the latch block rides on the cam until it reaches the notch, then it snaps into the engaged position.

(3) ADJUSTMENT. — Refer to paragraph *b*(6) preceding.

e. ENCLOSURE DOORS AND UP LOCK MECHANISM, MAIN GEAR. *(See figures 69 and 70.)*

(1) DESCRIPTION. — The enclosure doors for each main gear consist of an inner segment hinged parallel to the airplane center line, a center segment attached to the shock-strut lower end, and an outer segment hinged on the wing and connected to the shock strut by a spring-loaded actuator rod. The inner door segment is hydraulically operated by an actuating cylinder and mechanical linkage, in automatic sequence with the gear operation. A separate hydraulic actuating cylinder is installed for emergency release of the inner door segment.

(2) OPERATION. *(See figure 70.)*—The center and outer door segments move with the gear to their closed positions before the inner door segment closes. During retraction, a hook on the center door engages a roller on the outer door to lock the two segments in a flush position when completely closed. This sequence in closing operation is due to a mechanical delay provided by the inner-segment actuating linkage. The mechanical delay is overcome when the gear has nearly reached its retracted position, at which time lever (12) is struck by the center door segment. This latter action moves rod (10) to break a link from dead-center position. Hydraulic pressure in the door cylinder (5) is prevented from moving the door by dead-center position of link (14), thus when the link has broken from dead-center, the cylinder is free to swing the door to closed position. Upon closing, a roller (17) mounted on the door first contacts retainer hook (16) and moves the hook slightly inboard. This action relieves the cylinder force on trigger hook (15) at its notched end, and frees both hooks to rotate as further force by the cylinder moves them onto the roller. When up and locked, the doors serve to lock the gear in retracted position.

In opening, inner door and gear extension are almost simultaneous. As soon as the door actuating cylinder releases the up lock and starts the inner door to opening, the weight of the gear as it extends helps to force the door open.

Emergency opening of the inner door segment is effected by a small release cylinder (11) which rotates the hooks to their normal open positions. When rotated to their open positions, the hooks partially open the door. The door is then forced completely open by the gear as it extends.

(3) ADJUSTMENTS. — For positive closing and locking of all doors, careful adjustment of hook and roller mechanisms must be made. The roller (2) on the outer door must bottom in the notch of the center door hook (1) when doors are closed. The trigger-hook notch must bottom against the trigger hook bolt (6) when the inner door is open. Also, it is necessary that the inner door roller first contact hook (16) when closing.

**Note**

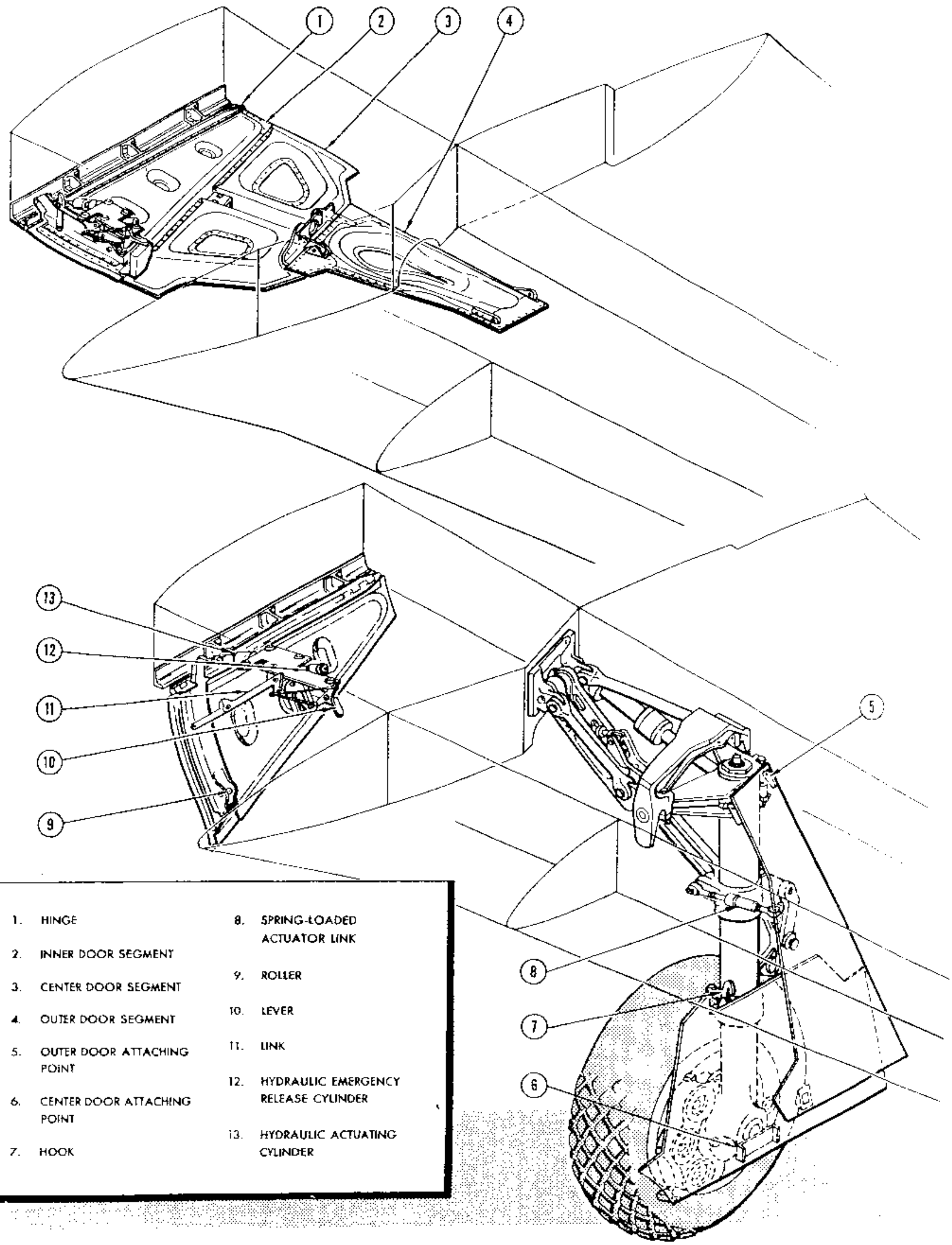
Skin gap is 3/32-inch mimimum and 5/32-inch maximum.

*(a)* OUTER DOOR TO CENTER DOOR HOOKING MECHANISM.

*1.* Place clay on inside of center door hook (1).

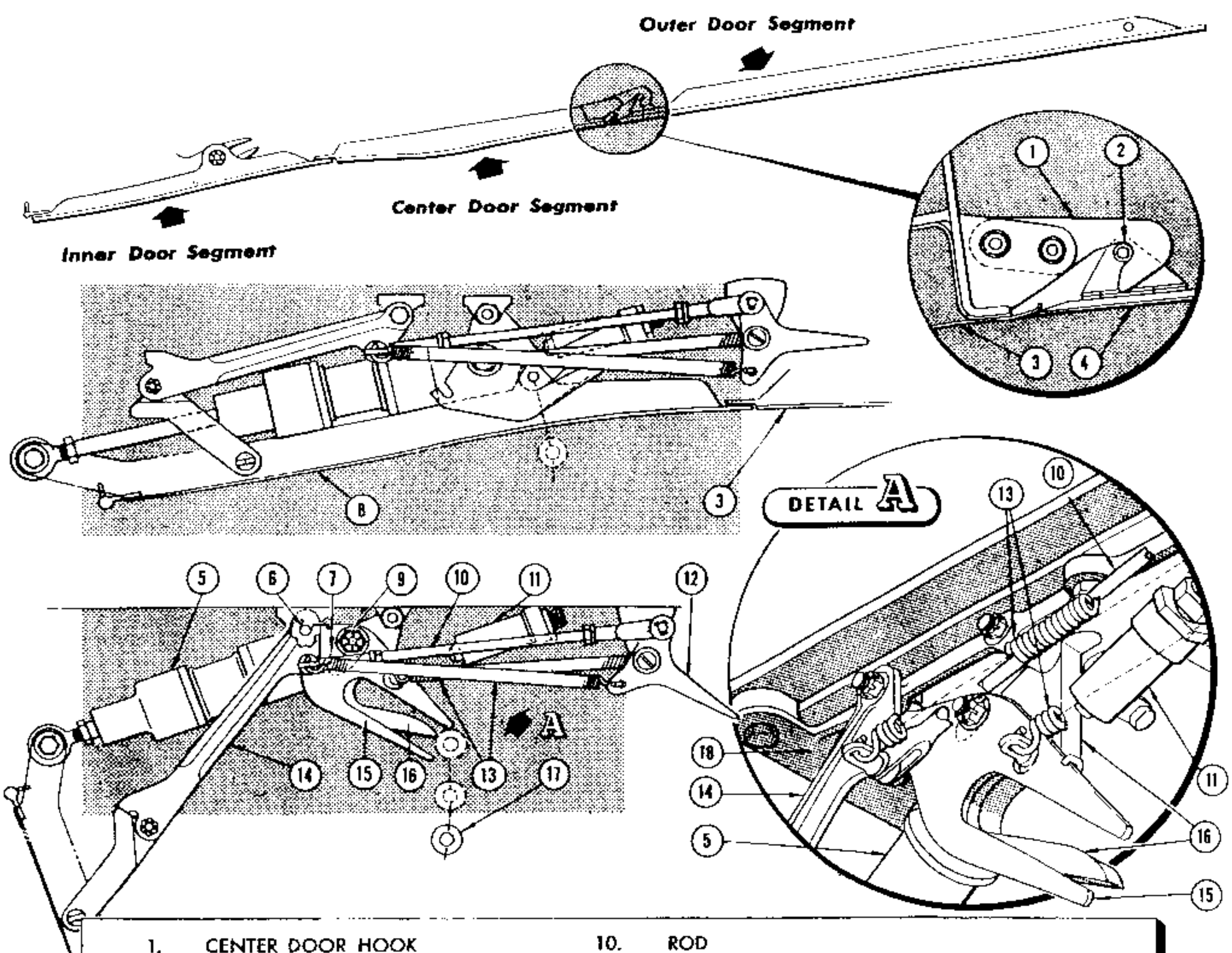
2. Loosen hook and move it along slotted holes as necessary to make roller bottom in the hook when outer and center doors close.

3. Adjust spring-loaded actuator rod (by screwing either end in or out) until outer-door travel is fast enough to insure roller entering hook opening at approximately the middle of the hook opening. Roller must not hit point of hook.



1. HINGE
2. INNER DOOR SEGMENT
3. CENTER DOOR SEGMENT
4. OUTER DOOR SEGMENT
5. OUTER DOOR ATTACHING POINT
6. CENTER DOOR ATTACHING POINT
7. HOOK
8. SPRING-LOADED ACTUATOR LINK
9. ROLLER
10. LEVER
11. LINK
12. HYDRAULIC EMERGENCY RELEASE CYLINDER
13. HYDRAULIC ACTUATING CYLINDER

*Figure 69 — Main Gear Door Linkage*




| | | | |
|---|---|---|---|
| 1. | CENTER DOOR HOOK | 10. | ROD |
| 2. | OUTER DOOR ROLLER | 11. | HYDRAULIC EMERGENCY RELEASE CYLINDER |
| 3. | CENTER DOOR SEGMENT | 12. | LEVER |
| 4. | OUTER DOOR SEGMENT | 13. | SPRINGS |
| 5. | HYDRAULIC ACTUATING CYLINDER | 14. | LINK |
| 6. | TRIGGER HOOK BOLT | 15. | TRIGGER HOOK |
| 7. | LOCK PLATE | 16. | RETAINER HOOK |
| 8. | INNER DOOR SEGMENT | 17. | INNER DOOR ROLLER |
| 9. | ECCENTRIC STUD BOLT | 18. | MECHANISM SUPPORT |

*Figure 70 — Main Gear Door Trigger Assembly*

(*b*) INNER DOOR MECHANISM.

*1.* With the door open, check for bottoming of bolt (6) in notch of trigger hook (15).

*2.* Close door until roller (17) contacts hook (16) and deflects hook from 0.03 to 0.06 inch. If it is necessary to adjust deflection:

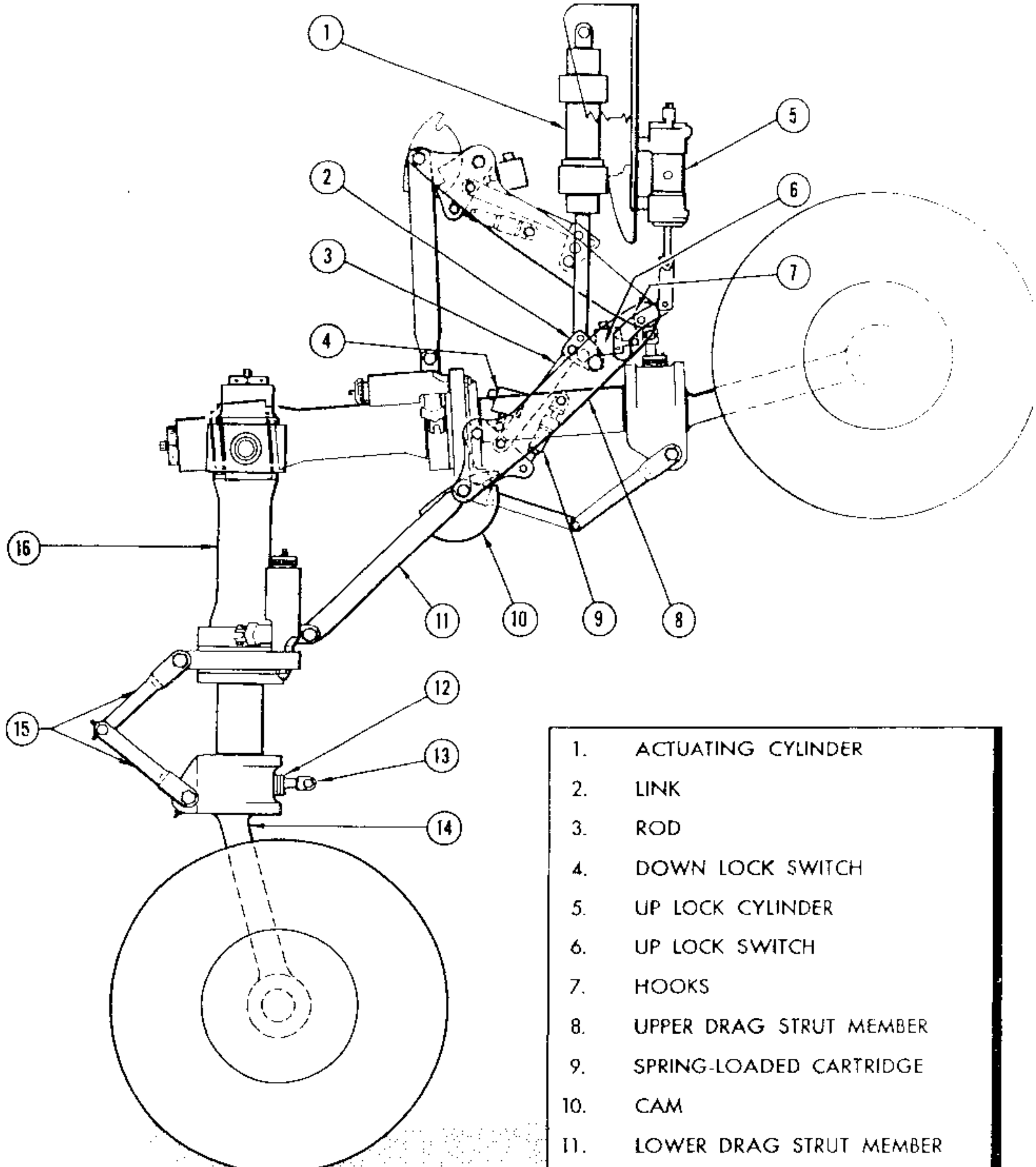
a. Loosen eccentric stud bolt (9) and lock plate (7).

b. Rotate bolt (9) until correct hook deflection is obtained.

c. Tighten lock plate and bolt. Be sure that hook (16) rotates freely on bolt (9).

**Note**

If installing a new knee-joint link (14), center line of joint bolt must have offset of from 0.06 to 0.10 inch from center line through upper and lower link attachment points. File as necessary at joint stop points to obtain this off-center dimension.




| | |
|---|---|
| 1. | ACTUATING CYLINDER |
| 2. | LINK |
| 3. | ROD |
| 4. | DOWN LOCK SWITCH |
| 5. | UP LOCK CYLINDER |
| 6. | UP LOCK SWITCH |
| 7. | HOOKS |
| 8. | UPPER DRAG STRUT MEMBER |
| 9. | SPRING-LOADED CARTRIDGE |
| 10. | CAM |
| 11. | LOWER DRAG STRUT MEMBER |
| 12. | SHIMS |
| 13. | UP LOCK ENGAGEMENT FITTING |
| 14. | FORK |
| 15. | TORQUE ARMS |
| 16. | SHOCK STRUT |

*Figure 71 — Nose Alighting Gear*

*f.* NOSE ALIGHTING GEAR.
*(See figures 71 and 72.)*

(1) DESCRIPTION. — The nose alighting gear consists of an air-oil shock strut assembly with shimmy damper device, a drag strut assembly with down lock mechanism, a hydraulic actuating cylinder, two torque arms, and a wheel assembly.

The gear is mounted by means of a fulcrum which is made integral with the shock strut. The fulcrum pivots in a bearing support attached to the bottom of station 81 sloping bulkhead. The lower drag strut member is connected to the shock strut, and the upper drag strut member is connected to a fitting on the forward side of station 103 bulkhead. The fitting provides mounting at its upper extremity for the hydraulic actuating cylinder. The cylinder piston rod is connected to the two links of the down lock mechanism, which is in turn mounted between the two members of the upper drag strut. Two truss members interconnect the fulcrum bearing support and fitting at the point where the drag strut attaches, thus forming a rigidly aligned assembly. The hydraulically operated up lock is located on the aft side at station 103 bulkhead. A static arrestor is attached to the nose-gear fork for electrical grounding of the airplane when the wheels are in contact with the ground.

(2) OPERATION. — When the cockpit control lever is placed in "UP" position, hydraulic pressure delivered to the cylinder moves the piston rod up, releasing the down lock and breaking the upper and lower drag struts from dead-center position. The struts then pull the gear aft and up into the wheel well, where it is locked by the up lock mechanism.

Extension of the gear is essentially a reversal of the retracting operation.

For details of the operation of locks, refer to paragraphs *h* and *i* following.

(3) REMOVAL AND DISASSEMBLY.

*(a)* Jack the airplane. (See section III, paragraph 2*c*.)

*(b)* If desired, remove the wheel assembly.

*(c)* Disconnect cylinder piston rod at links of down lock mechanism.

*(d)* Disconnect lower drag strut at shock strut.

*(e)* Disconnect wiring leading to down lock switch.

*(f)* Remove bolt from upper drag strut attachment fitting and remove complete drag strut assembly.

**Note**

When bolt is removed, truss members, drag strut, up lock hooks and switch assembly, and spacer washers are freed. Hook assembly will be retained by bolt in its actuating link and may be removed if desired. Save washers for reinstallation.

*(g)* Remove four bolts in bearing caps of fulcrum. (See figure 73.)

*(h)* Remove bearing caps, and lower gear clear of airplane.

**Note**

Truss members are detachable only after gear is removed. Detach by removing pin, spacer, shim, and outer bearing.

(4) CLEANING.

*(a)* Wash bearing parts, shims, etc., with either kerosene or unleaded gasoline.

*(b)* Wipe parts dry with clean cloth.

(5) ASSEMBLY AND INSTALLATION.

*(a)* Place a shim, truss member, washer, bearing, shim, and spacer on each side of the fulcrum in that order. Lock spacer in place with pin.

**Note**

Separate washer and bearing so that bearing supports will slip between them when gear is lifted into place.

*(b)* Lift gear into place and seat fulcrum firmly in bearing support.

*(c)* Install bearing caps and secure with four bolts.

*(d)* Check for free rotation of fulcrum in bearings, and for end play of 0.005 inch maximum. Either add or peel shims for adjustment.

*(e)* Install drag strut.

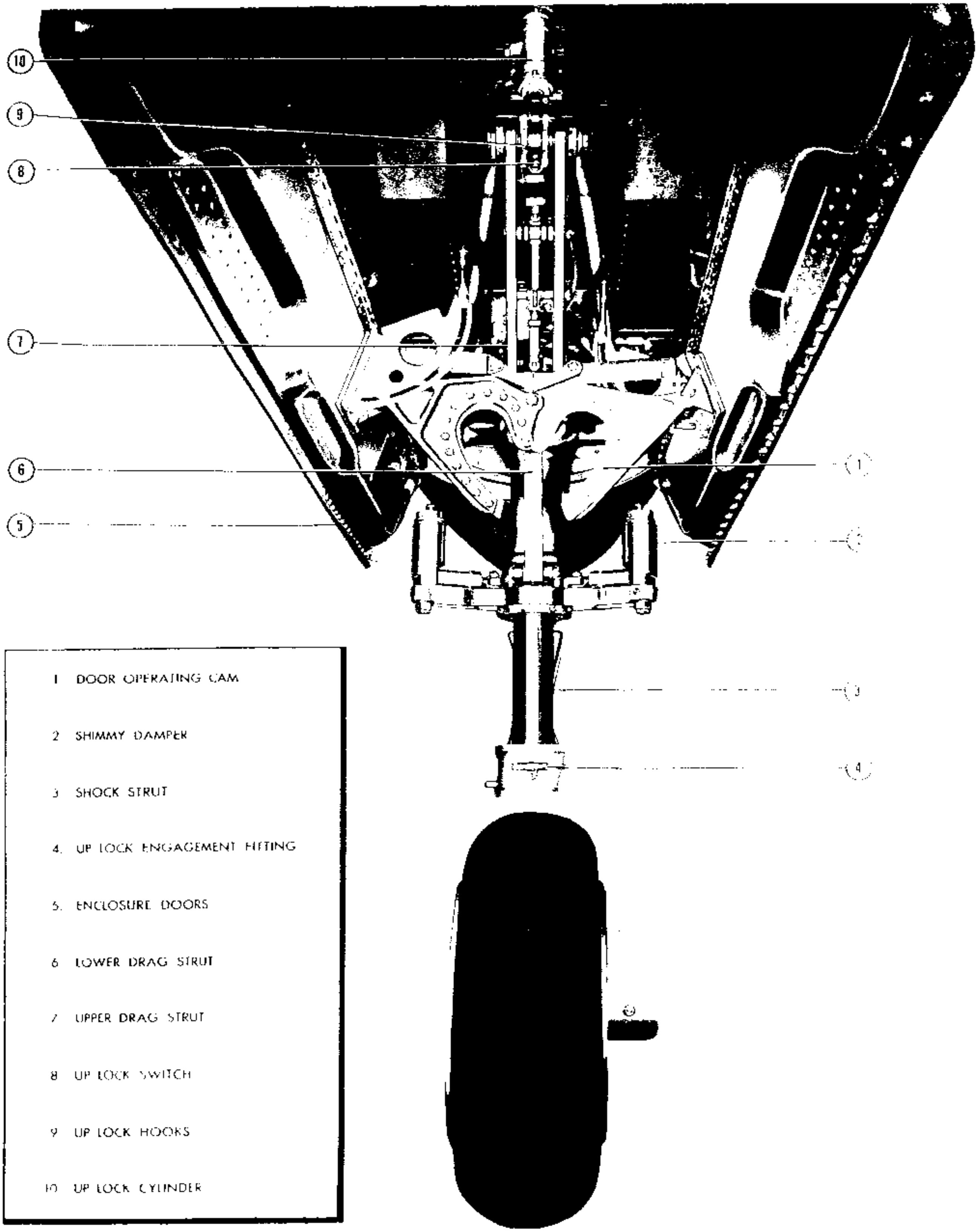
**Note**

Be sure truss members, up lock, and washers are correctly installed as shown on figure 76.

*(f)* Connect cylinder piston rod.

*(g)* Connect electrical wiring.

*(h)* Lubricate affected parts.




1 DOOR OPERATING CAM
2 SHIMMY DAMPER
3 SHOCK STRUT
4 UP LOCK ENGAGEMENT FITTING
5 ENCLOSURE DOORS
6 LOWER DRAG STRUT
7 UPPER DRAG STRUT
8 UP LOCK SWITCH
9 UP LOCK HOOKS
10 UP LOCK CYLINDER

*Figure 72 — Nose Alighting Gear Installation*

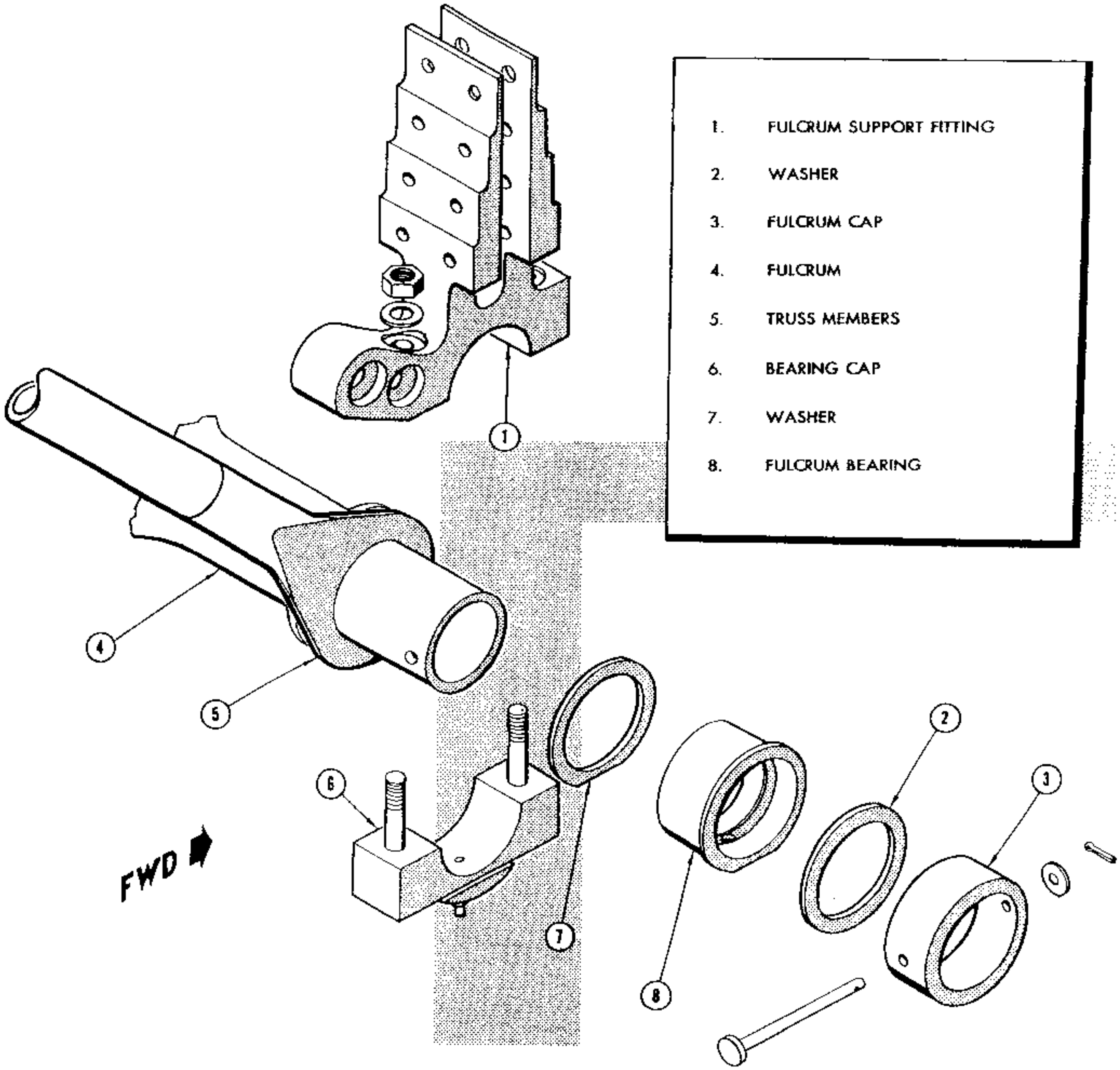


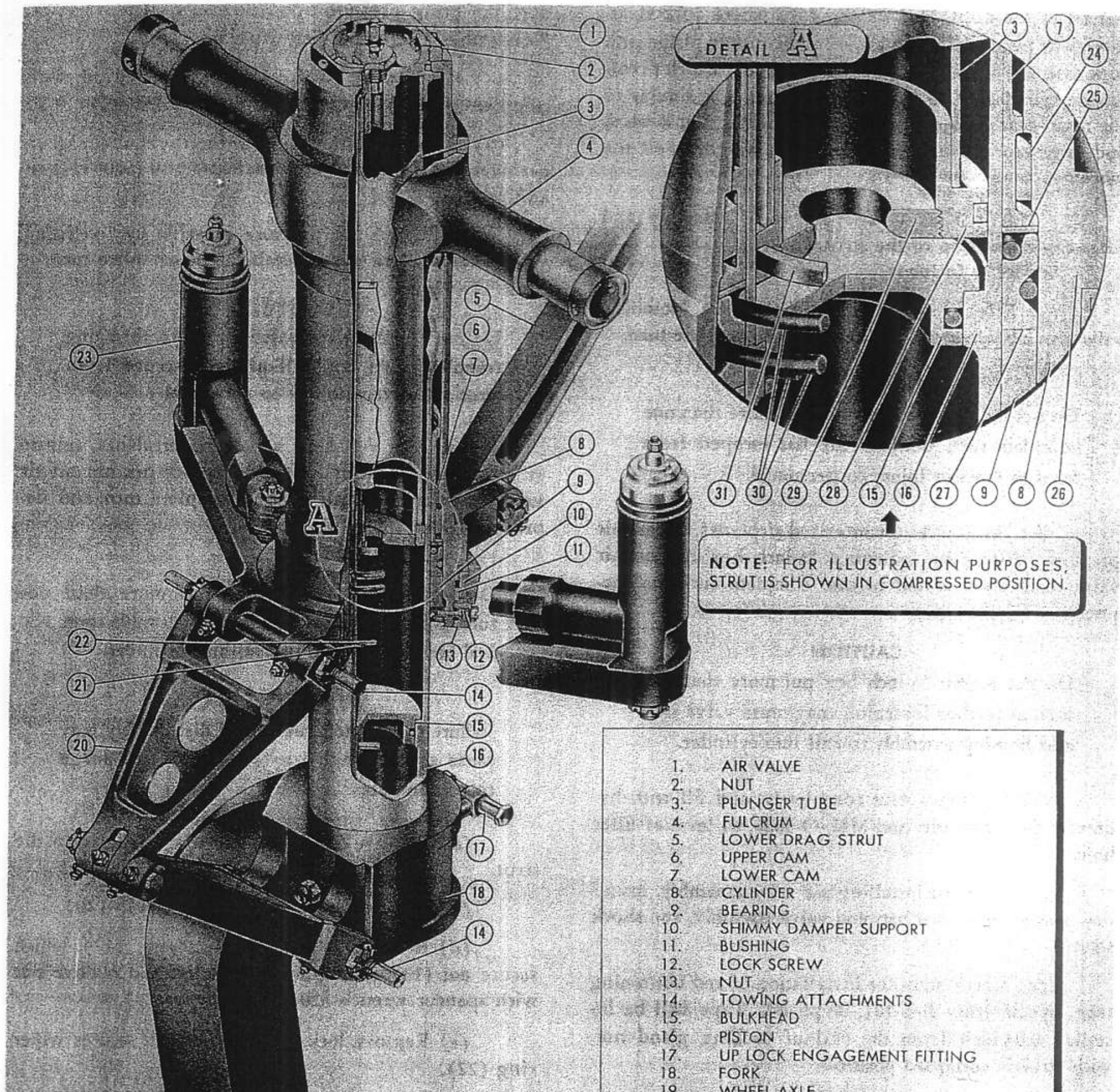

*Figure 73 — Nose Gear Fulcrum Bearing Cap Removal*

(6) ADJUSTMENTS. *(See figures 71 and 76.)*—The gear down position is controlled by the drag strut and no adjustment for dead-center position of the drag strut is required. The gear up position is regulated by varying the cylinder piston-rod length by means of the terminal fitting, or by shimming the up lock engagement fitting on the strut. The latter method is preferred. Add to or reduce the number of shims so that up lock hooks are completely engaged when the gear reaches its maximum up position. Check engagement of the up lock hooks by looking through inspection hole in right side of the fuselage.

For adjustment of the down lock, see paragraph *b*(3) following.

*g*. SHOCK STRUT, NOSE GEAR. *(See figure 74.)*

(1) DESCRIPTION.—The shock strut is an air-oil type with a maximum stroke of 8 inches. The cylinder is made with an integral fulcrum at the upper end, and lugs at the lower end for attachment of the upper torque arm and the two shimmy damper pistons. The piston incorporates a cantilever fork and axle for the wheel. An engagement bolt for the up lock hooks is in-




1. AIR VALVE
2. NUT
3. PLUNGER TUBE
4. FULCRUM
5. LOWER DRAG STRUT
6. UPPER CAM
7. LOWER CAM
8. CYLINDER
9. BEARING
10. SHIMMY DAMPER SUPPORT
11. BUSHING
12. LOCK SCREW
13. NUT
14. TOWING ATTACHMENTS
15. BULKHEAD
16. PISTON
17. UP LOCK ENGAGEMENT FITTING
18. FORK
19. WHEEL AXLE
20. TORQUE ARMS
21. LOCK RING
22. WIPER RING
23. SHIMMY DAMPER
24. KEY
25. RETAINER
26. LOWER DRAG STRUT SUPPORT
27. ADAPTER
28. SUPPORT
29. ORIFICE PLATE
30. "O"-RING PACKINGS
31. PISTON RING

*Figure 74 — Nose Gear Shock Strut*

stalled at the upper end of the fork where fork is attached to piston. Torque arms inter-connect piston and fork assembly with shimmy-damper support which pivots on the cylinder. The nose-gear shock strut is similar to the main-gear strut except that no metering pin is used, and cams center the nose wheel when weight is off the wheel.

(2) SERVICING. — The air valve assembly and filler cap are on top of the strut.
Service as follows:

*(a)* Release air pressure in strut by loosening valve assembly hex nut one-half to one complete turn.

## WARNING

Do not loosen air valve assembly more than one complete turn until all air has escaped from strut to prevent injury to personnel.

*(b)* On F-80A-10 winterized airplanes, release air pressure in strut by loosening ⅝-inch hex nut on air valve assembly one-half to one complete turn and depressing valve stem.

### CAUTION

Do not loosen ⅝-inch hex nut more than one turn as further loosening may cause valve stem and housing assembly to fall into cylinder.

*(c)* Compress strut completely, and fill with hydraulic fluid, Specification MIL-O-5606, to level of filler hole.

*(d)* Prior to installing air valve assembly, install new aluminum gasket between valve assembly, and shock strut.

*(e)* Check strut for installation of red bottoming tape, Specification L-T-101, Type III. Tape will be installed 0.03-inch from the end of packing gland nut, with strut in collapsed position.

*(f)* For take-off gross weights under 12,000 pounds (full fuel load without drop tanks), inflate strut with air until piston is extended 4 inches from red bottoming tape. Over 12,000 pounds (full fuel load with drop tanks), inflate strut until piston extends 3 inches from red bottoming tape.

*(g)* On F-80A-10 winterized airplanes, following inflation of strut, tighten ⅝-inch hex nut on air valve assembly to a torque of from 50 to 70 inch-pounds.

(3) MAINTENANCE. — Wipe piston after each landing with clean cloth saturated with hydraulic fluid, Specification MIL-O-5606. If leakage is apparent, do not tighten bearing at lower end of cylinder, as bearing does not bring pressure upon packings. Remove strut, disassemble, and install new packings.

(4) REMOVAL. — Shock strut is removed with complete gear. (See paragraph *f*(3) preceding.)

(5) DISASSEMBLY.—Special tools required: Spanner wrenches S20424-36, S38405, S20411-29 (S20911-29), and S40704.

*(a)* Release air pressure in strut by loosening valve assembly hex nut one-half to one complete turn.

## WARNING

Do not loosen valve assembly more than one complete turn until all air has escaped from strut to prevent injury to personnel.

*(aA)* On F-80A-10 winterized airplanes, release air pressure in strut by loosening ⅝-inch hex nut on air valve assembly one-half to one complete turn and depressing valve stem.

### CAUTION

Do not loosen ⅝-inch hex nut more than one turn as further loosening may cause valve stem and housing assembly to fall into cylinder.

## WARNING

Failure to deflate strut before disassembly may cause serious injury to personnel or damage to equipment.

*(b)* Remove filler plug and drain fluid from the strut.

*(c)* Disconnect or remove torque arms (20).

*(d)* Remove the four lock screws (12) which secure nut (13) at bottom of cylinder, and remove nut with spanner wrench S20424-36 (figure 29).

*(e)* Remove lock ring (21) which secures wiper ring (22).

*(f)* With spanner wrench S38405 (figure 28) unscrew bearing (9) from cylinder.

*(g)* Pull piston assembly out of cylinder.

### Note

Alternate jarring action when pulling out piston should dislodge lower cam (7), key (24), retainer (25), O-ring packings (30), and adapter (27).

*(h)* Disconnect shimmy damper pistons from cylinder.

*(i)* Remove shimmy damper and support assembly from cylinder.

*(j)* To remove upper cam (6), packings, etc., from piston, unscrew Allen-head setscrews, and with spanner wrench S20411-29 (figure 30) remove upper cam. Slide parts off the piston.

*(k)* If leakage at bulkhead O-ring packing is in evidence, remove bulkhead (15) and packing by driving it out with a soft metal bar inserted from the bottom of the piston.

*(l)* With a pointed tool, remove piston ring (31) from support (28).

*(m)* Remove plunger tube (3) by removing nut (2) at top of cylinder and withdrawing plunger tube from bottom of the cylinder. Hold plunger tube with spanner wrench S40704 (figure 28) to keep it from turning while removing the nut.

**Note**

Do not attempt to remove orifice (29) unless it is damaged, as attachment threads are seized by litharge process.

(6) CLEANING. — Wash all disassembled parts with either kerosene or solvent, Federal Specification P-S-661. Wipe parts dry with a clean cloth.

(7) INSPECTION.

*(a)* Inspect inside of cylinder for corrosion, scoring, and worn spots.

*(b)* Inspect piston for continuity of plating and for pitted condition.

*(c)* Inspect piston ring (31) groove at bottom of plunger tube for possible wear at sides or groove.

*(d)* Inspect keys (24) and keyways for possible wear.

(8) REPLACEMENTS. — Whenever strut is disassembled, replace with new parts all O-ring packings, gasket at large retainer nut on top of cylinder, gasket under filler cap, and valve core.

(9) ASSEMBLY.—Special tools required: Spanner wrenches S38505, S38403, and S20911-29.

*(a)* Insert plunger tube in cylinder and secure with large nut (2). Use new replacement gasket. Tighten firmly; gasket will seat in chamfer of cylinder head.

*(b)* Install piston ring (31) on plunger tube.

*(c)* If bulkhead (15) has been removed, install new replacement O-ring packing and press bulkhead in piston.

*(d)* Place cam, packings, etc., on piston in order specified following:

*1.* Lock ring (21).

*2.* Wiper ring (22) with sharp edge at bottom.

*3.* Bearing (9).

*4.* Adapter (27) with new replacement O-ring packing installed. Install adapter so the widest edge is at the bottom.

*5.* O-ring packing. Slip O-ring down on piston until it is under the lip of the adapter.

*6.* Lower cam (7) with keys (24) in slots.

**CAUTION**

Keys must be in place to lock the cam, or strut will not center itself.

*(e)* Screw upper cam (6) on piston with Spanner wrench S20911-29 and safety with three Allen-head setscrews.

**CAUTION**

Piston head acts as a centering cam. Be sure cam lobes of piston head are positioned parallel to wheel axle.

*(f)* Assemble shimmy damper and support on cylinder and secure temporarily with nut (13).

*(g)* Wet inside of cylinder and piston assembly with hydraulic fluid, Specification MIL-O-5606.

*(h)* Insert piston assembly in cylinder, being sure that cam and keys are aligned with slot in cylinder. Use spanner wrench S38505 (figure 28) to position cam for engagement of keys in keyways.

*(i)* Screw bearing (9) in place and tighten securely with spanner wrench S38405 (figure 28); then unscrew sufficiently to align lock screw holes.

*(j)* Adjust shimmy-damper support bearing by inserting a 0.005-inch shim between bearing and nut (13). Tighten nut firmly against shim, then unscrew until lock screw holes are aligned.

*(k)* Insert four lock screws (12) and safety in place.

*(l)* Connect shimmy damper pistons to cylinder.

*(m)* Place wiper ring (22) in position and secure with lock ring (21).

*(n)* With strut fully compressed, fill to level of filler hole with hydraulic fluid, Specification MIL-O-5606.

*(o)* Work piston several times to eliminate trapped air.

*(p)* Install filler cap with new gasket, and tighten securely.

*(q)* Install new valve core.

*(r)* Inflate with air pressure to approximately 275 psi.

*(s)* On F-80A-10 winterized airplanes, following inflation of strut, tighten ⅝-inch hex nut on air valve assembly to a torque of from 50 to 70 inch-pounds.

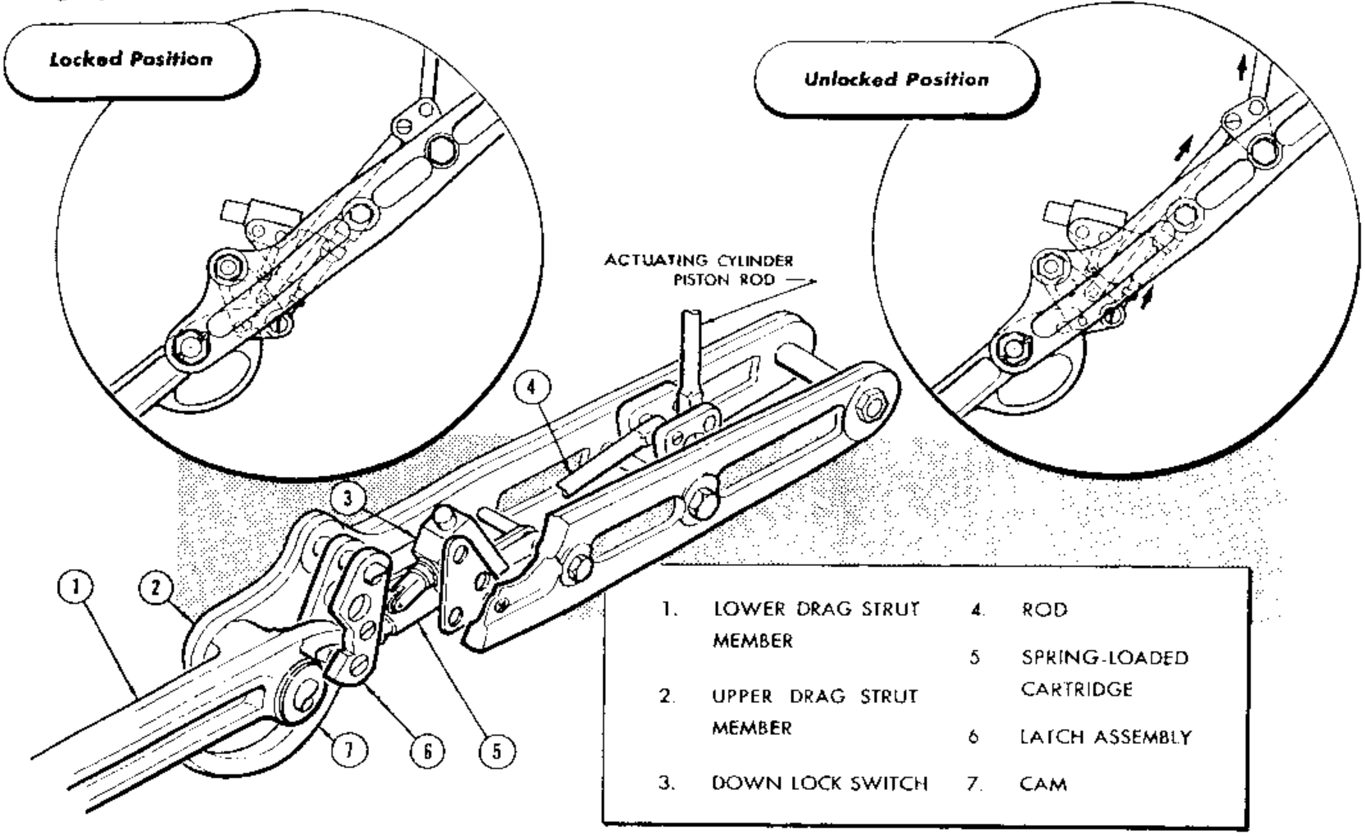



*Figure 75 — Nose Gear Down Lock*

(10) TEST.—Test with soapy water for air leakage around filler cap and valve core. Leakage around other parts will be evidenced by fluid seepage.

(11) INSTALLATION.—Shock strut is installed with complete alighting gear. (See paragraph *f*(5) preceding.) After installation, and with weight of fully loaded airplane on strut, regulate air pressure until piston is extended the proper distance from cylinder. For information on strut inflation, see paragraph (2)*(d)*, preceding.

*h.* DRAG STRUT AND DOWN LOCK MECHANISM, NOSE GEAR. *(See figures 71 and 75.)*

(1) DESCRIPTION.—The drag strut and down lock mechanism for the nose gear consists, as does the side strut and down lock mechanism used on the main gear, of two upper members, a lower member, a spring-loaded cartridge, and a latch assembly. While operation and construction of the two gear strut and down lock mechanisms are essentially the same, a difference exists in the method of connection used in attaching the nose gear actuating-cylinder piston rod to the drag strut assembly. On the nose gear the piston rod is connected between two links attached to the upper drag strut member. A rod is connected to the links and to the down lock latch assembly and movement of the links moves the rod and latch.

(2) OPERATION.—Upon application of hydraulic pressure in the actuating cylinder, the cylinder piston rod moves upward rotating the links, lifting the latch assembly from the notch in the cam. This movement then breaks the drag struts from dead-center position and permits retraction of the gear by the cylinder.

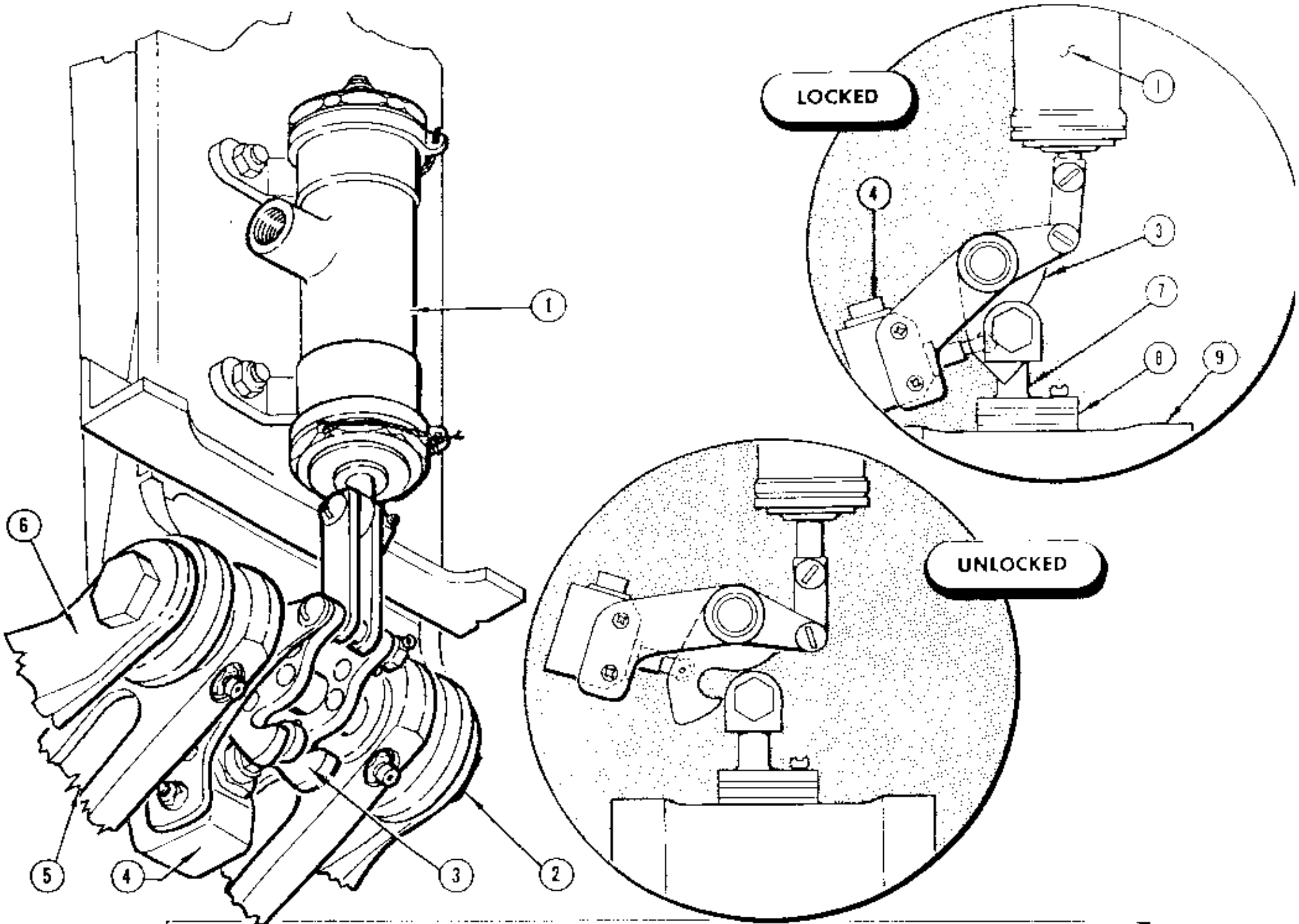
(3) ADJUSTMENT.—Since there is no adjustment for down position of the drag strut, adjustment must be made on the down lock to insure the latch snapping into the notch in the cam on which it rides. Adjust as follows:

*(a)* With the gear in the down position, adjust the length of the cylinder so that latch engages slot in cam 0.34 inch (± 0.03 inch). This adjustment is made by unscrewing lower end cap to lengthen cylinder.

*(b)* With gear partially retracted (less than half way), adjust the spring-loaded cartridge so that the latch block clears arc of cam from 0.03 to 0.06 inch.

For adjustment of the gear-up position see paragraph *f*(6) preceding.

*i.* UP LOCK MECHANISM, NOSE GEAR. *(See figure 76.)*—The nose-gear up lock mechanism consists of two hooks, a bolt fitting, and a hydraulic cylinder. The hooks are mounted on the same pivot as the upper drag strut member. A bolt is inserted through the hooks, drag strut, and a support fitting mounted on station 103 bulkhead. The hooks are actuated simultaneously by linkage of the hydraulic up lock cylinder. (For informa-




1. UP LOCK CYLINDER
2. SUPPORT FITTING
3. UP LOCK HOOKS
4. UP LOCK SWITCH
5. UPPER DRAG STRUT MEMBER
6. TRUSS MEMBER
7. UP LOCK ENGAGEMENT FITTING
8. SHIMS
9. SHOCK STRUT

*Figure 76 — Nose Gear Drag Strut Upper Pivot and Up Lock*

tion on the cylinder, see paragraph 16*c*(8), this section.) When the gear is in the retracted position, the hooks engage the fitting provided on the aft side of the wheel fork. (See paragraph *f*(6) preceding.)

*j.* ENCLOSURE DOORS, NOSE GEAR.
*(See figure 77.)*

(1) DESCRIPTION.—Two enclosure doors for the nose gear are mounted on continuous hinges and are mechanically actuated by the gear as it retracts or extends. In addition to the doors, the assembly includes stop plates, spring-loaded cartridges, stop arms, and the operating cams, all of which are mounted on the doors.

(2) OPERATION.—The mouth-shaped operating cams are contacted by and wrap around the shock strut piston when the gear retracts. This action pivots the cam upward and closes the doors. When the gear extends, a reverse action takes place. The doors are held open by two spring-loaded cartridges, one mounted on each cam and door. The cartridges operate on an over-center principle in that they also tend to hold the doors tightly in the closed position. The closed position of the doors is limited by the gear travel; the open position is restricted by the stop arms.

(3) REMOVAL.

*(a)* Grasp either one of the operating cams and swing it up sufficiently to align locking holes in the spring-loaded cartridges. Place pins or PK screws in holes of cartridges to lock them in place.

**CAUTION**

Do not remove spring-loaded cartridges without first locking them with pins or PK screws.

1. SHIMS
2. SERRATED PLATE
3. STOP PLATE
4. SPRING LOADED CARTRIDGE
5. STOP ARM
6. PIANO HINGE
7. DOOR
8. OPERATING CAM

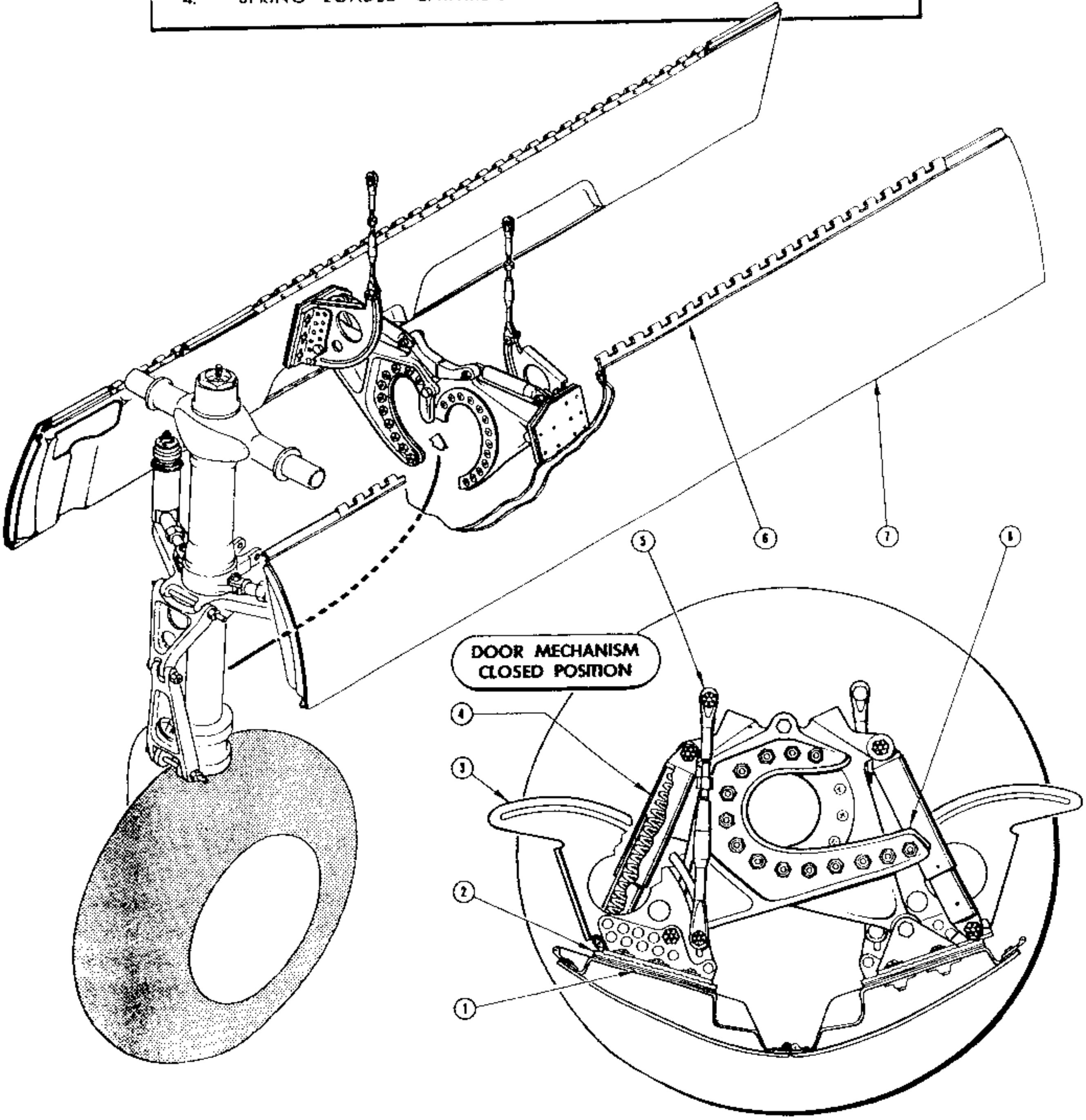
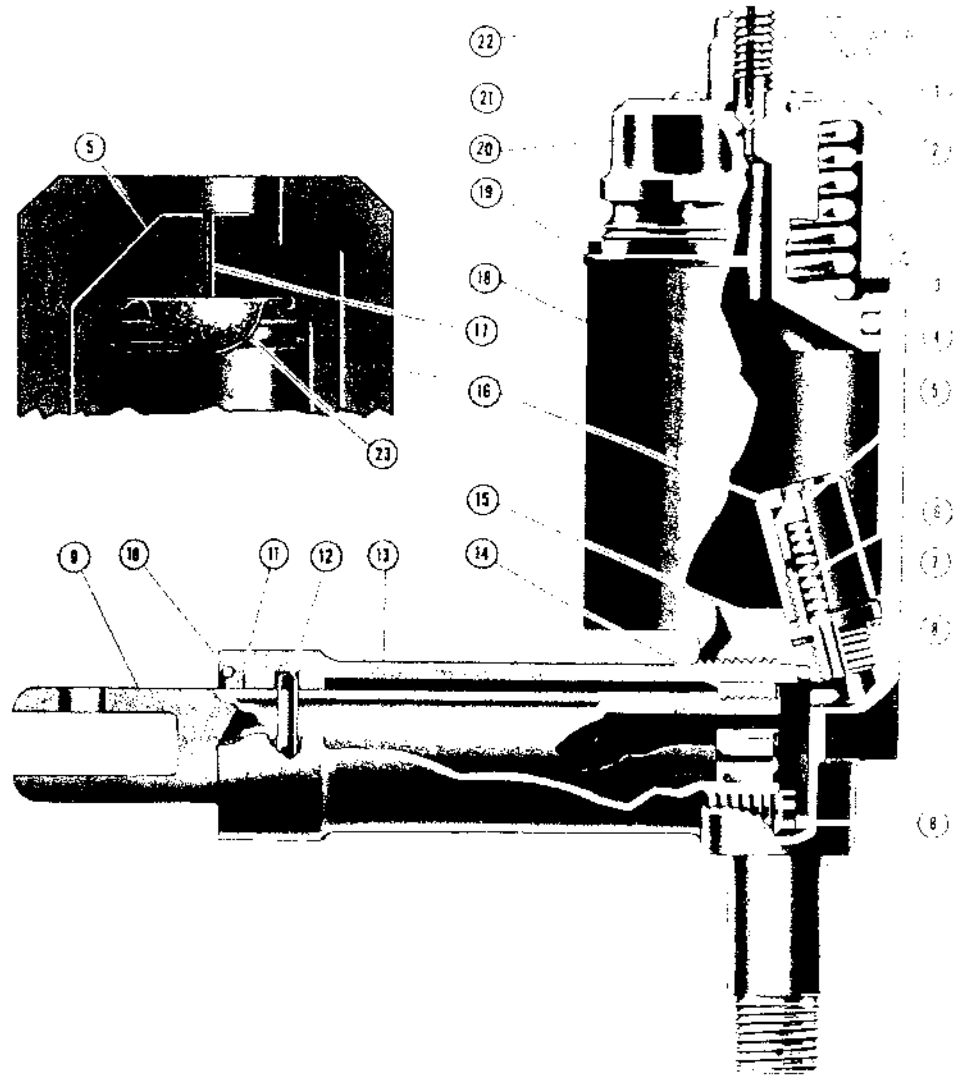
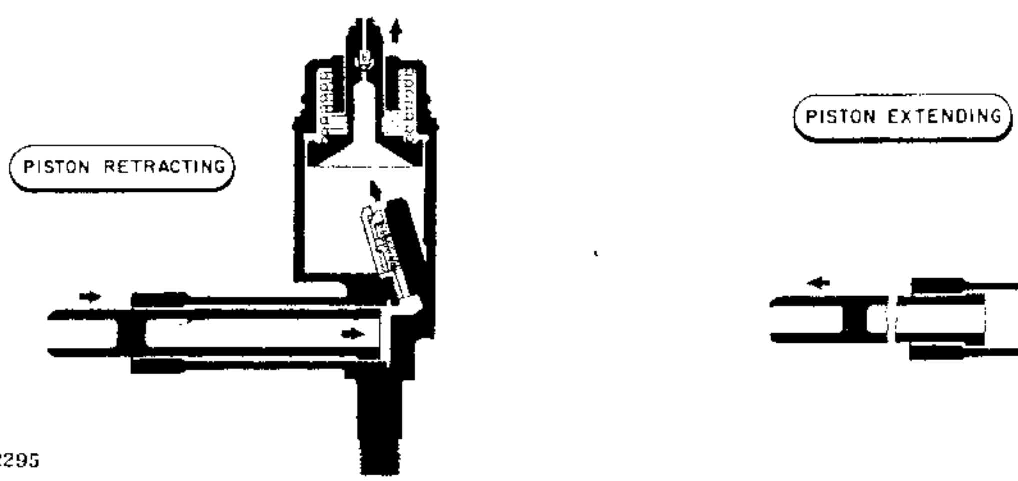



*Figure 77 — Nose Gear Doors*

1. BUSHING
2. SPRING
3. "O" RING PACKING
4. PISTON
5. POPPET
6. POPPET SPRING
7. WASHER
8. GASKET
9. PISTON ROD
10. LOCK RING
11. WIPER
12. "O" RING PACKING
13. CYLINDER
14. PISTON
15. ORIFICE CAP
16. ORIFICE BODY
17. ORIFICE
18. BODY (RESERVOIR)
19. LOCK RING
20. CAP
21. LOCK NUT
22. BLEED
23. SCREEN






AB 2295

*Figure 78 — Shimmy Damper*

*(b)* Disconnect and remove spring-loaded cartridges.

*(c)* Disconnect stop arms.

*(d)* Pull hinge pins and remove doors.

(4) ADJUSTMENT.

*(a)* CLOSED POSITION.—Adjust and align doors in the closed position by varying the number of shims where the mechanism attaches to the doors, and by positioning the attachment brackets with respect to the door hinge line. Slotted holes with which to make the latter adjustment are provided in the brackets. Proceed as follows:

*1.* Install sufficient shims under brackets to give approximately ¼-inch thickness. Place same number of shims under each bracket.

*2.* Retract gear and note alignment of doors.

**Note**

Maximum skin gap at forward and aft ends of doors is $\frac{3}{64}$-inch.

*3.* If doors are not in alignment with each other, extend gear and adjust as follows:

a. Loosen brackets on both doors.

b. Move brackets on lower door toward hinge line and tighten in place.

c. Move brackets on higher door away from hinge line and tighten in place.

d. Retract gear and again note alignment of doors.

e. If doors are not in true alignment, repeat preceding steps until doors are even.

f. Remove shims as necessary to bring doors to fully closed position.

*(b)* OPEN POSITION.—After the doors have been adjusted for closed position, they must be adjusted for clearance between the lower ends of the operating cams and the shock strut piston.

**Note**

When adjusting, be sure that bottoming of stop arms in slots is determining factor for open position, and not the cam mechanism.

*1.* Retract gear until piston is between ends of operating cams and check for equal clearance on each side.

*2.* To move doors to left, lengthen left stop arm and shorten right stop arm.

*3.* To move doors to right, lengthen right stop arm and shorten left stop arm.

*4.* Lengthen or shorten both stop arms equal amounts until a definite spring action can be felt when pushing up on center of mechanism. The spring action must be sufficient to spring the door back to full open position after pushing mechanism up approximately one inch.

*k.* SHIMMY DAMPER.

(1) DESCRIPTION. *(See figure 78.)*—The shimmy damper assembly consists of two spring-oil damper units mounted on a support member which pivots around the lower end of the shock-strut cylinder. The support rotates with the wheel fork since the two assemblies are joined by the torque arms. Pistons of the damper units are attached to the shock-strut cylinder and operate alternately when the support is oscillated by the wheel fork.

Each shimmy damper unit is composed of the body or reservoir, the spring-loaded reservoir piston, the cylinder, and the cylinder piston. A poppet valve incorporating an orifice and screen is screwed into the port between the reservoir and cylinder.

(2) OPERATION. When the cylinder piston is extended, fluid is forced through the check valve by action of the spring-loaded reservoir piston. The return stroke of the cylinder piston is retarded by the resistance of the orifice to the flow of fluid. The check valve is closed on this return stroke. By this action, oscillating motion of the wheel fork and shimmy damper support is resisted and progressively reduced.

(3) SERVICING.

*(a)* Remove shimmy damper from airplane.

*(b)* Remove lock ring from upper end of reservoir.

*(c)* Remove cap, spring, and piston from the reservoir.

## WARNING

Bleed damper before removing cap to lessen danger from expansion of reservoir piston spring.

*(d)* Fill reservoir with hydraulic fluid, Specification AN-0-366.

**CAUTION**

Take care that hydraulic fluid contains no foreign matter. Clogging of the damper orifice will cause poor damper action, and serious damage may result.

*(e)* With the cylinder piston rod pointed down approximately 30 degrees from horizontal, and reservoir on the top side, actuate the piston rod slowly through its full travel until all air is eliminated from the cylinder.

*(f)* Loosen bleeder screw in reservoir piston and install piston in reservoir. Press piston down until its top flange is even with the bottom threads of the reservoir.

*(g)* Tighten bleeder valve. Replace spring, cap, and lock ring.

*(h)* Install shimmy damper on nose gear, and connect piston rod. Bleed off fluid as necessary for installation.

**Note**

A 0.070 inch diameter vent hole was previously drilled in all shimmy damper cap assemblies. The vent hole has been discontinued on later cap assemblies. Installation of one vented and one unvented shimmy damper is permissible, although matched pairs should be installed when available.

*(i)* If lower red indicator line shows, open bleeder valve and allow fluid to escape until the lower line is hidden. Wheel should be in straight forward position. If upper red indicator line does not show, add fluid to the reservoir.

(4) CLEANING AND FLUSHING NOSE GEAR SHIMMY DAMPER.

*(a)* Remove shimmy damper from airplane.

*(b)* Remove lockring from upper end of reservoir.

**WARNING**

Bleed damper before removing cap to lessen the danger from sudden expansion of reservoir piston spring.

*(c)* Remove cap, spring and piston from reservoir and pour out hydraulic fluid.

*(d)* Using wrench 207925, remove orifice assembly and gasket. Discard gasket.

*(e)* Flush out cylinder with clean hydraulic fluid, specification MIL-O-5606. Accomplish this by submerging cylinder body in clean hydraulic fluid and while holding piston rod vertically pump in and out. This will remove loose foreign particles and flush out all old hydraulic fluid. Repeat this procedure until all foreign particles are removed and unit is thoroughly clean.

*(f)* Wash orifice assembly in clean hydraulic fluid; check poppet for free movement and cleanliness.

*(g)* Reinstall orifice assembly, using new gasket. Tighten to torque of 80 to 100 pounds-inch, using wrench 207925.

*(h)* Service and reassemble shimmy damper in accordance with instructions contained in paragraph 4k(3).

(5) TESTING AND PRIMING.—To check shimmy dampers for proper priming, the upper torque arm must be disconnected from the lower torque arm so it can be used as a lever for turning the damper support. Proceed as follows:

Turn the support rapidly approximately 5 degrees on each side of centered position. If shimmy dampers are properly primed, there will be no appreciable lost motion. Piston must feel solid on compression. Spongy action indicates air trapped in the shimmy damper. If spongy action is noted, disconnect cylinder piston rod from shock strut and repeat servicing process.

## 5. WHEELS AND BRAKES.

*a.* GENERAL.—The airplane has three wheels cor structed of magnesium alloy. Single-disc, three-spo hydraulically operated brakes are mounted on the mai gears and are actuated by the rudder pedals. Two maste cylinders, replenished from two hydraulic fluid rese voirs, supply pressure for brake operation.

**CAUTION**

When brakes have been in use under load conditions, they must be allowed to cool for a minimum of 15 minutes. Too frequent use may result in tire failure because of heat dissipation from overheated brakes.

*b.* WHEEL ASSEMBLY, MAIN GEAR.

(1) DESCRIPTION.—The wheel assembly consist of a 26 x 6.6, Goodyear Part No. 530746M-1 wheel, 26 x 6.6, 12-ply rating, extra high pressure, type VI casing and a 26.6 x 6.6 inner tube. The two sections o the wheel are bolted together and can be separated fo tire removal. Both rim flanges are cast integral with th wheel. Keys under the rim flange on the brake side o the wheel drive the brake disc which is provided witl slots to receive the keys. The wheel assembly is mounte on the axle with two roller bearings, one on each sid

(2) REMOVAL.—Jack the airplane. Remove locl ring and cover at the wheel retainer nut. Remove retaine nut and washer. Remove wheel by pulling it straigh inboard.

**Note**

Do not allow inboard bearing and race to drop as the wheel is removed. The outboard bearing is held in the wheel by a grease retainer and lock ring.

(3) REMOVAL OF TIRE AND TUBE.

*(a)* Remove wheel assembly from the airplan

*(b)* Deflate tire by removing the valve core.

**WARNING**

Failure to deflate tire before separating wheel sections may result in injury from sudden expansion of the tire.

*(c)* Remove 12 bolts, and separate the whee sections.

*(d)* Push valve stem through hole in the rin base, and remove the tube.

(4) INSTALLATION OF TIRE AND TUBE.—Since tire failure can easily result if mounting is carelessly accomplished, observe the following instructions closely.

*(a)* Entirely deflate tube and insert it in casing. Fold tube to make this operation easier. Install valve core. Inflate until tube is rounded out.

*(b)* Insert valve-hole section of wheel into tire. Push valve stem through valve-stem hole in wheel. Insert other side of wheel, holding valve in position. Wheels are statically balanced and have letter "B" stamped on corresponding bolt bosses of the two sections. Assemble the two sections with marks opposite each other. Take care during this operation to avoid pinching tube between wheel sections.

*(c)* Install locking nuts and tighten securely. On newer type wheels, required wrench torques will be stamped on wheel.

*(d)* Inflate tire until beads are properly seated against rim flanges. Deflate tire, then reinflate to proper pressure. Check pressure with an accurate gage. Deflating and reinflating relieves pressure of folds or buckles, and permits tube to assume its proper contour within casing.

(5) OPTIONAL METHOD OF INSTALLATION OF TIRE AND TUBE.—Use this method if inner tube is slightly oversize and/or casing is slightly undersize.

*(a)* Place inner tube in casing, and inflate very slightly.

*(b)* Place valve-hole section of wheel in casing, and place assembly on floor. To facilitate installation of two wheel bolts later, place casing and wheel on wooden blocks so that bolts may be inserted and held from the under side.

*(c)* Insert tube inside casing all around, and press sidewalls together so that both beads are on one section of wheel. Have an assistant hold beads together as tube is inserted in casing. This may be accomplished by having assistant stand on tire, first with one foot, and later with both feet.

*(d)* Insert other wheel section, with bosses marked "B" opposite each other, and secure in place with two bolts diametrically opposite. Take care during this operation to hold valve in position. Install remainder of bolts.

*(e)* Inflate, deflate, and reinflate tire to relieve pressure of folds and buckles to permit tube to assume its proper contour within casing.

*c.* WHEEL ASSEMBLY, NOSE GEAR.

(1) DESCRIPTION.—The nose wheel assembly consists of a 22 x 7.25—11.50, low-profile, cantilever wheel (Bendix 145120), a 22 x 7.25—11.50, smooth contour, six-ply rating casing, and a 22 x 7.25—11.50, low-profile tube. The wheel is the split type, with the two sections bolted together, similar to the main-gear wheel.

(2) REMOVAL AND INSTALLATION.—Refer to paragraph *b*(2), (3), and (4) preceding.

*d.* BRAKE SYSTEM. *(See figure 79.)*

(1) DESCRIPTION.—The airplane is equipped with hydraulic brakes operated by the rudder pedals (5). Hydraulic fluid is supplied by two reservoirs (2) connected one to each master cylinder (1). The reservoirs are mounted on the armor plate in the armament compartment. The master cylinders, one connected to each rudder pedal, supply pressure through lines to the single-disc brake assemblies, Goodyear part No. 511980, mounted one on each main alighting gear. Since the master cylinders are connected individually to the left and right brake units, the two brakes are independent systems, and may be applied individually or simultaneously. A parking brake, with control handle located below the instrument panel on the airplane center line, is also included in the brake system.

(2) OPERATION.—When brake pedals are operated, the master cylinder forces fluid under pressure through lines to cylinders on the brake units. The fluid then energizes pistons of the brake unit, applying braking force to the disc which revolves with the wheel. To set the parking brake, depress the rudder pedals and pull out the control handle. (See figure 139.) When the handle (10) is pulled, cable-operated pawls (20) engage with ratchet teeth (F-80A-1 airplanes only) of the bell crank (3) and lock the brakes. Depress the pedals to release the parking brake.

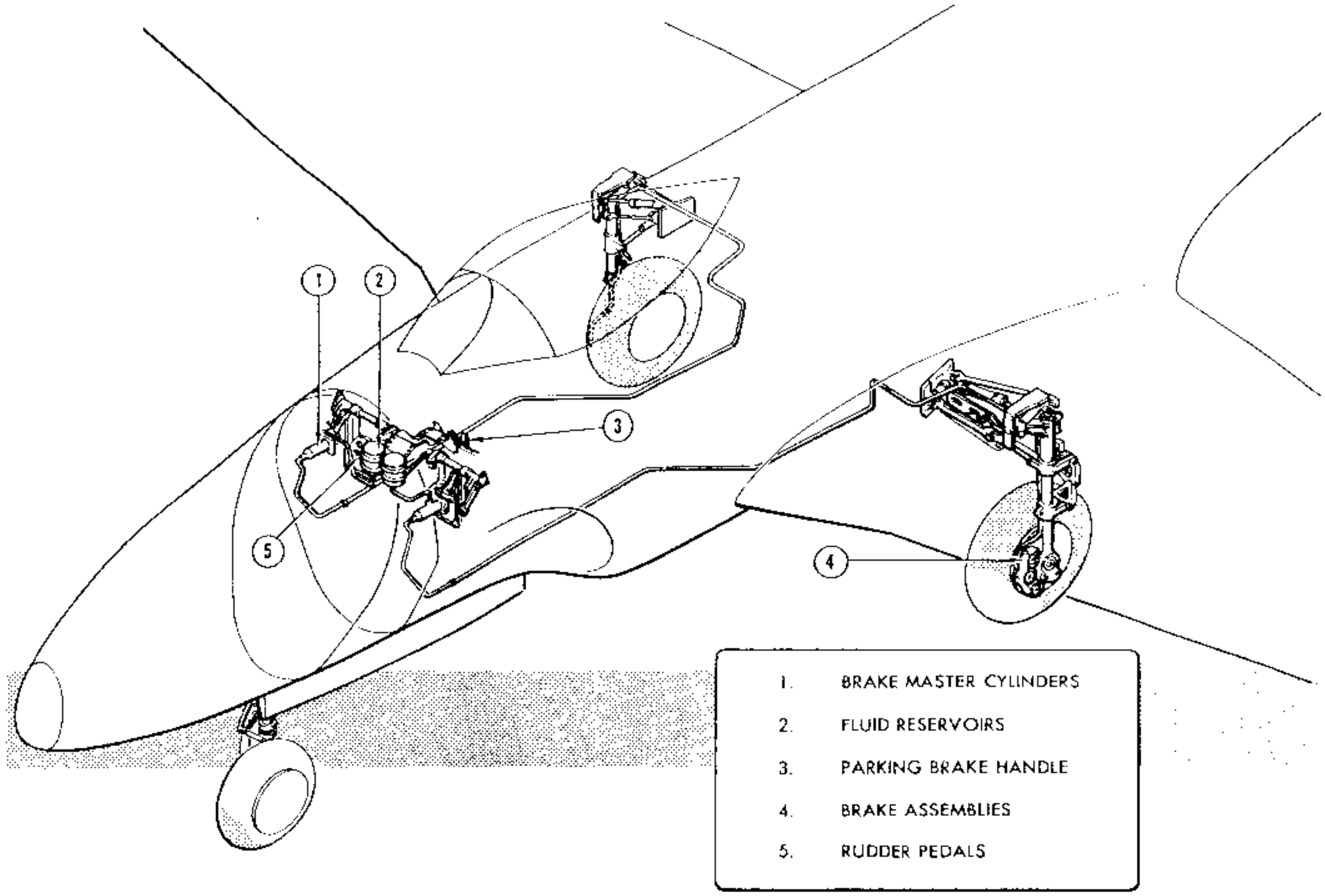



*Figure 79 — Brake System*

(3) BRAKE MASTER CYLINDER.

(*a*) P-80A AIRPLANES SERIAL NOS. AF44-84992 THROUGH 44-85336. (*See figure 80.*)

*1.* DESCRIPTION.—The two master cylinders are mounted in the armament compartment on the cockpit forward pressure bulkhead, one on each side. Seals (7) are installed under the mounting flanges to prevent loss of cockpit pressure. The piston-rod ends protrude into the cockpit where they are connected to the actuating mechanisms.

*2.* OPERATION.—When the brakes are applied, piston (15) moves to develop pressure on fluid in the master cylinder. Fluid is forced through lines to cylinders on the brake units where it actuates the wheel brake pistons. Upon release of the brakes, the piston is returned to normal position by spring (16) aided by spring-loaded valve (14). The valve, held in place by the spring, provides for entry of fluid to replace possible fluid leakage through the system, thus preventing pulling of air into the cylinder by the return of piston (15). This insures prompt return of the piston to normal position and permits rapid operation of the brake pedals.

*3.* REMOVAL.

a. Working in the cockpit, detach boot (8) from end of cylinder.

b. Working in the armament compartment disconnect the brake and reservoir lines.

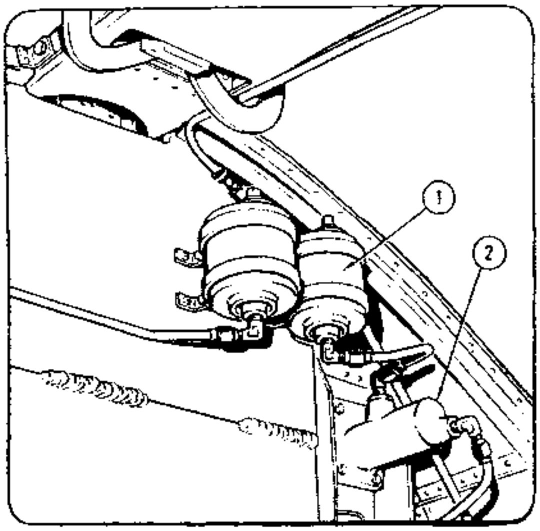
c. Remove four mounting bolts.

d. Remove the cylinder and its seal, leaving the piston rod and boot in the airplane.

(*b*) P-80A AND FP-80A AIRPLANES SERIAL NOS. AF44-85337 AND SUBSEQUENT. (*See figure 81.*)

*1.* DESCRIPTION.—The two master cylinders are mounted on the cockpit forward pressure bulkhead. Seals are installed under the mounting flanges to prevent loss of cockpit pressure. The piston-rod ends protrude into the cockpit where they are connected to the rudder pedal linkage.

The assembly contains a master cylinder, a parking brake unit, and a chamber to compensate for any fluid expansion resulting from changes in temperature. The parking brake is operated by hydraulic fluid in the brake system, and actuated from a handle located in the cockpit. A cable runs from the cockpit to the parking brake lever on the master cylinder.



| | |
|---|---|
| 1. | BRAKE RESERVOIRS |
| 2 | BRAKE MASTER CYLINDER |
| 3. | CYLINDER BODY |
| 4 | COMPENSATOR PORT |
| 5 | INLET PORT |
| 6. | MOUNTING FLANGE |
| 7. | RUBBER SEAL |
| 8 | BOOT |
| 9. | CLEVIS |
| 10. | PISTON ROD |
| 11. | SNAP RING |
| 12. | WASHER |
| 13. | "O" RING PACKINGS |
| 14. | VALVE ASSEMBLY |
| 15. | PISTON |
| 16. | SPRING |
| 17. | PRESSURE PORT |

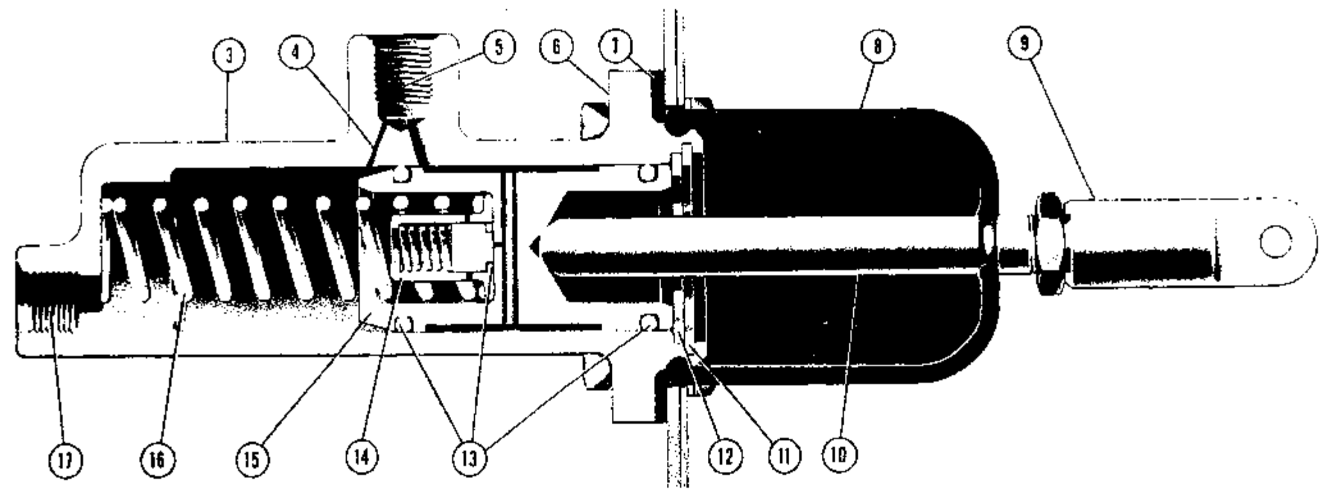


*Figure 80 — Brake Master Cylinder, Serial Nos. AF44-84992 through 44-85336*

*2.* OPERATION.—When the brakes are applied, piston rod (2) moves forward closing poppet valve (7) against the valve seat, shutting off flow of fluid to the cylinder chamber. Further movement of the piston rod moves piston head (8) to develop pressure in the chamber. Fluid is forced out and through the brake lines to actuate the wheel brake units. Upon release of the brakes, spring (10) forces the piston head and rod assembly back to original position.

A parking brake unit is an integral part of the master cylinder assembly. When lever (14) is actuated, valve and seat (12) close off flow of fluid from the master cylinder chamber, trapping fluid in the line system. Pressure from the lines then holds the valve closed, maintaining pressure on the wheel brake units. While the brakes are on, if any change in temperature occurs causing fluid expansion, piston (16) compresses spring (17) to make room for the excess fluid.

*3.* REMOVAL.

a. Working in the cockpit, remove bolt attaching master cylinder piston rod to rudder pedal linkage.

b. Remove boot (3).

c. Working in armament compartment, detach parking brake cable at lever (14) on master cylinder.

d. Disconnect brake and reservoir lines.

e. Remove four mounting bolts.

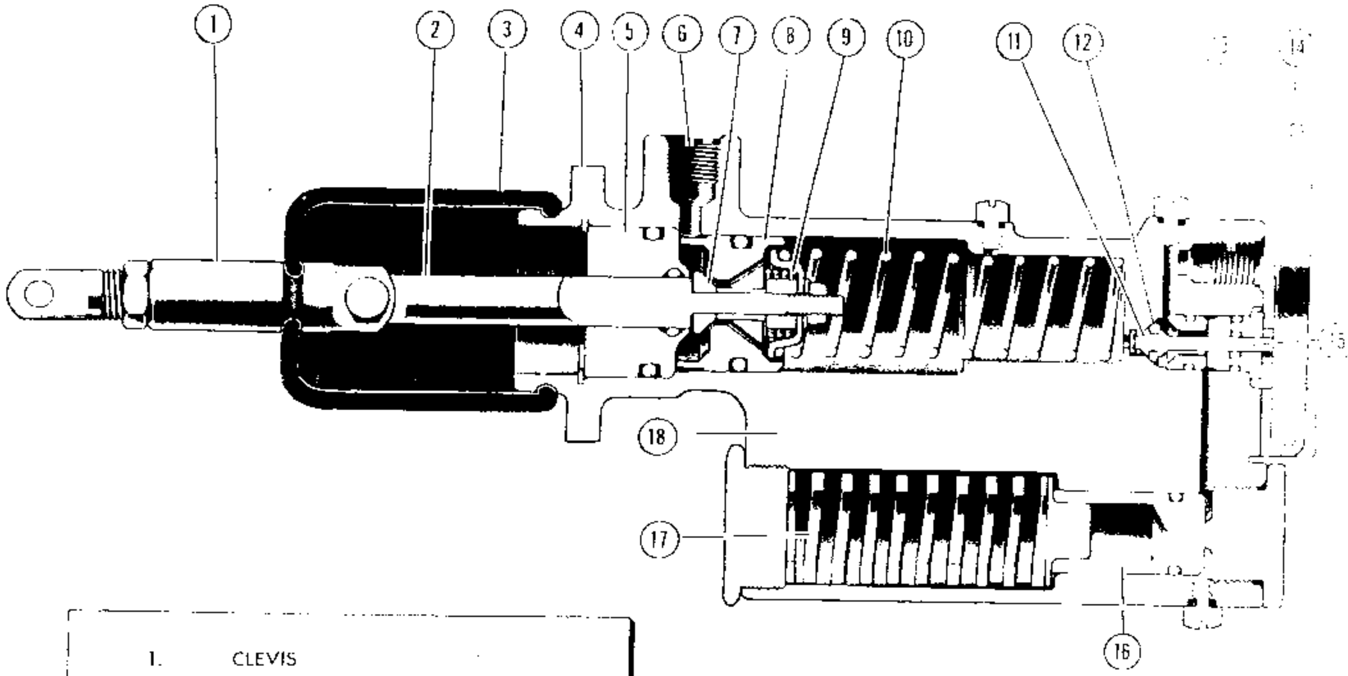
f. Remove cylinder assembly and its seal.

*(c)* CLEANING.—Wash parts with isopropyl alcohol, Specification AN-F-13.

*(d)* INSPECTION.

*1.* Inspect cylinder for scoring and worn spots.

*2.* Inspect compensating port and valve ports for freedom from obstruction.




| | |
|---|---|
| 1. | CLEVIS |
| 2. | PISTON ROD |
| 3. | BOOT |
| 4. | MOUNTING FLANGE |
| 5. | BEARING |
| 6. | ENTRY PORT |
| 7. | POPPET VALVE |
| 8. | PISTON HEAD |
| 9. | SPRING (PISTON VALVE) |
| 10. | SPRING (PISTON) |
| 11. | PISTON HEAD (PARKING BRAKE) |
| 12. | VALVE SEAT |
| 13. | PRESSURE PORT |
| 14. | PARKING BRAKE LEVER |
| 15. | PISTON ROD (PARKING BRAKE) |
| 16. | PISTON (ACCUMULATOR) |
| 17. | SPRING (ACCUMULATOR) |
| 18. | BODY (BRAKE ASSEMBLY) |
| 19 | BRAKE RESERVOIRS |
| 20. | BRAKE MASTER CYLINDER |

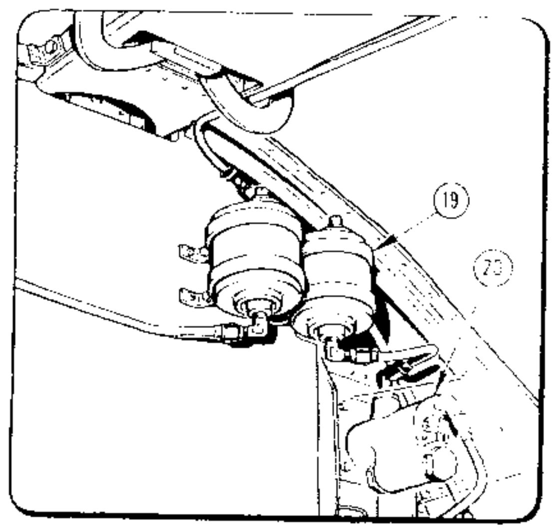



*Figure 81 — Brake Master Cylinder, Serial Nos. AF44-85337 and Subsequent*

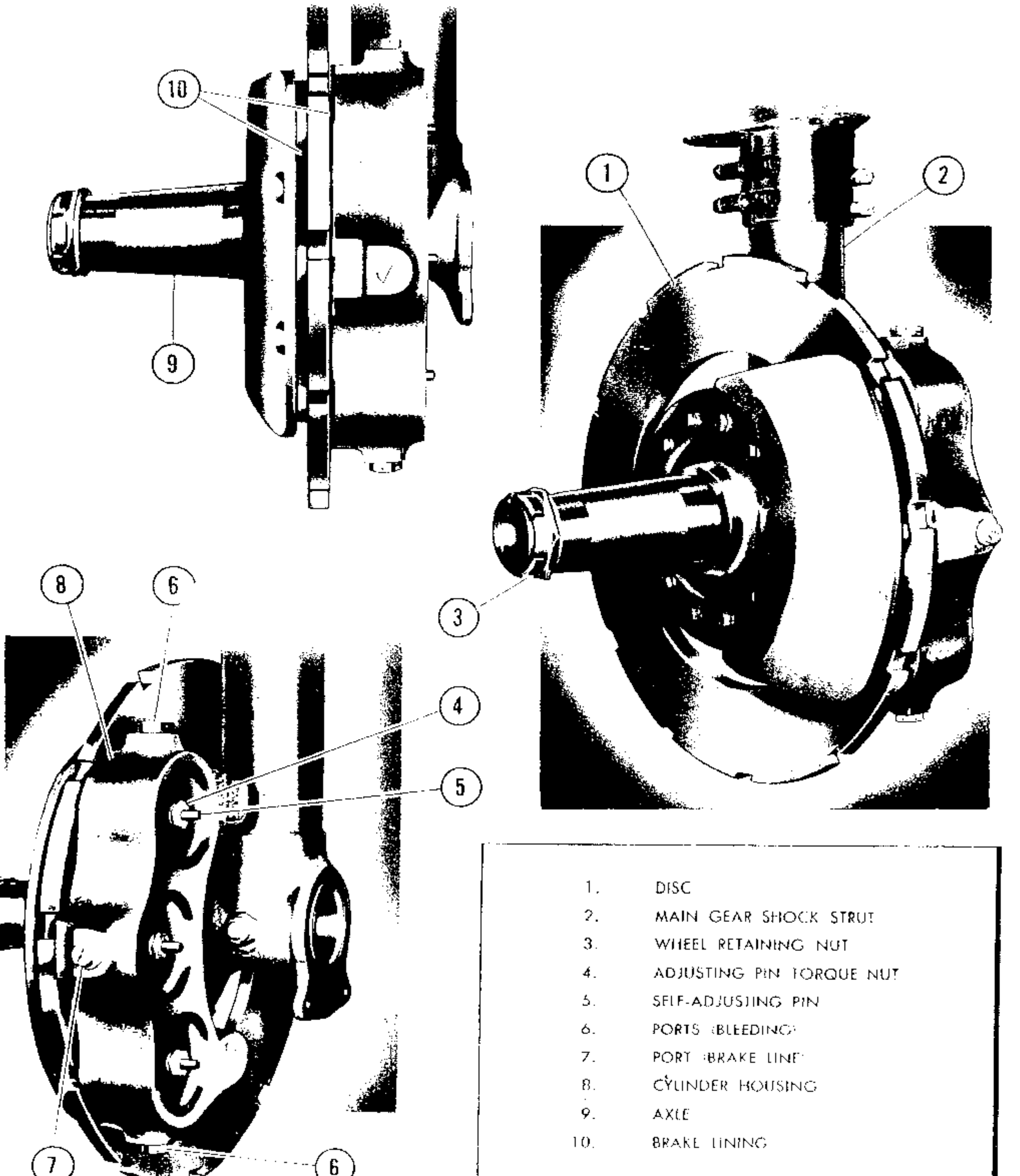
*(e)* REPLACEMENTS.

*1.* Replace "O" rings with new parts.

*2.* Replace springs if they are worn or damaged.

*3.* Replace seal.

*(f)* INSTALLATION.—Reverse removal procedure. Be sure that pressure seal between cylinder flange and bulkhead is installed. Flush and bleed the brake system. (See paragraph (7) following.)




| | |
|---|---|
| 1. | DISC |
| 2. | MAIN GEAR SHOCK STRUT |
| 3. | WHEEL RETAINING NUT |
| 4. | ADJUSTING PIN TORQUE NUT |
| 5. | SELF-ADJUSTING PIN |
| 6. | PORTS (BLEEDING) |
| 7. | PORT (BRAKE LINE) |
| 8. | CYLINDER HOUSING |
| 9. | AXLE |
| 10. | BRAKE LINING |

*Figure 82 — Brake Assembly*

*(g)* TEST.—Pressurize the cockpit, and check with soapy water for leakage around cylinder seals. If there are any leaks, do not attempt correction by overtightening cylinder mounting bolts. Remove the cylinder and inspect for proper fit and sealing.

*(h)* ADJUSTMENTS.—See paragraph (8) following.

(4) BRAKE ASSEMBLY.

*(a)* DESCRIPTION. *(See figure 82.)*—A brake assembly, consisting of a cylinder housing (8) and a disc (1), is mounted on each main alighting gear. The housing is bolted to a flange on the wheel axle, and contains piston assemblies and round linings called "pucks" (10) to effect braking action on the outboard side of the disc. Another opposing puck is placed in contact with the inboard side of the disc. The notched disc is held in place by keys which are part of the wheel. At the time of installation, or upon replacement of the puck, the brake assembly must be adjusted. Other than this adjustment, it needs no further adjustment during the life of the puck. Brake lining clearance remains constant, and the brake pedal remains in the same position with any degree of puck wear.

*(b)* OPERATION. *(See figure 83.)*—When hydraulic pressure from the master cylinder reaches the wheel cylinder through port (1), piston (2) moves inboard clamping the disc between the two pucks. When pressure is released, return springs (9) force plate (4), which is held in position by lock ring (3), outboard to the designed lining clearance. Due to torque on nut (6), the adjusting pin (7) and plate (10) remain stationary.

Since the assembly is self-adjusting, it immediately readjusts to restore designed lining clearance when necessary. As the pucks wear, pressure applied to the system moves piston (2) inboard the distance of the designed lining clearance. This normal piston movement will not bring the puck into contact with the disc. Continued pressure overcomes the 15 foot-pounds torque on nut (6), and the adjusting pin moves with the entire assembly until the pucks contact the disc. Upon release of the brake, torque on nut (6) prevents return springs (9) from moving the pin. This restores the designed clearance between pucks and disc.

The assembly remains full of fluid from the brake reservoir in the fuselage nose section.

*(c)* REMOVAL.

*1.* Remove the wheel. (See paragraph *b*(3) preceding.)

*2.* Detach brake line at center piston fitting, and plug the opening.

*3.* Remove bolts at the mounting flange.

*4.* Remove brake assembly with disc, takin care that linings do not fall out.

*(d)* DISASSEMBLY.

*1.* Drain fluid from the brake assembly.

*2.* Remove nut (6) and automatic adjustin grip (8).

*3.* Remove lock ring (11) and cylinder hea (5).

*4.* Remove piston assembly (2).

*5.* Remove lock ring (3) from piston. Adjus ing pin, springs, and plates are then free.

*(e)* CLEANING.—Wash parts with isoprop alcohol, Specification AN-F-13, or with kerosene c naphtha. Do not use gasoline.

*(f)* INSPECTION.

*1.* Inspect the disc. If it is warped or dishe replace it with a new disc.

*2.* Check piston for damage or evidence c leakage.

*3.* Inspect lining for excessive wear.

*(g)* REPLACEMENTS.

*1.* Replace "O" rings and packing.

*2.* Replace piston if necessary.

*3.* Replace lining.

*(h)* ASSEMBLY AND INSTALLATION.—Reverse disassembly and removal procedures. Flush an bleed the system. (See paragraph (7) following.)

*(i)* REPLACEMENT OF BRAKE LINING.

*1.* Jack airplane by placing jack under axl directly beneath strut.

*2.* Remove wheel.

*3.* Remove six rearmost brake-assembly moun ing bolts.

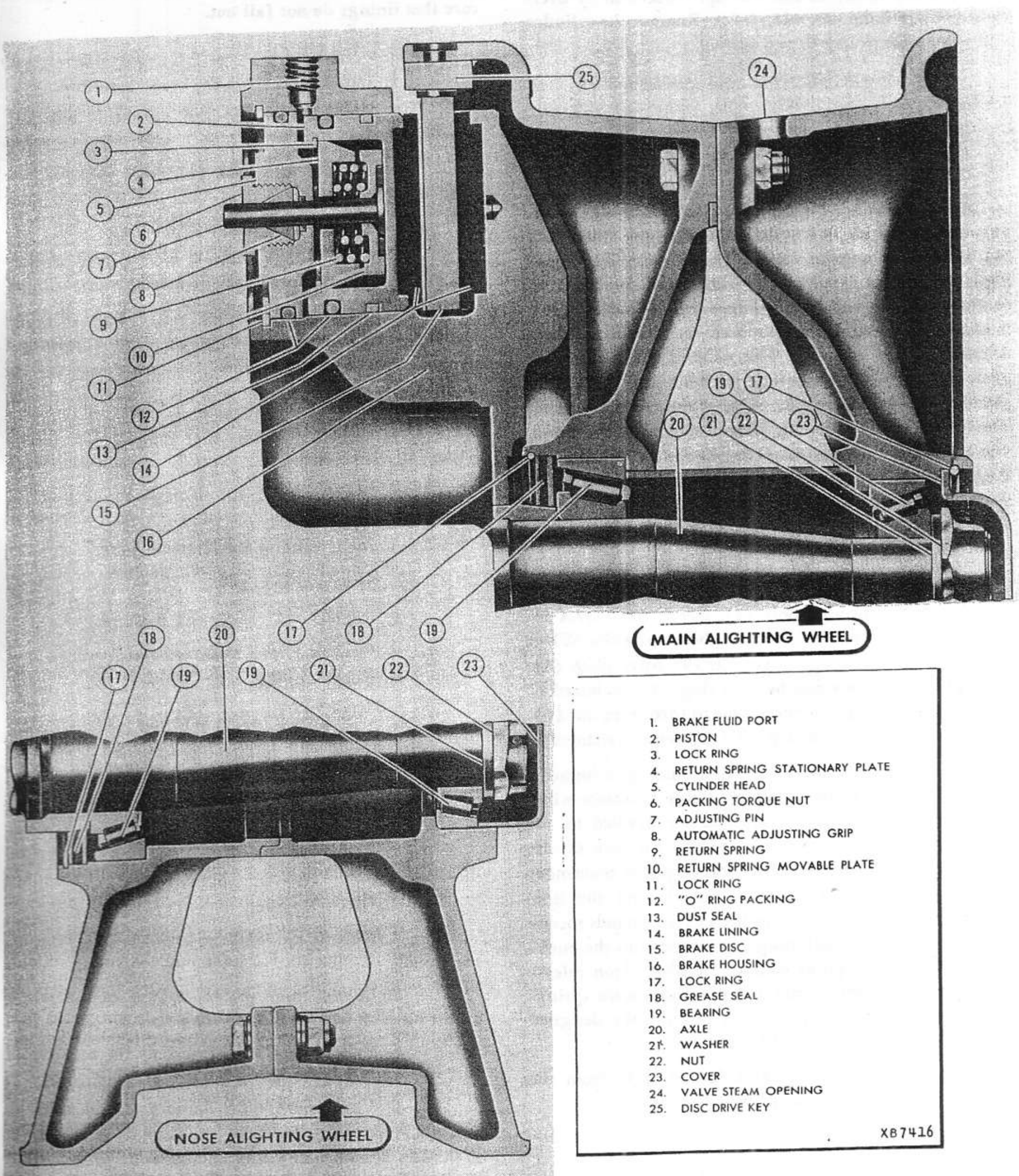
*4.* Loosen three packing-torque nuts, and pu adjusting pins outboard as far as possible.

*5.* Pull brake disc forward as far as possibl and remove old brake-lining pucks.

*6.* Install new brake lining pucks in pairs be ginning at bottom cylinder and working upward, puttin brake disc between all pucks simultaneously.

**Note**

Apply small amount of heavy grease to back side of brake lining pucks to hold them in place while brake disc is being installed.




1. BRAKE FLUID PORT
2. PISTON
3. LOCK RING
4. RETURN SPRING STATIONARY PLATE
5. CYLINDER HEAD
6. PACKING TORQUE NUT
7. ADJUSTING PIN
8. AUTOMATIC ADJUSTING GRIP
9. RETURN SPRING
10. RETURN SPRING MOVABLE PLATE
11. LOCK RING
12. "O" RING PACKING
13. DUST SEAL
14. BRAKE LINING
15. BRAKE DISC
16. BRAKE HOUSING
17. LOCK RING
18. GREASE SEAL
19. BEARING
20. AXLE
21. WASHER
22. NUT
23. COVER
24. VALVE STEAM OPENING
25. DISC DRIVE KEY

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*Figure 83 — Wheel and Brake Unit*

7. Install brake-assembly mounting bolts.

8. Adjust brakes. (See paragraph *(j)* following).

9. Check brake assembly for proper operation and absence of leakage.

10. Install wheel, and remove jack.

*(j)* ADJUSTMENT.—Manual adjustment of the brake assembly is necessary only upon installation of a brake assembly or upon replacement of the linings. Adjust as follows:

1. Remove alighting gear center door.

2. Loosen torque nut (6) until adjusting pin (7) can be moved. This should take place before leakage occurs.

3. Move the pin out as far as possible. This can be accomplished by shaking brake disc.

4. Using a suitable spanner wrench to keep cylinder head (5) from turning, tighten nut (6) to 15 foot-pounds torque. Do not exceed required torque as faulty operation or damage to automatic adjusting grip (8) may result. If nut flange should bottom against the cylinder head before reaching 15 foot-pounds torque, replace the automatic adjusting grip.

5. Replace alighting gear door.

6. Depress brake pedal in cockpit. The brake unit will then automatically adjust to the designed clearance.

*(k)* MAIN GEAR SWING JOINT.—A swing joint is installed in each brake line between the brake master cylinder and the main gear brake assembly. The joint is between the front and aft fulcrums of the main gear in the wheel well.

*(l)* REMOVAL OF SWING JOINT.

1. Drain brake system.

2. Disconnect brake lines from swing joint.

3. Remove two bolts holding unit in airplane, and remove swing joint.

**Note**

Outboard attaching nut is accessible through access panel No. 14 (See figure 7.)

*(m)* DISASSEMBLY OF SWING JOINT.

1. Remove shaft retaining nut and washer.

2. Push shaft out of body and supports.

*(n)* ASSEMBLY OF SWING JOINT. — Reverse removal procedure.

**Note**

On those aircraft incorporating T.O. No. 01-75F-28, the 175913 brass washers have been replaced with 206772 corrosion-resistant steel washers. If necessary, manufacture 1.000-inch OD, 0.760-inch ID, by 0.032 to 0.034-inch thick washers from type 302-1A corrosion-resistant steel, Spec AMS-5515.

(5) SERVICING THE BRAKE SYSTEM.—The reservoirs are located together and are accessible from the left side of the nose section. Remove filler plug and fill reservoirs to ½ inch below the filler hole with hydraulic fluid, Specification AN-O-366. Replace filler plugs.

(6) CLEANING.—Clean all brake system parts including seals, with isopropyl alcohol, Specification AN-F-13, kerosene, or naphtha. Do not use gasoline.

(7) BLEEDING BRAKES.—Each main gear wheel is equipped with a complete brake system, and each system must be bled separately.

**Note**

Bleed the brake system carefully or faulty brake action will result from air remaining in the system. Be careful to prevent any fluid from getting on linings or disc. If any fluid gets on linings or disc, it must be cleaned off thoroughly.

**CAUTION**

Do not use auxiliary air pressure when bleeding brakes.

*(a)* Clean the entire system and fill the reservoirs. Use hydraulic fluid, Specification AN-O-366.

**Note**

It is important that reservoirs be kept full of fluid during bleeding process.

*(b)* Open lower port on brake casting, and allow fluid to flow freely. Close port.

*(c)* Make sure that screw on each piston cylinder head is at the top. Pump brake pedal slowly several times, then hold the pedal down. Remove screw from bottom cylinder head and allow air to escape. Replace screw. Repeat at center and upper pistons.

**CAUTION**

Be sure that packing ring is replaced with cylinder head screw.

*(d)* Attach bleeder hose to bleed fitting at top port on casting. Place free end of hose in clean glass receptacle containing fluid. Pump brake pedal slowly several times, then hold pedal down. When fluid is free of air, remove the hose.

*(e)* With parking brake on, open two bleed ports on top of master cylinder, and allow air to escape. Close the ports.

*(f)* Check pedal operation. If soft, repeat bleeding procedure until brakes operate satisfactorily.

*(g)* Fill reservoirs. (See paragraph (5) preceding.)

(8) ADJUSTMENT OF BRAKE PEDAL LINKAGE. *(See figures 139 and 140.)*—Adjust each brake pedal and linkage to its respective master cylinder as follows:

*(a)* With brakes off and master-cylinder piston rod bottomed in the piston, adjust clevis so that bell crank (3) is in the position shown in figures 139 and 140.

**Note**

This adjustment must be made accurately to insure the correct amount of piston travel at the master cylinder.

*(b)* Fix rudder-pedal hangers in neutral position. This may be checked with a protractor-level, using the cockpit floor for reference. Front and rear faces of hanger each have a 2-degree taper.

*(c)* Adjust rod (2) so that a forward angle of not more than 8 degrees is obtained between aft face of pedal and aft face of hanger.

(9) LINING INSPECTION. — Inspect lining for excessive wear as follows:

*(a)* Apply brakes.

*(b)* Attempt to insert a 0.313-inch feeler gage between face of steel disc and the flat surface of the brake housing. If gage can be inserted, replace the inboard lining.

*(c)* Place 1/16-inch gage against disc face close to the outboard lining. If wearing-surface thickness of lining is 1/16 inch or less, replace the lining.

*(d)* Release brakes.

(10) TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Excessive pedal action or insufficient braking action. | Worn linings. | Replace with new set of linings. See paragraph 5*d*(9). |
| | Leak in system. | Check for leaks. Replace worn, deteriorated, or damaged seals. |
| | Air in system (rubbery, springy pedal action). | Bleed system. |
| | Lack of fluid in supply line. | Reservoir must be kept full to ½ inch below filler hole. |
| | Reservoir vent clogged. | Open vent to allow passage of air. |
| | Improper adjustment of brake linkage. | Check linkage for adjustments shown on figures 139 and 140. |
| Dragging brakes. | Dirt in system. | Disassemble and clean master cylinders and brake units. Flush lines and reservoirs with hydraulic fluid. |
| | Brake piston binding. | Remove piston and clean with isopropyl alcohol. |
| | Improper fluid. | Drain system;flush with isopropyl alcohol, kerosene, or naphtha. Replace seals if damaged. Fill system with hydraulic fluid, Specification AN-O-366, and bleed. |
| | Improper adjustment of parking brake. | Be sure the parking-brake ratchet is disengaging properly (early airplanes only). |
| | Incorrect lining clearance. | Adjust wheel brake assembly. See paragraph 5*d*(4)*(i)*. |

## 6. ENGINE.

*a.* GENERAL (See figure 84.) The engine is installed in the fuselage at approximately its intersection with the wing trailing edge. The engine is suspended on three quickly detachable mounts. The compartment in which it is installed receives air rammed in flight through two ducts contained within the fuselage contour. Air enters the ducts through two scoops located on either side of the fuselage forward of the wing leading edge.

The engine unit consists basically of a centrifugal air compressor and a single-stage gas turbine. The compressor is made up of casing, a diffuser, and an impeller. The impeller shaft is connected to the turbine by means of a coupling and a turbine shaft. The turbine is driven by burning a liquid hydrocarbon in combustion chambers. Air, for supporting combustion, reaches the combustion chambers through air adapters. The exhaust cone is mounted on the rear of the unit. Accessories are mounted on the accessory-drive gear case on the front of the engine.

(1) COMPRESSOR UNIT.—The compressor unit includes a compressor casing, an impeller, a diffuser, bearing supports, and guide blades. The impeller is a multi-vaned forging supported by bearings at front and rear and surrounded by the compressor casing and diffuser. The diffuser is cast with 14 identically symmetrical channels radiating outward on all sides. Through these channels the air is distributed into the air adapters leading to the combustion chambers. Guide blades direct the rammed air into each side of the impeller.

*(a)* Compressor impeller and rotating guide vanes do not normally require inspection during the service life of the engine. However, if foreign objects have passed through the engine and the rotating guide vanes are found to be nicked, a visual inspection may be performed to determine serviceability.

*(b)* Any nick or dent 1/8 to 3/16-inch deep in outer 2/3 of leading edge will be blended into contour of vane.

*(c)* Any nick or dent on rotating guide vanes 1/16 to 1/8-inch deep in inner 1/3 of leading edge will be blended into contour of vane.

*(d)* Depth of final blend will be 1/16-inch greater than original nick or dent, and length of final blend will be six times final depth. All edges of blend will be rounded.

*(e)* If, at any time during inspection, the compressor shims indicate movement or slippage from position and protrude less than 3/8 inch, retorque the compressor studs to the maximum side of the 240-234 inch-pound limits. J33-A-21 and earlier engines not having studs part No. 6710075 installed, will require 144-180 inch-pound torque. Record time of retorquing for future reference. If additional slippage occurs after retorquing and shims protrude more than 3/8 inch, reject the engine.

(1A) REPAIR OF AIR INLET SCREENS J-33 SERIES ENGINES.—Air inlet screens used on J-33 jet engines will be repaired, when required, as follows:

*(a)* Unweave each end of the broken screen wire far enough to secure it to a sound cross-wire.

*(b)* Fill the gap left by the severed wire by weaving a piece of 0.032-inch diameter stainless steel lock wire through the cross-wires remaining. Wrap the ends of the safety wire around the same two cross-wires which anchor the severed ends of the screen wire when possible.

*(c)* Cut off the surplus ends of the safety wire. Securely silver solder all ends of the wire to sound members of the screen. Solder each intersection of the safety wire to provide additional strength. Copper bronze may be used as an alternate for this repair.

*(d)* The above operation will be repeated as often as necessary to repair all of the broken screen wires in the affected screen assemblies. The end of the repair lock wires may only be anchored to sound strands of screen wire and will not be anchored to other strands of repair lock wires.

(2) ENGINE AIR ADAPTERS.—The diffuser of the compressor is connected to the ring-and-tube assembly of the turbine unit by 14 air adapters and spacers. The spacers adjoin the diffuser openings. The combustion-chamber end of each air adapter is recessed to absorb the tube expansion caused by the heat. Each air adapter contains a dome-and-nozzle assembly through which the fuel is injected into each combustion chamber. The air adapters for outer tubes Nos. 7 and 14 (see figure 87 for chamber numbering) each have a mounting pad for a spark plug which ignites the fuel. Adapters Nos. 5 through 11 have outlets for draining unburned fuel through a drain manifold from the combustion unit.

(2A) REMOVAL OF ENGINE AIR ADAPTERS.

*(a)* Remove engine from airplane. See paragraph 6e this section, for removal instructions.

**Note**

Take care to prevent entrance of dirt and other foreign material into engine while performing the following maintenance. Wherever practicable, temporary covers should be used.

*(b)* Disconnect drain manifold coupling nuts fittings on Nos. 5, 6, 7, 8, 9, 10 and 11 air adapters. Remove drain manifolds.

*(c)* Remove main fuel manifold coupling nuts from Nos. 7 and 14 starting fuel manifold check valves. Disconnect starting fuel system hose at each starting fuel manifold check valve. Remove check valves. Remove remaining fuel manifold coupling nuts from air adapter elbows.

*(d)* Remove spark plugs.

*(dA)* Carbon deposits located on the fuel nozzle tips will be removed by a soaking process. Using a shallow container filled with a suitable carbon solvent, Federal Specification P-S-661, and a soft bristle brush, hold the nozzle in a downward position and stroke downward toward the nozzle tip, thus dissolving the carbon, and flowing it off with the cleaning fluid.

**CAUTION**

Take care to make sure that no carbon particles are lodged in the nozzle tip orifice.

*(e)* Remove 10 hex-head bolts securing each air adapter and spacer to the diffuser. Remove air adapter spacer and gaskets. Discard gaskets. Slide air adapter forward and remove it.

*(f)* Remove three nuts securing combustion dome brackets to air adapter. Remove dome, lifting it carefully over nozzle tip.

*(g)* Remove hex-head plug, gasket and filter retaining spring. Discard gasket.

*(h)* Insert puller No. 9074026 in open end of tubular filter and rotate handle slightly in either direction to free filter in housing. Remove filter.

*(i)* Remove fuel nozzle and gasket, using particular care not to damage nozzle orifice and filter screen. Discard gasket.

(2B) INSTALLATION OF ENGINE AIR ADAPTERS.

*(a)* Coat threads of each fuel nozzle with a light coat of compound, Specification No. MIL-C-5544, and install nozzle and new gasket. Tighten to torque specified in Section IX.

*(b)* Carefully place dome in position over fuel nozzle and secure it with nuts.

*(c)* Install tubular filter, retaining spring, new gasket, and hex head plug. Coat plug threads with Permatex No. 3 or equivalent, and tighten plug to torque specified in Section IX.

**Note**

All air adapters are numbered and must be installed at diffuser elbows having corresponding numbers.

*(d)* Install compression rings by hand in combustion chamber ring grooves. Position rings so that their gaps are above the horizontal center line of tube opening and at least 60 degrees apart before air adapter is installed.

*(e)* Install air adapters. Gently, but firmly, press recessed end of adapter over compression rings, turning adapter at the same time. The flared edge of adapter recess will compress rings, allowing adapter to slide into position. Rotate adapter until it is in proper position for installation of spacer.

*(f)* Place a new gasket on each face of spacer, and install spacer with narrow flange to front.

*(g)* Install bolts with lock washer between head of bolt and plain washer. Draw down all bolts evenly and lightly to obtain contact with gasket, then torque to between 50 and 60 pound-inches.

*(h)* Install drain manifolds.

*(i)* Install combustion chamber check valves. Install main fuel manifold coupling nuts, and starting fuel hoses. See Section IX for torque values of coupling nuts and fittings.

*(j)* Install spark plugs. See Section IX for torque values of spark plug mounting nuts.

(3) TURBINE UNIT.—The turbine unit consists of a turbine wheel and shaft, a nozzle diaphragm, and a series of combustion chambers called the ring-and-tube assembly. A continuous ring of curved blades (buckets) is dovetailed into the outer rim of the turbine wheel. The nozzle diaphragm directs the gas against the wheel buckets. The ring-and-tube assembly, where combustion takes place, consists of 14 interconnected stainless-steel cylinders converging on a supporting ring. Each tube contains a removable liner, or flame tube, joined to its adjacent liner by crossover tubes.

Combustion chambers will be acceptable for further service under the following conditions: Any number of cracks in the outer combustion chamber are permissible providing none show soot deposits. However, cracks shall not exceed a maximum length of 1½ inches with a minimum distance of ½ inch between any two cracks.

When hot spots are found on the ring and tube assembly transition end, and an inspection of the fuel nozzles is made to correct the difficulty, the inner liners will be removed for inspection. If buckling is of a minor nature, or cracks do not converge from hole to hole or hole to louver, or progress in such a manner that a piece may break out, and no more than one crack emanates from either hole or louver, and no cracks are existent on the liner transition end, the liner is considered satisfactory for additional use.

*(a)* A dent is an imperfection on the blade surface or on the leading or trailing edge of a bucket, and is generally shallow with rounded edges and bottom. Such impressions are believed to occur most commonly when the wheel is operating, and result from the bucket being struck by some object passing through the engine. The impression may be likened to that caused by a steel ball hitting a surface.

*(b)* Any dent on the blade surface or on the leading or trailing edge not exceeding 0.1875 inch in diameter at the surface, and which has not caused metal deformation on through to the opposite side of the blade, or caused visible damage on the leading or trailing edge, will be lightly stoned to remove the crater outline on the surface. The allowable depth of a dent on the leading or trailing edge will not exceed 0.015 inch after stoning. (See figure 84A.)

*(c)* A nick is a gouge or furrow showing increasing depth in travel from its source, usually sharp sided and V-shaped in the bottom. Such markings are the results of sharp objects passing through the engine, e.g., the mark made by the sharp edge of a cap-screw head when driven against a piece of metal at high velocity.

(*d*) Any nick on the blade surfaces which is not greater than 0.1875 inch in length and which has not caused metal deformation through to the opposite side of the blade will be lightly stoned to remove furrow outlines on the surface. (See figure 84A.) Any nick on the leading edge of the blade which is not greater than 0.125 inch in length and which has not caused metal deformation of the edge other than to raise furrow sides will be lightly stoned to remove the furrow outline. The depth of the nick after stoning will not exceed 0.015. (See figure 84A.) Any nick on the trailing edge or on the trailing edge radius of the blade will be cause for bucket replacement. (See figure 84A.)

(*e*) The diameter of a dent or length of a nick is the dimension before stoning. When furrow outlines have been stoned away, the surface measurement of the stoned area may exceed the acceptable limit of the original dent or nick and still be acceptable.

(*f*) A crack is a distinct break in the surface of a bucket or in the leading or trailing edge. This type of damage may be the result of unusual bucket stretch, deformation, and/or fatigue of the metal. Cracks resulting from bucket stretch or unusual deformation generally present jagged surface characteristics and tend to follow the grain boundaries in the metal. Fatigue cracks, at least at their points of origin, are somewhat smooth and straight and are generally intracrystalline. A short distance from their point of origin, they may become less regular and tend to follow the grain boundaries.

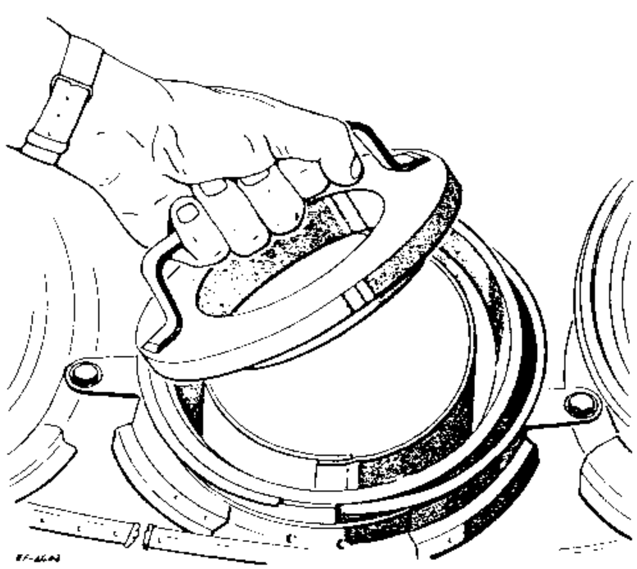


*Figure 83A — Inner Liner Centering Tool, Allison Tool No. 3144*

(*g*) Any crack, either on the blade surface or on the leading or trailing edge, will be cause for engine removal.

(*h*) The maximum allowable rework of the turbine bucket tip wear that can be tolerated before engine change is 0.030 inch in depth, and may extend all the way across the tip. If the turbine wheel buckets meet these requirements, stone any feathered edges from the affected buckets and stone all metal deposits from the exhaust cone shroud ring. (See figure 84A.)

(*i*) If the dovetail base of any staked-type bucket has shifted forward or aft in excess of 0.020 inch, the buckets will be repositioned. Slowly rotate the turbine wheel while pushing forward on it. Any indication of rubbing against the gas baffle or diaphragm inner ring is cause for engine replacement.

(*iA*) Remove four turbine blades, located approximately 90° apart, from turbine wheel. Dye penetrant inspect loaded side of innermost serrations of four blade recesses in turbine wheel. Crack indications may be found in this area as a result of excessive speed and temperature stresses which are concentrated at fore and aft center of bottom side of sixth serration from outside diameter of wheel (see figure 83B). To examine this area, use a thin metallic mirror or other device that will permit viewing bottom side of serration. Condemn turbine wheel if indications of a crack of any length is found in any of these locations.

**Note**

It is not required that all blades be removed from a turbine wheel to make this inspection. Inspection of two bottom serrations in each of four dovetails will be adequate to accept or reject turbine wheel.

(*j*) Determine fore and aft position of turbine nozzle ring by inserting a locally manufactured gage (See figures 84B and 84C) between leading edge of inner ring and inner ring and tube mounting flange face at 8 or more equally spaced positions. If gage blade will enter any position so that tip bottoms on outer side of mounting flange, reject engine.

(*k*) Nozzle diaphragms will be acceptable for further service under the following conditions:

*1.* If the diaphragm is a pinned type unit (as evidenced by inspection through the turbine wheel blades), inspection of the mounting flange-to-inner spacer ring weld for cracks will not be necessary. Cracks

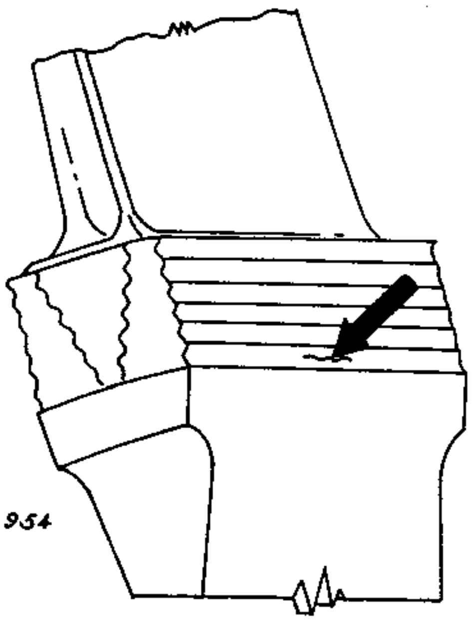



*Figure 83B — Turbine Wheel Inspection*

may be evident in pinned type units, however, the engine will be retained in service. Unpinned type diaphragms will be inspected for cracks after the first 50 hours and at each succeeding 25 hours thereafter. When 200 hours of operation is attained the engine will be rejected. If cracks are found prior to 200 hours, reject the engine.

*2.* Inspect diaphragm in accordance with figure 84D, views F and G, and reject engine if cracks in either ring indicate danger of pieces breaking out or if any cracks exceed 1/32-inch in width or if cracks emanate from both leading and trailing edges of same vane.

*3.* Distortion or warpage of vanes will not be cause for engine removal unless engine performance is affected.

*4.* If nicks are no greater than 0.010-inch deep, regardless of number, continue engine in service. One nick per vane to a maximum depth of 1/8-inch is permitted in addition to the above.

*5.* If a dent does not exceed the distortion limits, as set forth above, the dent is acceptable.

*6.* If a crack or cracks emanate from a dent, which does not exceed the distortion limits, the acceptability must be further judged by the crack limitations, as outlined in figure 84D.

(3A) REPLACEMENT OF TURBINE WHEEL BUCKETS.

*(a)* Special tools required: AF Stock No. 8004-43, puller-turbine bucket impact, Class 18; AF Stock No. 8700-501570 or 8700-501580, paper-stencil board oiled smooth Grade 1, Class 25-B; and six locally manufactured plug gages made to the following dimensions:

| | "GO" END | "NO-GO" END |
|---|---|---|
| Standard | 0.124 (+0.0000, −0.0005) | 0.127 (+0.0005, −0.0000) |
| 0.010 Oversize | 0.134 (+0.0000, −0.0005) | 0.137 (+0.0005, −0.0000) |
| 0.020 Oversize | 0.144 (+0.0000, −0.0005) | 0.147 (+0.0005, −0.0000) |
| 0.030 Oversize | 0.154 (+0.0000, −0.0005) | 0.157 (+0.0005, −0.0000) |
| 0.040 Oversize | 0.164 (+0.0000, −0.0005) | 0.167 (+0.0005, −0.0000) |
| 0.050 Oversize | 0.174 (+0.0000, −0.0005) | 0.177 (+0.0005, −0.0000) |

*(b)* Buckets will be replaced 100 percent if required. When a turbine wheel bucket that has failed is replaced, the bucket diametrically opposed 180 degrees shall also be replaced.

*(c)* Place a piece of stencil paper between gas baffle and base of bucket to prevent baffle damage.

*(d)* Using a composition or plastic drift against bucket base, drive bucket forward carefully with a one-pound hammer until bucket retaining pin is sheared.

*(e)* Install turbine wheel bucket impact puller and remove bucket from wheel by tapping toward the rear with impact puller.

*(f)* Removal of buckets will leave sheared portion of retaining pin in the turbine wheel. To remove pin, apply penetrating oil to sheared pin and let it stand approximately two hours. Drift pin from wheel with a 1-inch by 0.112-inch diameter straight shank drift. Drive pin from wheel fillet toward serrations.

Gage pinhole to determine its minimum diameter, taking into consideration that wheel metal may have been upset at wheel fillet. Ream fillet end with a tapered reamer of same size as gage to prevent pin seizure when replacement pin is installed.

*(g)* New bucket installation.

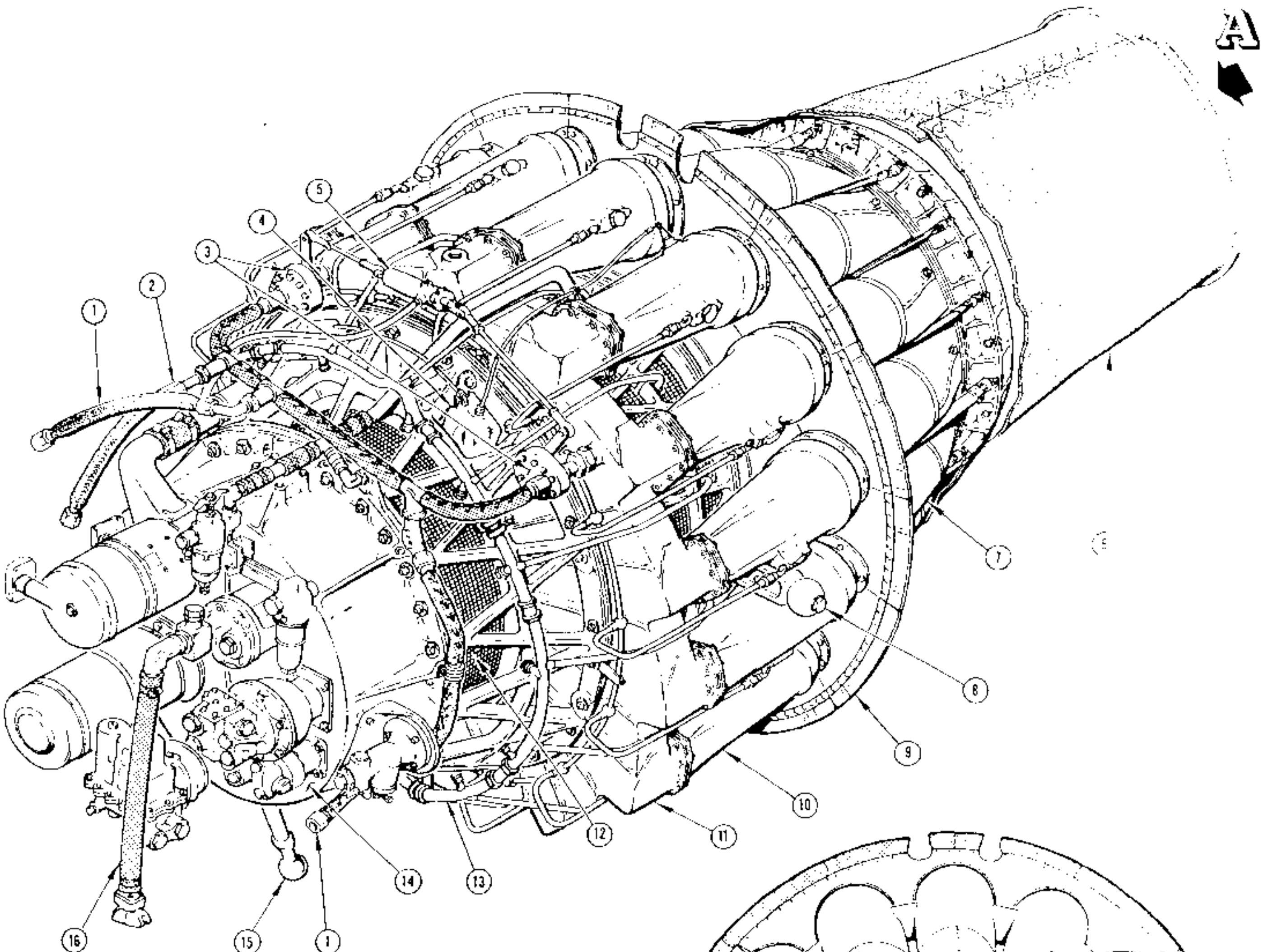
Position buckets in turbine wheel. Insert gage in pinhole to make certain that bucket is properly positioned. Be sure that gage enters and bottoms in pin slot of bucket. This can be determined by "feel."

**Note**

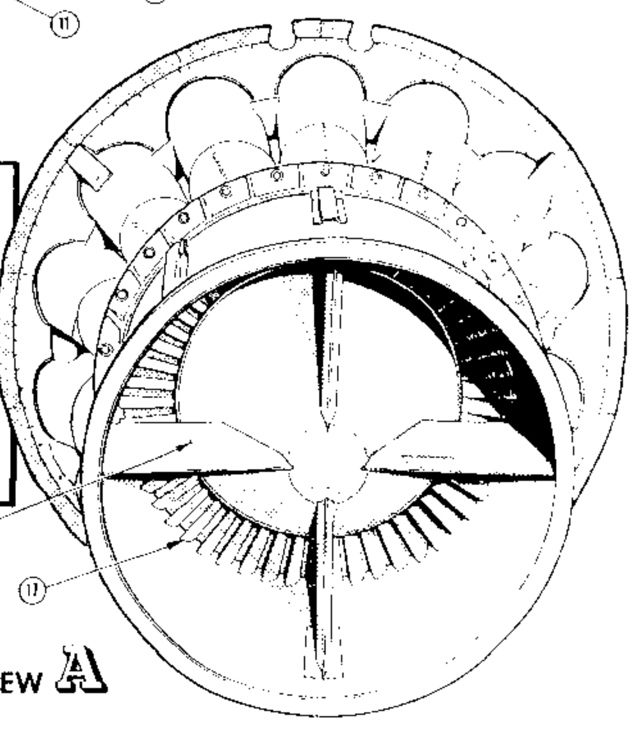
Do not attempt to hammer gage into position.

Tap retaining pin through wheel hole into bucket slot until bucket begins to tighten on wheel. Use a 0.112-inch diameter straight shank drift to install pin.

Using a plastic or composition drift, tap each bucket on platform at rear of bucket base to make sure that bucket is not binding on pin, and that it is free for circumferential shake.



1. HEATING COOLING AND PRESSURIZATION MANIFOLD
2. CAMERA HEATING MANIFOLD (FP-80A 10 AIRPLANES ONLY)
3. AIR SHUT OFF VALVES
4. BOOSTER COIL
5. AIR SHUT-OFF VALVE ACTUATOR
6. EXHAUST CONE
7. COMBUSTION CHAMBER
8. TRUNNION MOUNT
9. AIR SEAL
10. AIR ADAPTER
11. COMPRESSOR CASING
12. AIR INTAKE SCREEN
13. FLUID INJECTION MANIFOLD
14. ACCESSORY DRIVE GEAR CASE
15. BALL SUPPORT
16. MAIN FUEL LINE
17. TURBINE WHEEL
18. VANES



VIEW A

*Figure 84 — Complete Engine*

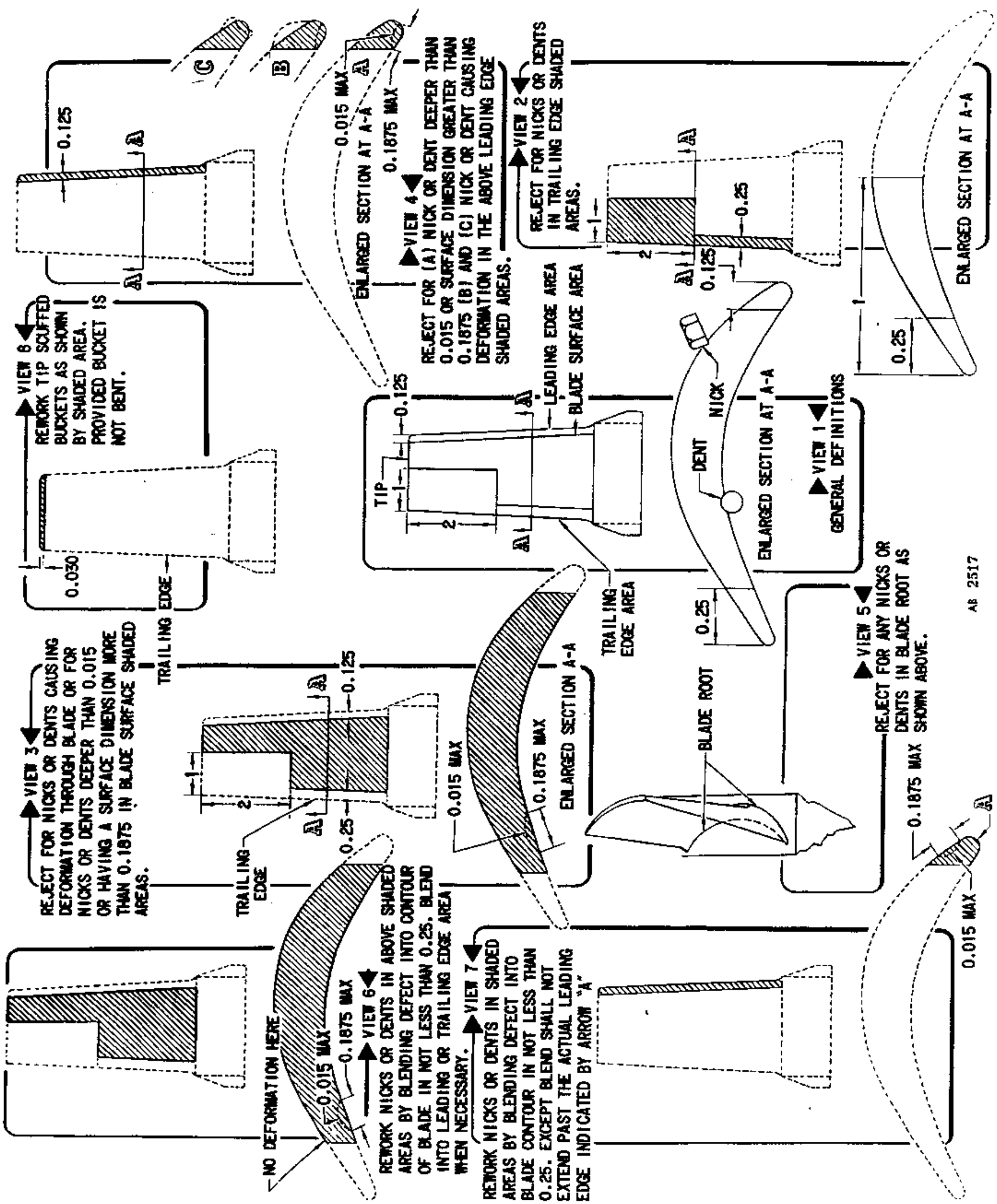



Figure 84A — Turbine Bucket Repair

(3B) INSPECTION AND INSTALLATION OF INNER LINERS AND CROSSOVER TUBES. *(See figure 83A.)*

*(a)* When hot spots are found on the ring and tube assembly transition end, and an inspection of fuel nozzzle is made to correct the difficulty, the inner liners will be removed for inspection. If buckling is of a minor nature, or cracks do not converge from hole to hole or hole to louver, or progress in such a manner that a piece may break out, and no more than one crack emanates from either hole or louver, and no cracks are existent on the liner transition end, the liner is considered satisfactory for additional use.

*(b)* If replacement of inner liners is required the procedure outlined below will be followed. Use special inner liner centering tool Allison tool No. 3144 for centering the front end of the inner liner in the combustion chamber tube and for gaging the axial position of the inner liner. Install tool No. 3144 into the front end of the inner liner so that the front edge of the inner liner will be firmly seated against the shoulder of the tool. The entering edge of the tool contains a chamfer which will aid in guiding an out-of-round liner into the pilot diameter of the tool.

*(c)* Insert the inner liner into the combustion chamber tube of the ring and tube assembly, using tool No. 3144 and lightly tapping with a mallet, if necessary, seat the inner liner into position until the flange of the tool bottoms against the combustion chamber tube.

*(d)* If more than light tapping with a mallet is required to fully seat the inner liner into position, remove liner for possible use in another location, and select liners which can be properly positioned without binding.

(e) With tool No. 3144 held in position, mark the locating dowel hole on the elongated pad of the inner liner. Then, remove the inner liner from the combustion chamber tube. Mark inner liner with the number of the combustion chamber tube. Drill through and using a tapered lead reamer, ream a 0.181–0.183 inch diameter hole for the locating dowel at the marked position.

*(f)* Install inner crossover tubes into position.

*(g)* Install inner liners in combustion chamber tubes, of corresponding number, using procedure outlined above for replacement of inner liners.

*(h)* Install locking clips and dowel bolts which secure inner liners. Lock tab washers.

*(i)* Install engine air adapters.

(4) EXHAUST CONE. — The exhaust cone is tapered cylindrical outlet for exhaust gas. It contains closed, smaller cone, around which gas is ejected in gradually expanding jet form. The exhaust cone bolted to the turbine, forming the rear end of the uni

Exhaust cones with the welds cracked at the out reinforcement band (regardless of length) will be r moved and repaired by field maintenance by heli-a welding. Use welding rod type 18-8CB, Spec MIL-I 5031, Composition 5, S/N 6800-725100 or welding ro 19-9 WX, Spec MIL-R-5031, Composition 6, S/N 680 725400. If welding equipment is not available, install serviceable cone, and return repairable cone to overhau

**Note**

One piece exhaust cone assemblies are interchangeable with three piece exhaust cone assemblies.

(4A) REMOVAL OF ENGINE EXHAUST CONE.

(a) Remove engine from airplane. See para graph 6*e* this section, for removal procedure.

*(b)* Remove tail pipe clamp from engine exhaus cone.

**CAUTION**

Handle clamp with extreme care to prevent damage to insulating blanket.

*(c)* Remove exhaust cone thermocouples.

*(d)* Remove wire lacing of tail pipe adapter ir sulation pad, and carefully unwrap insulation fror adapter.

*(e)* Remove wire lacing of ring and tube rear flange insulation pad, and carefully unwrap insulatio from engine.

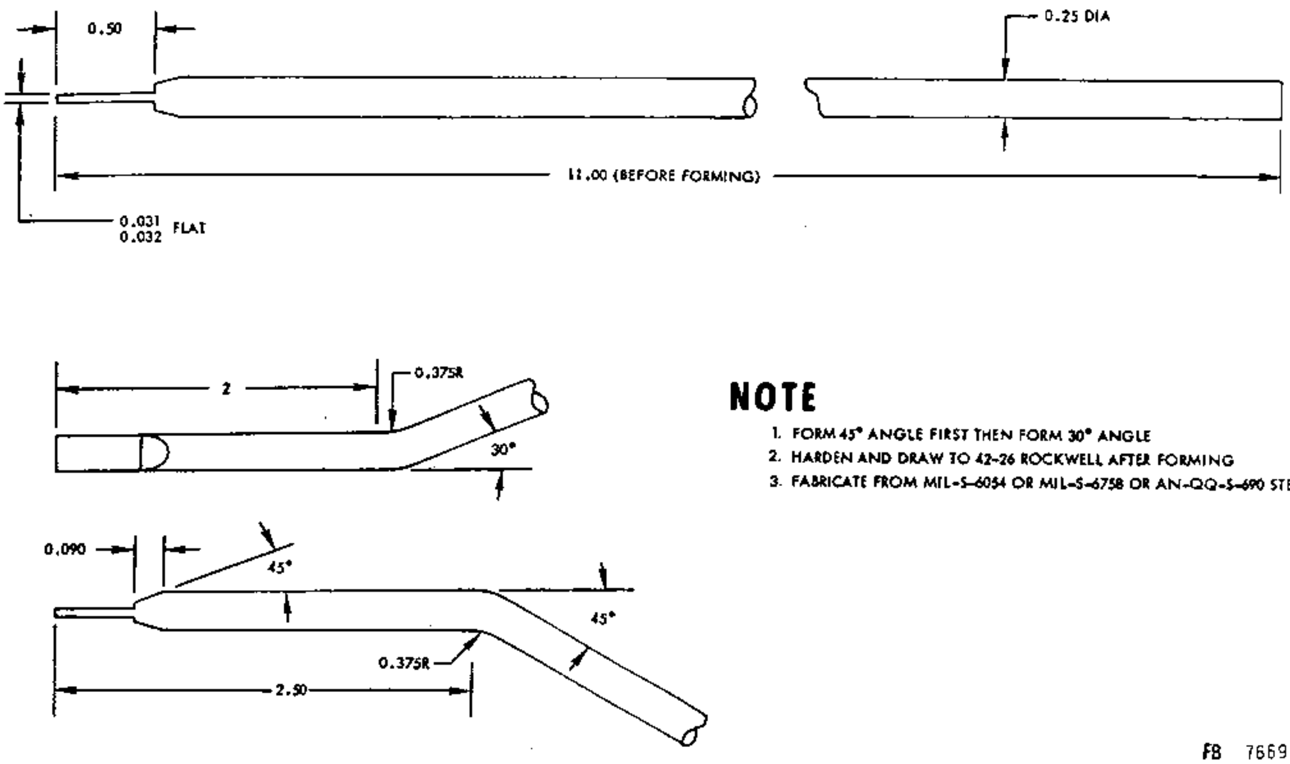
*(f)* Remove wire lacing of exhaust cone insula tion pad and carefully unwrap insulation pad fror exhaust cone.

*(g)* Remove air diaphragm from between ring and-tube flange and exhaust cone.

*(h)* Remove all exhaust-cone retaining bolts, an remove exhaust cone.

(4B) INSTALLATION OF ENGINE EXHAUS CONE.

(a) Lubricate the four, $\frac{5}{16}$ - 24 x $\frac{13}{16}$ inch re




## NOTE

1. FORM 45° ANGLE FIRST THEN FORM 30° ANGLE
2. HARDEN AND DRAW TO 42-26 ROCKWELL AFTER FORMING
3. FABRICATE FROM MIL-S-6054 OR MIL-S-6758 OR AN-QQ-S-690 STEEL

FB 7669
M-23-20-4-56C

*Figure 84B — Turbine Nozzle Inner Ring Gage*

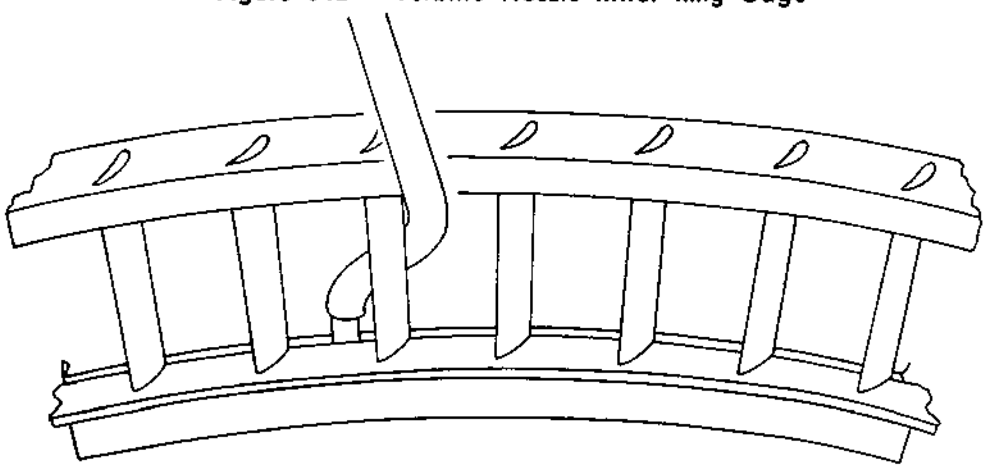
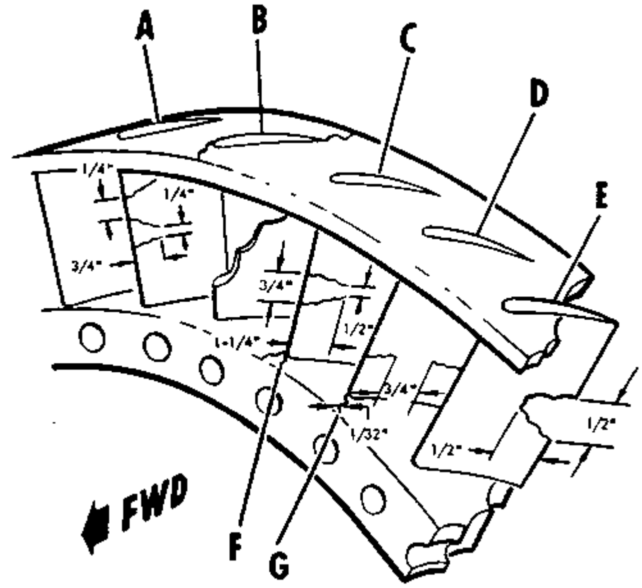


*Figure 84C — Turbine Nozzle Ring Inspection*

FB 7668
M-23-20-4-56D




| | NUMBER ALLOWABLE | SEPARATION LIMIT | CONVERGENCE LIMIT |
|---|---|---|---|
| A. VANE CRACKS - LESS THAN 3/4 IN. LONG | ANY NUMBER | 1/4 IN. MINIMUM | 1/4 IN. MINIMUM |
| B. CRACKS - IN BOTH LEADING AND TRAILING EDGE OF INNER OR OUTER SPACER RING OF SAME VANE LOCATION | NONE | | |
| C. VANE CRACKS - 3/4 TO 1-1/4 IN. LONG | 3 PER VANE | 1/4 IN. MINIMUM | 1/2 IN. MINIMUM |
| D. VANE CRACKS IN LEADING AND TRAILING EDGE OF SAME VANE | 1 PER VANE | | 3/4 IN. MINIMUM |
| E. PIECE BROKEN OUT OF VANE ON TRAILING EDGE ONLY | 1 PER VANE NO LARGER THAN 1/2 IN. X 1/2 IN. | | |
| F. TWO CONVERGING CRACKS IN INNER OR OUTER RINGS | ANY NUMBER | | 1/2 IN. MINIMUM |
| G. CRACK IN INNER OR OUTER SPACER RING<br>NICKS OR DENTS<br>DISTORTION OR WARPAGE OF TRAILING EDGE OF VANE | ANY NUMBER<br>NO LIMIT<br>NO LIMIT ON SIZE OR NUMBER OF VANES AFFECTED | 1/32 IN. MAX. WIDTH | |

M20-27-4-94 CB 7764

***Figure 84D — Nozzle Diaphragm Limitations***

cessed head screws and the fifty-six, ⅜ - 24 x 1$^{13}/_{32}$-inch bolts with compound, Spec MIL-C-5544.

*(b)* Install the turbine shroud ring over the turbine exercising extreme caution to prevent damaging the buckets, and align the four $\frac{5}{16}$-inch holes in the ring-and-tube flange. Insert the four recessed head screws and install four, $\frac{5}{16}$-24 Klincher nuts finger tight.

*(c)* Make a preliminary measurement of the bucket-to-shroud ring clearance with Feeler Gauge Allison No. 2825. Refer to Table of Limits. The shroud ring may be shifted radially to equalize clearances. If the turbine shroud ring fails to meet required limits, remove and select another shroud ring until clearances are within limits.

*(d)* The 0.065 inch clearance between bucket tip and the turbine shroud ring given in Table of Limits, is a minimum clearance for a new exhaust cone shroud ring. The 0.045 inch limit is minimum for installation of shroud ring in service.

*(e)* Tighten and torque the four $\frac{5}{16}$-24 Klincher nuts to 90-110 inch-pounds.

*(f)* Install the exhaust cone assembly so that the inner cone supporting vanes are in the vertical and horizontal plane through the cone's axis.

*(g)* Install the exhaust cone flange reinforcing ring in such position as to expose the four recessed head screws that secure the turbine shroud ring to the ring and tube. Insert four of the ⅜-24 bolts at approximately 90 degree intervals through the assemblies and

install four ⅜-24 Klincher nuts, finger tight. Measure the inner exhaust flange to turbine wheel clearance in four places at 90 degree intervals with Feeler Gauge Allison No. 2825.

*(h)* Install the remaining fifty-two, ⅜-24 bolts, with heads to front (nuts on the exhaust cone side) except the two bolts near the top, which are reversed because of the engine lifting boss. Tighten and torque the ⅜-24 nuts to 290-310 inch-pounds.

*(i)* Limit for looseness of inner cone of exhaust unit assembly will not exceed 0.125 inch. Buckling from the original contour of exhaust cone assembly is permissible provided buckling does not exceed 0.75 inch, or buckling does not have sharp radii which may result in cracking.

*(j)* Install air diaphragm.

*(k)* Install all insulating pads and lace securely.

*(l)* Install exhaust cone thermocouples.

*b.* TABLE OF SPECIFICATIONS.

| | |
|---|---|
| Model | |
| F-80A-1 | J33-A-9 or J-33-GE-11 |
| F-80A-5, RF-80A-5 | J33-A-17 |
| F-80A-10, RF-80A-10, RF-80A-15 | J33-A-9A or -9B J33-G-11A or -11B, J33-A-17A, or J33-A-21 |
| RF-80A-20, RF-80A-25 | J33A-35 |

**Note**

The J33-A-21 engines, Serial No. A-073347 and subsequent, are desirable for low temperature operation. Should engine change become necessary on winterized airplanes, replace with aforementioned recommended engine.

| | |
|---|---|
| Type | For turbo-jet propulsion |
| Number of Combustion Chambers | 14 |
| Normal Rating (Sea Level) | |
| Thrust | 3275 lb |
| Speed | 11,000 rpm |
| Exhaust Temperature | 700°C (1292°F) |
| Normal Rating (Sea Level) | J33-A-35 |
| Thrust | 3900 lb |
| Speed | 11,250 rpm |
| Exhaust Temperature | 655°C (1210°F) Max |
| Military Rating (Sea Level) | |
| Dry | |
| Thrust | 3825 lb |
| Speed | 11,500 rpm |
| Exhaust Temperature | 700°C (1292°F) |
| Wet (Fluid Injection) | |
| Thrust | 4500 lb |
| Speed | 11,500 rpm |
| Exhaust Temperature | 700°C (1292°F) |
| Military Rating (Sea Level) | J33-A-35 |
| Dry | |
| Thrust | 4600 lb |
| Speed | 11,750 rpm |
| Exhaust Temperature | 715°C (1319°F) Max |
| Wet (Fluid Injection) | |
| Thrust | 5400 lb |
| Speed | 11,750 rpm |
| Exhaust Temperature | 715°C (1319°F) Max |
| Altitude | 40,000 ft<br>47,500 ft (J33-A-35) |
| Idling Speed | 4000 (+0, —50) rpm<br>4000 (±80) rpm (J33-A-35) |
| Maximum Governor Setting (Sea Level) | 11,500 (—0, +115) rpm |
| J33-A-35 | 11,750 (±75) rpm |
| Weights (Less Generator and Tachometer Generator) | |
| J33-A-9 | 1958 lb |
| J33-GE-11 | 1905 lb |
| J33-A-17 | 1875 lb |
| J33-A-21 | 1850 lb |
| J33-A-35 | 1795 lb |
| Mounting | 2 trunnions, 1 ball support |
| Dimensions | |
| Diameter | 50½ in. |
| Length | 103 in. |
| J33-A-35 | 107 in. |
| Height Over Fittings | 50½ in. |

bA. ENGINE OPERATION. Refer to T. O. 1F-80A-1 Pilots Handbook for engine operating procedures.

*c.* OPERATION.

(1) GENERAL.—Atmospheric air enters on both sides of the compressor casing where it is compressed by a multi-vaned impeller. The compressed air leaves the impeller and passes to the combustion chambers where it is mixed with fuel (introduced by nozzles) and burned. The exhaust gas leaves the combustion chambers and passes through diaphragm nozzles on to the turbine bucket wheel. The energy of this gas passing through the turbine turns the shaft which, being connected to the impeller shaft, furnishes the motive power for the compressor. As the gas leaves the bucket wheel it enters the exhaust cone and passes through the tail pipe.

(2) ELECTRICAL.—Refer to paragraph 17, this section.

(3) FUEL SYSTEM.—Refer to paragraph 13, this section.

(4) OIL SYSTEM.—Refer to paragraph 12, this section.

(5) STARTING SYSTEM.—Refer to paragraph 11, this section.

*d.* ENGINE MOUNT. *(See figure 85.)*—The engine is mounted on three ball-socket fittings. The sockets are located one on the left side and one one the right side of fuselage station 277 bulkhead, and one at the bottom center of fuselage station 252 bulkhead. The two sockets at fuselage station 277, where the aft section detaches, hold the trunnion mounted balls that are located on either side of the engine. The lower socket at fuselage station 252 receives a ball support which extends downward from the forward end of the engine. Each socket is constructed in the form of a hinged clamp, the halves of which are secured with a toggle bolt and wing nut to permit quick disassembly for engine removal.

The balls and trunnion bolts on either side of the engine are interchangeable left and right, although the hex heads of the trunnion bolts differ slightly in design. One of the bolts has a hex head smaller than the inside diameter of the ball, which permits the ball to slide the full length of the bolt. This feature is provided to allow for expansion and contraction of the the engine. The bolt with the smaller head may be installed on either side of the engine and with either ball since the balls are identical parts. Do not attempt to remove trunnion spindles, P/N 8659103 and 8659146, from trunnion support assembly, P/N 901-5413, unless set screw, P/N 9039013, has been removed.

*e.* REMOVAL OF AFT SECTION AND ENGINE. *(See figure 85.)*

Special tools required: A piece of ¾-inch hex bar one inch long, or a ¾-inch internal adapter, and a fuselage aft section stand, S-84702, or fuselage aft section sling, S-84402.

(1) Clamp elevator in neutral position.

(2) Through access panel No. 31 (figure 7) remove tail pipe clamp to disconnect the tail pipe.

(3) Remove access panel No. 30 and through this opening, disconnect the following:

*(a)* Elevator control rods. (See paragraph 15*d* (3), this section.)

*(b)* Rudder cables. (See paragraph 15*e*(3)*(b)*, this section.)

(4) Through access panel No. 13 (figure 7) disconnect the following:

*(a)* Electrical disconnect plug.

*(b)* Pitot pressure line at quick disconnect fitting.

*(c)* Tail pipe thermocouple leads.

*(d)* Antenna coaxial cable (later airplanes).

(5) Disconnect radio antenna at fin by turning insulator clockwise one-half turn. Coil antenna and tape it to the canopy.

(6) Support the aft section by either cradle S-84702, or sling S-84402.

(7) Through access panels Nos. 12 and 69 (figure 7) remove locking pins and the three tension bolts which attach the aft section to the mid section. Use ¾-inch hex bar, ¾-inch socket, and ratchet.

(8) Remove fuselage aft section.

(9) Disconnect air pressure lines at disconnect fitting in upper right side of engine compartment.

(10) Through access doors Nos. 38 and 39 (figure 7) disconnect the following:

*(a)* Main fuel line to engine.

*(b)* Oil pressure line at transmitter located on right side of engine compartment fuselage structure.

*(c)* Starter negative cable at terminal on fuselage lower longeron.

*(d)* Starter positive cable at terminal on right side of engine compartment.

*(e)* Generator cable at terminal on generator.

*(f)* Miscellaneous engine wiring at plug near tachometer generator.

*(g)* Disconnect fluid injection line at forward end of flexible hose which attaches to manifold (P-80A-10 and FP-80A-10 airplanes only).

*(h)* Disconnect fluid injection pressure line at fluid injection pressure gage transmitter (P-80A-10 and FP-80A-10 airplanes only).

*(i)* Disconnect air shut-off valve actuator-pressure transmitter line at fluid injection pump (P-80A-10 and FP-80A-10 airplanes only).

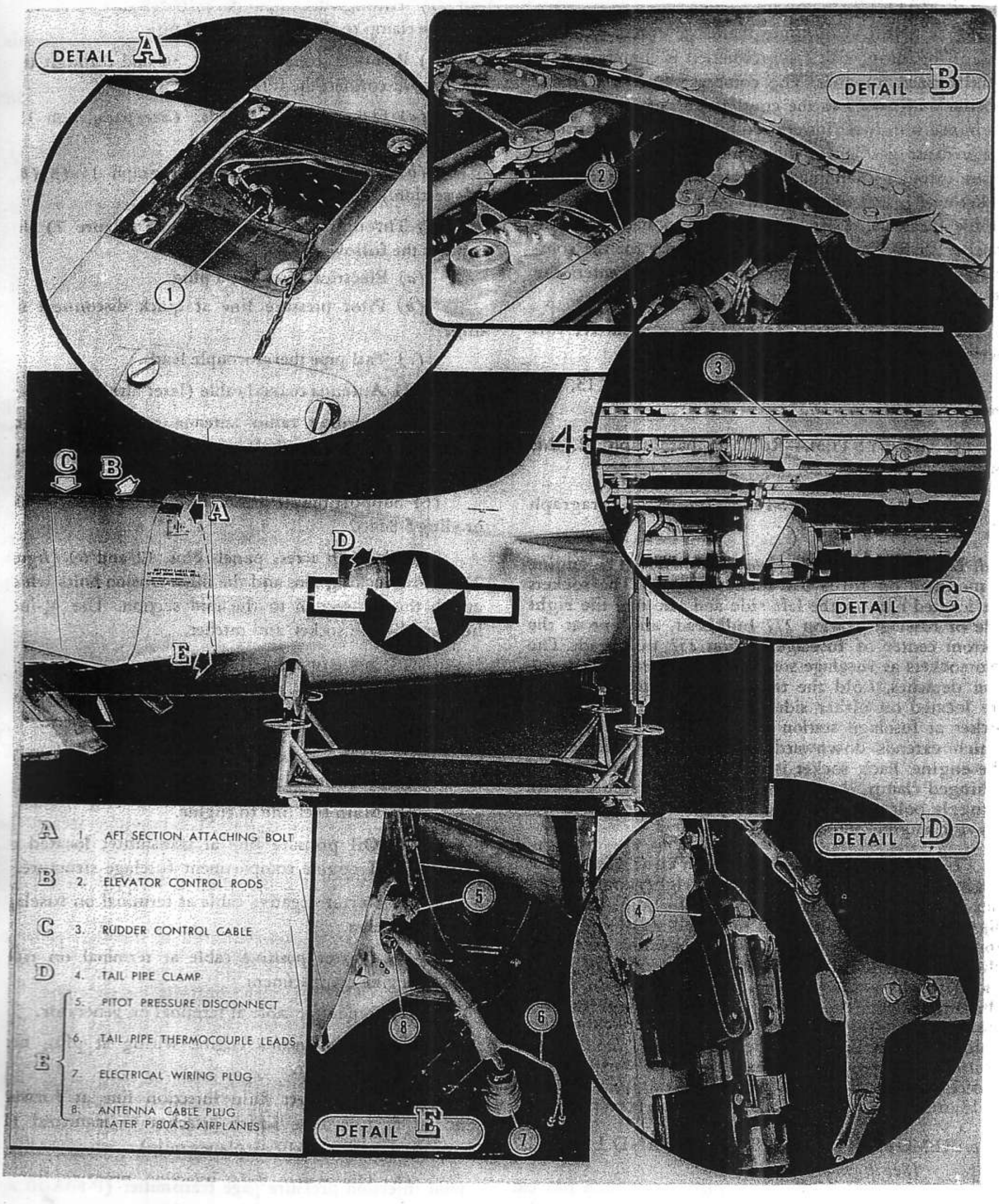



*Figure 85 (Sheet 1 of 7 Sheets) — Aft Section and Engine Removal*

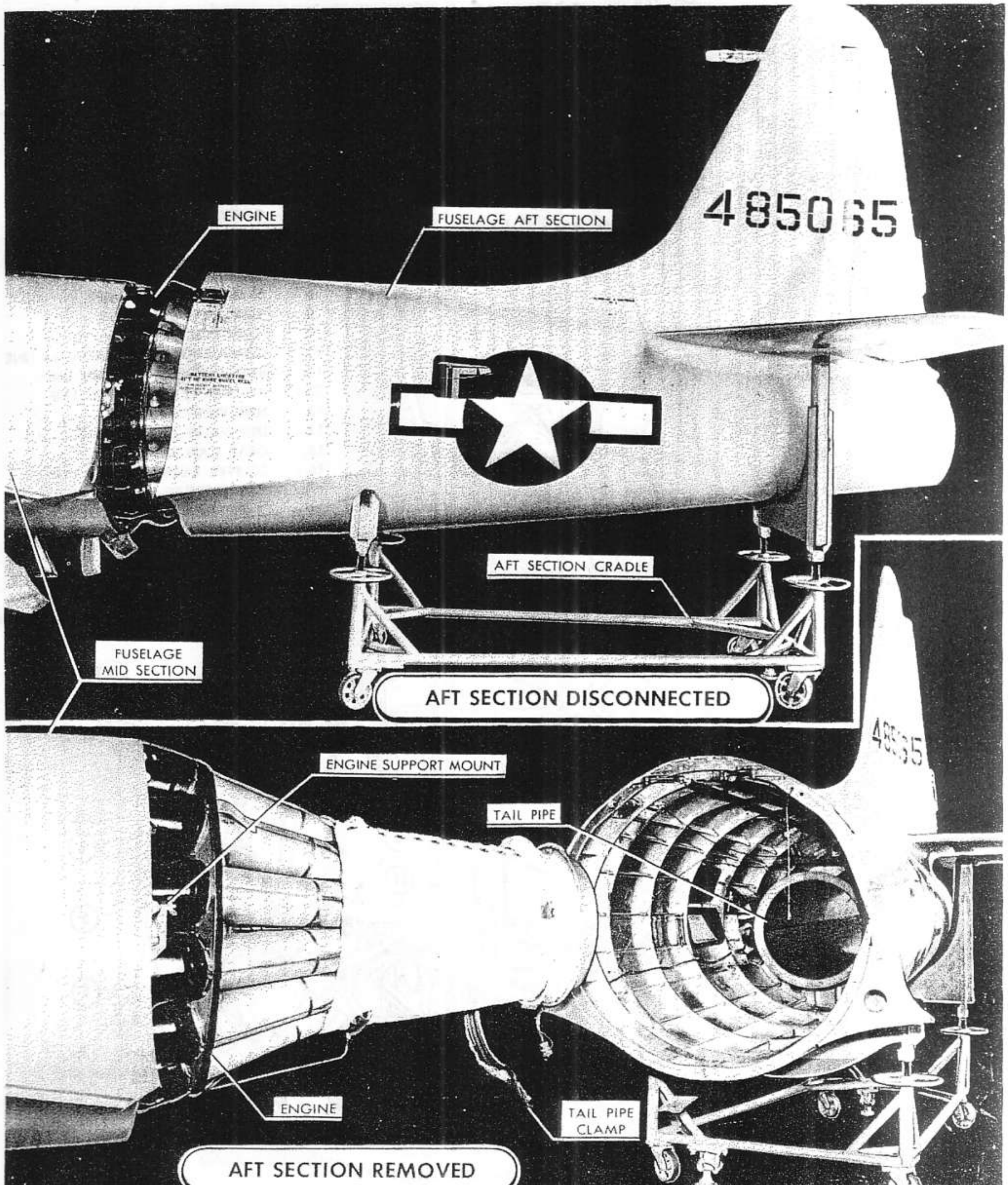
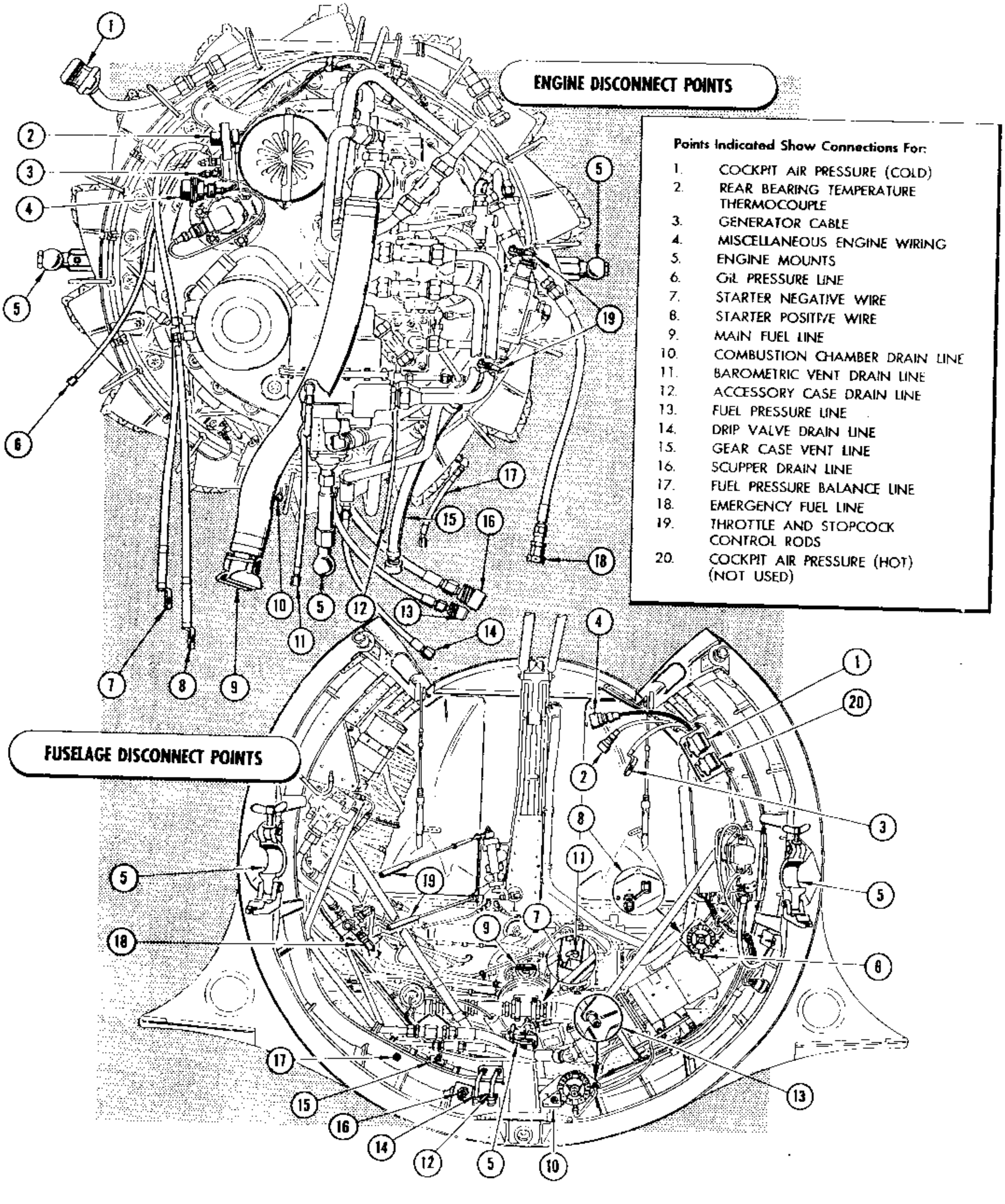



*Figure 85 (Sheet 2 of 7 Sheets) — Aft Section and Engine Removal*

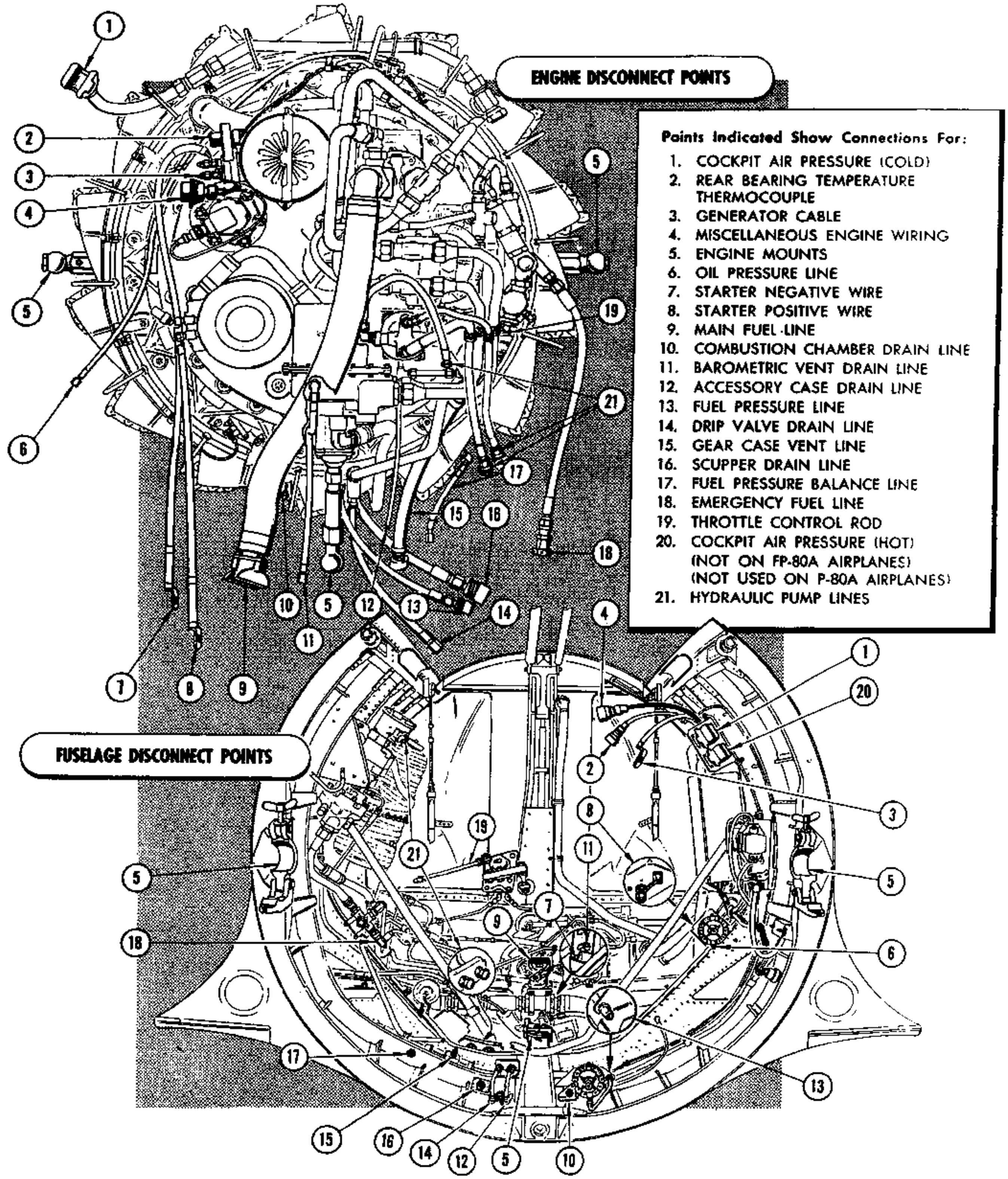



**Points Indicated Show Connections For:**

1. COCKPIT AIR PRESSURE (COLD)
2. REAR BEARING TEMPERATURE THERMOCOUPLE
3. GENERATOR CABLE
4. MISCELLANEOUS ENGINE WIRING
5. ENGINE MOUNTS
6. OIL PRESSURE LINE
7. STARTER NEGATIVE WIRE
8. STARTER POSITIVE WIRE
9. MAIN FUEL LINE
10. COMBUSTION CHAMBER DRAIN LINE
11. BAROMETRIC VENT DRAIN LINE
12. ACCESSORY CASE DRAIN LINE
13. FUEL PRESSURE LINE
14. DRIP VALVE DRAIN LINE
15. GEAR CASE VENT LINE
16. SCUPPER DRAIN LINE
17. FUEL PRESSURE BALANCE LINE
18. EMERGENCY FUEL LINE
19. THROTTLE AND STOPCOCK CONTROL RODS
20. COCKPIT AIR PRESSURE (HOT) (NOT USED)

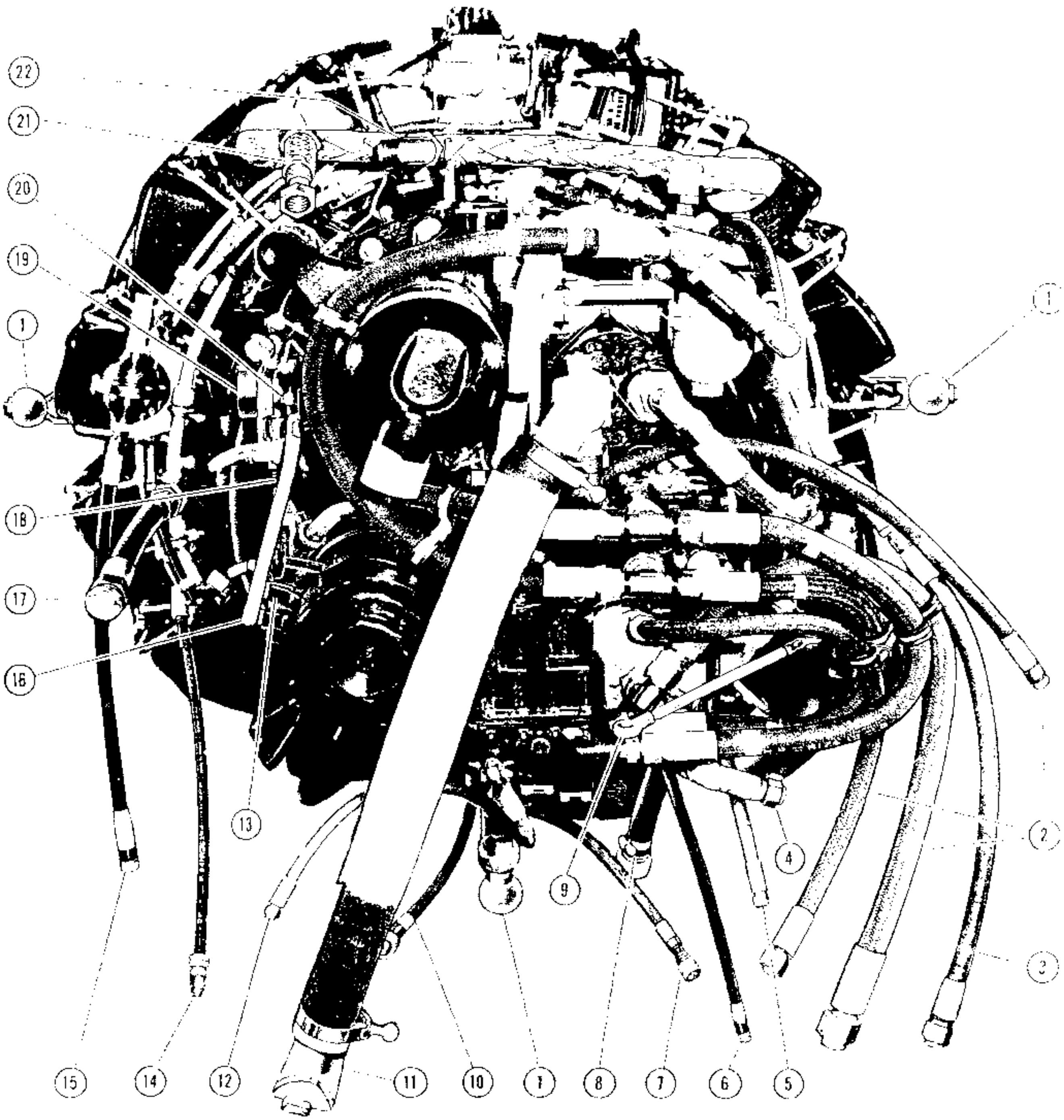
P-80A-1 AIRPLANES

*Figure 85 (Sheet 3 of 7 Sheets) — Aft Section and Engine Removal*




P-80A-5 AND FP-80A-5 AIRPLANES

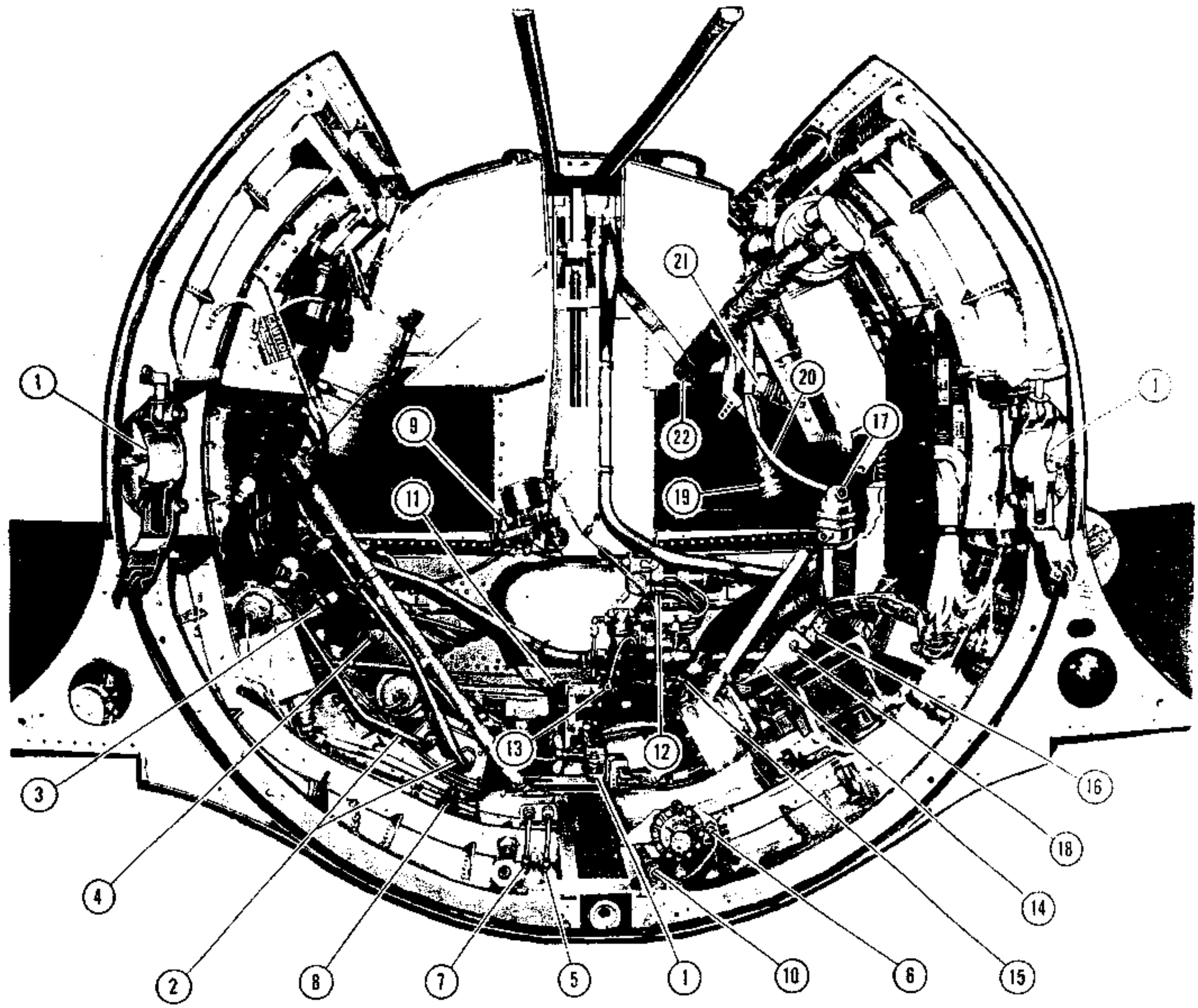
*Figure 85 (Sheet 4 of 7 Sheets) — Aft Section and Engine Removal*




1. [illegible]
2. HYDRAULIC [illegible]
   EMERGENCY FUEL [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]
    [illegible]
11. [illegible]
13. STARTER NEGATIVE WIRE
14. [illegible] LINE
15. AIR SHUT-OFF VALVE TO [illegible] LINE
16. STARTER POSITIVE WIRE
17. FUEL INJECTION LINE
18. OIL PRESSURE LINE
19. [illegible]
20. [illegible]
21. CAMERA HEATING [illegible]
    AIRPLANES ONLY
22. [illegible] LINE

P-80A-10 AND FP-80A-10 AIRPLANES

*Figure 85 (Sheet 4A of 7 Sheets) — Aft Section and Engine Removal*




1. ENGINE MOUNTS
2. HYDRAULIC PUMP LINES
3. EMERGENCY FUEL LINES
4. AUXILIARY AIR PRESSURE LINES
5. ACCESSORY CASE DRAIN LINE
6. FUEL PRESSURE LINE
7. DRIP VALVE VENT LINE
8. GEAR CASE VENT LINE
9. ENGINE CONTROL VALVE ROD
10. COMBUSTION CHAMBER DRAIN LINE
11. MAIN FUEL LINE
12. BAROMETRIC VENT DRAIN LINE
13. STARTER NEGATIVE WIRE
14. FLUID INJECTION PRESSURE LINE
15. AIR SHUT-OFF VALVE TO TRANSMITTER LINE
16. STARTER POSITIVE WIRE
17. FLUID INJECTION LINE
18. OIL PRESSURE LINE
19. MISCELLANEOUS ENGINE WIRING
20. GENERATOR CABLE
21. CAMERA HEATING LINE (FP-80A-10 AIRPLANE ONLY)
22. HEATING, COOLING AND PRESSURIZATION LINE

P-80A-10 AND FP-80A-10 AIRPLANES

***Figure 85 (Sheet 4B of 7 Sheets) — Aft Section and Engine Removal***

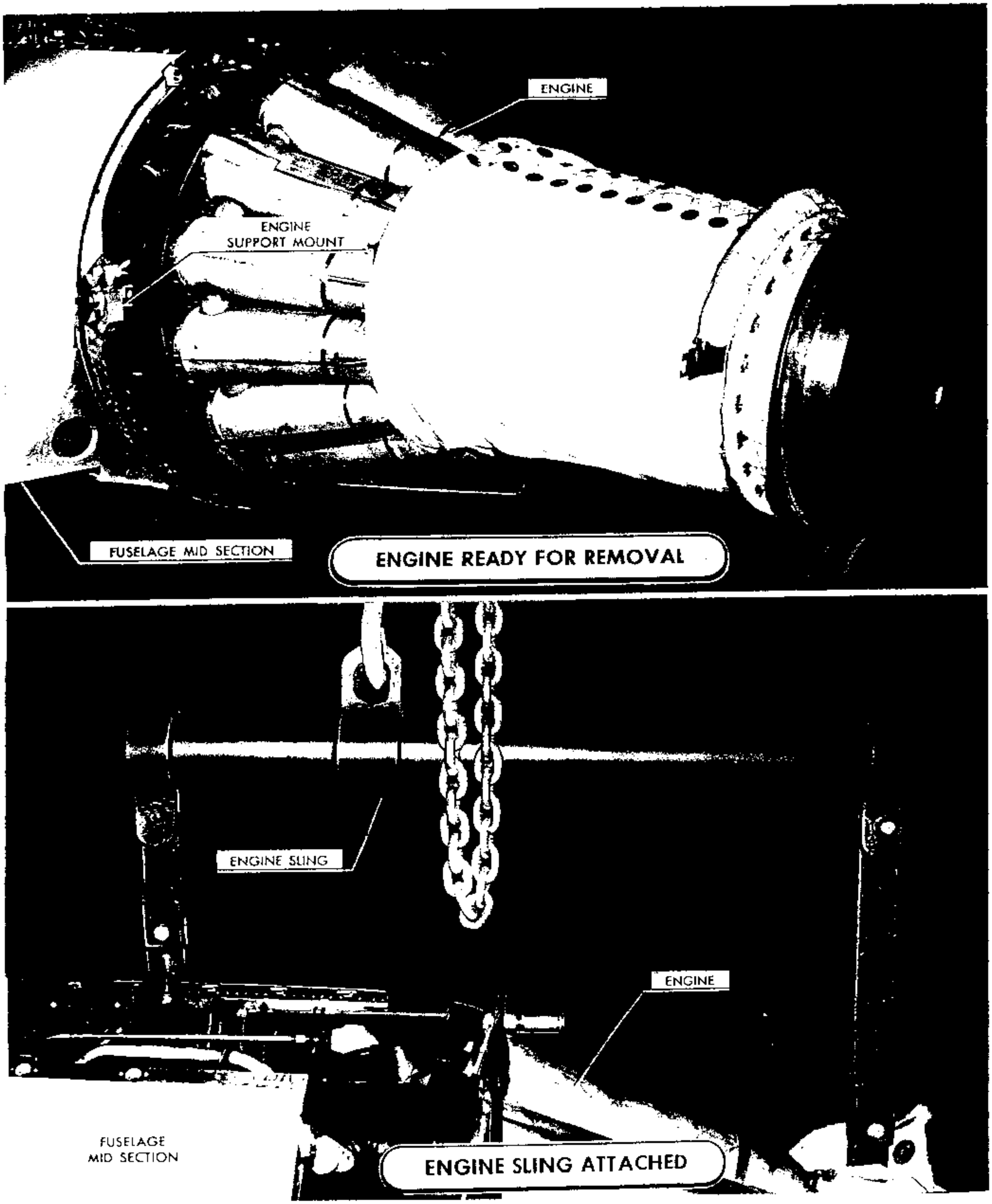



*Figure 85 (Sheet 5 of 7 Sheets)—Aft Section and Engine Removal*

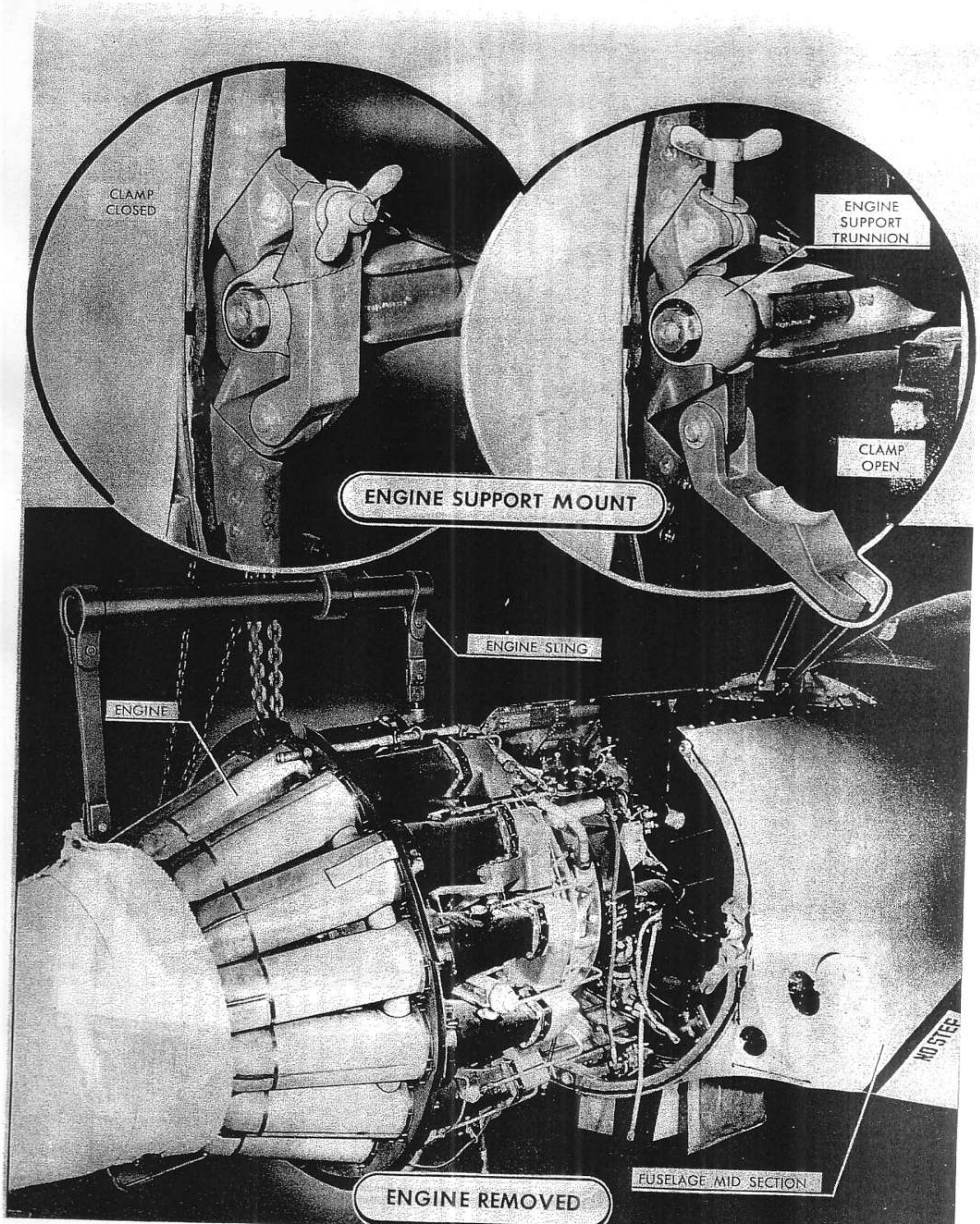



*Figure 85 (Sheet 6 of 7 Sheets) — Aft Section and Engine Removal*

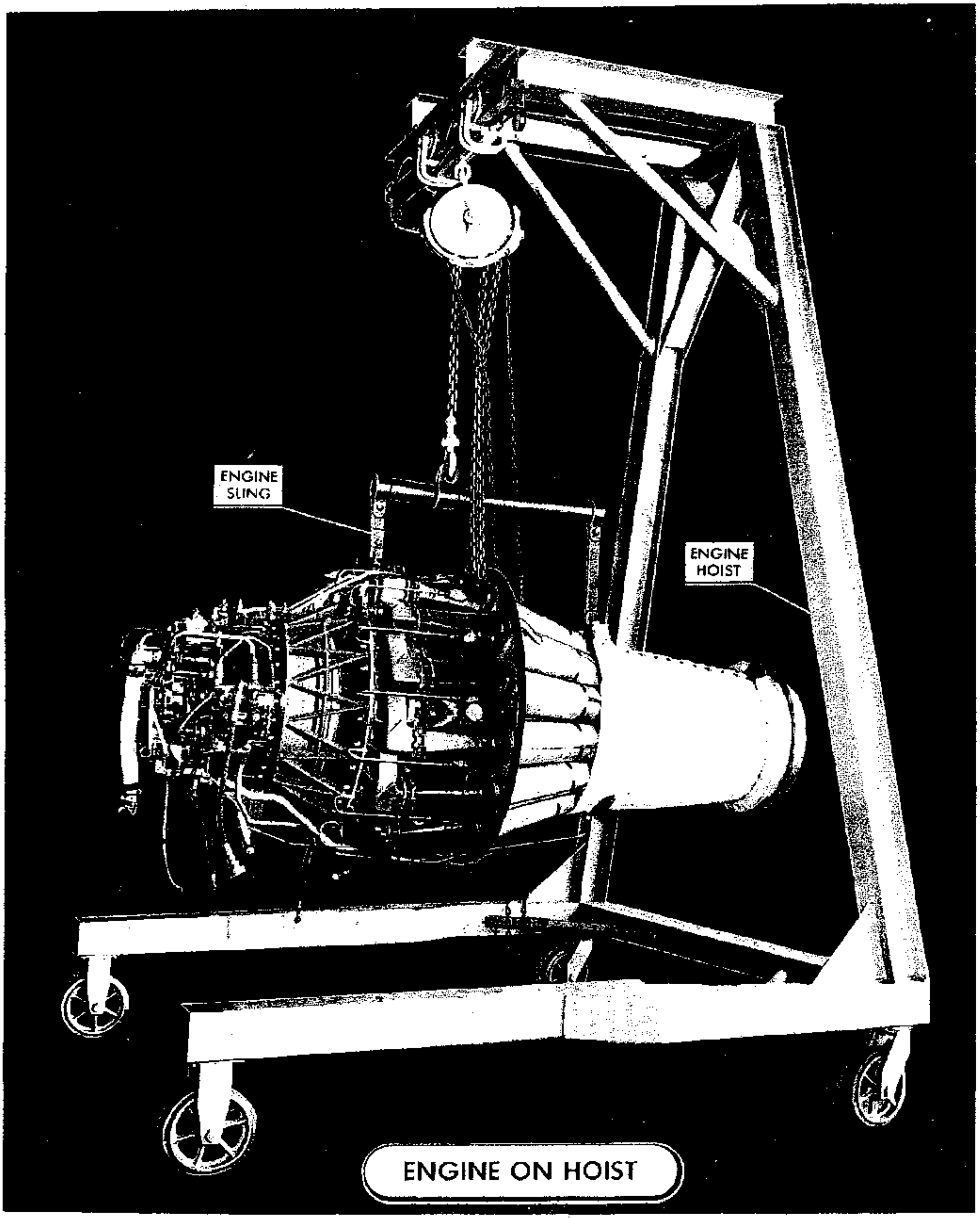



*Figure 85 (Sheet 7 of 7 Sheets) — Aft Section and Engine Removal*

*(j)* Rear bearing temperature thermocouple plug near tachometer generator (some airplanes only).

*(k)* Emergency fuel line at fitting in left side of engine compartment.

*(l)* Throttle and stopcock control rods. Rods are equipped with quick disconnect couplings. On F-80A-1 airplanes the engine control valve has two levers. On F-80A-5, RF-80A-5, F-80A-10, and RF-80A-10 airplanes it is necessary to disconnect only one rod from the single-lever valve.

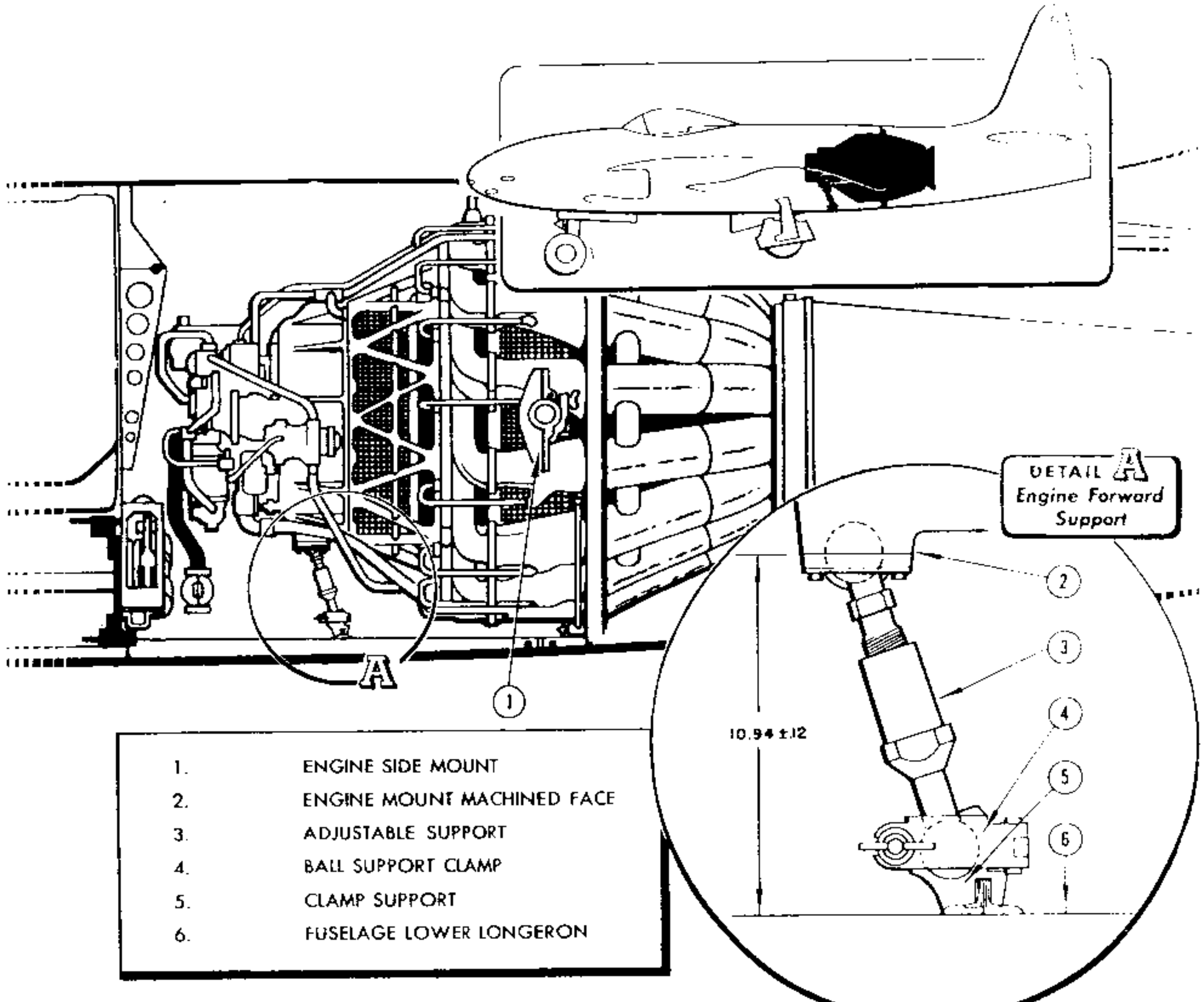



***Figure 86 — Engine Alignment***

*(m)* Disconnect three lines from the engine-driven hydraulic pump at nose-end fittings on the fuselage. (F-80A-5, RF-80A-5, F-80A-10, and RF-80A-10 airplanes only).

(11) Disconnect engine scupper drip valve and combustion chamber drain lines at fittings under the engine.

(12) Disconnect accessory case drain line, gear case vent line, and fuel pressure differential line at fittings under the engine.

(13) Loosen clips on lower end of barometric vent line.

(14) Attach sling to engine and connect sling to a hoist. Loosen wing nuts and release the three engine mounts. Remove engine by moving it straight aft.

*f.* INSTALLATION.—Only J33-A-17, J33-A-17A, J33-A-21 engines, or J33-A-9A, J33-A-9B, J33-GE-11A or J33-GE-11B engines incorporating a single lever fuel control valve may be installed in F-80A-10 or RF-80A-10 airplanes. The "A" modification to -9 and -11 engines includes the installation of an engine-driven hydraulic pump. The "B" modification to -9A and -11A engines and the "A" modification to -17 engines includes the installation of fluid injection plumbing. When -9A, -11A, or -17 engines are installed in F-80A-10 or RF-80A-10 airplanes, the airplane fluid injection system will be drained and all outlets capped, and engine dual-lever fuel control valves, if installed, will be replaced with the single-lever fuel control valve from the engine taken from the airplane. When a -21 engine is installed in an F-80A-10 or RF-80A-10 airplane, the aft engine air seal (diaphragm) located at the engine-tail-cone juncture, if installed, will be removed.

(1) ENGINE.—Engine installation is the reverse of the removal procedure. Before installation, adjust the forward support until approximately 11 threads are showing. This will lessen adjustment after installation.

Install the tail pipe clamp with the toggle between the 1-o'clock and 2-o'clock position (looking forward) to get the joint sufficiently clear of the fire warning units.

Torque trunnion spindle bolts to 500–600 inch pounds.

(2) FUSELAGE AFT SECTION.—Reverse removal procedure. Make sure the seals between the bulkhead rings at fuselage station 277.5 are adjusted to keep out moisture. Use spreader bar S-10406 (figure 31) to align the two upper attachment points. Attach the spreader bar to the forward lifting-lug attachment point on the engine, and to the upper structure of the airplane on each side. The bar may be extended or retracted to align the airplane mid section to the aft section upper attachment holes.

**Note**

Torque aft to mid-section attaching bolts to between 1100 and 1300 pound-inches.

When connecting rudder cables, be sure they are not twisted. Twisted cables cause inaccurate movement of the rudder.

**Note**

Antenna wire should have 20 pounds tension when connected.

(3) ENGINE ALIGNMENT. *(See figure 86.)*—Work through access panels Nos. 31 and 38 (figure 7) to align the engine as follows:

*(a)* Adjust the forward support until the machined face of the support mounting on the engine is 11.08 inches from the top of the fuselage lower longeron.

*(b)* Slide the tail pipe forward until the adapter and the tail pipe flanges are as close together as possible.

*(c)* Check gaps between upper and lower sides of the adapter and tail pipe flanges. If unequal, make the gaps as nearly the same as possible by readjusting the forward support to 10.94 (±0.12) inches.

**Note**

Adjustment must be kept within the 0.12-inch tolerance given. Any remaining gap variation will be taken care of by the tail pipe clamp. No other adjustment is required.

*(d)* Install the tail pipe clamp.

(4) OPERATIONAL CHECK.—Check all affected electrical and control systems for proper functioning.

**CAUTION**

When engine is to be operated in excess of 85% (10,000) rpm during ground operation, except taxiing, take-off, or take-off check, remove engine upper access door, and block open the engine lower access doors. Limit continuous 85% (and greater) rpm operation on ground to a minimum (not to exceed one minute duration). Should additional high-rpm operation be required, reduce rpm and allow engine to cool before operating above 85% rpm for the next one-minute period.

*g.* TROUBLE SHOOTING.

**CAUTION**

In the event engine fuel system difficulties are encountered, plugging of lines or isolation of a fuel system component may result in serious hazards due to excessive fuel pressure.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Unit fails to start. | FUEL SYSTEM: Lack of fuel. | Fill fuel tank and repair possible leaks in piping or tanks. |
| | Selector valves. | Check position of selector valves. |
| | Improper fuel. | Drain and fill with specified fuel. |
| | Dirty fuel filter. | Replace filter. |
| | Check valve in main fuel-pump discharge. | If stuck, tap lightly with hammer to release. If broken, replace. |
| | Fuel pump inoperative. | Replace defective fuel pump. |
| | Sticky control valves in barometric. | Replace barometric. |
| | Ruptured bellows in barometric. | Replace barometric. |
| | Faulty seat in barometric main control valve. | Replace barometric. |
| | STARTER SYSTEM: Starter speed low. | Check battery. |
| | Dirty starter commutator (oil film). | Clean commutator and replace glazed brushes. |
| | Starter control fails to function. | Repair or replace. |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| | Clutch pawls or ratchet broken. | Replace unit. |
| | IGNITION SYSTEM: Dirty spark plugs. | Clean, and re-adjust gap to 0.070 to 0.080. |
| | Broken electrodes. | Replace spark plugs. |
| | Defective spark-plug-terminal insulator. | If sleeve is cracked, replace spark plug. |
| | Improper spark plug gap. | Set gap to 0.070 to 0.080. |
| | Defective wires. | Repair or replace. |
| | Coil functions improperly. | Replace coil. |
| Low manifold fuel pressure. Engine will not come up to full speed. | Leaks in system. | Check all lines and stop leaks. |
| | Improper throttle setting. | Check and set properly. |
| | Stopcock not open. | Check linkage to see that valve is fully open. |
| | Main fuel pump faulty. | Replace pump. |
| | Inaccurate reading of fuel pressure gage. | Recalibrate gage. |
| | Dirty fuel filters in air adapter. | Reset governor. |
| | Governor functions improperly. | Clean or replace. |
| Low lubricating-oil pressure. | Lack of oil. | Check level of oil in gear case. |
| | Leaks. | Check all piping and connections. |
| | Clogged oil lines. | Flush and clean lines. |
| | Dirty oil filter. | Clean filter. |
| | Faulty relief valve in filter. | Clean or replace valve. |
| | Inaccurate reading of oil pressure gage. | Recalibrate gage. |
| | Faulty adjustment of spring in lube pump relief valve. | Replace or re-adjust spring. |
| | Sheared pump drive in lube and scavenger pump. | Replace pump. |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| High lubricating-oil pressure. | Improper oil. | Use specified oil. |
| | Plugged oil line. | Clean oil lines. |
| | Inaccurate reading of oil pressure gage. | Recalibrate gage. |
| | Dirt in oil-jet screens. | Remove unit and send to overhaul depot. |
| Fuel and/or lubricating-oil leakage from drain or drip valve. | Drip valve in fuel manifold stuck. | Tap lightly to release. Remove and clean, or replace. |
| | Chamber-drain valve stuck. | Tap lightly to release. Remove and clean, or replace. |
| | Determine whether fuel or oil leakage. | Isolate particular accessory from which leakage occurs and replace defective unit. Inspect these three accessories: Control valve, governor, main fuel pump. |
| High exhaust-gas temperature. | Wrong type of fuel. | Use specified fuel. |
| | Foreign matter clogging compressor-inlet screening. | Clean screens. |
| | Faulty exhaust-pipe temperature gage. | Recalibrate gage. |
| | Faulty tachometer indicator (overspeeding). | Replace or recalibrate tachometer indicator. |
| | Faulty burner nozzles. | Replace old type nozzles with a complete set of late type nozzles. Late type nozzles, with pressed-in filter, may be replaced individually. |
| | Improper firing of combustion chambers. | See that all nozzles are functioning properly and all chambers are firing. |
| | Bucket wheel and diaphragm. | See that buckets and nozzle diaphragm are in proper condition. |
| Faulty or no combustion. | Burning continues in one or more combustion chambers after shutting stopcock (system flooded). | If combustion does not stop, keep starter in operation and admit $CO_2$ to compressor inlet. |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| | Stopcock valve not seating. | Check for cause. Replace valve if necessary. |
| | Fuel nozzles out of balance. | Replace old type nozzles with a complete set of late type nozzles. Late type nozzles, with pressed-in filter, may be replaced individually. |
| | Liners touching outer casing. | Remove, and repair or replace. |
| Incorrect or low speed indication. | Indicator reads backwards. | Reverse leads on indicator. |
| | Low tachometer-indicator reading at high speeds. | Check tachometer generator, indicator, and wiring. |
| Excessive oil consumption. | Loose fittings or connections. | Check and tighten all loose connections. |
| | Drain leakage from drip valve. | Isolate particular accessory from which leakage occurs and replace defective unit. Inspect these three accessories: Control valve, governor, main fuel pump. |
| | Orifice omitted in clutch shaft. | Install orifice. |
| | Excessive clearance around oil seals. | Replace unit. |

*b.* TROUBLE SHOOTING OF J33-A-35 ENGINE.

**CAUTION**

In the event engine fuel system difficulties are encountered, plugging of lines or isolation of a fuel system component may result in serious hazards due to excessive fuel pressure.

| Trouble | Probable Cause | Remedy |
|---|---|---|
| Engine fails to start. | Battery switch "OFF." | Turn switch "ON." |
| | Ignition switch "OFF." | Turn switch "ON." |
| | Low starter rpm. | Low battery voltage. Check voltage.<br>Dirty starter commutator. Clean commutator and replace glazed brushes. |
| | Starter does not motor engine. | No power supply to starter. Turn off all fuel and ignition switches. Disconnect lead to starter. Turn on starter switch and check power supply to starter. If no power, check continuity of all wiring. Check voltage at starter relay. Replace starter relay if defective.<br>Open circuit in starter. With starter relay operating and test lamp across starter terminals, check power supply. If power supply is satisfactory, replace starter. |
| | Starting clutch in accessories gear casing damaged. | Replace engine. |
| | Manual shut-off valve in "OFF" position. | Place manual shut-off valve in proper position. |
| | Lack of fuel. | Fill fuel tanks with required amount of specified fuel. |
| | Air in starting fuel control and lines. | Try second start. |
| | Spark plugs temporarily fouled by flushing oil. | Try second start. |
| | Fuel booster pumps inoperative. | Check electrical operation of booster pumps by watching aircraft ammeter for correct discharge when pumps are energized. If correct power drain does not occur, check wiring to pumps for breaks or shorts. |
| | Broken or leaking fuel line to engine. | Replace defective lines. |
| | Dirty fuel filters. | Clean filter and element. |
| | Clogged fuel line to engine. | Remove fuel line and check for obstruction. |

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| | Water or other contaminant in fuel. | Check sample of fuel. If contaminated, drain all fuel from system, and fill with specified fuel. |
| | Incorrect fuel specification. | Same as preceding item. |
| | No spark obtained at either spark plug. | Check all ignition disconnects. Check battery voltage; 16 volts required at dynamotor. Check battery-to-dynamotor connection. Check control switches and dynamotor. Check transformers by temporarily replacing with known satisfactory units. Check for spark plugs with broken electrodes. Set spark plug gap at 0.070-0.080 inch. Turn switch "ON." |
| | Drip valve sticking in open position. Fuel drains from starting fuel control. | Replace starting fuel control. |
| | Starting fuel control inlet solenoid valve inoperative. | Check electrical connection at starting fuel control. Check throttle switch on main fuel control for open circuit. Check starting fuel control switch in cockpit for defects. |
| | Regulator valve in starting fuel control stuck. | Replace starting fuel control. |
| Spark obtained at one spark plug only. | Defective spark plug, high-tension lead, or transformer unit. | Replace each unit successively with another unit known to be satisfactory. |
| | Defective exciter unit. | Replace exciter unit. |
| Starting temperatures too high or temperatures of acceleration to changeover speed too high. | Leakage of fuel from emergency fuel control or main fuel control. | Check linkage to fuel controls to ensure that both controls are set at the cut-off position when engine control lever is "OFF." To check controls for leakage at "OFF" positions: Disconnect main fuel control-to-main double check valve and emergency fuel control-to-main double check valve hose at either check valve or controls. Turn ignition switch "OFF." With engine |

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| | | control lever closed and engine motored with starter, no fuel should flow from either control. If flow occurs, check linkage and adjust as necessary. Replace control if leakage continues with engine control lever "OFF." |
| | Dirt in starting fuel control dashpot piston bleed, or piston stuck in lowest position. | Disassemble and clean dashpot. |
| | Regulator valve in starting fuel control stuck open. | Remove regulator valve and clean piston. Do not disturb adjustment. |
| Engine starts slowly and temperature of acceleration changeover speed too high. | Engine manifold Nos. 7 or 14 check valve leaking. | Remove dirt or replace leaking valve. |
| | Starting fuel control cut-off valve stuck closed or dirt in cut-off bleed. | Disassemble cut-off valve and clean. |
| | Bleed plugged in Nos. 7 and 14 fuel manifold supply port on starting fuel control. | Remove bulkhead fitting from fuel control and remove dirt from bleed. |
| Engine acceleration to changeover speed too slow or acceleration temperatures too low. | Fuel supply to starting fuel control too low (emergency fuel control bypassing total output of emergency pump to inlet of pump). | Connect a fuel pressure gage to emergency fuel control outlet (emergency fuel filter outlet pressure sensing connection). Turn ignition switch "OFF" and energize emergency fuel control bypass solenoid. Motor engine with starter. If emergency fuel control inlet pressure is less than 400 psi, emergency control bypass valve is probably bypassing total output of emergency pump to pump inlet. If investigation reveals that wire "F" to emergency control is energized while valve is bypassing total pump output, replace emergency fuel control |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| | Dirt in starting fuel control dashpot piston bleed or piston stuck in lowest position. | Disassemble and clean dashpot. |
| | Regulator valve in starting fuel control stuck open. | Remove regulator valve and clean piston. Do not disturb adjustment. |
| Engine temperature too high at changeover speed. | Main control throttle switch not breaking circuit at changeover. | Adjust switch operating lever for cut-out or replace switch if short circuit is found. |
| | Dirt under solenoid operated inlet valve seat in starting fuel control. | Disassemble and clean inlet valve assembly. |
| Engine unable to reach full speed (low manifold fuel pressure) on main fuel system. | Engine control system linkage. Main fuel control maximum speed stop incorrectly set. | Check linkage between engine control lever and main fuel control. With engine control lever in full open position, main control full-rpm-stop adjustable-stop-shoe should be against full rpm fixed stop. |
| | Dirt or other obstruction in fuel supply system. | Check lines for obstructions. Clean all filters and check fuel flowmeter. |
| | Fuel leaks. | Check all fuel lines and connections. |
| | Dual fuel pump defective. | Replace pump. |
| | Fuel pressure or tachometer gage reads incorrectly. | Recalibrate gages. Check tachometer by temporarily replacing with known satisfactory unit. |
| | Tachometer generator electrical leads reversed. | Reverse leads. |
| | Drip valve leaking. | If drip valve leaks excessively during normal operation, replace starting fuel control. |
| | Bypass valve in main fuel control sticking. | Remove valve and clean. |
| Acceleration temperature too high during ground operation. | Defective exhaust gas temperature gage. | Recalibrate gage and check thermocouples. |
| | Main fuel control altitude compensation needle stuck in rich position. | Using fiber mallet, tap lightly on aneroid section. If no improvement, replace main fuel control. |
| | Emergency fuel system supplying additional fuel. | During operation on main fuel system only, bypass valve of emergency fuel control should be open. Check airplane switches to ensure wire "F" to emergency fuel control is not energized, and make electrical check of wire "F" if necessary. Replace emergency fuel control if bypass valve is stuck closed. |
| Temperatures too high or too low during acceleration or deceleration. | Centrifugal pressure regulator or governor valve in main fuel control sticking. | Increase and decrease engine speed for several cycles to dislodge dirt. If no improvement, replace main fuel control. |
| Excessive exhaust gas temperature. | Wrong type of fuel. Water or other contaminant in fuel. | Check sample of fuel. If fuel is of incorrect specification or contaminated, drain all fuel from tanks and flush system; fill with specified fuel. |
| | Exhaust gas temperature gage reading incorrect. | Recalibrate gage. |
| | Fuel nozzles out of balance. Combustion chamber inner liner damaged. | Inspect inner area of exhaust cone for heat streaks or excessive warpage. Location of heat streaks on inner surfaces of exhaust cone provides a rough check of location of combustion chamber where nozzle (or inner liner) is malfunctioning. Defective nozzles may be replaced individually but nozzles must not be disassembled. |
| | Foreign matter clogging compressor inlet screens or inlet ducts. | Remove foreign matter. |
| | Tail pipe nozzle out of round. | Replace if not possible to rework to satisfactory condition. |
| | Damaged or defective turbine wheel buckets or nozzle diaphragm. | Refer to AN 01-75FJ-6 for inspection instructions. |
| Engine speed fluctuates (on main fuel system). | Main fuel control centrifugal pressure regulator dragging. | Increase and decrease speed for several cycles to dislodge dirt. If no improvement, replace main fuel control. |

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| | Starting fuel control supplying additional fuel. | Replace starting fuel control. |
| | Emergency fuel system supplying additional fuel. | Check airplane switches to ensure that wire "F" to emergency fuel control is not energized, and make electrical check of wire "F" if necessary. Replace emergency fuel control if bypass valve is stuck closed. |
| | Water or other contaminant in fuel. | Check sample of fuel. If contaminated, drain all fuel from tanks and flush system; fill with specified fuel. |
| | Main fuel control bypass valve dragging. Loose bleeds in bypass venting channel. | Clean bypass valve. Tighten loose bleeds. |
| | Low fuel supply. | Fill tanks with required amount of specified fuel. |
| | Defective airplane booster pumps. | With engine operating, turn off all booster pumps not necessary for continued operation and watch ammeter for changing current demand, indicating defective booster pump. Check wiring to pumps for shorts. |
| | Restrictions in fuel supply lines to engine-driven pump. | Check fluid supply lines to pumps for internal damage. Check for air leaks at inlet. |
| Engine overspeeding. | Faulty tachometer generator or indicator. | Check indicator by temporarily replacing with unit known to be satisfactory. Recalibrate gage. |
| | Main fuel control maximum governor speed set too high or governing mechanism defective. | Refer to paragraph 8*dA* for instructions regarding checking and setting of maximum governor setting on main fuel control. NOTE: If engine overspeeds after having operated satisfactorily for several hours, do not reset main control maximum governor setting until cause of overspeeding is found. Check maximum rpm locking bolt for tightness as well as adjustable stop. |
| Engine speed in power range increases with altitude at fixed engine control setting. | Main fuel control altitude needle or linkage sticking. | Replace main fuel control. |
| | Bypass valve in main fuel control sticking. | Clean bypass valve. |
| Idle speed too high at altitudes over 30,000 feet. | Excessive leakage by regulator, or regulator sticking (in main fuel control). | Increase or decrease speed to dislodge dirt. Replace main fuel control if no improvement. |
| | Emergency fuel system supplying additional fuel. | Check airplane switches to ensure wire "F" to emergency fuel control is not energized, and make electrical check of wire "F" if necessary. Replace emergency fuel control if bypass valve is stuck closed. |
| | Starting fuel system supplying additional fuel. | Check starting fuel control inlet valve and solenoid. |
| | Main fuel control altitude needle sticking in rich position. | Tap aneroid section. Replace control if no improvement. |
| Idle speed too low at altitude. | Idle bleed in main control plugged. | Replace control. |
| | Main fuel control bypass or relief valve stuck open. | Clean bypass or relief valve. |
| Rumbling noise with movement of engine control lever. | Looseness of spindle trunnion supports. | Make thorough inspection for looseness at spindle trunnion supports and other loose parts, such as engine front mount ball socket joint, air intake ducts, and tail cone mounts. |
| Excessive fuel or oil leakage from drain. | Starting fuel control drip valve stuck. | Lightly tap drip valve housing to release. If necessary, replace defective starting fuel control. |
| | Defective accessory. | Isolate particular accessory from where leakage occurs and replace defective unit. |
| Low oil pressure. | Lack of oil in reservoir. | Check oil level. |
| | Dirty oil filter. | Clean oil filter. |
| | Oil leaks. | Check all lines and connections. |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| | Defective oil pump. | Remove pump and check for sheared drive. |
| | Oil pressure gage records inaccurately. | Replace gage. |
| High oil pressure. | Oil pressure gage records inaccurately. | Replace gage. |
| | Improper oil. | Fill reservoir with MIL-O-6081, Grade 1010. |
| | Dirt in oil jet screens. | Remove engine and forward to overhaul depot. |
| | Plugged pressure oil line. | If an external line is plugged, remove and clean. If an internal line is plugged, remove engine and forward to overhaul depot. |
| Excessive oil consumption. | Loose fittings or connections. | Check for and tighten loose connections and fittings. |
| | Excessive clearance around oil seals. | Fill oil reservoir to 12-quart mark on oil bayonet gage. Drain oil into a clean 5-gallon container. Let oil drain for 5 minutes. Weigh and record weight of oil and container. Service engine with contents of container. Accomplish a normal one-hour flight. Stop engine and drain oil into 5-gallon container. Let oil drain for 5 minutes. Container must not be used for other purposes during this check, nor shall it be cleaned prior to end of check. Weigh and record weight of oil. If the differential between recorded weights exceeds 2 pounds per hour for check flight, remove engine and forward to overhaul depot. |
| | Scavenge lines not air tight. | Check connections and tighten if loose. |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| Burning continues in one or more combustion chambers after closing engine control lever. | | If combustion does not stop, keep starter in operation (with all fuel switches "OFF") and admit $CO_2$ into compressor inlet. |
| | Main control valve not seating. | Check linkage from engine control lever to main fuel control. Also check linkage between main and emergency fuel controls. |
| | Combustion chamber drain valve or connecting lines clogged. | Remove and clean. |

*b.* ASSEMBLY OF ENGINE QUICK-CHANGE UNIT (J33-A-35 ENGINE ONLY.) *(See figure 86A.)*

(1) GENERAL.—The following assembly procedure will be used when building up a new or overhauled engine prior to installation:

**Note**

See Section IX for torque values of fittings, clamps and nuts.

*(a)* Install one 178334 yoke and one AN316-4R nut on each piston rod end of 663147 cylinder (7). Mount 663147 cylinder (7) on 178333 bracket (64) with two NAS221-12 screws and two AN365-1032 nuts. Install one AN919-10D reducer and one AN902B-4 gasket in inlet port of cylinder. Install cylinder and bracket on engine accessory gear case using existing nuts with one AN906D616 washer under right nut in place of existing beveled engine washer. Clip ignition lead to No. 14 air adapter (10) to No. 1 air adapter left-hand fuel line with one AN754-8-23 clamp (8), one AN755-2-8 clamp, one AN520-10R8 screw and one AN365-1032 nut.

*(b)* Install one 178331 adapter (4), one AN924-16D nut and one AN902B-16 gasket on each engine compressor outlet.

*(c)* Install one 178332 lever on each 644268 valve (3) with one AN509-10R18 screw, one AN960-10 washer and one AN365-1032 nut. Install one 644268 valve (3) on each 178331 adapter (4).

*(d)* Assemble two Fafnir REB3N bearings, two AN316-4R nuts and one 178335-3 rod (9). Install rod assembly between 663147 cylinder (7) and left 644268 valve (3) with one AN23-16 bolt, one AN23-13 bolt, one LS881-6 washer, two AN320-3 nuts and two AN-380C-2-2 cotter keys.

*(e)* Assemble two Fafnir REB3N bearings, two AN316-4R nuts and one 178335-2 rod (5). Install rod assembly between 663147 cylinder (7) and right 644268 valve (3) with one AN23-16 bolt, one AN23-13 bolt, one LS881-6 washer, two AN320-3 nuts and two AN380C-2-2 cotter keys.

*(f)* Attach one end of 179403-2 manifold assembly (31) to each 644268 valve (3).

**Note**

Double outlet openings of 179403-2 manifold assembly are on right side of engine; single opening on left side of engine.

*(g)* Install one Chicago Metal Hose Corp. No. S-68133B hose assembly (27) on each outlet opening of -2 manifold assembly. Cover each hose assembly with one LS1569-20-15 blanket (1).

*(h)* Install one AN784-16 clamp with two NAS-221-8 screws and two AN365-1032 nuts on 179403-2 manifold assembly. Attach clamp to engine accessory gear case with one 179416-2 clip (26), one AN4H-4R bolt and one piece of AN995-47-3 lock wire.

*(i)* Cover right section of -2 manifold assembly with one LS1569-16-14½ blanket (2), center section with one LS1569-16-12¼ blanket (25), and left section with one LS1569-16-10½ blanket (19).

*(j)* Install 3094 tail pipe adapter (14) on engine exhaust cone (15) using forty-eight 175718 bolts, forty-eight 175719 nuts, ninety-six AN960C-516 washers and forty-eight AN380C-2-2 cotter keys.

*(k)* Prior to torquing and safetying the tail pipe adapter, install four 179526 engine thermocouple stand-off assemblies (46, 48, 49, and 50) as indicated in view B.

*(l)* Install one AN742D8 clamp (12) on stand-off assembly (46), one AN742-6 clamp (51) on stand-off assembly (50) and one AN742-4 clamp (47) on each stand-off assembly (48 and 49). Install each clamp with one AN520-10R8 screw, one AN315-3R nut and one AN363C-1032 nut.

*(m)* Install three 629139-12 thermocouple assemblies (13) in tail cone adapters. Install thermocouple leads in AN742 clamps so that all leads terminate at stand-off assembly.

*(n)* Install hydraulic pump (32) with existing bolts from cover plate.

*(o)* Install one flame arrestor assembly (34) composed of one 179132 holder, one 179046 bracket, one Zenith C177-6 element, and four AN515-8R7 screws with one AN878-32-11 hose assembly and two AN748-82 clamps on generator (23).

*(p)* Install 178316-5 diaphragm (16) so parting surfaces between halves are horizontal. Attach diaphragm together with six AN3-4 bolts, twelve AN960-10 washers and six AN363C-1032 nuts. Attach diaphragm to engine using existing tail cone attaching bolts.

*(q)* Install 177267 scupper assembly (37) at forward end of tail cone using tail cone attaching bolts for installation.

*(r)* Install 175692-23 tube (36) with one AN-901-8C gasket, one AN837-8D elbow and one AN924-8 nut on 177267 scupper assembly (37).

*(s)* Press existing grommet on -23 tube into hole in engine air seal (11).

*(t)* Install one AN815-4D union (35) on No. 8 engine air adapter to accept combustion chamber drain line.

*(u)* Install one Aeroquip No. 9550-24-35½ hose assembly (22) on inlet port of dual fuel pump. Install 639058 disconnect on free end of -35½ hose assembly using two AN75-11 bolts, one AN75-10 bolt, and one 18467 gasket. Safety bolts with stainless steel lock wire. Clip -35½ hose assembly to fuel line between main fuel control as shown in view D, with one AN742D-30CB clamp (67), one AN742D-19CB clamp (71), one AN520-10R8 screw and one AN365-1032 nut.

*(v)* Clip 633463 transmitter to 178337 bracket (42) with two 178330-11 clamps, two NAS221-11 screws and two AN365-1032 nuts. Attach two 178330-12 brackets (58 and 60) to the two wide-spaced holes of 178337 bracket (42). Attach 633463 transmitter and bracket assembly to engine truss ring in position shown with two 178330-14 clamps, two NAS221-8 screws and two AN365-1032 nuts. Attach 178330-12 bracket (58) to existing ignition harness clamp on engine accessory gear case (45). Attach 178330-12 bracket (60) to one 178798 bracket with one NAS221-10 screw and one AN365-1032 nut. Attach lower bracket assembly to engine accessory gear case with existing engine nut.

*(w)* Install one AN6264-8D-19 hose assembly (43) on lower end of 633463 transmitter (59), using one AN902B-6 gasket and one AN919-12D reducer.

*(x)* Install one AN919-12D reducer, one AN-926-8D tee, one AN814-8D plug, one AN833-8D elbow, one AN924-8D nut, three AN902B-8 gaskets and one

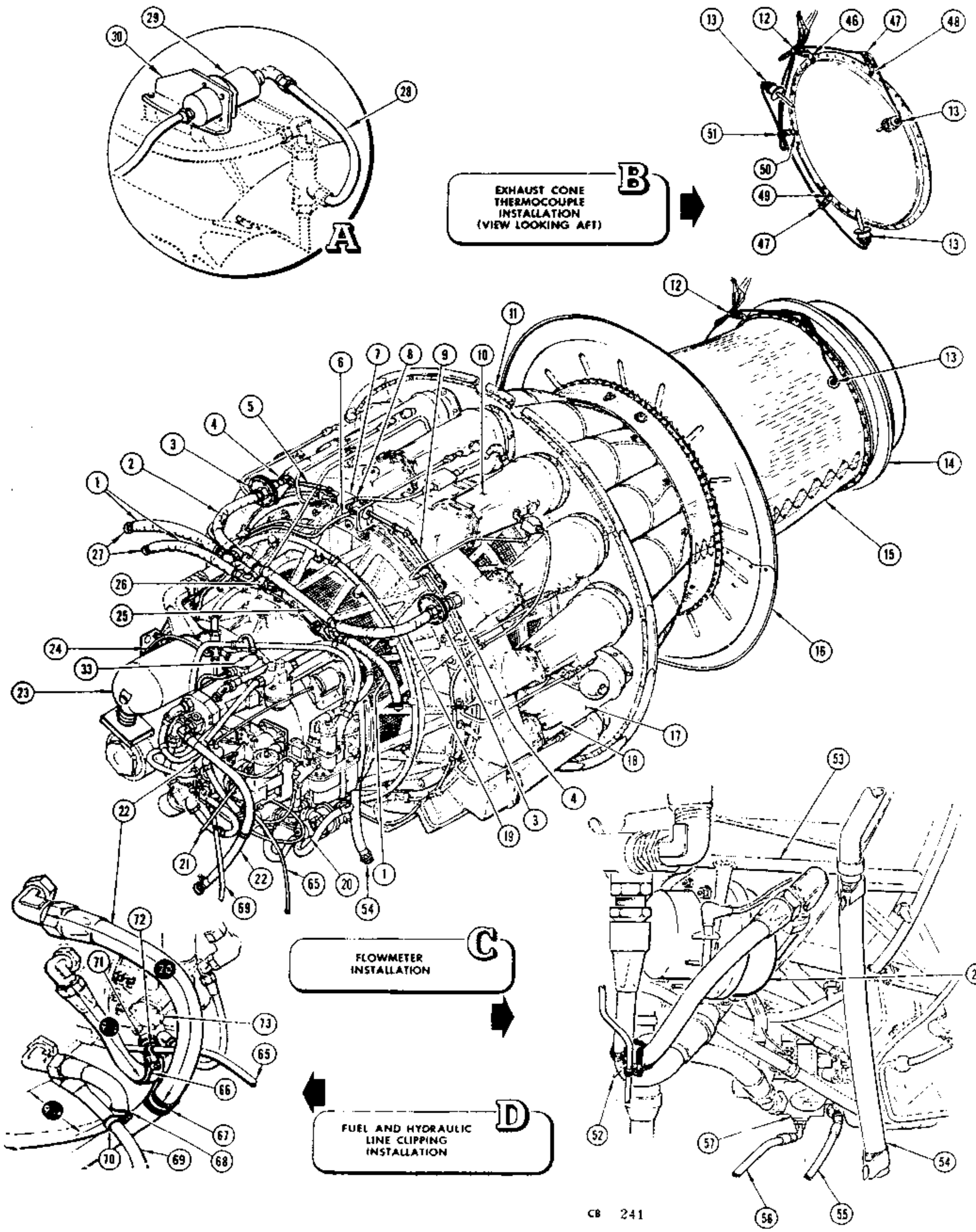
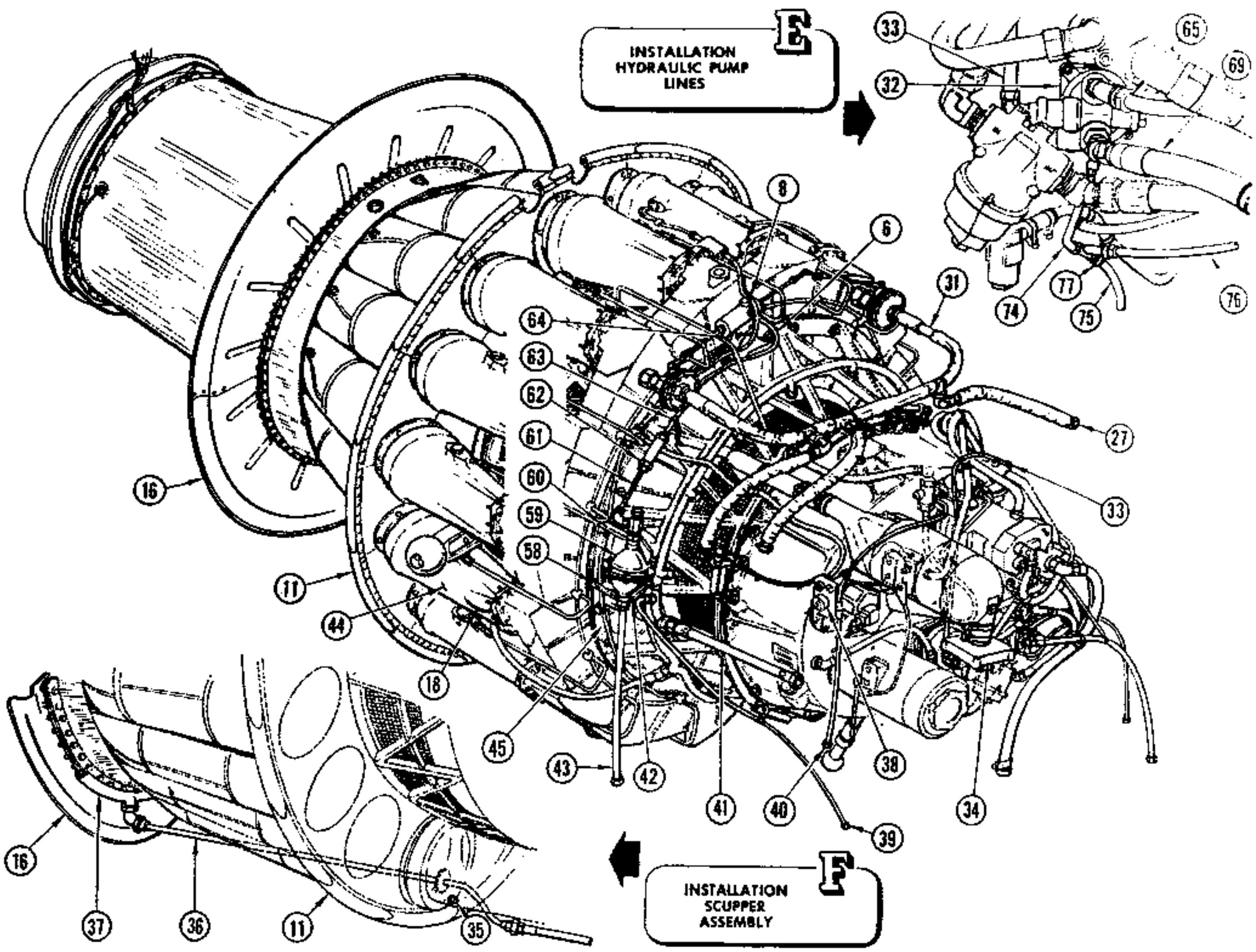



*Figure 86A (Sheet 1 of 2 Sheets) — Assembly of Engine Quick-change Unit — J33-A-35 only*




| REF | PART | REF | PART | REF | PART |
|---|---|---|---|---|---|
| 1. | LS1569-20-15 BLANKET | 27. | CHICAGO METAL HOSE NO. S-68133B | • 53. | FLOWMETER MOUNTING BRACKET |
| 2. | LS1569-16-14 1/2 BLANKET | 28. | AN6264-4-8 7/8 HOSE ASSEMBLY | 54. | 179413-3 HOSE |
| 3. | 644268 VALVE | 29. | TYPE F-2 OIL PRESSURE TRANSMITTER | 55. | AN6264-4-19 1/2 HOSE ASSEMBLY |
| 4. | 178331 ADAPTER | 30. | 205643 BRACKET | 56. | AN6264-4-9 1/2 HOSE ASSEMBLY |
| 5. | 178335-2 ROD | 31. | 179403-2 MANIFOLD ASSEMBLY | 57. | STARTING FUEL CONTROL |
| 6. | 178330-7 TUBE ASSEMBLY | 32. | HYDRAULIC PUMP | 58. | 178330-12 BRACKET |
| 7. | 663147 CYLINDER | 33. | AN6264-6-30 HOSE ASSEMBLY | 59. | 633463 TRANSMITTER |
| 8. | AN742-10C CLAMP | 34. | FLAME ARRESTER ASSEMBLY | 60. | 178330-12 BRACKET |
| 9. | 178335-3 ROD | 35. | AN815-4D UNION | 61. | 178330-6 TUBE ASSEMBLY |
| 10. | NO. 14 AIR ADAPTER | 36. | 175692-23 TUBE | 62. | 667628 VALVE |
| 11. | ENGINE AIR SEAL | 37. | 177267 SCUPPER ASSEMBLY | 63. | ADEL NO. 782-1-8 CLAMP |
| 12. | AN742D8 CLAMP | 38. | ENGINE MISCELLANEOUS WIRING PLUG | 64. | 178333 BRACKET |
| 13. | 629139-12 THERMOCOUPLE ASSEMBLY | 39. | AN6264-4-29 1/2 HOSE ASSEMBLY | 65. | AN6264-8D-33 HOSE ASSEMBLY |
| 14. | 3094 TAIL PIPE ADAPTER | 40. | AN6264-4-26 HOSE ASSEMBLY | 66. | AN742-22C CLAMP |
| 15. | ENGINE EXHAUST CONE | 41. | AN6264-16D-13 HOSE ASSEMBLY | 67. | AN742D-30CB CLAMP |
| 16. | 178316-5 ENGINE DIAPHRAGM | 42. | 178337 BRACKET | 68. | AN742-18C CLAMP |
| 17. | NO. 11 AIR ADAPTER | 43. | AN6264-8D-19 HOSE ASSEMBLY | 69. | AN6264-12D-28 1/2 HOSE ASSEMBLY |
| 18. | WHITTAKER NO. CF7GX JUMPER | 44. | NO. 5 AIR ADAPTER | 70. | AN742-14C CLAMP |
| 19. | LS1569-16-10 1/2 BLANKET | 45. | ENGINE ACCESSORY GEAR CASE | 71. | AN742-D-19CB CLAMP |
| 20. | FUEL FLOWMETER | 46. | 179526 STANDOFF ASSEMBLY | 72. | AN742-14C CLAMP |
| 21. | 179409 ROD ASSEMBLY | 47. | AN742-4 CLAMP | 73. | MAIN FUEL CONTROL |
| 22. | AEROQUIP NO. 9550-24-35 1/2 HOSE ASSY | 48. | 179526 STANDOFF ASSEMBLY | 74. | AN6264-4-8 7/8 HOSE ASSEMBLY |
| 23. | GENERATOR | 49. | 179526 STANDOFF ASSEMBLY | 75. | AN6264-4-26 1/2 HOSE ASSEMBLY |
| 24. | AN6264-4-13 HOSE ASSEMBLY | 50. | 179526 STANDOFF ASSEMBLY | 76. | AN6264-4-16 HOSE ASSEMBLY |
| 25. | LS1569-16-12 1/4 BLANKET | 51. | AN742-6 CLAMP | 77. | AN834-4D TEE |
| 26. | 179416-2 CLIP | 52. | WHITTAKER NO. CE5GX JUMPER | | |

CB 240

*Figure 86A (Sheet 2 of 2 Sheets) — Assembly of Engine Quick-change Unit — J33-A-35 only*

AN902B-6 gasket on upper end of 633463 transmitter (59).

(*y*) Attach 178330-6 tube assembly (61) to AN-833-8D elbow on transmitter. Attach 667628 valve (62) to -6 tube.

(*z*) Attach 178330-7 tube assembly (6) between 667628 valve (62) and 663147 cylinder (7). Clip -7 tube to engine truss approximately two inches from 667628 valve with one 178330-13 clamp, one Adel No. 782-1-8 clamp (63), two AN520-10R10 screws and two AN363C-1032 nuts.

*(aa)* Install one AN833-4D elbow, one AN902B-4 gasket, one AN924-4D nut and one AN6264-4-29½ hose assembly (39) on forward fluid injection manifold.

*(ab)* Install one AN833-6D elbow, one AN902B-6 gasket, one AN924-6D nut and one AN6264-6-30 hose assembly (33) on hydraulic pump return port.

*(ac)* Install one AN837-8D elbow, one AN902B-8 gasket, one AN924-8D nut and one AN6264-8D-33 hose assembly (65) on hydraulic pump pressure port. Install one AN6221-8 coupling and one AN6224-8 nut on free end of -33 hose assembly (65). Clip -33 hose assembly to fuel line between main fuel control (73) and main double check valve with one AN742-22C clamp (66), one AN742-14C clamp (72), one AN520-10R8 screw, and one AN365-1032 nut.

*(ad)* Install one AN837-12D elbow, one AN902B-12 gasket, one AN924-12D nut and one AN6264-12D-28½ hose assembly (69) on hydraulic pump suction port. Clip -28½ hose assembly to -33 hose assembly with one AN742-18C clamp (68), one AN742-14C clamp (70), one AN520-10R8 screw and one AN365-1032 nut. Install one AN6221-12 coupling and one AN6224-12 nut on free end of -28½ hose assembly.

*(ae)* Install one AN833-4D elbow, one AN902B-4 gasket, one AN924-4D nut and one AN6264-4-16 hose assembly (24) one engine oil pressure connection as shown. Install one F-124 nipple in hole on engine wiring plug bracket and connect -16 hose assembly. If required, install one type F-2 oil pressure transmitter (29) on one 205643 bracket (30) using existing transmitter bolts. Mount bracket and transmitter assembly on engine accessory gear case in position shown in view A, using existing engine bolts. Connect pressure transmitter to engine oil pressure take-off with two AN833-4D elbows, two AN902B-4 gaskets, two AN924-4D nuts, and one AN6264-4-8⅞ hose assembly (28). Connect electrical receptacle to transmitter, and connect NE7B20 wire to pin "M"; EG1F20 wire to pin "X"; EG2E20 wire to pin "C"; and EG3E20 wire to pin "H" of engine miscellaneous wiring plug (38).

*(af)* On lower end of F-124 nipple previously installed in engine wiring plug bracket, install one F-121 coupling, one AN902B-4 gasket, one AN924-4D nut and one AN6264-4-26 hose assembly (40).

*(ag)* Install one AN6264-16D-13 hose assembly (41) on inlet connection of forward fluid injection manifold.

*(ah)* Install one 179413-3 hose (54), two AN748-46 clamps and one 633408 body on accessory case vent line.

*(ai)* Install one 628110 fuel flowmeter (20) with six AN365-524 nuts on flowmeter mounting bracket (53). Connect electrical connector to flowmeter.

*(aj)* Install one AN816-4D nipple or AN837-4D elbow in hydraulic pump drain opening. Attach one AN6264-4-8⅞ hose assembly (74) to nipple or elbow.

*(ak)* Install one AN816-4D nipple in dual fuel pump seal drain and attach one AN6264-4-8⅞ hose assembly.

*(al)* Install one AN834-4D tee into main fuel control seal drain. Attach -8⅞ hose assembly from the dual fuel pump seal drain.

*(am)* Attach one AN6264-4-6½ hose assembly to free end of -4D tee installed in the main fuel control seal drain.

*(an)* Install one AN834-4D tee into the main fuel control aneroid drain line. Attach -6½ hose assembly from main fuel control seal drain.

*(ao)* Attach one AN6264-4-16 hose assembly (76) to free end of -4D tee installed in the main fuel control aneroid assembly.

*(ap)* Attach one AN834-4D tee (77) to free end of -16 hose assembly (76).

*(aq)* Attach -8⅞ hose assembly (74) from hydraulic pump to end of -4D tee.

*(ar)* Attach one AN6264-4-26½ hose assembly (75) to free end of -4D tee.

*(as)* Install one AN837-4D elbow, one AN902B-4 gasket, one AN924-4D nut and one AN6264-4-19½ hose assembly (55) on starting fuel control (57).

*(at)* Install one AN833-4D elbow, one AN902B-4 gasket, one AN924-4D nut and one AN6264-4-9½ hose assembly (56) at drain connection on starting fuel control (57).

*(au)* Install one Whittaker No. CE5GX jumper (52) and two AN960D10 washers under forward left trunnion mounting bolt.

*(av)* Install one Whittaker No. CF7GX jumper (18) and two AN960D416L washers under spring and washer of each center bolt of No. 5 (44) and No. 11 (17) engine air adapters.

*(aw)* If a Jack and Heintz generator is installed on the engine, cover the generator vent openings with one Aircraft Standard Mfg. Co. No. QS200-M100S clamp to render the generator flame arrestor effective.

*(ax)* Install one 179409 rod assembly (21) with one AN174-11 bolt, one NAS70A-.261-.750 washer, one AN310-4 nut, and one AN380-2-2 cotter key on auxiliary fuel control lever of main fuel control.

## 7. ENGINE ACCESSORIES.

*(See figures 87 and 88.)*

For information on the engine accessories, refer to the indicated paragraphs in this section.

*a.* GENERATOR, 17*c*(2).

*b.* STARTER, 17*d*.

*c.* MAIN FUEL PUMP, 13*c*(3).

*d.* HYDRAULIC PUMP (P-80A-5, FP-80A-5), 16*b* (5).

*e.* LUBRICATING AND SCAVANGER PUMP, 12*c*.

*f.* GOVERNOR, 13*c*(7).

*g.* TACHOMETER GENERATOR, 17*i*(2).

*h.* DRIP VALVE, 13*c*(10).

*i.* COMBUSTION CHAMBER DRAIN VALVE, 13*c*(11).

*j.* SPARK PLUGS, 17*e*(2).

*k.* FUEL CHECK VALVE, 13*c*(4).

*l.* OIL FILTER, 12*d*.

*m.* BAROMETRIC FUEL CONTROL, 13*c*(6).

*n.* FUEL CONTROL VALVE, 13*c*(8).

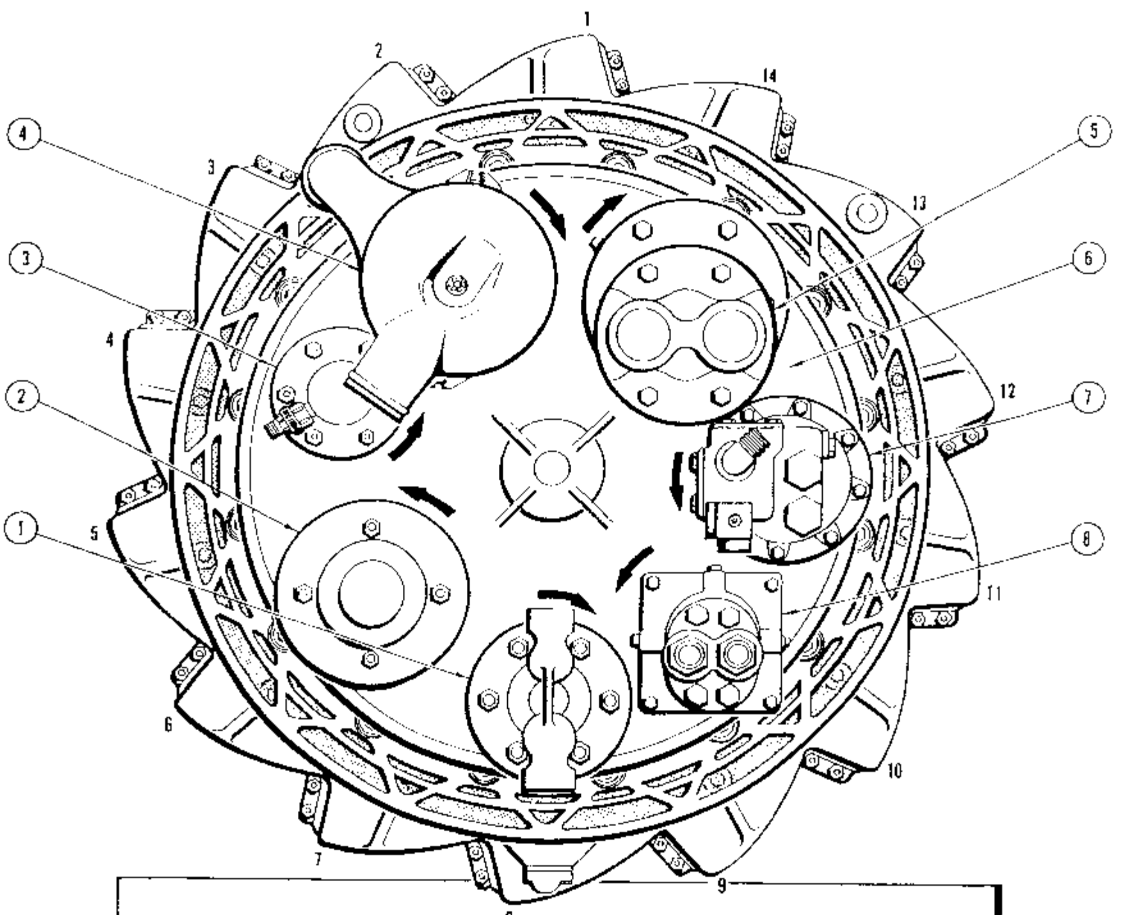
*o.* OIL PRESSURE TRANSMITTER, 12*e*.

*p.* OIL HEATER AND THERMOSTAT, 12 and 17*b*.

*q.* FUEL PRESSURE TRANSMITTER, 13*b*(18).

*r.* IGNITION COILS, 17*e*.

*s.* HIGH PRESSURE FUEL FILTER, 13*b*(11).

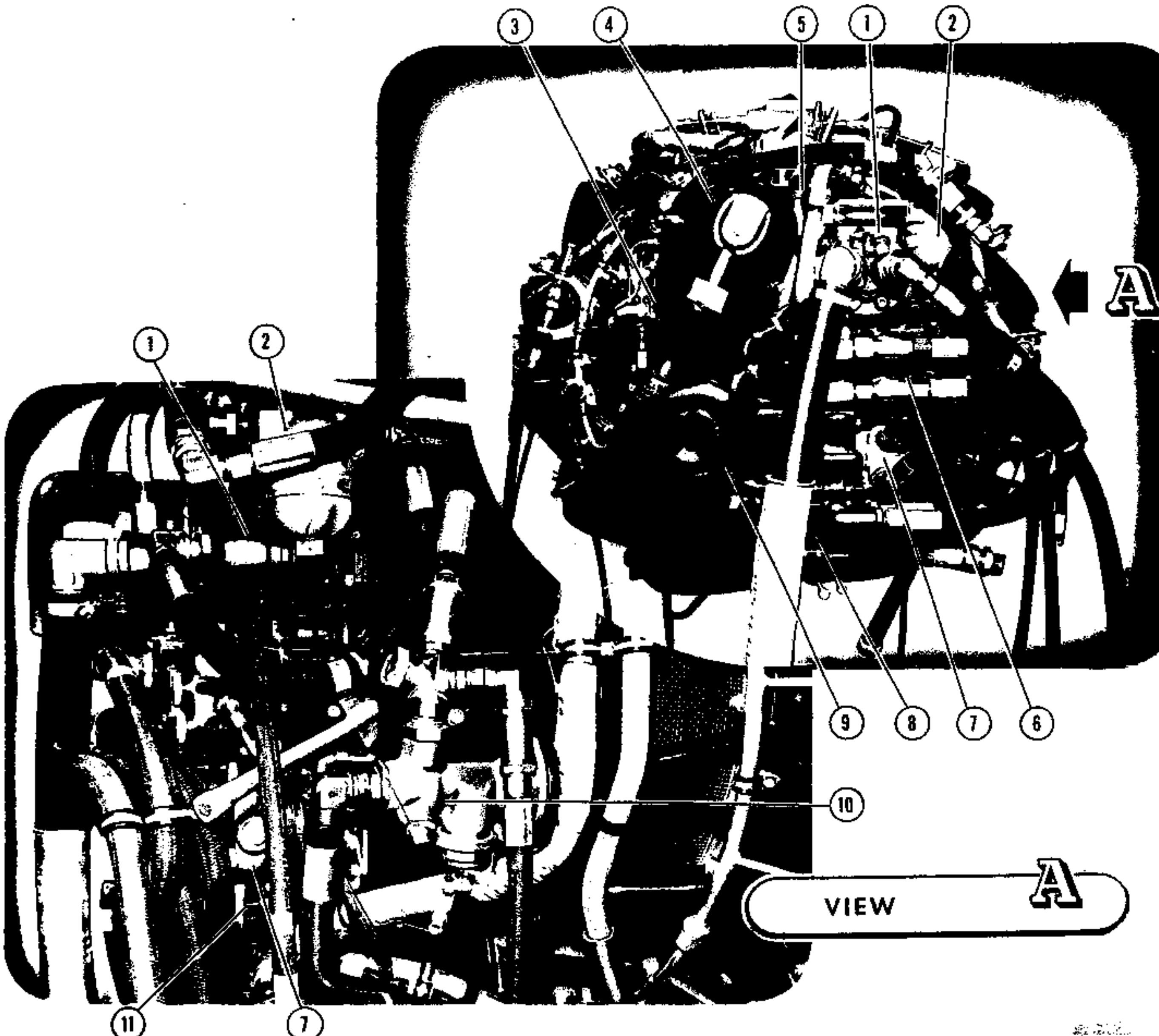


| | | | |
|---|---|---|---|
| 1. | OIL PUMP | 6. | ACCESSORY GEAR CASE |
| 2. | STARTER | 7. | GOVERNOR |
| 3. | TACHOMETER GENERATOR | | |
| 4. | GENERATOR | 8. | HYDRAULIC PUMP (NOT ON P-80A-1 AIRPLANES) |
| 5. | MAIN FUEL PUMP | | |

*Figure 87 — Direction of Rotation, Engine Accessories*


1. FUEL CONTROL VALVE
2. TACHOMETER GENERATOR
3. HIGH PRESSURE FUEL FILTER
4. FUEL PUMP
5. GOVERNOR
6. LUBRICATING OIL PUMP
7. BAROMETRIC FUEL [illegible]
8. STARTER
9. GENERATOR
10. LUBRICATING OIL [illegible]
11. HYDRAULIC PUMP

*Figure 88 — Engine Accessories*




| | |
|---|---|
| 1. FUEL PUMP | 7. HYDRAULIC PUMP |
| 2. HIGH PRESSURE FUEL FILTER | 8. BAROMETRIC FUEL CONTROL |
| 3. TACHOMETER GENERATOR | 9. STARTER |
| 4. GENERATOR | 10. ENGINE CONTROL VALVE |
| 5. LUBRICATING OIL FILTER | 11. LUBRICATING OIL PUMP |
| 6. GOVERNOR | |

*Figure 88A — Engine Accessories, P-80A-10 and FP-80A-10 Airplanes*

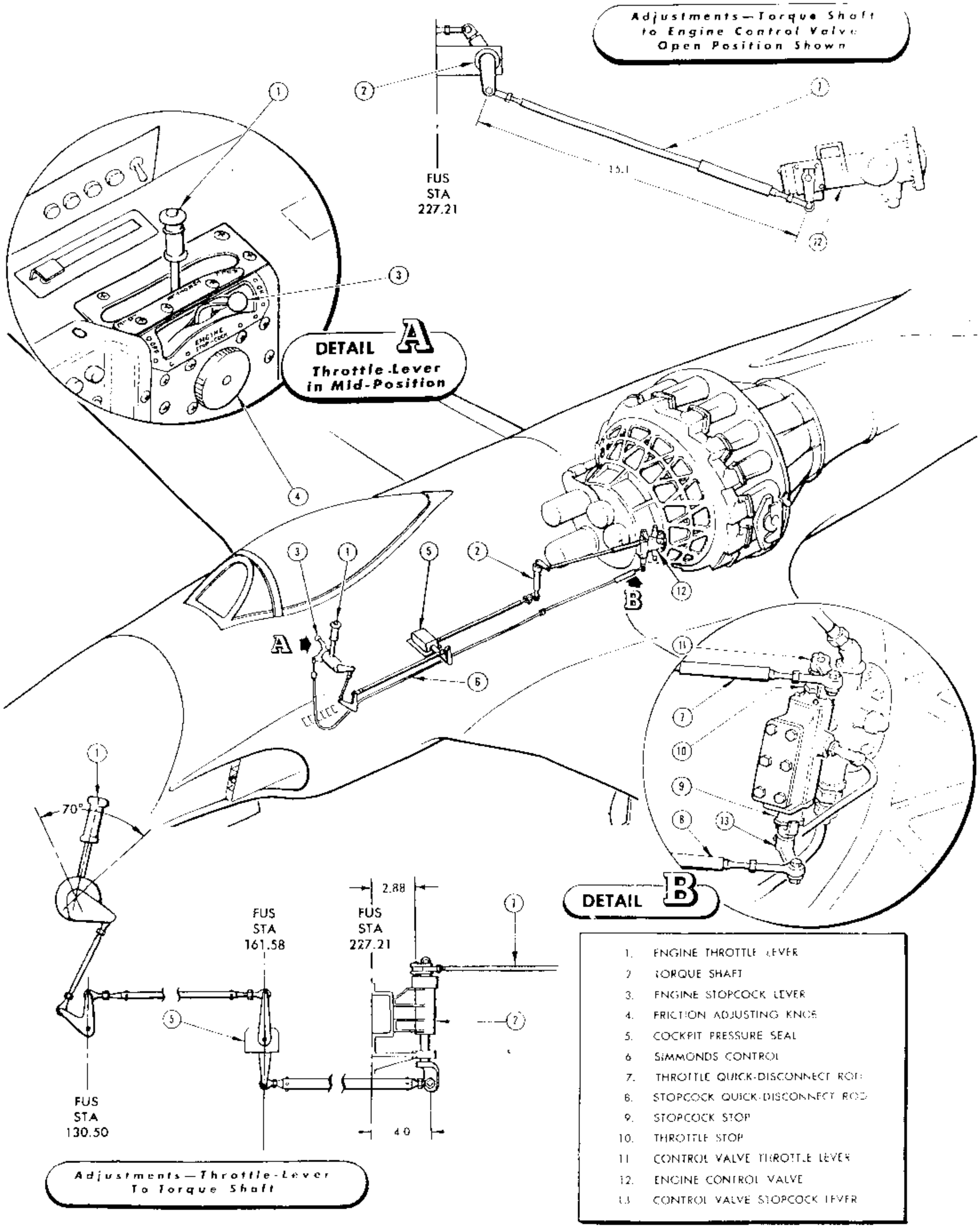
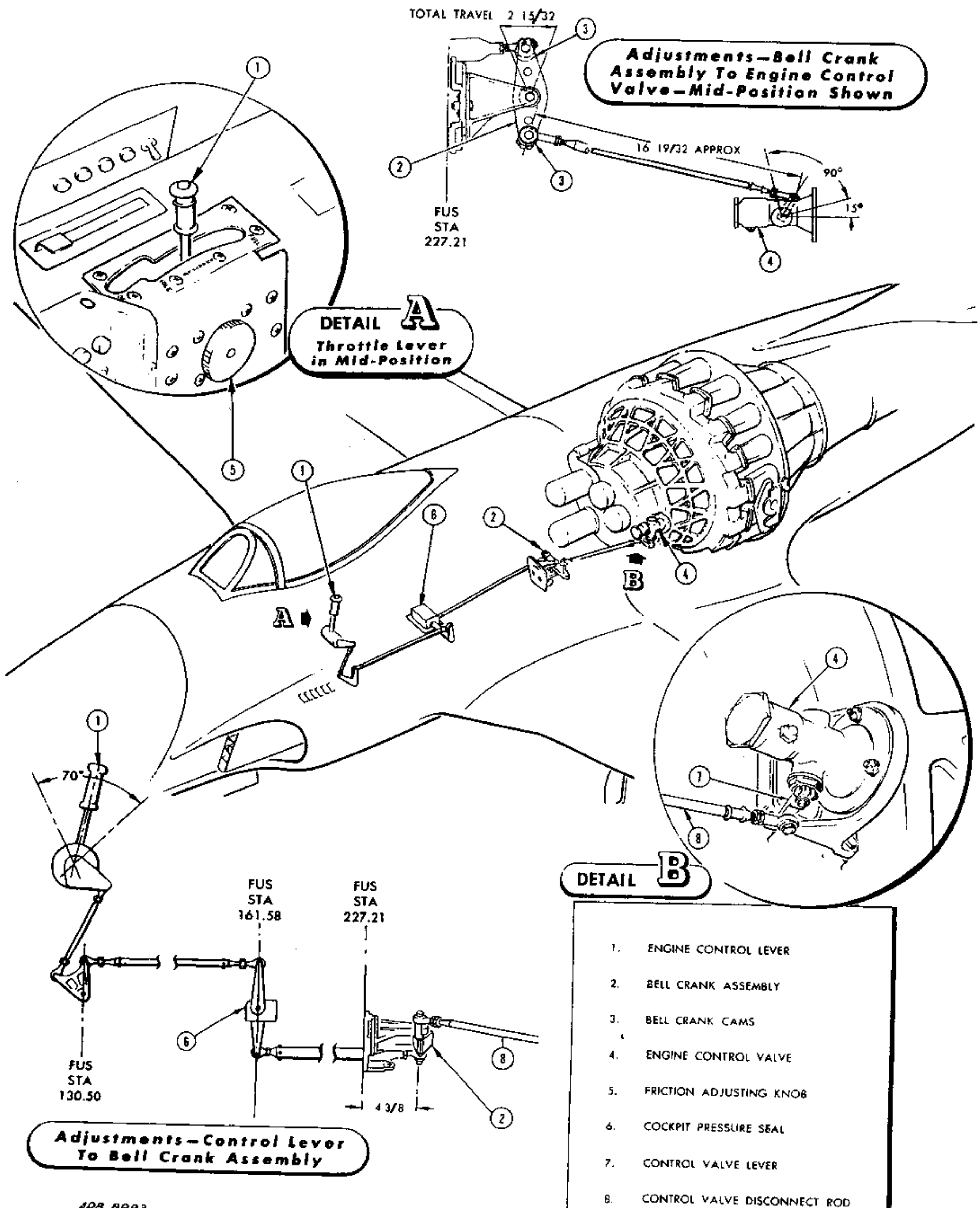



*Figure 89 — Engine Controls Diagram, P-80A-1 Airplanes*




| | |
|---|---|
| 1. | ENGINE CONTROL LEVER |
| 2. | BELL CRANK ASSEMBLY |
| 3. | BELL CRANK CAMS |
| 4. | ENGINE CONTROL VALVE |
| 5. | FRICTION ADJUSTING KNOB |
| 6. | COCKPIT PRESSURE SEAL |
| 7. | CONTROL VALVE LEVER |
| 8. | CONTROL VALVE DISCONNECT ROD |

*Figure 90 — Engine Controls Diagram, F-80A-5, RF-80A-5, F-80A-10 and RF-80A-10 Airplanes*

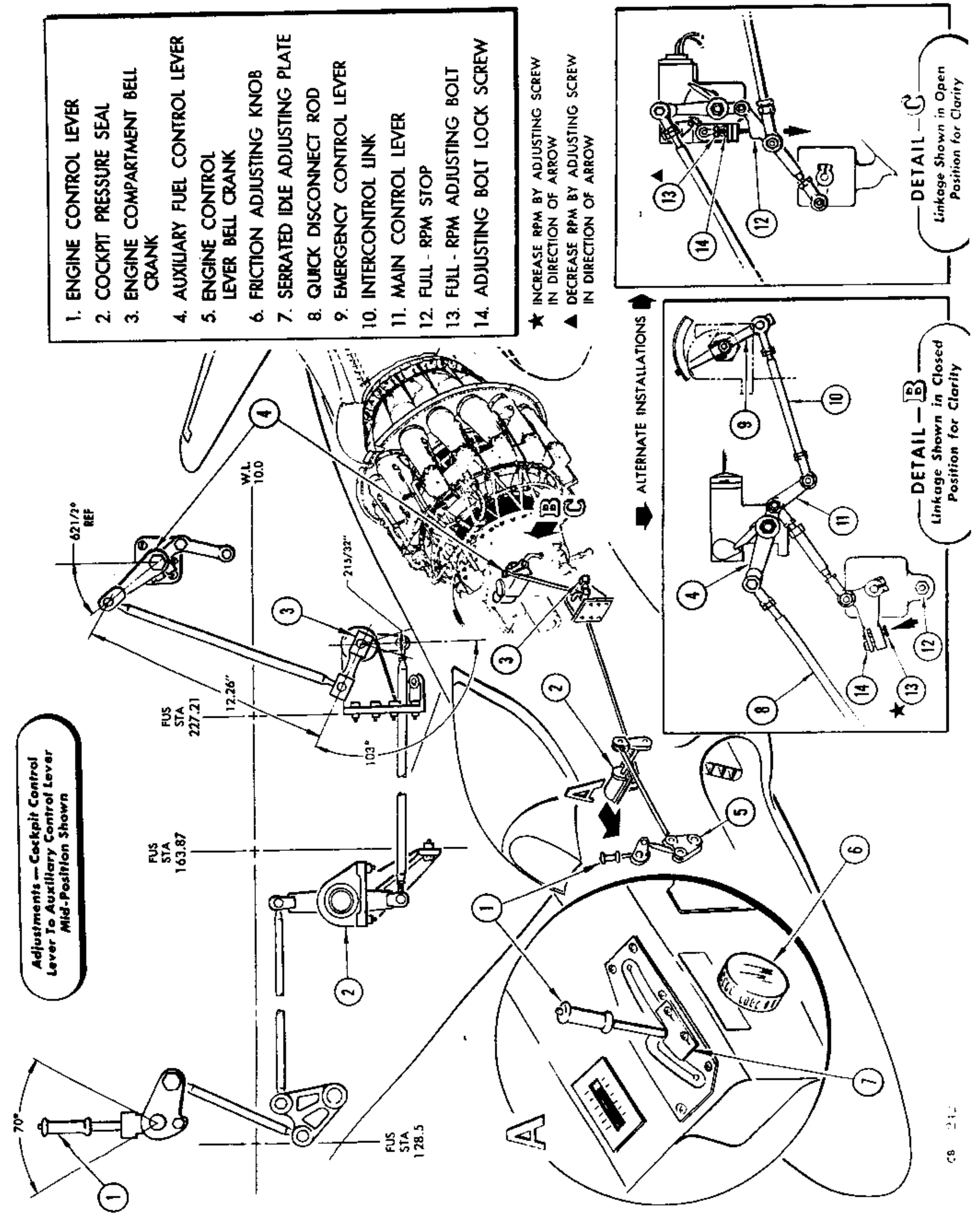



Figure 90A — Engine Controls Diagram, RF-80A-20 and RF-80A-25 Airplanes

## 8. ENGINE CONTROLS.

*(See figures 89 and 90.)*

*a.* GENERAL.—The engine is controlled from the cockpit through a control valve mounted on the engine.

On P-80A-1 airplanes, the control valve unit contains a stopcock valve and a throttle valve, with separate levers in the cockpit to operate each valve. The levers are connected to the engine control valve through a system of rods, bell cranks, and a Simmonds control. Both levers travel through slots in the cockpit left shelf and both are mounted on the same fulcrum assembly, but operate independently.

When both levers are in the aft ends of the slots, the stopcock is closed and the throttle is in idling position. When the stopcock lever is moved forward, the Simmonds control operates to open the stopcock portion of the engine control valve. At the end of the stopcock lever travel a snap lock maintains that position until force is used to move the lever aft. In turn, forward movement of the throttle lever opens the throttle function of the control valve from idling to full throttle. A push-pull rod from the throttle lever in the cockpit operates a bell crank, a torque tube, and push-pull rods to actuate the throttle valve. The control mechanism is sealed for cockpit pressurization at the torque tube in the aft part of the cockpit. (See figure 26 for lubrication requirements of the seal.) Both systems have quick-disconnect rods near the engine to facilitate engine removal.

On P-80A-5, FP-80A-5, P-80A-10, and FP-80A-10 airplanes the engine control valve is different from the early valve which had separate throttle and stopcock valves operated by separate levers. The new valve performs the same work through operation of only one lever on the valve which is actuated by a single lever in the cockpit. The control system is located the same as in early airplanes. In the later system, the torque shaft at fuselage station 227.2 is replaced by a bell crank assembly. A single disconnect rod connects the bell crank assembly with the engine control valve.

*b.* ENGINE CONTROL LEVERS.

*(See figures 91 and 92.)*

(1) DESCRIPTION.—The engine control levers are mounted on the cockpit left shelf. The stopcock lever slot is just below the throttle lever. The early assembly includes the two levers on a single fulcrum assembly. The later assembly contains only one lever. Both assemblies also contain a friction plug and a coil spring. Friction on the levers is adjusted by a knurled knob outside the shelf.

The top of the throttle lever contains a microphone switch used for controlling transmission on the command radio. The lever can be rotated about its longitudinal axis and this motion is used to operate the gun-sight range control. Fore-and-aft movement of the lever operates the engine throttle. The lever is attached to a rotatable fulcrum assembly by a bolt. The fulcrum assembly is mounted on the airplane through two fulcrum supports. One support is mounted on the cockpit structure and the other is mounted on the lever-assembly cover plate. A friction disc in the fulcrum can be adjusted by the knurled knob. Two arms integral with the fulcrum assembly actuate the push-pull rod to operate the throttle. The fulcrum serves also as a mount for the throttle-switch actuating cam. A bolt holds the cam in place.

(2) REMOVAL.

*(a)* Remove trim around cockpit left shelf.

*(b)* Disconnect three microphone-switch wires from terminal panel in side shelf.

*(c)* Remove nut and bolt attaching throttle push-pull rod to fulcrum assembly. (Nut and bolt are accessible from under side of shelf.)

*(d)* Remove nut and bolt attaching stopcock Simmonds control to stopcock lever (P-80A-1 airplanes only).

*(e)* Remove screws attaching slotted cover plate to side shelf.

*(f)* Displace control levers from side shelf sufficiently to gain access to the gun-sight actuating arm.

*(g)* Remove cotter pin from gun-sight push-pull rod where attachment is made to gun-sight operating arm on throttle, and disconnect arm from control lever.

*(h)* Remove throttle lever and stopcock lever assembly, including cover plate.

(3) DISASSEMBLY.

*(a)* Remove bolt, washer, and nut attaching throttle lever to fulcrum.

*(b)* Remove screw holding knob on stopcock lever, and remove knob (P-80A-1 airplanes only).

*(c)* Remove friction-adjusting knob and washer.

*(d)* Remove throttle lever, including cover plate, fulcrum support, and stopcock lever.

*(e)* Remove disc, spring, and friction plug, by sliding them out of fulcrum body.

*(f)* Remove spacer from end of fulcrum.

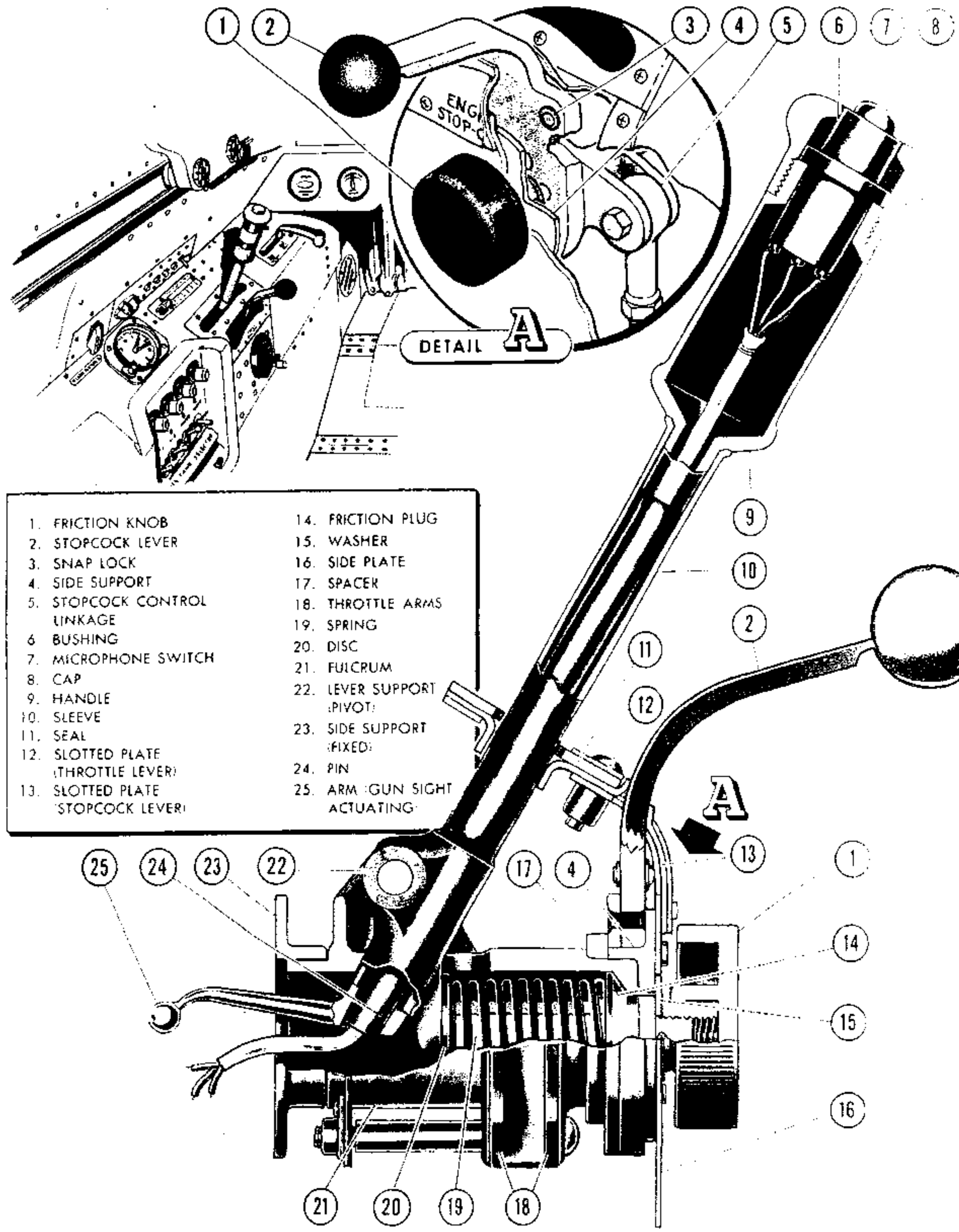
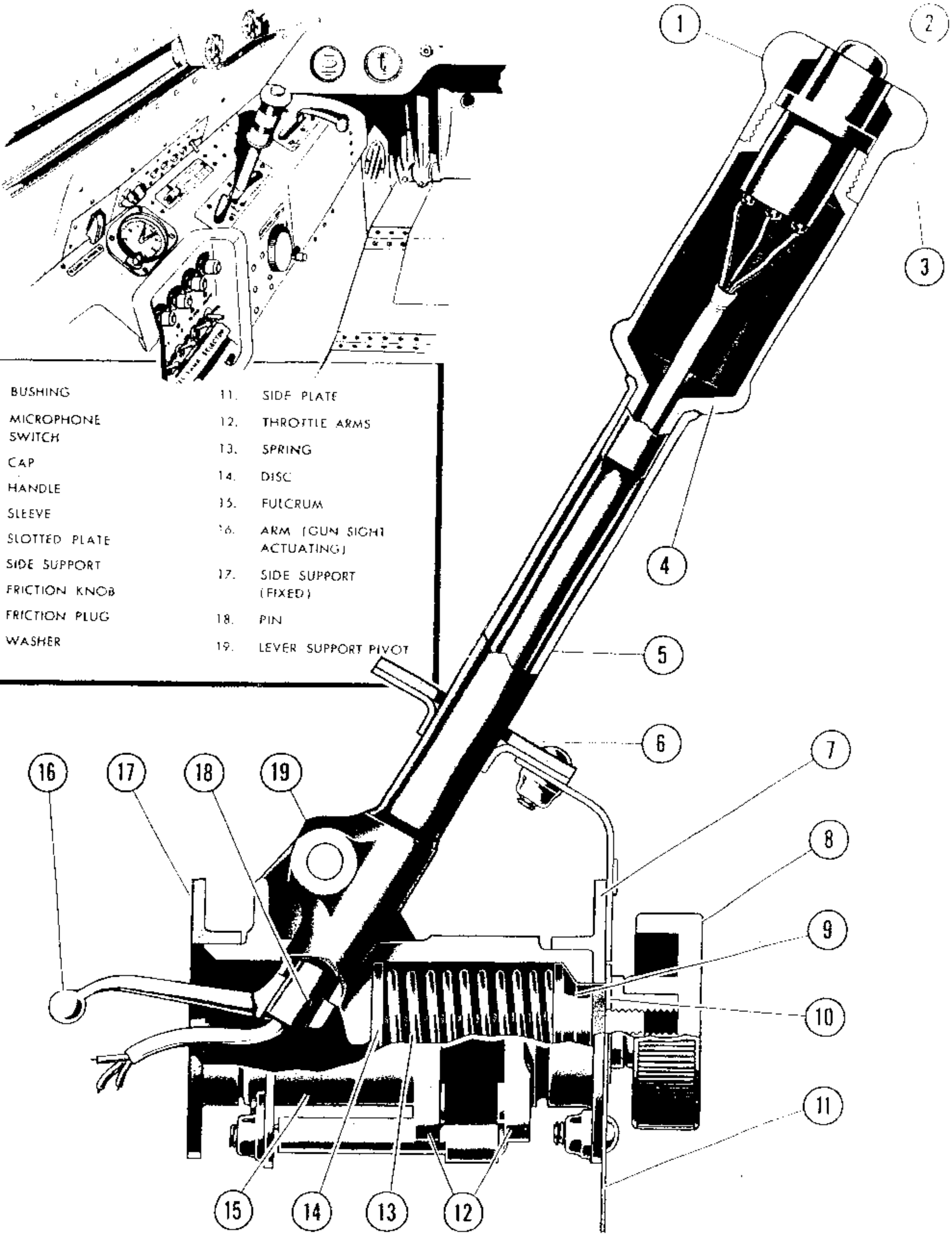



*Figure 91 — Engine Control Levers, P-80A-1 Airplanes*




| | | | |
|---|---|---|---|
| 1 | BUSHING | 11. | SIDE PLATE |
| 2. | MICROPHONE SWITCH | 12. | THROTTLE ARMS |
| 3. | CAP | 13. | SPRING |
| 4 | HANDLE | 14. | DISC |
| 5. | SLEEVE | 15. | FULCRUM |
| 6 | SLOTTED PLATE | 16. | ARM (GUN SIGHT ACTUATING) |
| 7. | SIDE SUPPORT | 17. | SIDE SUPPORT (FIXED) |
| 8 | FRICTION KNOB | 18. | PIN |
| 9 | FRICTION PLUG | 19. | LEVER SUPPORT PIVOT |
| 10 | WASHER | | |

*Figure 92 — Engine Control Lever, P-80A-5, FP-80A-5, P-80A-10, and FP-80A-10 Airplanes*

*(g)* Drill out the small pin in the base of the throttle lever, and remove the gun-sight arm.

*(h)* Slide out the inner part of the throttle lever, and remove cover plate assembly.

*(i)* Remove stopcock lever from support attached to cover plate (P-80A-1 airplanes only).

*(j)* Remove screw clamping throttle-switch cam to throttle arms and remove cam.

*(k)* To remove microphone switch from throttle lever handle, unscrew cap. Remove bushing and microphone switch.

(4) ASSEMBLY.—Reverse disassembly procedure.

**Note**

To assemble gun-sight actuating arm to lever, use 0.094 pin, and stake in place.

**CAUTION**

Be sure that special washer is placed between friction-adjusting knob and side support. Omission of washer results in binding of throttle lever when friction knob is tightened.

(5) INSTALLATION. — Reverse removal procedure.

**Note**

Rotate throttle lever to check operation of gun-sight equipment. Tighten friction-adjusting knob and operate lever to see that lever does not bind.

*c.* RIGGING ADJUSTMENTS (P-80A-1). *(See figure 89.)*

(1) THROTTLE.

*(a)* Position the throttle control lever in the center of the slotted plate on the cockpit left shelf. (See detail A.) This corresponds approximately to the mid position of the control lever travel.

*(b)* Adjust push-pull rod connecting control lever with bell crank (at station 130.50) so that aft arm of bell crank is perpendicular to cockpit floor.

*(c)* Adjust push-pull rod between bell crank and cockpit pressure seal (5) so that arms on both ends of cockpit seal are perpendicular to the floor.

*(d)* With the throttle lever still in mid position, adjust push rod between cockpit pressure seal and the

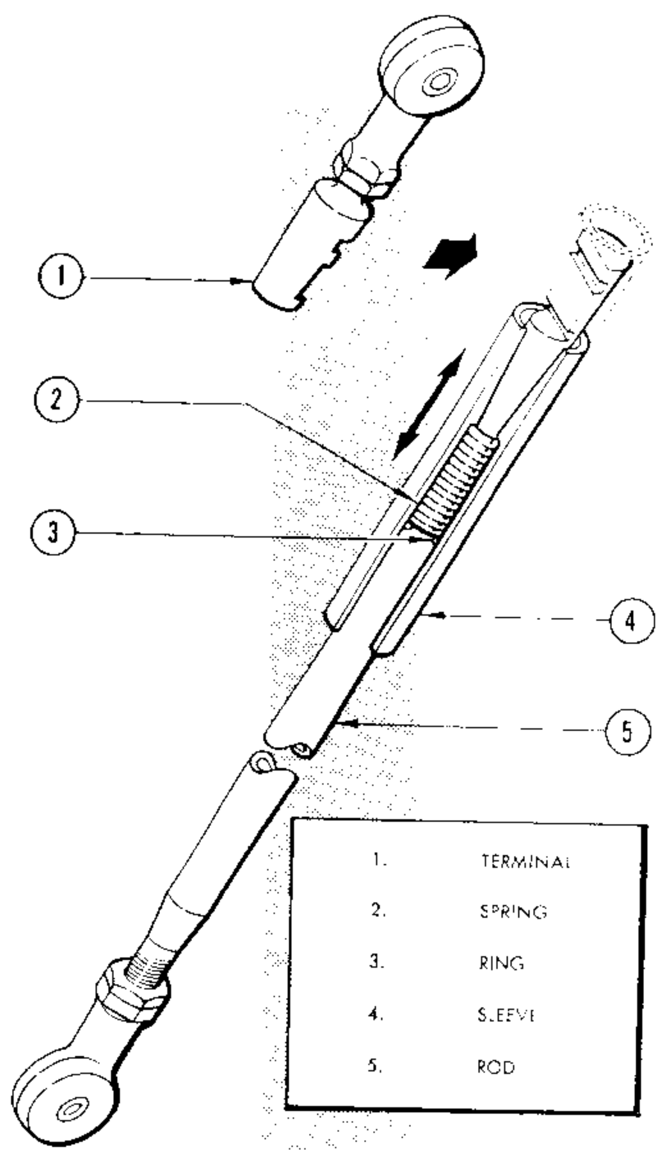



***Figure 93 — Quick Disconnect Rod, Engine Control Valve, P-80A-1 Airplanes Only***

torque shaft (2) mounted on the aft support panel for the fuel tank (fuselage station 227.2) so that distance between the center line of the rod-end bearing and the support panel is 4.0 inches.

*(e)* Attach engine control valve quick-disconnect rod to upper lever on torque shaft, and position lever so that center line of disconnect-rod end bearing is 2.88 ($2\frac{7}{8}$) inches from the tank support panel. Use torque shaft serrations for adjustment.

*(f)* Move throttle lever in cockpit and throttle lever on engine control valve to open positions. Adjust quick disconnect rod to approximately 15.1 inches and attach to lever on control valve.

*(g)* Operate control lever in cockpit to closed position. Adjust disconnect rod and lever on torque shaft, if necessary, to bring control valve lever against closed stop.

(2) STOPCOCK.

*(a)* Place stopcock lever in cockpit in open position. A snap lock on the lever cam will hold the lever in open position.

*(b)* Place stopcock lever on engine control valve in open position.

*(c)* Attach Simmonds control between cockpit level and control valve lever.

*(d)* Adjust ends as necessary to get linkage tight.

*(e)* Move cockpit lever to closed position and check travel of control valve lever to see if it is against closed stop. Adjust as necessary to obtain full travel of control valve lever from closed to open stops.

*d.* THROTTLE RIGGING ADJUSTMENTS (F-80A-5, RF-80A-5, F-80A-10, and RF-80A-10). *(See figure 90.)*

(1) Place the throttle lever in the center of the slotted plate on the left-hand shelf.

(2) Adjust push-pull rod connecting throttle lever with bell crank (at station 130.50) so that aft arm of bell crank is perpendicular to the cockpit floor.

(3) Adjust push-pull rod between bell crank and cockpit pressure seal (6) so that arms on both ends of cockpit seal are perpendicular to the floor.

(4) Set both cams in bell crank (2) so that control-rod attaching points are from full inboard to 15 degrees forward, and adjust push rod between the cockpit seal (6) and inboard cam of bell crank so that distance between the center line of rod-end bearing and the support panel is 4⅜ inches.

(5) Check position of push rod through wing tunnel for a minimum of 1/16 inch clearance in extreme throttle positions. Adjust serrated bell crank bracket (2) if necessary to provide proper clearance.

(6) Check total travel of tunnel push rod at aft end for full throttle travel of 2 15/32 inches as shown in upper detail of figure 90.

(7) Move engine control valve lever to full closed position. (Valve must be seated firmly in closed position to insure proper seal on rubber gasket within valve.) Check valve pointer indication on index ring. Loosen screws if necessary, and rotate index ring to read correctly. Lock the ring and recheck.

(8) Attach quick-disconnect rod to outboard cam of bell crank (2) and move throttle to ⅛ inch forward of aft end of quadrant slot (closed position). Tighten friction lock.

(9) Adjust length of quick-disconnect rod (approximately 16 19/32 inches) and attach to engine control valve lever. With the control valve in the fully closed position and the throttle lever ⅛ inch forward of the closed position, angle between valve lever arm and quick disconnect should be approximately 105 degrees.

(10) Check throttle system for freedom of operation, and see that no play exists in the linkage.

(11) Check engine control valve for leakage by disconnecting outlet tube and running emergency pump with the valve closed.

(12) Move throttle to idle notch and note pointer reading on control valve index ring. If pointer travels past idle mark, remove valve lever arm and rotate it aft one or two serrations to close the angle between valve lever arm and quick disconnect rod. If pointer undertravels, move lever arm forward to correct. Readjust quick disconnect rod for springback as in step (9).

(13) Move throttle to wide open position, less 1/16 inch measured on quadrant, and note pointer reading on control valve index ring. If pointer overtravels past open mark, rotate both cams on bell crank (2) inboard. If pointer undertravels, rotate both cams outboard. Both cams must be rotated an equal amount to keep throttle in correct rigging.

(14) Run up engine and set idle adjustment on control valve to 4000 (+0, −50) rpm.

*dA.* THROTTLE RIGGING ADJUSTMENTS (RF-80A-20 and RF-80A-25 Airplanes). *(See figure 90A.)*

(1) Place control lever (1) in center of slotted plate (7) on left shelf, and tighten friction lock.

(2) Adjust push-pull rod connecting control lever with bell crank (5) (at station 130.50) so that aft arm of bell crank is perpendicular to cockpit floor.

(3) Adjust push-pull rod between bell crank (5) and cockpit pressure seal (2) so that arms on both ends of cockpit seal are perpendicular to floor.

(4) Check engine compartment bell crank (3) aft of station 227.21 for angular setting of 103 degrees.

(5) Check total travel of tunnel push rod at aft end for full control lever travel of 2 15/32 inches as shown in figure 89A.

(6) Adjust quick disconnect rod (8) to length of approximately 12.26 inches and connect one end to the outboard bell crank.

(7) Place engine control lever ⅛ inch forward of closed-position stop on quadrant, and tighten friction lock.

(8) Adjust auxiliary fuel control arm (4) on main fuel control unit to 62½ degrees forward of vertical when in mid position.

(9) Connect arm to quick-disconnect rod (8).

(10) Check control system for freedom of operation and for absence of play.

(11) Operate engine to determine whether maximum governor setting on main fuel control is set at 11,750 (±75) rpm.

(12) If adjustment is necessary, loosen lock screw (14) while engine is idling or shut off. Turn adjustment bolt (13) as necessary to obtain 11,750 (±75) rpm. Increased rpm may be obtained by turning the adjustment bolt to increase lever or rod travel, and decreased rpm may be obtained by turning the adjustment bolt to decrease lever or rod travel. After adjustment, tighten lock screw and safety adjustment bolt and lock screw together.

(13) Check maximum speed of engine and if necessary, repeat steps (11) and (12) to obtain satisfactory adjustment.

(14) Loosen screws locking serrated idle adjustment plate to engine-control lever cover plate in cockpit.

(15) With engine operating at 4000 (±80) rpm on main fuel system, move serrated idle adjustment plate forward until joggle contacts engine control lever. Secure idle adjustment plate in this position.

(16) Accelerate engine to approximately 7000 rpm and then retard engine control lever to idle position. Engine speed should stabilize at 4000 (±80) rpm.

(17) If engine speed does not stabilize at 4000 (±80) rpm, repeat steps (14) through (16).

(18) Stop engine, place engine control lever in idle detent, and note position of pointer on emergency fuel control. The pointer should be in marked idle range.

(19) If pointer is past high end of idle mark, lengthen intercontrol link (10) to get pointer $\frac{1}{32}$ to $\frac{1}{16}$ inch inside idle range. Decrease length of emergency fuel control lever (9) to obtain a full open position approximately 5 degrees from full open mark.

(20) Start engine on main fuel system and set engine control lever at idle detent. Switch engine operation to emergency system, and allow engine rpm to stabilize. Open engine control lever slowly. A slight amount of movement should be possible without a change in engine speed. If a change in engine rpm occurs, stop engine and repeat steps (18) and (19).

(21) If idle speed on emergency fuel system operation is more or less than 4000 (±80) rpm, stop engine and make idle adjustment on emergency fuel control.

(22) Remove hex-head adjusting screw cap on emergency fuel control.

(23) Turn idle adjustment needle clockwise to decrease engine speed, or counterclockwise to increase speed.

**Note**

Emergency fuel control idle adjustment needle is very sensitive; a slight change in setting results in considerable change in idle speed.

(24) After making adjustment, start engine on main fuel system, switch to emergency fuel system and place engine control lever in idle position to check emergency idle rpm.

(25) Following adjustment of emergency fuel system idling, check emergency system top speed.

(26) If top speed is not reached, lengthen intercontrol link (10); if speed is too great, shorten intercontrol link.

**Note**

Intercontrol link should not be lengthened or shortened to point where emergency control pointer is outside idle or cut-off positions when engine control lever is in these positions. If this amount of adjustment is found necessary, more or less range of movement may be obtained by increasing or decreasing length of emergency fuel control lever.

*e.* FUEL CONTROL AND LINKAGE ADJUSTMENT (J33-A-9B, J33-A-11, J33-A-17A, AND J33-A-21 ALLISON ENGINES). To eliminate difficulty with adjustment of control valve part No. 9066302 which has failed to shut off fuel and is contributing to unstable conditions at idle rpm, accomplish the following inspection and adjustment.

(1) Check throttle linkage to ensure that lack of travel is not holding valve open.

(2) Inspect control valve outlet bushing, part No. 9053461. If the rubber seat is eroded, chipped, cracked, or shows signs of separating from the bushing, replace the control valve assembly.

(3) With engine running, hold throttle detent out. Tap throttle in 2-degree increments toward retard. Engine speed will decrease proportionately until control valve moves into the idle band.

(4) Record speed at which movement of the throttle results in no rpm change. This speed is idle rpm, and must be within limits of 32 to 34 percent of the maximum rpm.

(5) If the idle speed is within limits, continue to retard the throttle, and mark the throttle quadrant at the point where 5 percent below idle rpm is encountered. This point marks the lower end of the idle band.

(6) Tap the throttle toward advance, passing through the idle band, and mark the throttle quadrant at the point where the rpm increases to 5 percent above the idle rpm. This marks the upper end of the idle band.

(7) Set the idle detent to block off 75 percent of the lower idle band.

**Note**

On airplanes that do not incorporate an idle detent, mark the quadrant (using tape) at the 75 percent point.

(8) Check idle setting by retarding the throttle to the idle detent from 100 percent rpm. Idle speed must be within the limits of 32 to 34 percent of maximum rpm. If not, adjust control valve idle adjusting screw (under acorn nut adjacent to control valve shaft) to raise or lower rpm. Clockwise rotation of adjusting screw decreases idle speed, and vice versa. Reset the throttle detent if necessary. However, do not adjust idle rpm by changing the idle stop on the quadrant, without first accomplishing the procedure outlined in steps (3) through (7).

(9) Recheck idle setting several times by accelerating engine and then retarding the throttle against the idle stop. Be sure engine stabilizes at the same rpm and fuel pressure in each case.

## 9. AIR INTAKE SYSTEM.

*(See figure 94.)*

*a.* GENERAL.—Two ducts contained within the fuselage contour supply air to the power plant. Air enters the ducts through two faired scoops, one on each side of the fuselage, forward of the wing leading-edge. Each scoop contains ducts and louvres for venting overboard the inboard boundary intake air, reducing air turbulence. Air is vented both above and below the intake scoops. Further reduction of air turbulence in the scoops is obtained by a baffle across the aft end of each intake passage, approximately midway between the top and bottom of the passage.

During operation of the power plant with the airplane at standstill, air is admitted to the engine compressor openings through two auxiliary air inlet doors.

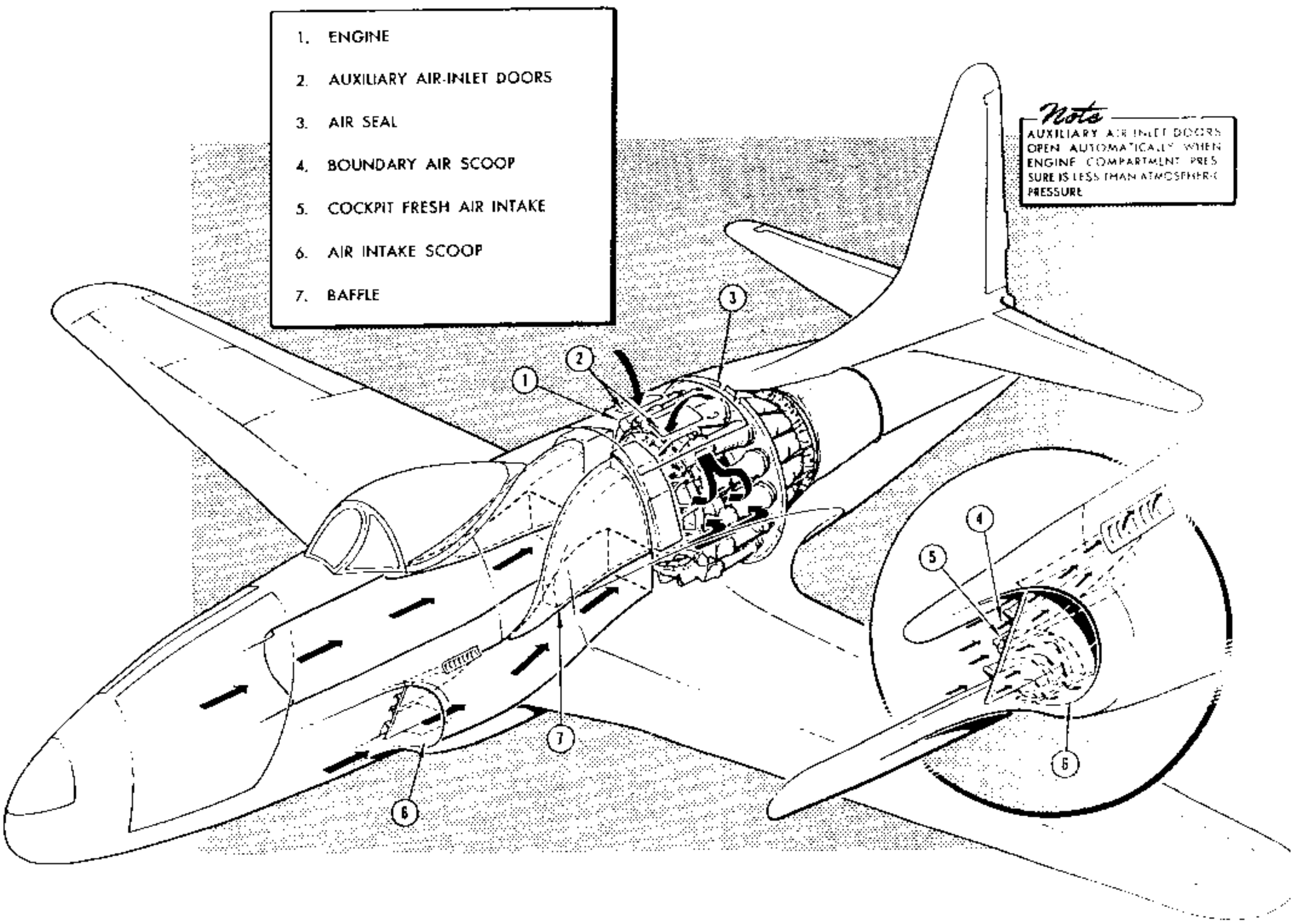



*Figure 94 — Engine Air Intake System*

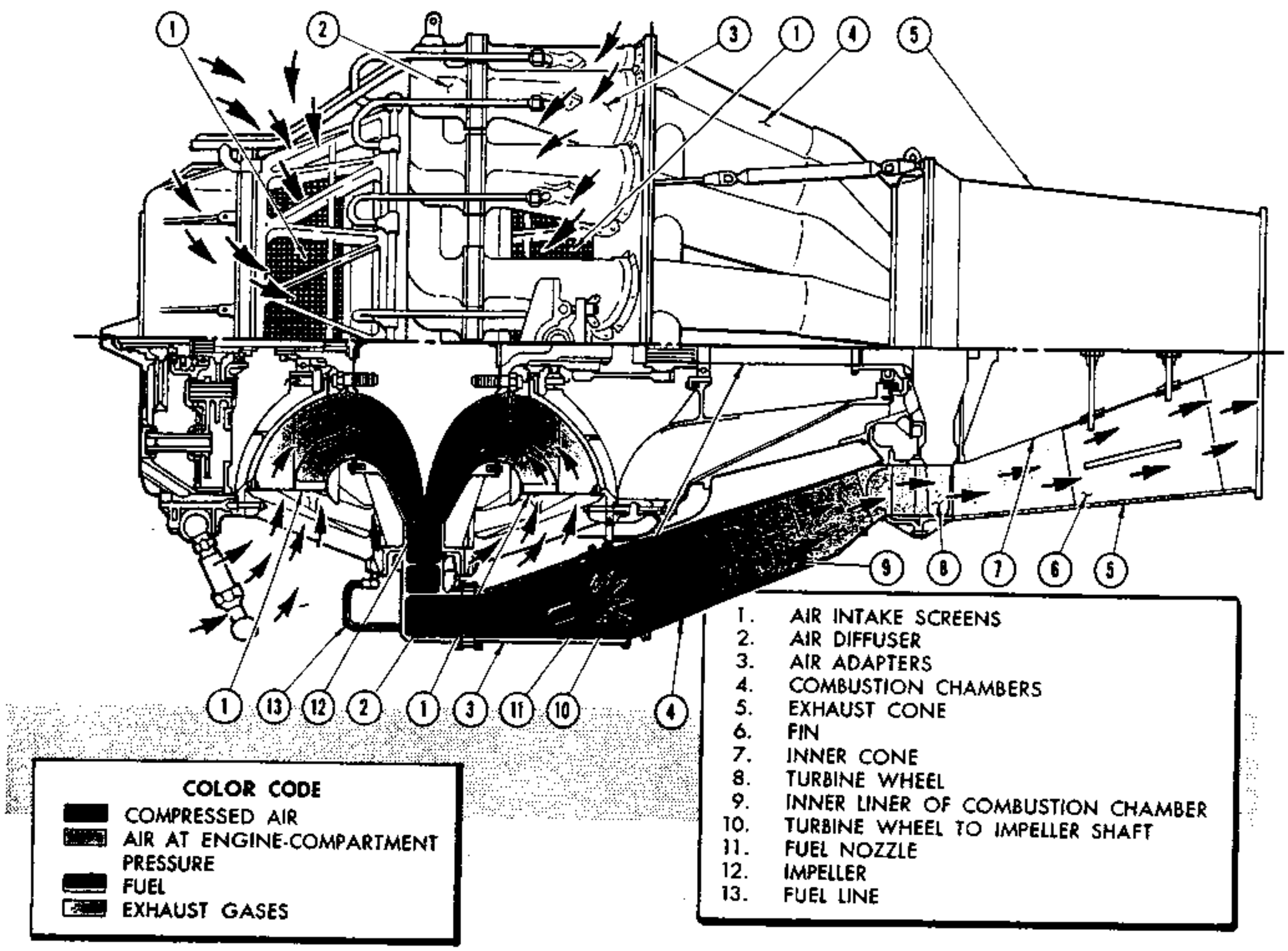



*Figure 95 — Engine Induction and Exhaust System*

These doors are spring-loaded to keep them closed during flight. Differential air pressure across the engine compartment and fuselage exterior during ground operation overcomes the spring force to open the doors.

Air entering the intake scoops or ground operating doors is dumped into the engine compartment where it enters the compressor. A seal around the engine periphery prevents loss of intake air through the fuselage aft section.

*b.* INTAKE DUCT. *(See figure 94.)*—The intake ducts are constructed of aluminum alloy sheet metal, with a beaded outer skin. Hat-section stiffeners on the inboard sides of the ducts serve to strengthen the structure. Each duct has a curved baffle located approximately midway between the top and bottom of the aft end of the duct.

The ducts extend from fuselage station 163.875 to station 228.30. Attachments are made with bolts and screws around each end of the ducts.

*c.* ENGINE INTAKE SYSTEM. *(See figure 95.)*—Air at engine-compartment pressure enters the engine compressor on both sides of the double-inlet multi-vaned impeller wheel. The air is compressed and forced out through the diffusers and air adapters into the combustion chambers. Each combustion chamber consists of an outer wall and an inner perforated liner. The compressed air is forced between the outer wall and inner liner and through the perforations into the interior of the chamber. The compressed air admitted to the inner chamber is mixed with fuel from the fuel nozzle, and burned. The exhaust gases pass through the turbine wheel. The turbine wheel is directly connected to the impeller, and drives the impeller and the accessories. The gases leaving the turbine wheel enter the exhaust cone and the tail pipe. The exhaust cone consists of a short tapered pipe covering an inner cone. It contains four fins to straighten the flow of gas as the gas leaves the turbine wheel.

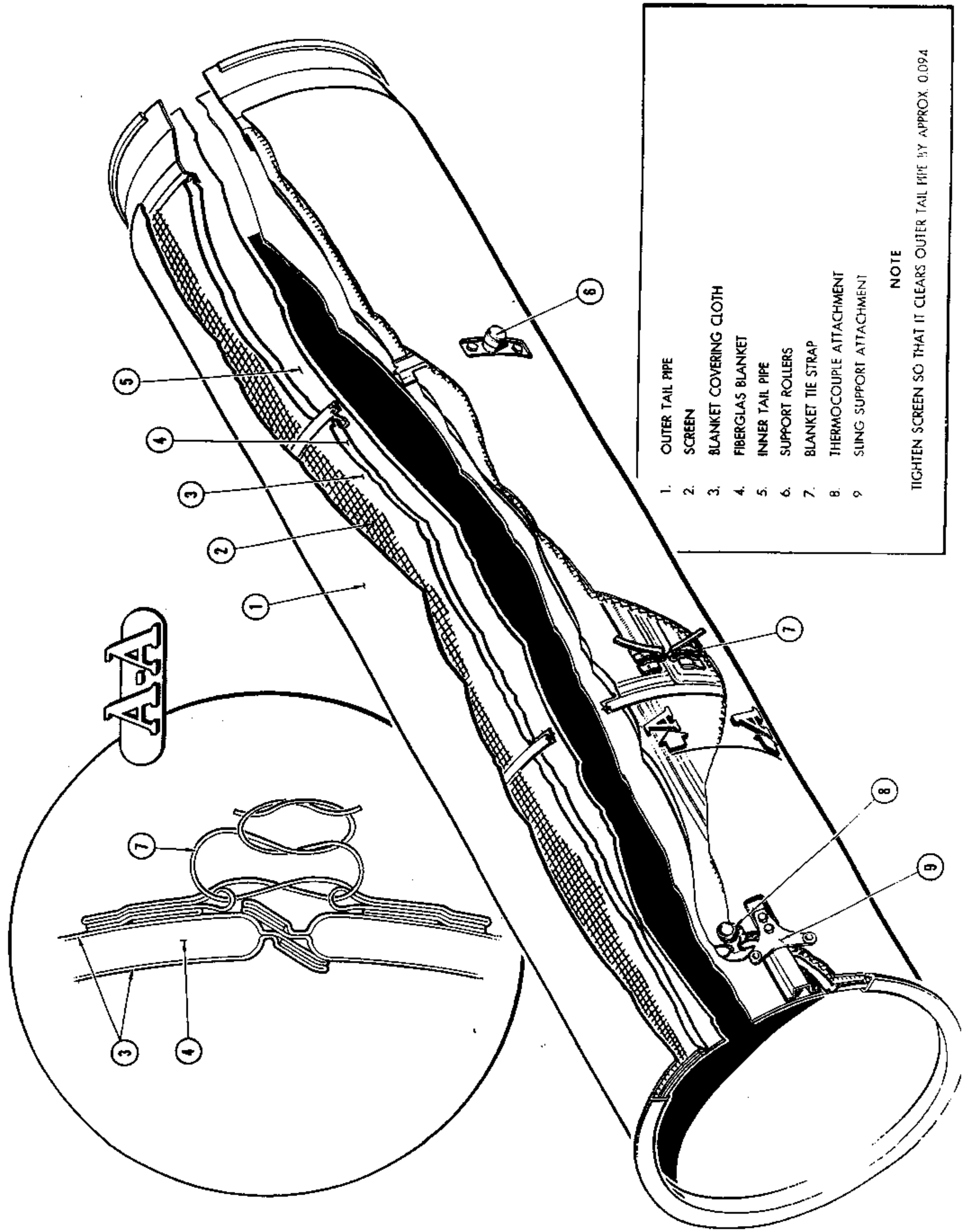



*Figure 96 — Tail Pipe*

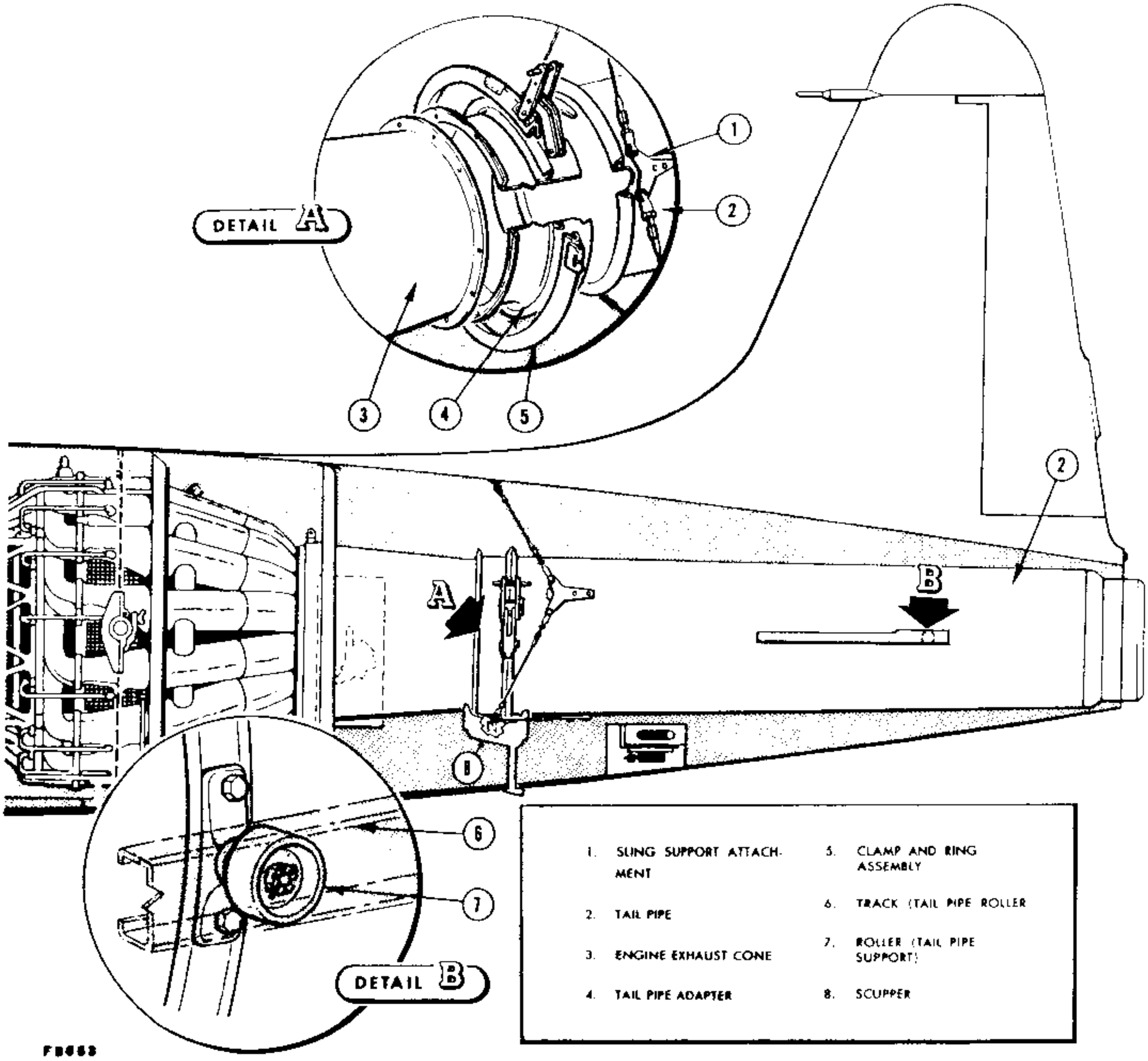



Figure 97 — Tail Pipe Installation

## 10. EXHAUST SYSTEM.

*a.* GENERAL.—The exhaust system consists of the engine exhaust cone, a tail pipe adapter, and the tail pipe. The exhaust cone is an integral part of the engine. It extends aft from the turbine wheel a short distance, and is covered by an asbestos cover. The adapter is a section bolted to the exhaust cone to connect the cone to the tail pipe. The tail pipe extends from the adapter just past the aft extremity of the fuselage. (Refer to paragraph 6*c*, this section for engine operation.)

*b.* TAIL PIPE AND TAIL PIPE ADAPTER.

(1) DESCRIPTION. *(See figures 96 and 97.)*—The tail pipe adapter is attached to the engine exhaust cone by bolts around the mounting flange, using Klincher type nuts or castle nuts safetied by cotter keys.

CAUTION

Some engine exhaust cones and some tail pipe adapters have 24 holes in the attaching flanges, while others have 48 holes for attaching bolts. Tail pipe adapters with 24 holes may be used with exhaust cones containing 48 holes, but the 48-hole adapters MUST NOT be used with

24-hole exhaust cones. Having unused holes in the adapters weakens the flange and may result in exhaust leakage between attaching bolts.

The tail pipe is connected to the adapter by a quickly detachable clamp, and is supported in the fuselage aft section by a sling and roller system. A triangular sling arrangement supports the forward end of the tail pipe by two cables from each of three points on the fuselage structure to fittings on the tail pipe. The cables are adjustable at the end which is fastened to the cable attaching plate on the tail pipe. The tail pipe maintains its position relative to the fuselage when the engine is removed. The aft end of the tail pipe is supported by rollers which ride in tracks located one on each side of the fuselage.

**CAUTION**

Adjust the tail pipe sling so it will be taut when the pipe flange is held away from the adapter by 1-inch wood blocks. This is to prevent loss of the tail pipe should the attachments fail.

The tail pipe is approximately 96 inches long and tapers from an inside diameter of approximately 21 inches at the forward end to 18.5 inches at the aft end. The inner skin of the tail pipe is of corrosion-resistant steel, which is wrapped with an aluminum and fiberglas blanket. The blanket is then covered with a stainless steel wire screen. An aluminum alloy outer skin is fitted over the entire assembly.

**Note**

A clearance of 0.094 inch is to be maintained between the screen and the outer skin.

(2) REMOVAL.—Tail pipe is removable after fuselage aft section has been removed from airplane. (See paragraph 6*e*, this section.) Tail pipe adapter is removed with engine.

**WARNING**

Use asbestos gloves when handling a hot tail pipe.

**CAUTION**

Handle tail pipe carefully to prevent damage to outer cover.

*(a)* Remove sling cables from attaching plates on fuselage structure.

*(b)* Remove tail pipe by pulling it forward.

**Note**

The tracks which support the rollers are approximately 23 inches long. Support the aft end of the tail pipe to prevent damage when rollers reach ends of tracks.

*(c)* Check tail pipe nozzle for out-of-round. The inside diameter is 18.500 (+0.075, −0.000) inches. The maximum allowable out-of-round is 18.700 inches along the major axis, and 18.300 inches along the minor axis.

**Note**

Replace tail pipe if it is not possible to return it to round.

*(d)* Slight evidence of wrinkling may be acceptable, but deep wrinkles (½ inch depths or more) will be cause for replacement.

**CAUTION**

After installation of a new tailpipe, to eliminate possible tailpipe collapse, unlace blanket, start and run engine for two minutes at approximately 36 percent rpm. Shut engine down and allow tailpipe to cool prior to relacing blanket. The above procedure will permit possible moisture accumulation in blanket to evaporate.

*c.* REPAIR OF TAIL CONE AND TAIL PIPE INSULATING BLANKETS. The following repairs can be made to the blankets using an H. I. Thompson 45-21144-110 welding kit or the equivalent:

(1) Holes from $\frac{1}{16}$ inch to 6 inches in diameter.

(2) Slits from ⅛ inch to 18 inches in length.

(3) Repairs not to exceed 25 percent of the total blanket area.

## 11. DELETED.

*a.* DELETED.

*b.* DELETED.

*c.* DELETED.

ALL MATERIAL DELETED FROM PAGE 148

## 12. OIL SYSTEM.

*(See figure 98.)*

*a.* GENERAL.—The engine is lubricated by a simple wet-sump system. Operationally, the system consists of a supply reservoir, a combination lubricating and scavenging pump, a filter, and a pressure transmitter. The pump and filter are mounted on the accessory gear casing. The supply reservoir is an integral part of the accessory-drive gear casing and is formed by the gear casing and the engine front-bearing support casting. Lubrication is by low-temperature oil, AAF Specification 3606. The reservoir contains an oil supply of 12 U.S. quarts (20 Imperial pints). The minimum supply allowable is 6 U.S. quarts (10 Imperial pints). Oil quantity is measured with a bayonet gage which is attached to the filler cover located on the left side of the accessory-gear casing, when facing the front. The oil supply is adequate for 10 hours of continuous operation at normal rated speed. To prevent the lubricating oil from congealing during sub-zero operation, provision is made for a temperature control system, built into the accessory-gear casing. The system consists of two 250-watt cartridge-type heaters and a thermostat. The thermostat, which is used with a relay to handle the heater current, closes at a temperature of —7° C (20° F). It will withstand a maximum temperature of 121° C (250° F). Airplanes leaving the factory are not equipped with the oil heaters and thermostat.

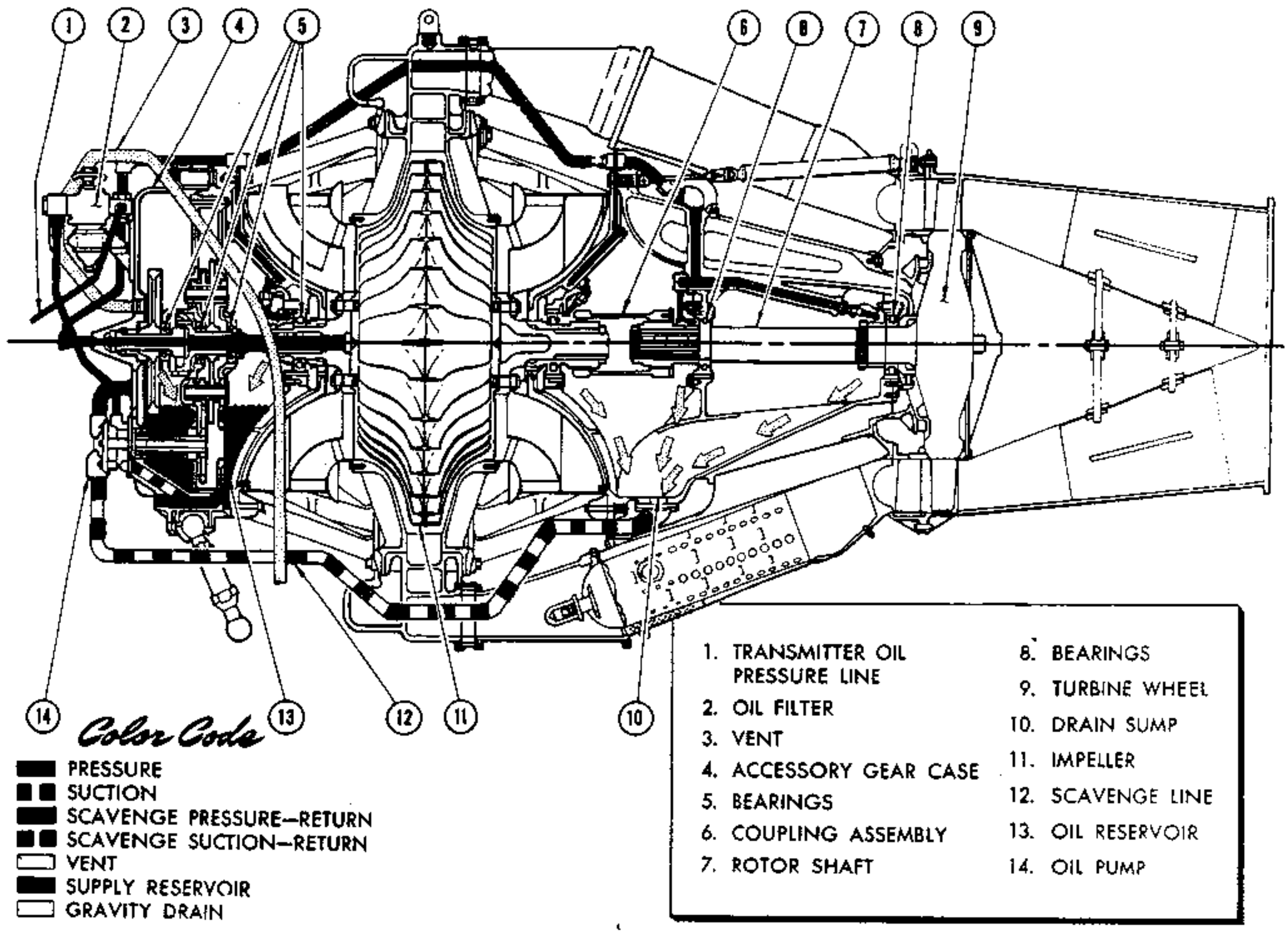



*Figure 98 — Engine Oil System*

*b.* OPERATION.—Lubricating oil is delivered under pressure to the bearings through a two-element lubricating and scavenger pump. The pump is located on the accessory-gear casing, and has a port on its mounting flange which is in direct contact with the oil in the reservoir. The lubricating oil passes from the lubricating element of the pump to an oil filter, and then through external tubing to the four rotor bearings and the couplings. The oil is directed into the coupling and bearings through jets with $\frac{1}{16}$-inch orifices, and into the large gear coupling through a jet which has a $\frac{1}{8}$-inch orifice. Oil seals prevent oil leakage past the front and rear compressor bearings and the rear turbine bearing. Unbalanced pressures between the inside and outside of the casings that contain the bearings provide a further check to oil leakage. Oil is returned to the reservoir by gravity and suction. The front compressor bearing and the quill shaft of the accessory drive both drain directly into the reservoir. The oil from the other three bearings and from the coupling drains into a sump, and from there it is drawn by the scavenger element of the lubricating and scavenger pump, and returned to the oil reservoir.

All of the gears and bearings in the accessory-drive casing are lubricated by a splash system from the gear which drives the pump. The gear is located in a special compartment under the oil level. Oil is admittted to the compartment through an orifice which controls the quantity of oil that is used for lubricating the gears and bearings, and prevents the oil in the reservoir from being churned into foam. A baffle in the reservoir prevents surging of the oil during maneuvers and negative accelerations. The lubricating and scavenger pump is so located that its inlet is supplied with oil at minimum oil level in a zero to 60-degree diving angle with a 10-degree inclination to either side, or a zero to 60-degree climbing angle with a 10-degree inclination to either side. It is possible to maintain inverted flight positions for short periods (one minute or less) without an appreciable loss of oil. The lubricating pump runs dry under inverted flight conditions, and the spline and gear couplings will operate for short periods without being damaged. A tube vents the oil reservoir to the atmosphere.

Continuous indication of oil pressure is given on an indicator located on the instrument panel. The indicator is actuated by an oil-pressure transmitter which is mounted on a bracket attached to the engine-compartment structure. The transmitter receives oil pressure through a flexible line from the accessory gear case on the engine.

*c.* OIL PUMP.—A combination lubricating and scavenging pump is mounted on the accessory-gear case slightly below the center, at the front of the engine. The pump is a mechanically driven two-element, pressure and suction rotary type pump, requiring from one to two horsepower to drive it at the ratings given in the following paragraphs. The head of the pump is secured to the body by six mounitng bolts; four of these bolts are special extension studs used to hold the bracket on which the bar netric fuel control is mounted. The mounting-flange bolt holes are spaced unequally for positive orientation of the pump. The pump should be mounted carefully so that the connections at the flange and on pipe fittings are tight, since a damaged gasket at the mounting flange or a loose inlet connection will admit air into the pump and cause failure of the suction element; it may even result in failure of the pump to prime.

The lubrication pumping element is located in the pump near the mounting flange and is rated to give a flow of 3 gallons per minute at 2400 rpm. The inlet port is in the machined face of the mounting flange. When the pump is mounted, this port lines up with the oil-passage hole in the face of the mounting pad on the gear case. The discharge port for the lubricating element is on the side of the pump casing, and is tapped with a one-inch pipe tap.

The scavenging element is similar to the lubricating element and is located in the pump casing above the lubricating element at the end opposite the mounting flange. The discharge port for the scavenging element is in the same plane as the inlet port but is displaced 180 degrees. The element is rated to give a flow of 10-gallons per minute at 2400 rpm.

The pump is equipped with a relief valve which bypasses oil from the discharge side of the lubricating pumping element through a port in the mounting flange directly back into the gear case. This valve is designed to open at from 80 to 100 psi pressure, and is not adjustable.

Except in an emergency, disassemble the pump only to clean it. If overhaul or repairs are necessary, replace the pump.

The oil pump inlet finger screen should be inspected for indication of green lacquer particles when oil gage fluctuation is greater than +3 or less than −3 psi, or oil consumption is in excess of one quart per hour. In the event such inspection discloses green lacquer particles on the oil pump inlet finger screen, and not exceeding in quantity the amount required to cover one square inch of the total area of the screen, accomplish the following flushing procedure.

(1) Remove all accessible oil filters and strainers.

(2) Disconnect flexible line from the accessory case oil filter pressure outlet to the front compressor bearing support at the fitting on the bearing support.

(3) Remove magnetic oil drain plug.

(4) Connect an external pumping system to the fitting on the compressor front bearing support.

(5) Circulate kerosene, Spec VV-K-211B or other solvent through the system for a period of 15 minutes, and completely drain from the accessory case.

(6) Circulate regular engine oil in the same manner for five minutes, and allow oil to drain completely from the engine.

(7) Remove the external circulating system line from the fitting on the compressor front bearing support.

(8) Reinstall the flexible line to the fitting on the compressor front bearing support, and reinstall the filters, strainers, and magnietic drain plug.

(9) Fill the engine oil system with 12 quarts of oil, Spec MIL-O-6081, and run up engine to check for fluctuating oil pressure. If no fluctuation beyond allowable +3 or −3 psi is observed, return the engine to service.

(10) When the engine has operated for five hours in service, check the oil finger screens again for indications of lacquer particles. In the event further lacquer particles are found on the oil pump inlet finger screens, and do not exceed in quantity the amount required to cover one square inch of the total area, repeat the same inspection and flushing procedure.

**CAUTION**

All engines having green lacquer particles exceeding one square inch of the total area shall be removed for depot major overhaul.

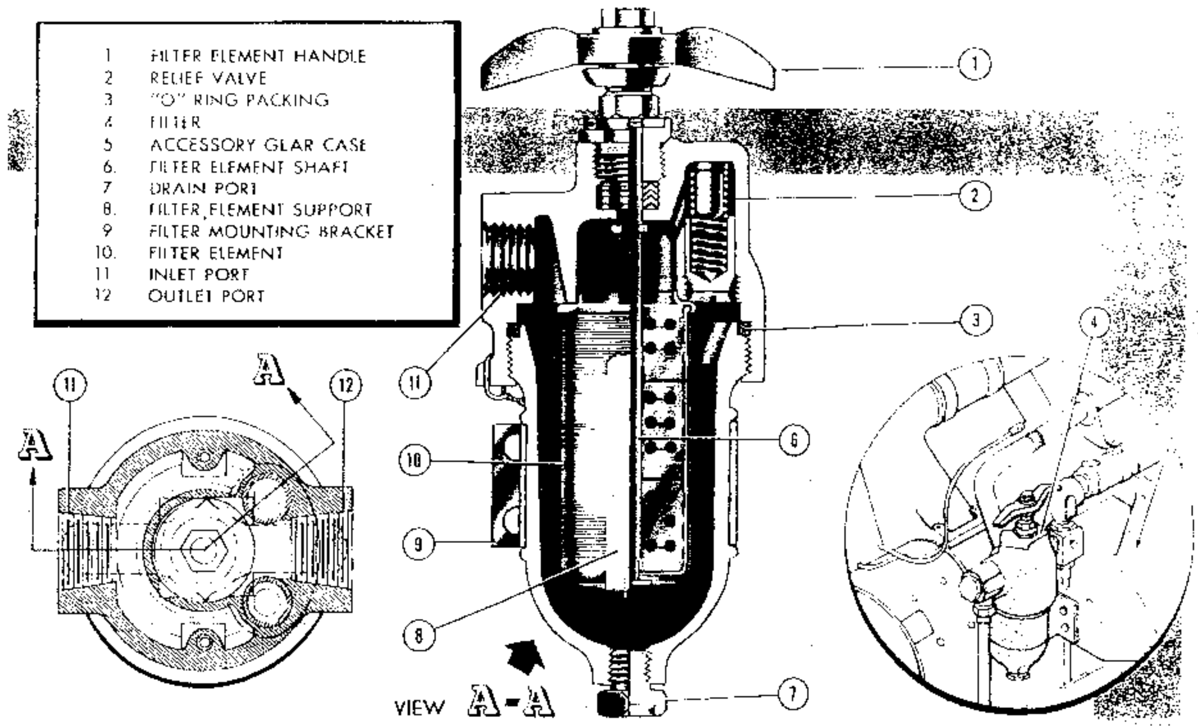



*Figure 99 — Oil Filter*

*d.* OIL FILTER. *(See figure 99.)*—A manually operated disc-type filter, Purolator No. G159J-10, is mounted on a bracket on the front, near the top of the accessory gear case. The metal-cased filter consists of a filter element (10), a handle (1) for turning the element, and two relief valves (2). The filter has a capacity of 12 gallons of fluid per minute. The element has a spacing of 0.003 inch. The two integral relief valves open at a differential pressure of 40 to 50 psi to prevent stoppage in the system if the filter becomes fouled.

Oil from the pressure side of the pump passes through the filter before entering tubes leading to the bearing surfaces of the engine.

*e.* OIL PRESSURE TRANSMITTER.—An oil pressure transmitter is located on the fuselage structure in the engine compartment. Pressure, through a line from the accessory gear case on the engine, registers on a gage on the instrument panel in the cockpit. The unit is the same as the fuel pressure transmitter, and is similar in operation and servicing. For detailed information, refer to paragraph 13*b*(18), this section, and figure 120.

*f.* OIL HEATER AND OIL THERMOSTAT.—Provisions are made in the accessory gear case for two oil heaters and one oil thermostat. These units may be installed by removing threaded plugs and inserting the units.

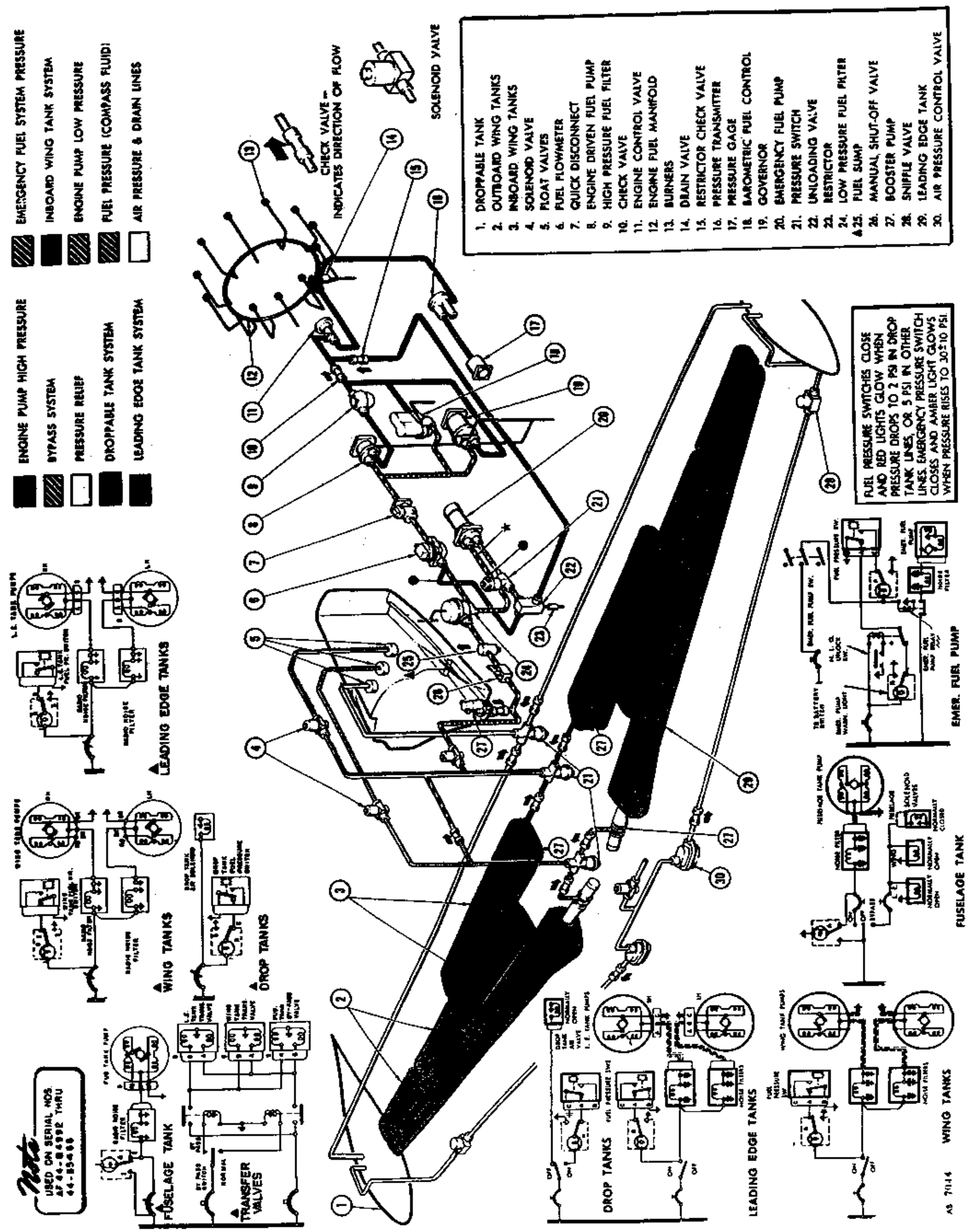



*Figure 100 — Fuel System Schematic Diagram*

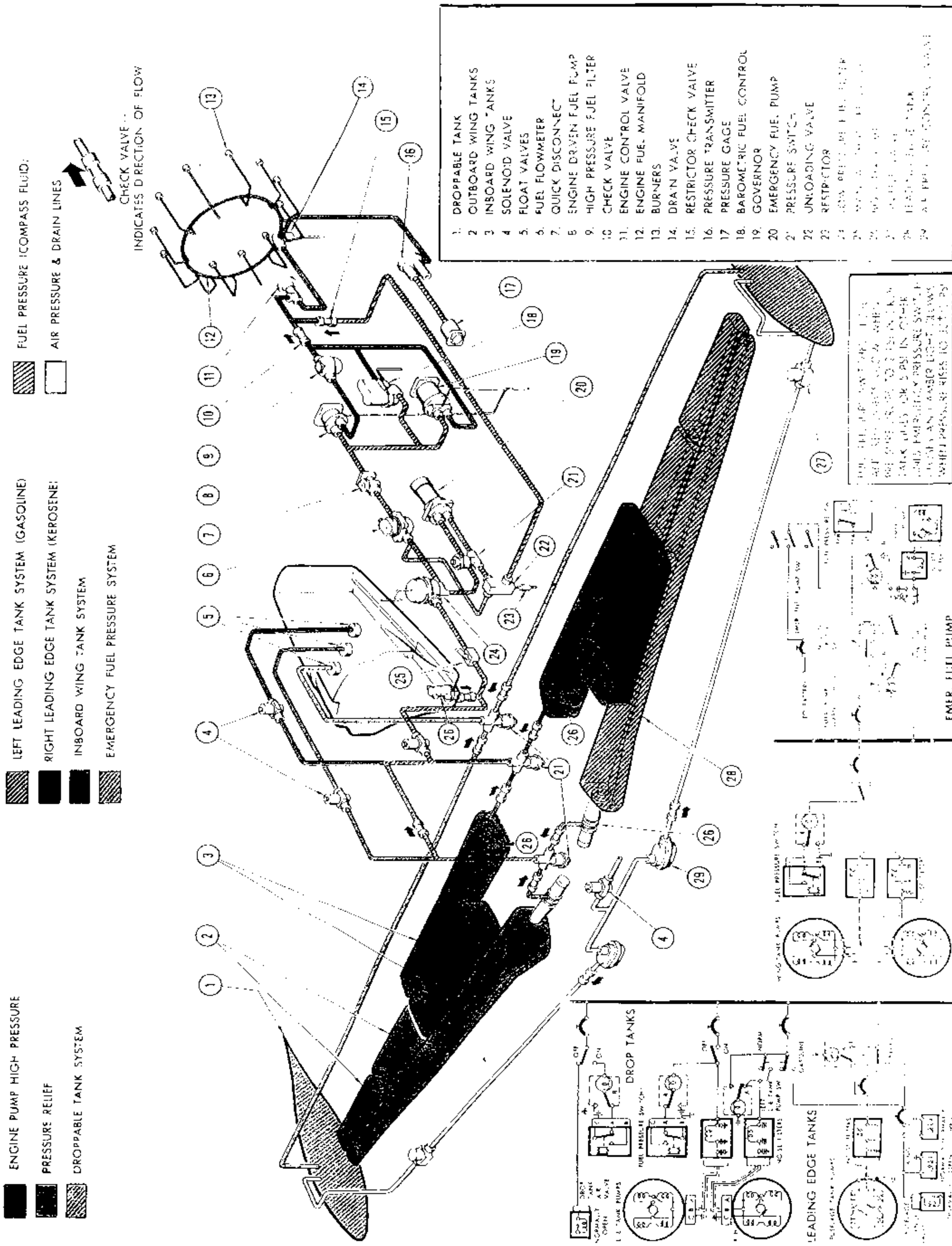



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*Figure 100A — Fuel System Schematic Diagram, F-80A-10 Winterized Airplanes*

## 13. FUEL SYSTEM.

*a.* GENERAL.—The fuel system is divided into two sections: the airplane system and the engine system. The parts that remain with the airplane when the engine is removed make up the airplane system. All other components are included in the engine system.

The fuel used is Specification MIL-F-5616, Grade JP-1.

*b.* AIRPLANE FUEL SYSTEM.
*(See figures 100, 100A, and 101.)*

(1) GENERAL.—The airplane fuel system consists of the following parts: droppable tanks, wing outboard and leading-edge tanks, wing inboard tanks, fuselage tank, float valves, fuel pumps, filters, solenoid valves, altitude idle valve, manual shut-off valve, check valves, fuel pressure transmitter, fuel flow meter, fuel level transmitter, and fuel pressure switches.

**CAUTION**

Do not add alcohol to the fuel system through any of the fuel tanks, regardless of the type.

The following is a list of the fuel tank capacities:

| *Tank* | *No.* | *Usable Capacity* Gal Each *U.S.* | Gal Each *Imp.* | Gal Total *U.S.* | Gal Total *Imp.* |
|---|---|---|---|---|---|
| Droppable | 2 | 165 | 137.0 | 330 | 274.0 |
| Wing Outer Outboard<br>Wing Inner Outboard<br>Wing Leading Edge | 2 | 44 | 36.5 | 88 | 73.0 |
| Wing Aft Inboard<br>Wing Fwd Inboard | 2 | 65 | 54.0 | 130 | 108.0 |
| Fuselage | 1 | 207 | 172.0 | 207 | 172.0 |
| Total | | | | 755 | 627.0 |

**Note**

In those airplanes incorporating T.O. 01-75F-42, each droppable fuel tank has 230 U.S. (191.6 Imperial) gallons capacity.

(2) OPERATION.—There are 13 fuel tanks in the fuel system. Each side of the wing incorporates two inboard tanks, two outboard tanks, and a leading edge tank. The leading edge and both outboard tanks are interconnected, and the two inboard tanks are interconnected. A fuel tank is installed in the fuselage immediately aft of the cockpit. Provision is made for attachment of a droppable tank to a shackle installed in each wing tip. All tanks except the droppable tanks are self-sealing.

Fuel is forced from the droppable tanks by air pressure supplied by the engine compressor. It is pumped from the wing tanks by electrically operated booster pumps, one located at the root of each leading edge tank, and one in the root of each aft inboard tank. Fuel is normally supplied to the engine from the fuselage tank, and as the supply is depleted in this tank, it is continuously replenished from the droppable and wing tanks.

To operate the fuel system, lift the selector bar of the fuel system switch panel. This opens the droppable tank air-pressure solenoid valve, and turns on the booster pumps for all tanks. During normal operation, fuel is supplied to the engine from the fuselage tank. The wing-panel tanks and droppable tanks in turn supply fuel to the fuselage tank.

**Note**

If droppable tanks are not installed, return the droppable tank switch to the "OFF" position. This closes the air pressure valve, preventing loss of pressure.

Transfer of fuel to the fuselage tank is regulated by three float valves installed in the tank. When the fuel level in the fuselage tank drops to the level of the upper float valve this valve opens and fuel is forced from the droppable tanks to the fuselage tank. When the droppable tanks are emptied, a pressure switch operates an indicator light adjacent to the control switches to show that the droppable tanks have discharged their fuel. The droppable-tank fuel control switch should be turned "OFF" to close the valve controlling the air pressure to the droppable tanks and to turn off the indicator light.

Additional lowering of the fuselage-tank fuel level opens the middle float valve to permit delivery of fuel from the leading edge tank to the fuselage tank. Upon transfer of all fuel from the leading edge tanks to the fuselage tank, a pressure switch operates a warning light indicating that the transfer of fuel has been completed. The leading-edge tank fuel pump should be shut down at this time to reduce the electrical load. The indicator light will then turn off.

When the fuel level in the fuselage tank reaches and opens the lowest float valve, fuel is transferred from the inboard tanks. An indicator light is actuated by a pressure switch in the fuel line to show when the inboard tanks are empty. The inboard tank pumps should be shut down at this time to decrease the electrical load and to turn off the indicator light. The float valves are near the top of the fuselage tank, so that after all fuel has been transferred from the wing tanks, almost the entire capacity of the fuselage tank is still available.

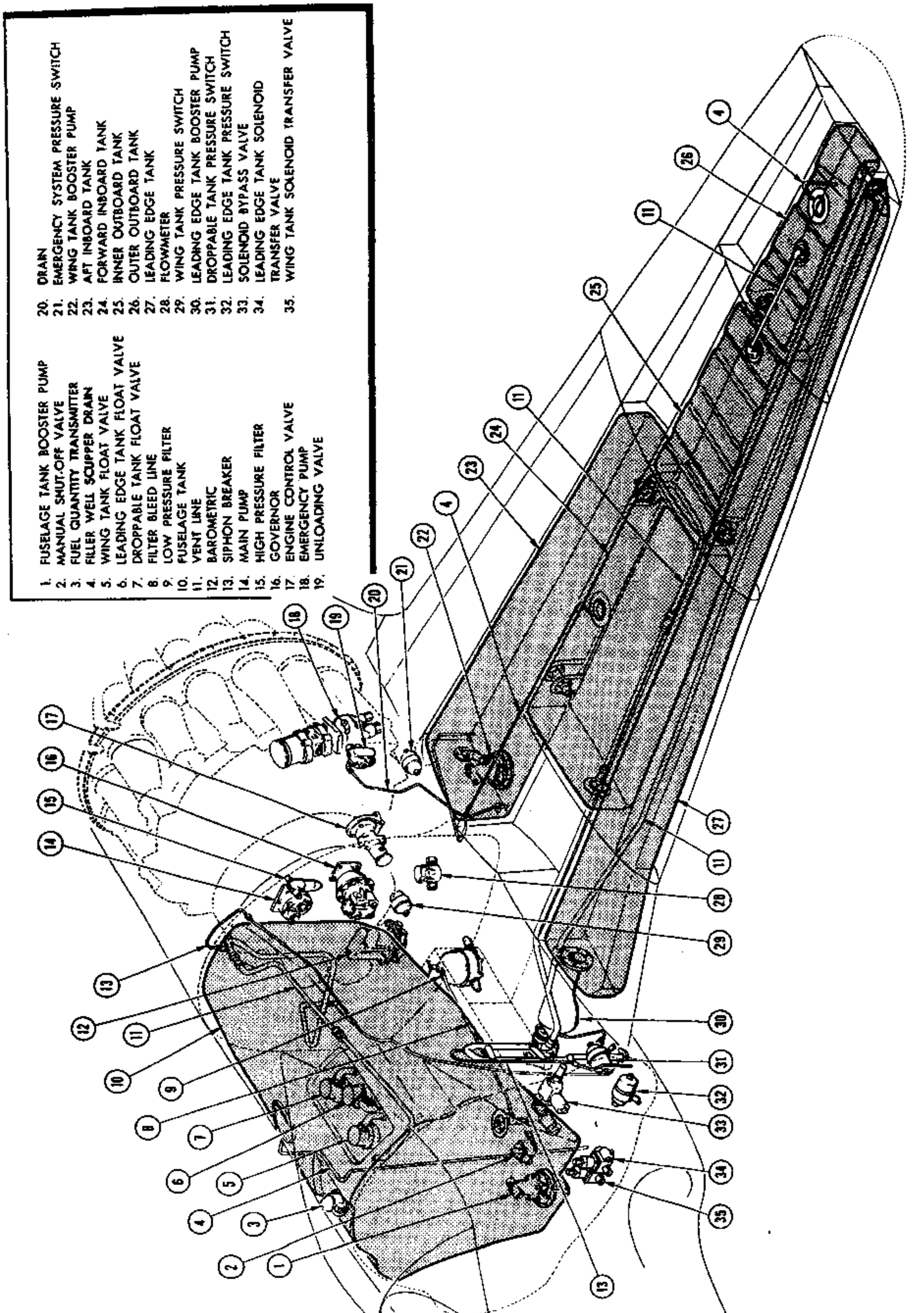



*Figure 101 — Fuel System Units Location Diagram*

A low-level switch contained within the fuel-gage transmitter actuates a warning light on the instrument sub-panel when the fuel gage drops to approximately 100 gallons. The fuel gage indicates only the quantity of fuel in the fuselage tank.

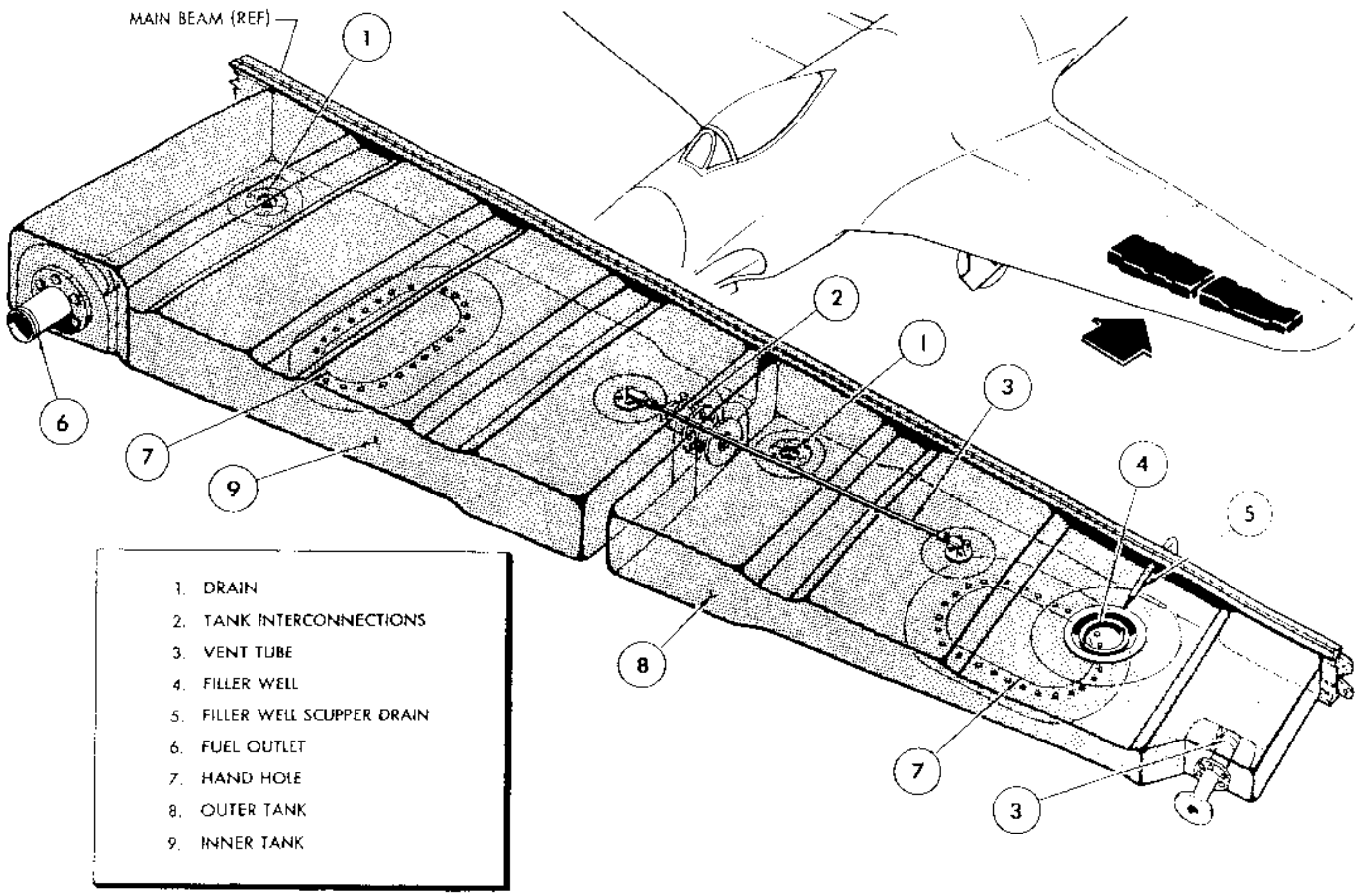



***Figure 102 — Wing Outboard Tanks***

To deliver fuel directly to the engine from the wing tanks, bypassing the fuselage tank on early airplanes, turn the fuselage tank pump switch off, and with the wing tank switches on, hold the bypass switch on "BYPASS" for two seconds, then release it. The droppable tank switch should be turned off to reduce the electrical load, as the fuel in the droppable tanks cannot be bypassed around the fuselage tank. To return the system to normal operation, turn on the fuselage tank pump switch and hold the bypass switch in the "NORMAL" position for at least two seconds.

On later airplanes the bypass switch is combined with the fuselage tank pump switch so that when the switch is placed in the "BYPASS" position, the fuselage tank pump is shut off simultaneously. To return the system to normal operation, return the switch to the fuselage-tank pump "ON" position. For electrical circuits see paragraph 17*f*, this section.

An altitude idle valve is installed in the fuel systems of early airplanes to permit the pilot, manually, to return excess fuel from the outlet side of the engine control valve to the low-pressure side of the main fuel pump. This valve is located on the left side of the cockpit floor. On most airplanes in which this valve is installed, it has been rendered inoperative by disconnecting the plumbing.

An emergency fuel pump located in the engine section just aft of the main hydraulic reservoir, is installed for use in case of failure of the engine main pump. The emergency pump is also used as a standby pump and is turned on for starting, during take-off, and during landing approach, and should be left on until a safe altitude is reached (approximately 5,000 feet), except in the event of main pump failure. It is a positive displacement, gear type pump operated by an attached electric motor. On early airplanes, a relief valve in the outlet line limits the outlet pressure. On later airplanes an unloading valve replaces the relief valve and performs the same function with less back pressure on the pump.

Gasoline for cold-weather starting may be carried in the left leading-edge fuel tank of P-80A-10 winterized airplanes. When the left leading-edge tank switch is moved to the "GASOLINE" position, the right leading-edge tank booster pump is disconnected, the left leading-edge tank booster pump is energized, and the fuel transfer valves are actuated to the bypass position, directing gasoline to the engine.

**Note**

When starting the engine with gasoline, all fuel switches other than the left leading-edge-tank switch should be "OFF."

After starting the engine, turn all booster pump switches "ON," and return the left leading-edge tank switch to "NORMAL."

Gasoline for cold-weather starting may also be carried in the left leading-edge fuel tank of F-80A and RF-80A airplanes which have been winterized by Service Activities. When the left leading-edge tank switch is moved to "GASOLINE," the right leading-edge tank booster pump is not energized, the left leading-edge tank booster pump is energized and the bypass switch must be held in "BYPASS" for approximately two seconds, then released for directing gasoline to the engine.

When starting the engine with gasoline, all fuel switches, other than the left leading-edge tank and the bypass switches should be "OFF."

After starting the engine, turn the fuselage booster switch to "ON." Hold the bypass switch in the "NORMAL" position for approximately two seconds. Turn the left leading-edge tank switch to "NORMAL," and then turn all other booster pump switches to "ON."

(3) WING OUTBOARD AND LEADING-EDGE TANKS. *(See figures 102 and 103.)*

**Note**

Wing outboard tank filler wells incorporate fuel filler nozzle stops in compliance with T.O. No. 01-75F-30.

*(a)* DESCRIPTION.—There are two outboard tanks and one leading-edge tank on each side of the wing on later airplanes. (See figure 101). The outboard tanks are positioned end-to-end spanwise of the wing, just inboard of the tip and aft of the front beam. These two tanks are interconnected and empty into the leading-edge tank. The leading-edge tank occupies the space between the wing tip and the wing root forward of the front beam. All these tanks are self-sealing and suitable for aromatic fuels. The filler well for all three tanks is in the outer outboard tank. A fitting for draining each tank is provided. Access to the outboard tanks is through panel No. 70 (figure 7). To gain access to the leading-edge tank, the leading edge must be removed.

*(b)* REMOVAL OF OUTBOARD TANKS.

*1.* Drain fuel from tanks.

*2.* Remove screws attaching filler well to wing upper surface.

*3.* Remove screws attaching drain fittings to access panel.

*4.* Remove access panel No. 70 (figure 7).

*5.* Remove handhole covers from tanks, and disconnect hose clamps within the tanks from fuel and vent lines.

*6.* Slip tank away from piping and disconnect filler-well overflow tube. Remove tanks.

*(c)* INSTALLATION OF OUTBOARD TANKS.—Reverse removal procedure. To facilitate installation, coat outside of tank with talc, Army Specification 4-33. Moisten tank fittings with water to facilitate installation of piping.

**Note**

The gasket in the outer wing cell interconnectors must be properly seated before the bolts are tightened.

*(d)* REMOVAL OF LEADING-EDGE TANK. —See paragraph 1*c*, this section.

(4) WING INBOARD TANKS. *(See figure 104.)*

*(a)* DESCRIPTION.—The wing inboard tanks are located one forward and one aft of the main beam just outboard of the main alighting gear. (See figure 101.) These tanks are self-sealing and suitable for use with aromatic fuel. The forward and aft tanks are connected and are filled through a well in the forward tank. The forward and aft tanks are vented to each other by a tube at the outboard end of the tanks. Both tanks are vented to atmosphere by a tube from the inboard end of the forward tank. The forward tank is provided with a baffle at its mid section, and two handholes on its lower surface. The aft tank has two baffles. The inboard baffle contains two surge valves. The fuel pump for both tanks is attached to the inboard lower surface of the aft tank.

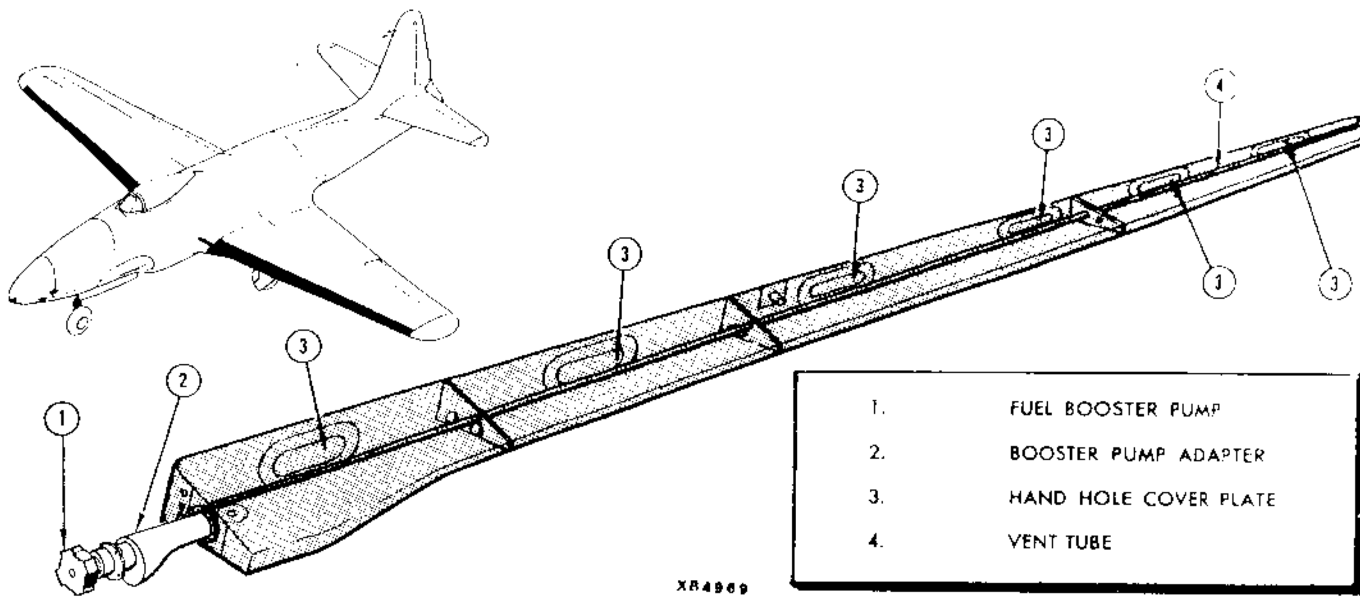
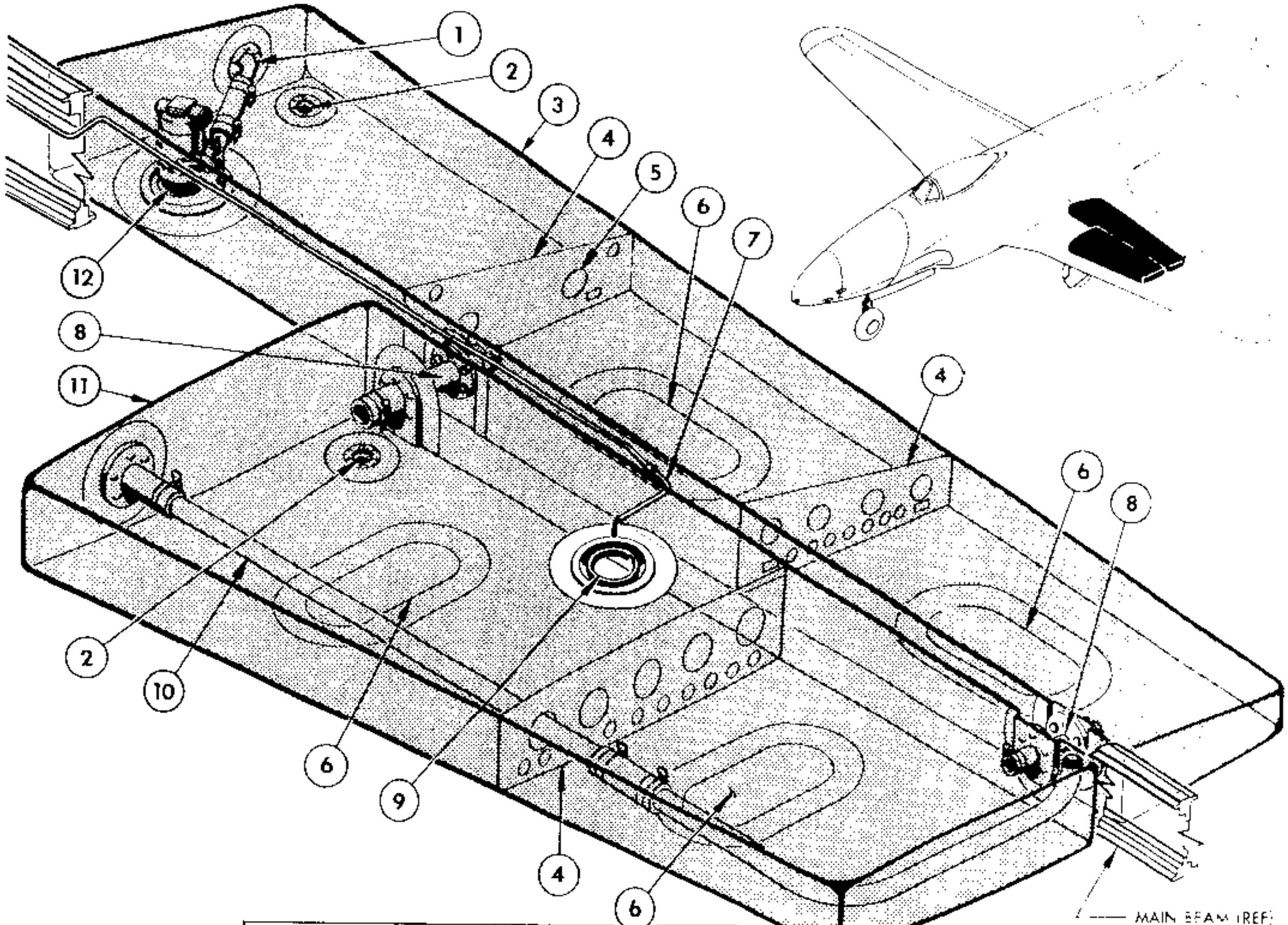



*Figure 103 — Wing Leading Edge Tank*




| | | | |
|---|---|---|---|
| 1. | PUMP OUTLET | 7. | FILLER WELL SCUPPER DRAIN |
| 2. | DRAIN | 8. | TANK INTERCONNECTION |
| 3. | AFT TANK | 9. | FILLER WELL |
| 4. | BAFFLE | 10. | VENT TUBE |
| 5. | SURGE VALVE | 11. | FORWARD TANK |
| 6. | HAND HOLE | 12. | BOOSTER PUMP |

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*Figure 104 — Wing Inboard Tanks*

Both tanks are provided with drain plugs that extend through the tank panels. To drain fuel, turn the slotted head of the drain one complete revolution.

**CAUTION**

When replacing tank fittings or handhole covers, bring parts to the best possible alignment so that the screws or bolts can be started with minimum torque. Then tighten all screws as much as possible with the fingers, as this may reveal threads in poor condition. Replace any screws with burred threads. Fittings with burred threads may be retapped with the same size tap. Tighten screws alternately on opposite sides of fitting or cover. Tighten all screws to three-fourths of the maximum required torque. Finally, tighten all screws to a torque of 35 (±5) inch-pounds.

(*b*) REMOVAL, FORWARD INBOARD TANK.

*1.* Drain fuel from both the forward and aft tanks.

*2.* Remove screws attaching filler well to wing upper skin.

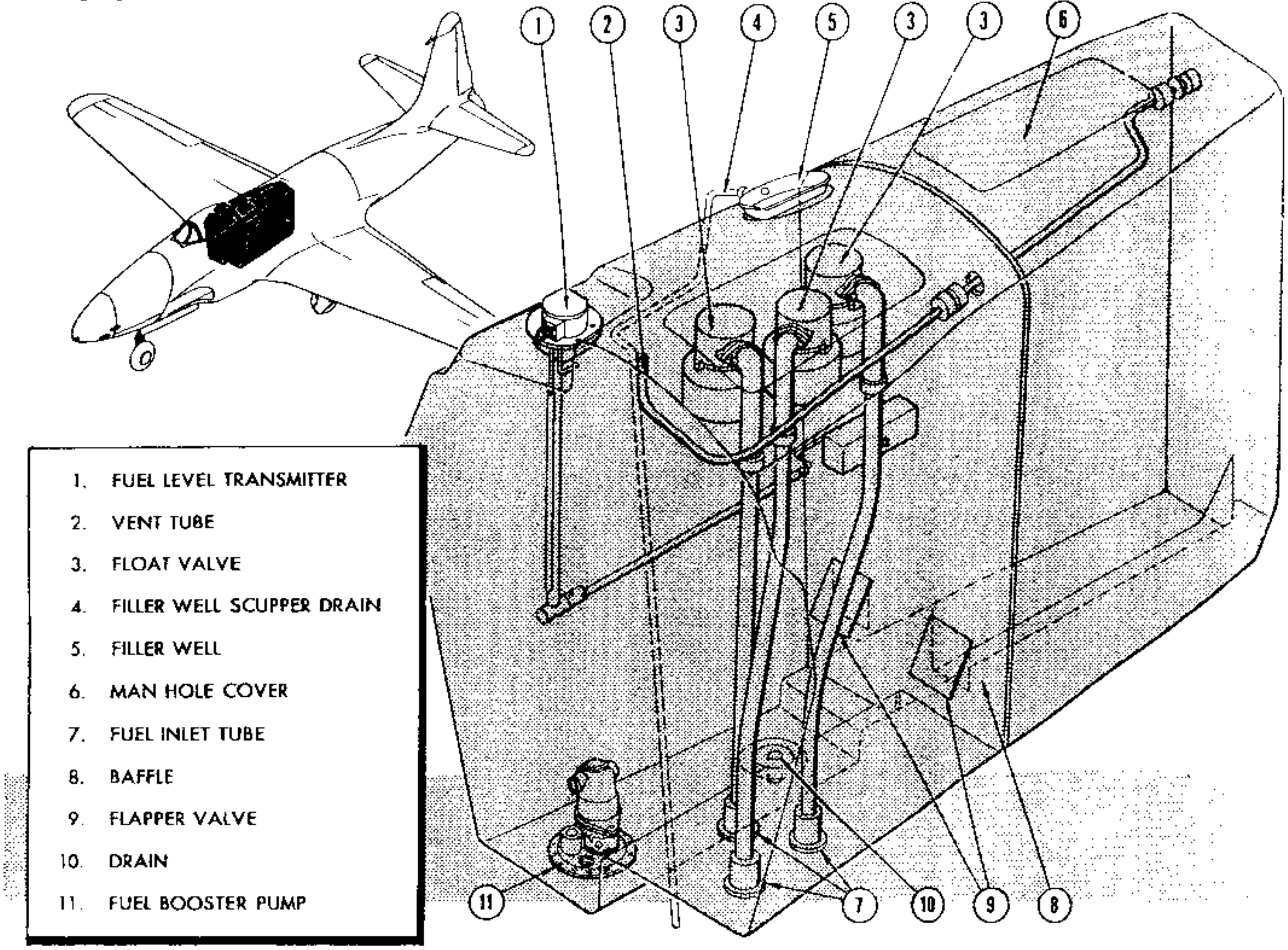



*Figure 105 — Fuselage Tank*

*3.* Remove screws attaching drain fitting to access panel.

*4.* Remove access panel No. 18 (figure 7).

*5.* Remove handhole covers and remove hose clamps within the tanks from vent and fuel lines.

*6.* Disconnect external plumbing and remove tank.

*(c)* INSTALLATION, FORWARD INBOARD TANK.—Reverse removal procedure. To facilitate tank installation, coat outside surface of tank with talc, Army Specification 4-33. Moisten piping with water to facilitate installation of tank.

*(d)* REMOVAL, AFT INBOARD TANK.

*1.* Drain fuel from both the forward and the aft tanks.

*2.* Remove screws attaching filler well to wing upper surface.

*3.* Remove screws attaching drain fitting to access panel.

*4.* Remove pump access panel.

*5.* Remove tank access panel and pump. For pump removal, see paragraph *b*(8)(*c*)*3*, following.

*6.* Remove tank handhole covers, and remove hose clamps within tank from vent and fuel lines.

*7.* Remove external plumbing connections.

*8.* Remove tank.

*(e)* INSTALLATION, AFT INBOARD TANK.—Reverse removal procedure. To facilitate tank installation, coat outside surface of tank with talc, Army Specification 4-33. Moisten piping with water to facilitate installation of tank.

(5) FUSELAGE TANK. *(See figure 105.)*

*(a)* DESCRIPTION.—The fuselage fuel tank located immediately aft of the cockpit, is a self-sealing tank suitable for use with aromatic fuels. Access to the tank is through panel No. 7 (figure 7). The tank is supported by the floor structure and by bolts which attach the tank to the access panel. Flapper valves and a baffle are installed integral with the tank in such a way that at least 90 gallons of fuel is retained forward of the baffle in a 30-degree climb attitude. The aft end of the tank upper surface is fitted with a handhole. The vent outlet is on the aft face of the tank, and the drain cock, three fuel inlets, and the booster-pump attachment are on the bottom surface. The filler well is on the upper forward surface of the tank; the overflow is routed over the right side of the tank. The fuel quantity gage transmitter is installed immediately forward of the filler well, and is accessible for adjustment through a hinged door.

**CAUTION**

When replacing tank fittings or handhole covers, bring parts to the best possible alignment so that the screws or bolts can be started with minimum torque. Then tighten all screws as much as possible with the fingers, as this may reveal threads in poor condition. Replace any screws with burred threads. Fittings with burred threads may be retapped with the same size tap. Tighten screws alternately on opposite sides of fitting or cover. Tighten all screws to three-fourths of the maximum required torque. Finally, tighten all screws to a torque of 35 (±5) inch-pounds.

*(b)* REMOVAL.

*1.* Drain fuel.

*2.* Remove cockpit canopy. (See paragraph 3*c*(3)*(b)1*, this section for manually operated canopy; see paragraph 3*c*(3)*(c)1*, this section for electrically operated canopy.)

*2A.* Remove canopy electrical actuating mechanism. (See paragraph 3*c*(3)*(c)*3b, this section.

*3.* Remove bolts connecting tank to access door.

*4.* Remove access door No. 7 (figure 7).

*5.* Disconnect vent line at tank fitting.

*6.* Disconnect overflow tube at filler well.

*7.* Remove electrical disconnect plug at fuel gage transmitter.

*8.* Disconnect three fuel inlets at bottom of tank.

*9.* Remove booster pump. (See paragraph *b*(8) *(c)2* following.)

*10.* Remove tank by hoisting it out of fuselage.

*(c)* INSTALLATION.—Reverse removal procedure. To facilitate tank installation, coat outside surface of tank with talc, Army Specification 4-33, class 29.

(6) DROPPABLE TANKS. *(See figure 106.)*

*(a)* DESCRIPTION.—A droppable fuel tank of 165 U.S. (137 Imperial) gallons capacity may be installed at the bomb shackle in each wing tip. Compressed air at 5 psi pressure forces fuel from the droppable tank to the fuselage tank. The air pressure is derived from the engine compressor, and is controlled by a pressure control valve located in the hydraulic compartment. (See paragraph 24*c*(3), this section.)

*(b)* REMOVAL.

*1.* Drain fuel from tank (as required).

*2.* Remove top access panel from wing-tip.

*3.* With one person holding each end of the tank, operate bomb-shackle cocking lever to release the tank. On airplanes equipped with the type S-1 shackle, trip the lever to which the manual release cable is attached.

**Note**

Tank may be released also by cockpit release switch or by the manual control.

Each tank weighs approximately 130 pounds.

**CAUTION**

Do not drop or roll tanks. When not installed on airplane, store tanks so they will not be damaged.

*(c)* INSTALLATION (Airplanes Equipped with Type B-10 Shackle).

*1.* Remove top access panel from wing tip.

*2.* Remove shackle by releasing spring-loaded catches at forward and aft ends of wing-tip casting.

*3.* Attach shackle to tank and cock the shackle.

*4.* Cock the release mechanism located in the wing tip.

*5.* Lift tank and attach shackle to wing-tip casting. In doing so, attach fuel and air-pressure lines.

*6.* Engage four sway braces by inserting a screw driver in fitting slots at top of braces, pushing down, and turning until braces are snug against tank.

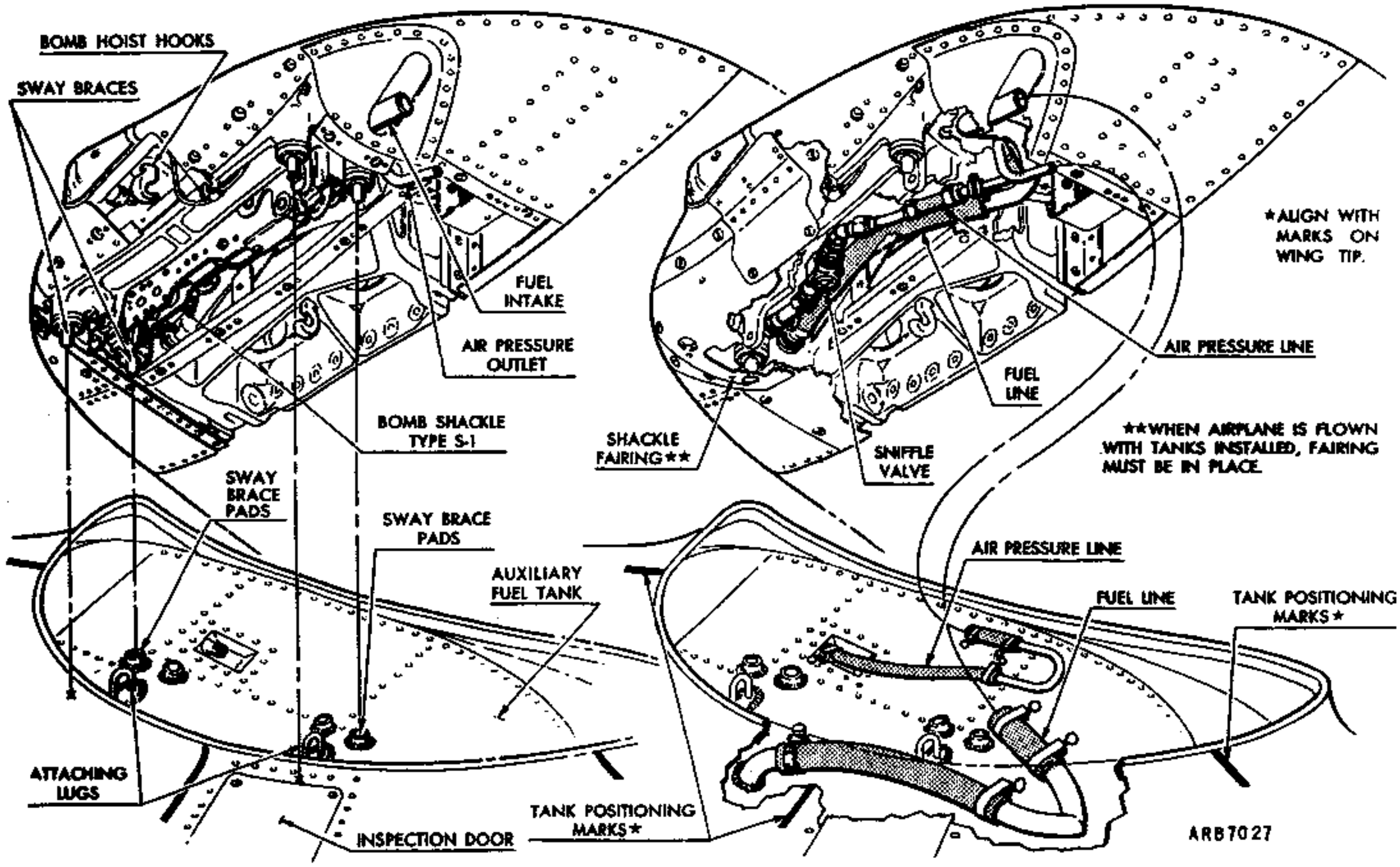



*Figure 106 — Droppable Tank Installation*

(*d*) INSTALLATION (Airplanes Equipped with Type S-1 Shackle).

*1.* Remove top access panel from wing tip, and inspection door from tank fairing.

*2.* Install plumbing on tank as shown in figure 106. Be sure hose clamps are positioned so they will not cause interference between the tank and shackle fairing, and attach hoses to airplane fuel and air lines.

*3.* Lift tank into position. Proper position may be determined by alignment of marks on tank with corresponding marks on wing tip. The "U" lugs must be held firmly in the slots of the shackle.

*4.* Secure tank to shackle by pulling shackle cocking ring aft until the shackle hooks completely engage the "U" lugs and the ring returns forward without releasing the hooks.

*5.* Engage four sway braces by inserting a 3/8-inch square drive speed-wrench handle in the fitting at the top of the braces, pushing down, and turning until the braces are snug against the tank.

**CAUTION**

Be sure the sway brace plungers are seated on the pads on the tank before tightening the braces. If they are not seated, they may push holes in the tank when they are tightened. Inspect plungers through door in tank fairing.

Be sure to check manual release cable at wing tip connection for proper slack. Allow at least 1/4 inch slack for movement of wing tip.

**Note**

The position of the tank with relation to the wing tip can be adjusted by tightening one or two of the sway braces more than the others. The reference marks on the tank must be in alignment with the reference marks on the wing tip. The tank center line must be parallel to the line of flight, and the tank must not be held in a rotated position.

*6.* Torque the sway braces evenly to not less than 90 inch-pounds, and not more than 100 inch-pounds.

*7.* Check to be sure the tank is secure by pushing the aft end of the tank to the right, left, up, and down. Retorque the sway braces to not less than 90 inch-pounds, and not more than 100 inch-pounds.

*8.* Replace top access panel.

(6A) NON-EJECTION TYPE CENTERLINE DROPPABLE TANKS (AIRPLANES INCORPORATING T. O. 1F-80-203). *(See figure 106A.)*

*(a)* DESCRIPTION.—A droppable fuel tank of 230 U.S. (191.6 Imperial) gallons capacity may be installed on each wing tip. Compressed air forces fuel from the droppable tanks to the fuselage fuel tank. The air pressure is derived from the engine compressor, and is controlled by a pressure control valve in the hydraulic compartment.

**WARNING**

The pressure system is capable of maintaining its pressure indefinitely. Prior to removing droppable tank filler caps, slowly "crack" the cap until the pressure has been relieved.

*(b)* REMOVAL.

*1.* Relieve tank pressure.

*2.* Drain fuel from tank.

**WARNING**

A full fuel tank weighs over 1500 pounds. Make certain tank is empty prior to removal.

*3.* Remove tank fairing.

*4.* Open access panel in wing tip.

*5.* With one person holding each end of the tank, operate tank release lever to release tank.

**Note**

Sway braces should remain with tank.

*6.* Disconnect light electrical leads.

**CAUTION**

Do not drop or roll tanks. When not installed on airplane, store tanks so they will not be damaged.

*(c)* INSTALLATION.

*1.* Open access panel in wing tip.

*2.* Loosen tip tank hook assembly.

*3.* Apply powdered graphite, Spec MIL-G-6711, to tank forward and aft ball fittings. Apply light film of grease, Spec MIL-G-3278, to fuel and air disconnects.

*4.* Lift tank into position.

*5.* Plug tank light electrical conectors into wing tip sockets.

*6.* Insert ball fittings of tank into wing tip sockets, and push tank inboard until tank hook closes. Indicator will show if hook is locked. Release arm may be moved by hand if necessary for it to reach final locked position.

*6A.* Install Ground Safety Pin (T. O. 1F-1-119).

*7.* Safety handle to indicator with a single strand of 0.020-inch soft copper safety wire.

*8.* Tighten tip tank hook to a torque of 25 foot-pounds.

*9.* Insert sway braces into sockets in wing and tank. Tighten braces to a torque of 8 foot-pounds. Overall length of the upper sway brace when torqued should be approximately 2.25 inches, and approximately 2.55 inches for the lower sway brace. Spring-loaded ends of sway braces must be inserted in tank sockets.

*10.* Retighten tip tank hook to a torque of 50 (+5, −0) foot-pounds. Tighten jam nut.

*11.* Check tip tank hook and indicator for proper alignment. Replace wing tip access door.

*12.* Fill tank and then retighten upper sway brace to a torque of 25 foot-pounds.

**Note**

When making routine or precautionary checks of sway brace torque values, it is permissible to do so with tanks partially full. When tanks are empty, torque value is 34 lb ft. and for every 25 gallons of additional fuel, subtract one lb ft of torque. When tanks are full, torque value is 25 lb ft.

Whenever torque is within 3 lb in. of required value, retorque sway braces. However, when torque is not within these limits, reduce torque to zero and check tip tank hook torque prior to retorqueing sway braces.

*13.* Remove tip tank filler cap and install locally manufactured test gig. (See figure 106C.)

14. Operate engine and check for 5.25 (±0.5) psi air pressure, and retorque upper sway brace to 25 foot-pounds.

**Note**

The same dimensional difference in sway brace lengths as in step 9 must be maintained.

*15.* Shut off engine, bleed air pressure from tank through valve on gig before removing gig, and replace filler cap.

*16.* Install tank fairing.

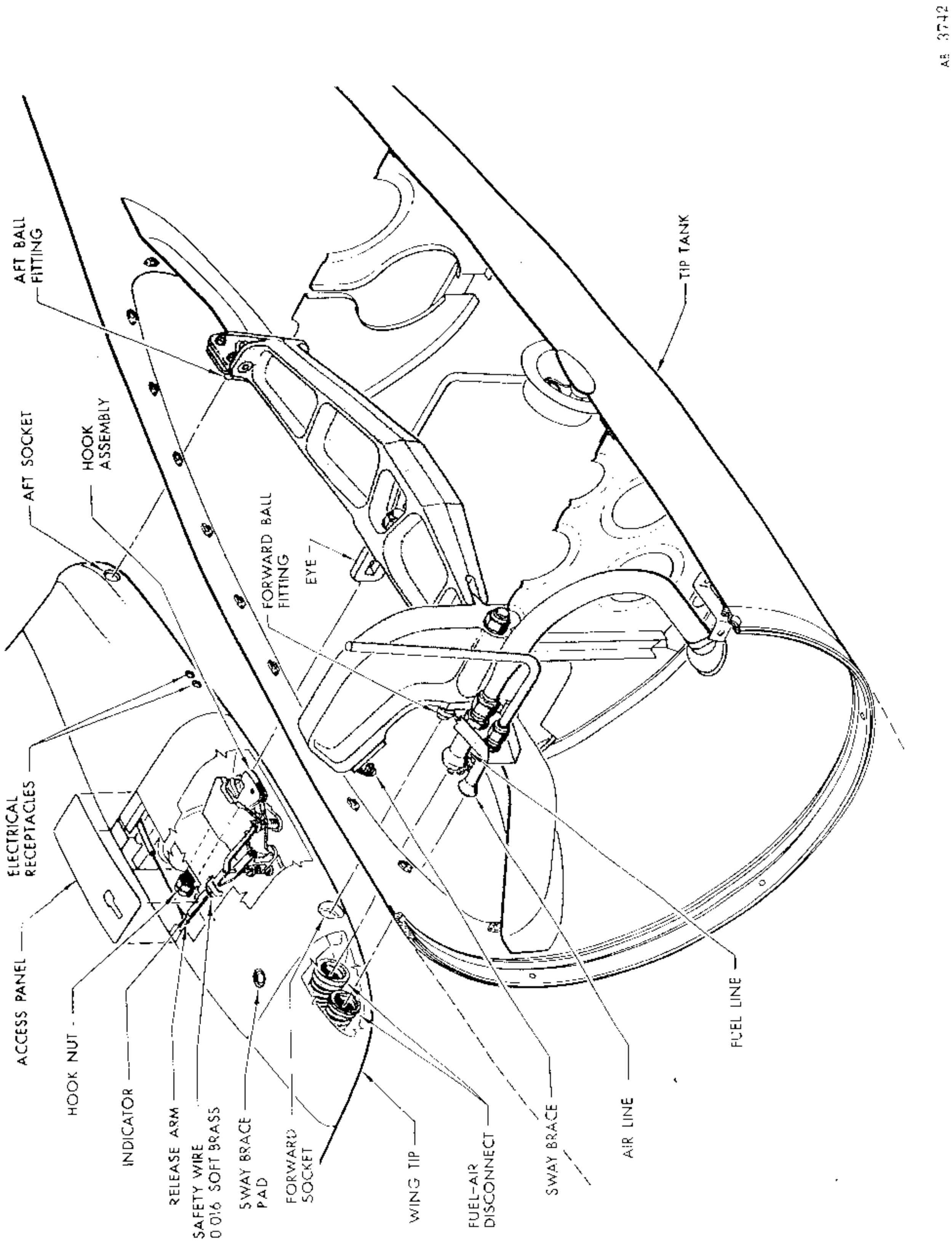



*Figure 106A—Non-Ejection Type Centerline Droppable Tank Installation (Airplanes Incorporating T.O. 1F-80-203)*

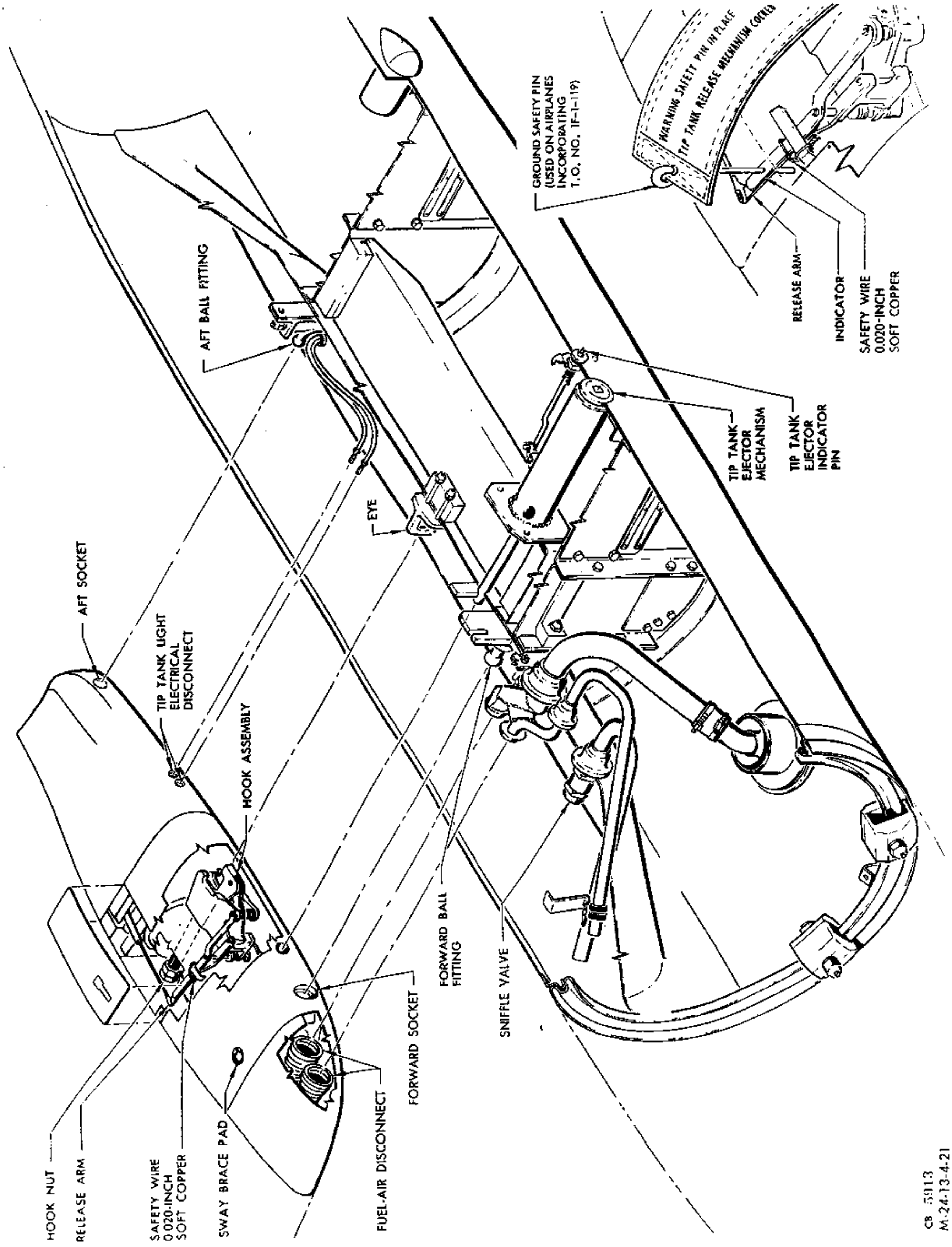



*Figure 106B—Ejection-Type Centerline Droppable Tank Installation (Airplanes Incorporating T.O. 1F-80-203 and T.O. 1F-80-137)*

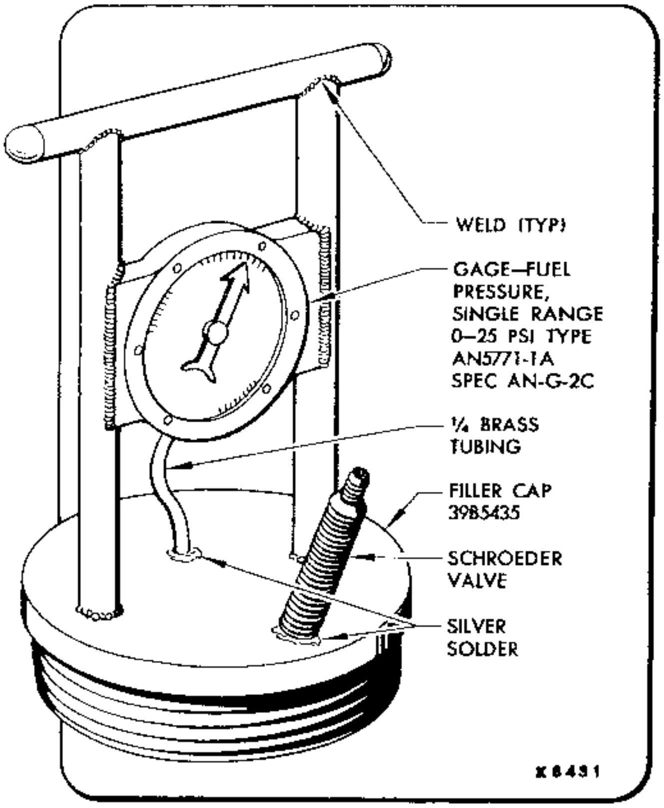



*Figure 106C — Droppable Tank Pressure Testing Gig*

(6B) EJECTION-TYPE CENTERLINE DROPPABLE TANKS (AIRPLANES INCORPORATING T.O. 1F-80-203 and 1F-80-137). *(See figure 106B.)*

*(a)* DESCRIPTION. A droppable fuel tank of 230 U.S. (191.6 Imperial) gallons capacity may be installed on each wing tip. A spring-loaded ejector mechanism which butts against a wing tip bumper plate is installed in each tank to insure positive tank jettisoning.

## WARNING

Never install ejection type tanks on wing tips not incorporating a wing tip bumper plate.

Compressed air forces fuel from the droppable tanks to the fuselage fuel tank. The air pressure is derived from the engine compressor, and is controlled by a pressure control valve in the hydraulic compartment.

## WARNING

The pressure system is capable of maintaining its pressure indefinitely. Prior to removing droppable tank filler caps, slowly "crack" the cap until the pressure has been relieved.

*(a1)* REMOVAL AND INSTALLATION OF FILLER CAP ASSEMBLY FOR FLETCHER CENTERLINE TIP TANKS.

*1.* Turn lock screw counter-clockwise and remove.

### CAUTION

Additional turns may shear the retaining pin and allow cap parts to drop into the tank.

*2.* Turn cap assembly ¼ turn counter-clockwise and remove.

*3.* Before installing cap assembly, turn the lock screw counter-clockwise until the bottom of the straddle bar is flush with the bottom thread on the lock screw.

*4.* Insure that the safety chain is fastened to the straddle bar and filler flange.

*5.* Install cap assembly into flange with arrows on the cap perpendicular to the arrows on the flange then turn the cap assembly clockwise ¼ turn aligning the arrows.

## WARNING

Do not strike the cap.

*6.* Center the cap in the flange and turn the lock screw until the cap is flush with the top surface of the flange and lock screw is hand tight. The "O" ring packing is then tight against the tapered sides of the flange sealing the cap.

### CAUTION

Do not force the lock screw when it seems tight before the cap is flush with the top surface of the flange. Remove the cap and inspect for defective threads on the lock screw.

*(b)* REMOVAL.

*1.* Relieve tank pressure.

*2.* Drain fuel from tank.

## WARNING

A full fuel tank weighs over 1500 pounds. Make certain that tank is empty prior to removal.

*3.* Remove plug covering tank ejector mechanism with a ¼-inch drive adapter.

*4.* Using a $\frac{7}{16}$-inch socket and a ½-inch drive handle at least 12 inches long, turn ejector mechanism plunger counterclockwise until plunger contacts internal stop and reinstall plug.

**Note**

This action requires approximately 30 revolutions of the drive handle.

*5.* Remove tank fairing.

*6.* Remove wing tip access panel.

*7.* With one person holding each end of tank, operate tank release lever to release tank.

**CAUTION**

Do not drop or roll tanks. When not installed on airplanes, store tanks so they will not be damaged.

**Note**

Sway braces should remain with tank.

*8.* Disconnect light electrical leads.

*(c)* INSTALLATION.

*1.* Remove plug covering tank ejector mechanism with a ¼-inch drive adapter.

*2.* Using a $\frac{7}{16}$-inch socket and a ½-inch drive handle at least 12 inches long, turn ejector mechanism plunger counterclockwise until plunger contacts internal stop and reinstall plug.

*3.* Remove wing tip access panel.

*4.* Loosen tip tank hook assembly.

*5.* Apply powdered graphite, Spec MIL-G-6711, to tank forward and aft ball fittings. Apply light film of grease, Spec MIL-G-3278, to fuel and air disconnects.

*6.* Lift tank into position.

*7.* Plug tank electrical connectors into wing tip sockets.

*8.* Insert ball fittings of tank in wing tip sockets and push tank inboard until tank hook closes. Indicator will show if hook is locked. Release lever may be moved by hand, if necessary, to final locked position.

*8A.* Install Ground Safety Pin (T.O. 1F-1-119).

*9.* Safety release lever and indicator together with a single strand of 0.020-inch soft copper wire.

*10.* Tighten tip tank hook to a torque of 25 lb ft.

*11.* Insert sway braces into sockets in wing and tank. Tighten braces to a torque of 8 lb ft. Overall length of the sway braces, when torqued, should be approximately 2.25 inches, for the upper and approximately 2.55 inches for the lower sway braces. Spring-loaded ends of sway braces must be inserted in tank sockets.

*12.* Tighten tip tank hook to a torque of 50 (+5, −0) lb ft. Tighten jam nut.

*13.* Check tip tank release lever for proper alignment. Replace wing tip access door.

*14.* Remove plug covering tank ejector mechanism with a ¼-inch drive adapter.

*15.* Using a $\frac{7}{16}$-inch socket and a ½-inch drive handle at least 12 inches long, turn ejector mechanism plunger clockwise until indicator pin, located aft of ejector mechanism, is flush with the fitting through which it protrudes. Reinstall plug.

**Note**

Indicator pin will not start to move in until approximately 25 revolutions of drive handle have been made.

*16.* Fill tank and then retighten upper sway brace to a torque of 25 lb ft.

**Note**

When making routine or precautionary check of sway brace torque values, it is permissible to do so with tanks partially full. When tanks are empty, torque value is 34 lb ft, and for every 25 gallons of additional fuel, subtract one lb ft of torque. When tanks are full, torque value is 25 lb ft.

Whenever torque is within 3 lb ft of required value, retorque sway braces. However, when torque is not within these limits, reduce torque to zero and check tip tank hook torque prior to retorqueing sway braces.

*17.* Remove tank filler cap and install locally manufactured test gig. (See figure 106C.)

*18.* Operate engine and check for 5.25 (±0.5) psi air pressure, and retorque upper sway brace to 25 lb ft.

**Note**

The same dimensional difference in sway brace lengths as in step *11* must be maintained.

*19.* Shut off engine, bleed air pressure from tank through valve on gig before removing gig; and replace filler cap.

*20.* Replace tank fairing.

(6C) DROPPABLE TANK FUEL LINE QUICK-DISCONNECT.—A dual air-fuel quick-disconnect is mounted on the forward face of each wing tip forging. The air line is unrestricted while the fuel line contains a spring-loaded shut-off valve. The shut-off valve remains in the closed position as long as a droppable tank is not installed on the wing tip. The fuel line fitting on the droppable tank, when installed, opens the valve permitting free fuel flow.

*(a)* REMOVAL OF DROPPABLE TANK FUEL LINE QUICK-DISCONNECT.

*1.* Remove wing tip skin.

*2.* Disconnect fuel and air lines at quick-disconnect.

*3.* Remove bolts holding quick-disconnect to wing tip forging, and remove quick-disconnect.

(6C) REPOSITIONING OF DROPPABLE TANK FILLER CAP TO MAKE IT VISIBLE FROM COCKPIT.

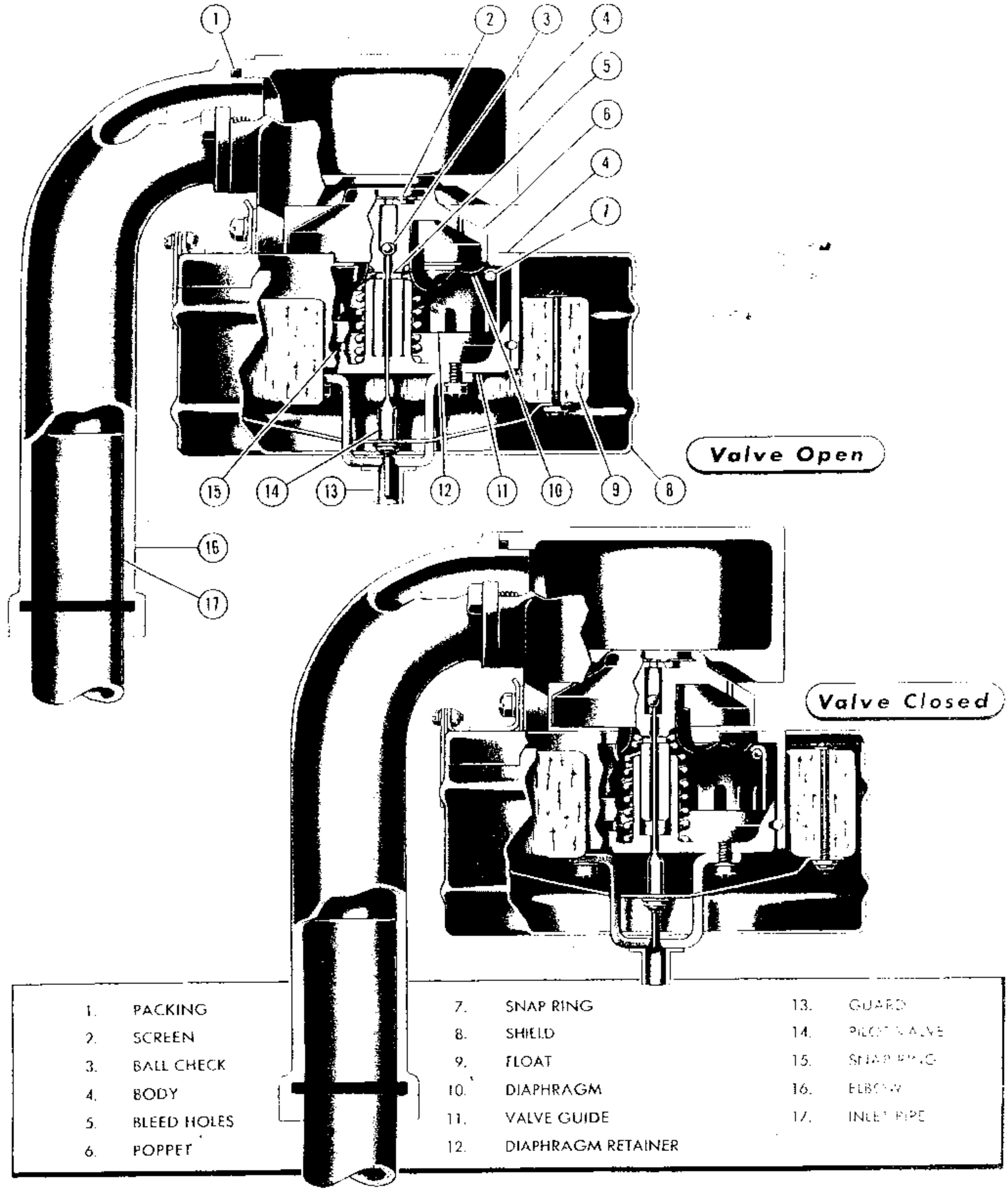
*(a)* Loosen the section joint clamps that attach the nose section to the center section.

*(b)* Rotate the nose section until the centerline of the filler cap is approximately 7¼ inches inboard from vertical or until index marks are aligned.

*(c)* Tighthen section joint clamps and torque clamp nuts to 435 pound-inches.

(7) FLOAT VALVES. *(See figure 107.)*

*(a)* DESCRIPTION. — Three float valves mounted on the top surface of the fuselage fuel tank control the transfer of fuel from the droppable, leading edge, and inboard tanks. The valves are operated by changes in level of the fuel within the fuselage tank.




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | PACKING | 7. | SNAP RING | 13. | GUARD |
| 2. | SCREEN | 8. | SHIELD | 14. | PILOT VALVE |
| 3. | BALL CHECK | 9. | FLOAT | 15. | SNAP RING |
| 4. | BODY | 10. | DIAPHRAGM | 16. | ELBOW |
| 5. | BLEED HOLES | 11. | VALVE GUIDE | 17. | INLET PIPE |
| 6. | POPPET | 12. | DIAPHRAGM RETAINER | | |

*Figure 107 — Fuel Float Valve, Fuselage Tank*

The float valve consists essentially of a cork float, a rubber diaphragm, a pilot valve, and a main poppet valve. The pilot valve is actuated by the float. When the fuel level is sufficiently high, the pilot valve is closed, but fuel pressure applied to the bottom surface of the main-valve rubber diaphragm through bleed holes in the main-valve stem keeps the main valve closed. When the fuel level drops, the pilot valve opens to relieve the pressure on the bottom surface of the rubber diaphragm. Fuel is then admitted to the fuselage tank from the wing tanks.

A ball check in the main valve is actuated by the pilot-valve stem. When the pilot valve opens, the ball check closes off pressure to the bottom of the rubber diaphragm.

*(b)* REMOVAL.

*1.* Remove screws attaching float-valve mounting plate assembly to the tank.

2. Displace mounting plate assembly sufficiently to unfasten float-valve elbow connections.

3. Remove assembly.

4. Remove four bolts attaching float valve to mounting plate, and remove float valve.

*(c)* DISASSEMBLY.

*1.* Remove three screws attaching shield, and remove shield.

2. Remove float by sliding it away from valve body.

3. Remove pilot valve.

4. Remove valve guide by displacing snap ring and pulling valve guide away from valve body. Access to snap ring is through the drilled holes in the valve body.

5. Remove rubber-diaphragm retainer snap ring.

6. Remove retainer.

7. Remove main valve and diaphragm assembly from valve body.

8. Slide diaphragm away from main valve.

*(d)* CLEANING.—Clean screen and metal parts with unleaded gasoline or kerosene.

*(e)* INSPECTION.

*1.* Inspect rubber diaphragm for cracks.

2. Inspect pilot valve and valve seat for wear.

3. Inspect main valve and valve seat for wear.

(f) ASSEMBLY. — Reverse disassembly procedure. Be sure that valve guide is held securely to valve body by snap ring.

*(g)* INSTALLATION. — Reverse removal procedure. If elbow has been removed from float valve, be sure that "O" ring is installed at connection before valve is assembled to elbow. Be sure that "O" ring is installed at bottom of elbow before valve is connected to piping within the tank.

*(h)* GROUND CHECK, FLOAT VALVES. — The fuselage fuel tank float valves for proper operation using external source of air pressure for tip tanks. With less than 100 gallons of fuel in the fuselage tank turn "ON" wing tank switch and watch for increase in fuselage tank quantity. Increase indicates valve open and pumps functioning. Turn switch "OFF." Repeat this check on leading edge tanks and tip tanks. With fuselage tank full, turn "ON" tip tanks, wing tanks, and leading edge tank switches. An increase in the fuel level at filler neck indicates leaking valve or valves.

**CAUTION**

When replacing cover assembly, tighten bolts to 20 inch-pounds minimum and 30 inch-pounds maximum torque.

(8) FUEL PUMPS.

*(a)* GENERAL. — The airplane fuel system is equipped with five fuel booster pumps. One pump is located in each aft inboard wing tank, one on an adapter attached to each leading edge tank, and one in the fuselage tank. All are centrifugal type pumps with built-in vapor eliminator.

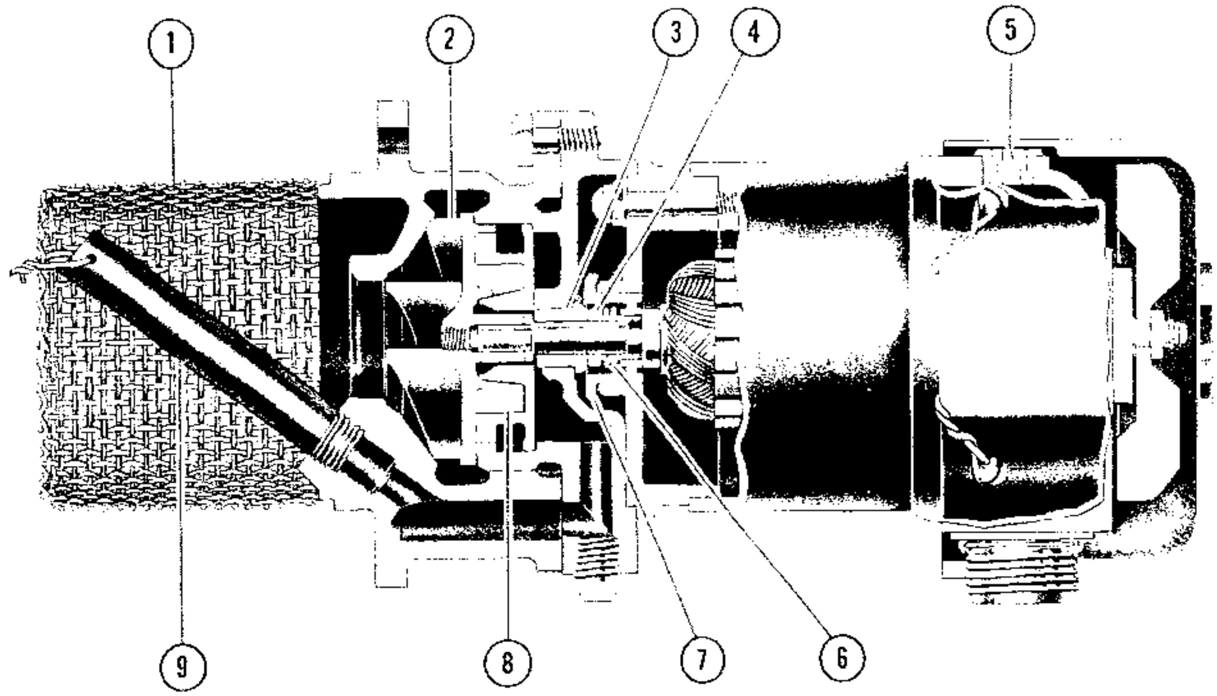
An emergency pump, located on the left-hand side of the engine compartment, is provided for use in case of engine main-pump failure. It is a variable volume, gear-type pump.

**Note**

Do not cut electrical leads to shorten, but roll and tape to desired length.

*(b)* LEADING EDGE TANK PUMP.
*(See figure 108.)*

*1.* DESCRIPTION. — The leading edge tanks are each equipped with a type B-7B booster pump. These pumps are located on either side of the sub-cockpit compartment. Access is gained through the dive flap openings. The impeller of the B-7B pump is driven by an electric motor. The armature of this motor is wound on the shaft to which the impeller is attached. The pump has a ball bearing on the motor-end of the shaft, and a carbon bearing on the impeller-end. The motor housing is sealed from the impeller housing by a rotating seal ring which rides against the carbon bearing and is held in place by a brass bellows and retainer. For information on the electrical circuit, see paragraph 17*f*(2), this section.




| | | | |
|---|---|---|---|
| 1. | STRAINER | 6. | BELLOWS |
| 2. | IMPELLER ROTOR | 7. | HOLDER |
| 3. | SLEEVE BEARING | 8. | LOBE |
| 4. | SEAL RING | 9. | VAPOR DISCHARGE |
| 5. | BREATHER | | |

ARB8 122

***Figure 108 — Fuel Booster Pump***

2. REMOVAL.

a. Disconnect plumbing and electrical lines from the pump.

b. Remove screws attaching pump and its adapter to the leading edge.

c. Remove strap from the pump support bracket.

d. Remove pump and its adapter.

e. Replace strap on the bracket.

## WARNING

Do not connect or disconnect electrical wiring to the pump when the circuit is energized.

3. MAINTENANCE.—This pump requires no maintenance unless malfunctioning occurs, but will be replaced at the expiration of each 1000 hours of operating time. Trouble will usually be indicated by excessive amperage while pump is operating.

**Note**

Use a new adapter gasket each time the booster pump is installed.

*(c)* FUSELAGE AND INBOARD WING TANK PUMPS.

*1.* DESCRIPTION.—The fuselage fuel tank is equipped with a type B-18A booster pump and each aft inboard tank is equipped with type B-19 booster pumps. These are submerged-type pumps. That is, the mounting flange is attached to the bottom of the tank with the fuel intake, impeller, and motor housings extending up into the fuel. The only difference between the wing inboard-tank pump and the fuselage-tank pump is the outlet neck. On the wing inboard-tank pump, the outlet neck extends up into the tank and connects with a tube that carries the fuel out through the inboard side of the tank. The outlet neck of the fuselage-tank pump extends down on the outside of the mounting flange. This pump is similar to the B-7B pump in that vapors in the fuel are centrifugally separated, gathered in a collecting groove, and exhausted to the top of the tank. The motor armature and impeller are attached to the same shaft, and separated by a ring seal that rotates against a carbon bearing. The seal is held by a retainer and a brass bellows. For information on electric motor, see paragraph 17*f*(2), this section.

*2.* REMOVAL, FUSELAGE TANK PUMP.

a. Drain fuselage tank.

b. Remove plumbing and electrical lines.

c. Disconnect and cap main fuel outlet tube at pump elbow.

d. Disconnect and cap fuel return line from auxiliary-pump relief valve at fuselage pump.

e. Disconnect electrical wiring to pump.

**WARNING**

Do not connect or disconnect electrical wiring to the pump when the circuit is energized.

f. Disconnect motor-seal drain tube at pump.

g. Unfasten pump-flange attaching bolts and remove pump.

*3.* REMOVAL, AFT INBOARD WING TANK PUMP.

a. Drain fuel from tank.

b. Remove pump inspection-hole cover.

c. Disconnect electrical wiring.

**WARNING**

Do not connect or disconnect electrical wiring to the pump when the circuit is energized.

d. Remove bolt securing outlet elbow, and push the elbow loose.

e. Unfasten pump-flange attaching bolts, and lower the pump out of the tank.

*4.* MAINTENANCE.—This pump requires no maintenance unless malfunctioning occurs, but will be replaced at the expiration of each 1000 hours operating time. Trouble will usually be indicated by excessive amperage while pump is operating.

FIGURE 109 DELETED IN REVISION DATED 15 APRIL 1949.

*(d)* EMERGENCY FUEL PUMP.

*1.* GENERAL.—The emergency fuel pump is in the engine compartment aft of the hydraulic reservoir. It is driven by an electric motor, and must be turned on for starting, during all take-offs, low flying, and landings. Refer to paragraph 13*c*(12) for operational check of emergency fuel system.

**CAUTION**

Use of the emergency fuel pump in normal flight can result in overspeeding the engine, since both the barometric and governor are bypassed by this pump.

*2.* INSPECTION OF EMERGENCY FUEL PUMP. *(Refer to T.O. No. 1F-80-78.)*

a. Remove oil drain plug from emergency fuel pump, and drain oil from lube chamber into a clean container.

b. Inspect condition of the oil removed to determine if oil is diluted with fuel.

c. If oil is diluted, remove and replace pump.

d. If oil is not diluted, reinstall drain plug, and refill lube chamber with applicable oil.

*3.* REMOVAL.

a. Uncouple the electrical plug at the drive motor.

b. Disconnect the plumbing at the pump.

c. Remove the four nuts from the studs and bolts attaching the pump to the drive motor and bracket.

d. Remove the pump and drive motor.

PARAGRAPHS 13*b*(8)*(d)* *4*, *5*, *6* AND *7* DELETED IN REVISION DATED 15 APRIL 1949.

PAGES 165 AND 166 DELETED IN REVISION DATED 15 APRIL 1949.

8. INSTALLATION. — Reverse removal procedure.

9. TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Pump not delivering fluid. | Wrong direction of rotation. | Rotation must be reversed immediately to prevent damage to seal parts. |
| | Scavenging or check valves not functioning. | Inspect and clean. |
| | Tank fluid low. | Check fluid level. |
| | Fluid intake line blocked. | Clear line of restrictions. |
| Pump not delivering pressure. | Irregular action of control system; result of air in system. | Repair any air leak in the system. |
| | Blocked pump shaft or internal parts. | Return to depot. |
| | Air leak at pump shaft seal. | Return to depot. |
| | Leak on control system. | Plug off system beyond relief valve to test. Examine scavenging or check valves to be sure fluid in seal chamber is maintained at proper pressure. |
| | Small air leak at inlet, or fluid leak at outlet port of pump. | Tighten fittings, or replace if necessary. |

10. (DELETED).

11. (DELETED).

12. INSTALLATION CHECK OF EMERGENCY FUEL PUMP.

a. Connect a shunted ammeter, capable of reading at least 150 amperes, in parallel with power supply to drive motor.

b. Disconnect plumbing line to pressure switch at elbow in pressure line below pump, and install a zero to 400-psi pressure gage.

c. With engine control lever closed, turn on emergency pump. Gage must indicate between 320 and 340 psi with no more than 120 amperes current drain by pump motor.

d. Remove top plug from back of governor, and attach a hooked wire to dumping arm.

e. Start and run up engine to 100% rpm. Disconnect battery cart.

f. With engine running below 100% rpm, valve must unload and bypass fuel to tank. Test gage will indicate between 40 and 80 psi.

g. With engine running at 100% rpm, dump the governor by pulling wire attached to dumping arm, and quickly advance engine control lever full forward. Maximum permissible current drain is 120 amperes with a minimum of 260 psi fuel pressure as indicated on cockpit pressure gage, and engine rpm in accordance with the following table. If the engine rpm does not fall within the limits of the table, adjust the emergency fuel system unloading valve until the desired rpm is obtained. Do not, under any circumstances, adjust the pump discharge pressure to exceed 340 psi as indicated on the test gage.

| *Ambient Air Temp., Deg.F* | *Max. RPM %* | *Min. RPM %* |
|---|---|---|
| —40 | 90.5 | 88.5 |
| —30 | 91.0 | 89.5 |
| —20 | 91.5 | 90.0 |
| —10 | 92.0 | 90.5 |
| 0 | 92.5 | 91.0 |
| 10 | 93.5 | 91.5 |
| 20 | 94.0 | 92.5 |
| 30 | 94.5 | 93.0 |
| 40 | 95.0 | 93.5 |
| 50 | 95.5 | 94.0 |
| 60 | 96.5 | 94.5 |
| 70 | 97.0 | 95.5 |
| 80 | 97.5 | 96.0 |
| 90 | 98.0 | 96.5 |
| 100 | 99.0 | 97.5 |
| 110 | 99.5 | 98.0 |

**CAUTION**

Do not release dumping arm until engine rpm is reduced to 50%. If governor is cut in at a higher rpm, a damaging surge may occur.

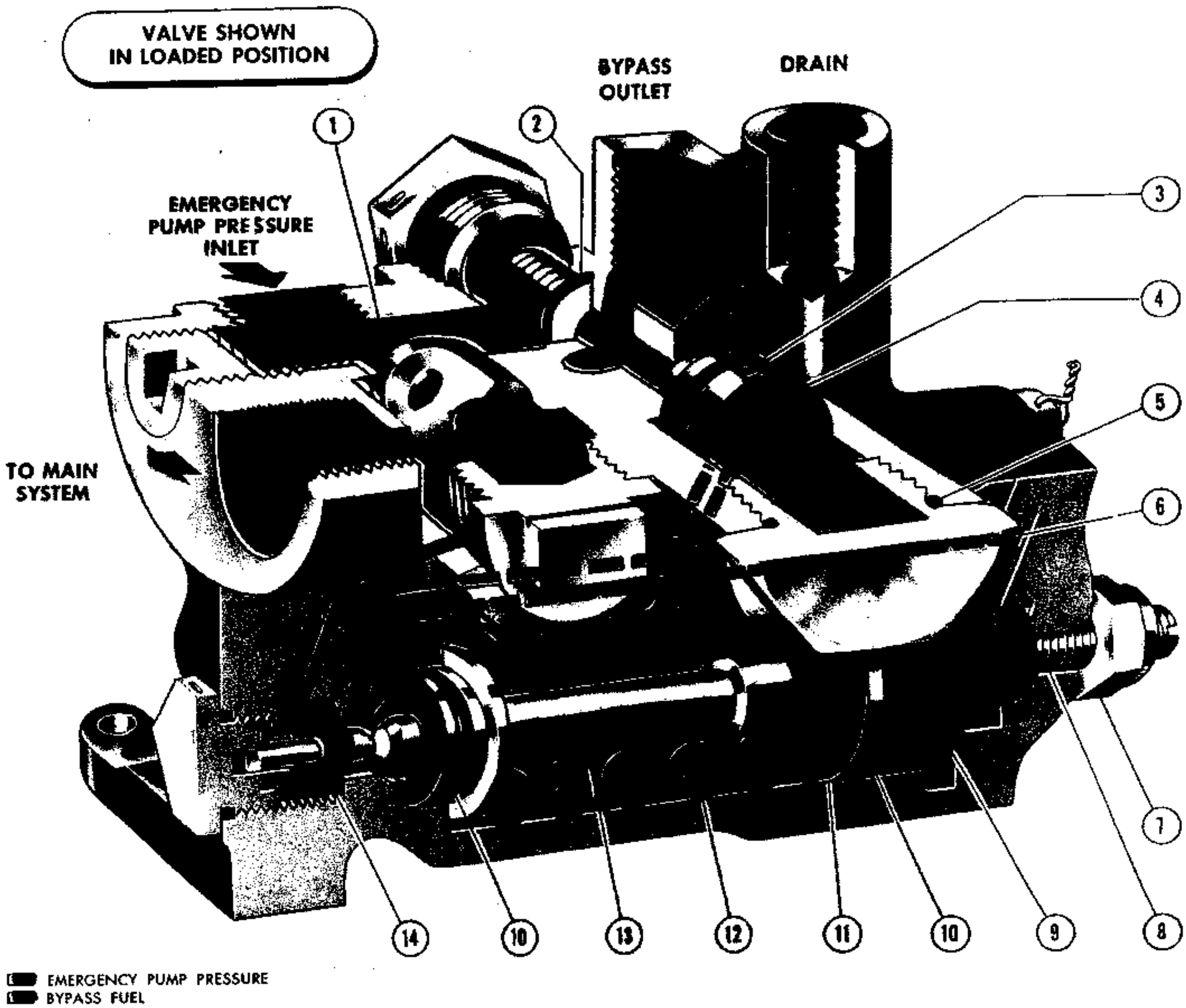
h. Remove dumping wire. Replace plug on governor, and safety it.

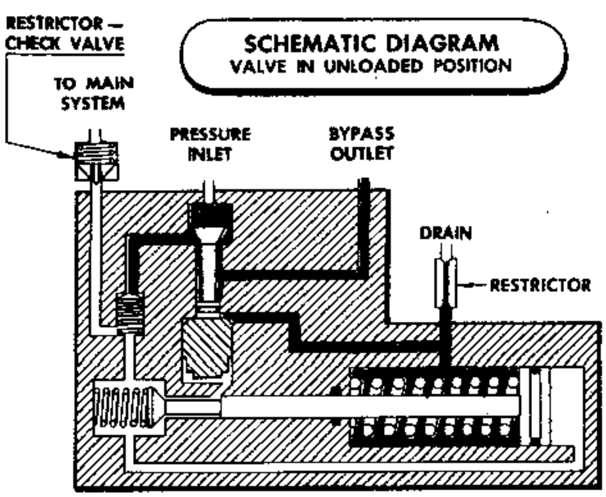
i. Check governor operation by advancing engine control lever full forward. Engine speed must stabilize at 11,500 (+115, —0) rpm if governor is operating properly.

(9) EMERGENCY SYSTEM UNLOADING VALVE (Later Airplanes).

*(a)* GENERAL.—The unloading valve functions as a pressure regulator for the emergency fuel pump. When the pump is used for standby service with the main pump operating, such as during take-off, landing, and low flying, the unloading valve is in the unloaded condition, thus reducing the load on the pump drive motor. Should the main pump fail, the unloading valve will immediately shift to the loaded condition, providing sufficient fuel pressure for 90% rpm. Refer to paragraph 13*c*(12) for operational check of emergency fuel system.

*(b)* OPERATION. *(See figure 110.)*—As emergency pump pressure or system pressure increases, it moves piston (11) to the left. When pressure is built up to 305 (±15) psi, pilot poppet (14) is forced open by piston stem (13) releasing pressure to poppet (4) which opens poppet (2). (On all airplanes incorporating the Pesco S-1324A emergency fuel pump, the unloading valve is set between limits of 320 and 340 psi.) This diverts pump pressure into the return line, thus reducing load on the pump. Should system pressure fall below 305




| | | | |
|---|---|---|---|
| 1. | POPPET — CHECK VALVE | 8. | ADJUSTING SCREW |
| 2. | POPPET | 9. | SNAP RING |
| 3. | "O" RING PACKING | 10. | CHEVRON PACKING |
| 4. | PISTON | 11. | PISTON |
| 5. | GASKET | 12. | SPRING |
| 6. | PLATE | 13. | PISTON ROD |
| 7. | LOCK NUT | 14. | PILOT POPPET |

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*Figure 110 — Emergency Fuel System Unloading Valve*

($\pm$15) psi, piston (10) moves to the right, closing pilot poppet (14) and reversing the above procedure. Adjusting screw (8) controls the tension of spring (12) which determines operating pressure of the valve. Spring tension is set at the factory and should require no further adjustment. A No. 55 restrictor is in the valve drain line to eliminate chatter.

*(c)* DISASSEMBLY.—Remove plug adjacent to the pressure inlet port, and take out the spring. Using long-nosed pliers, lightly grasp the end of poppet (2) and remove it. Remove the plug covering poppet (1) and take out spring and poppet. Remove plug covering piston (4) and remove the piston.

*(d)* DISASSEMBLY OF PILOT VALVE.—Remove the plug covering pilot poppet (14) and take out the spring and poppet. Using an Allen wrench, remove the three screws at the opposite end of the regulator. Remove the nut, and take out piston assembly (11). Unscrew the piston rod from the piston, and remove the seal. Remove the packing, washer, and adapter from the piston by taking off the snap ring (9).

*(e)* CLEANING AND INSPECTION.—Inspect all seals, packing, and gaskets. Replace if worn or damaged. Check the plastic poppets for evidence of wear or leakage. Replace if necessary. Inspect the honed cylinder surface for scored places and scratches. If cylinder walls show evidence of leakage caused by scores in the area of piston travel, the bore may be honed not to exceed a maximum diameter of 1.006 inches.

Before reassembly, wash out the regulator thoroughly with cleaning solvent, Federal Specification P-S-661, and blow out with air to remove any foreign particles.

(10) FILTER. *(See figures 111 and 112.)*

*(a)* DESCRIPTION.—A micronic fuel filter is installed in the pressure line between the fuselage-tank booster pump and the fuel flowmeter. The filter contains an integral relief valve to insure fuel delivery should the filter element become clogged. The filter is located in the right-hand wheel well. The line from the filter ot the engine-driven pump is equipped with a quick disconnect fitting. (See figure 121.) The filter element may be replaced without removing the filter base from the airplane. The filter dome is vented to the fuselage tank through a tube connected to the tank drain fitting.

*(b)* REMOVAL.

*1.* FILTER ELEMENT.—Drain filter. Disconnect vent line, remove housing retaining nut, and remove housing. Remove filter-element retaining nut. Remove element compression spring, and remove element.

**CAUTION**

Before replacing filter dome, carefully check to see that no foreign material has fallen into the filter body or the outlet elbow.

*2.* FILTER UNIT.

a. Disconnect and immediately cap fuel lines.

b. Disconnect and cap both fuel de-icing pressure sensing lines (if installed).

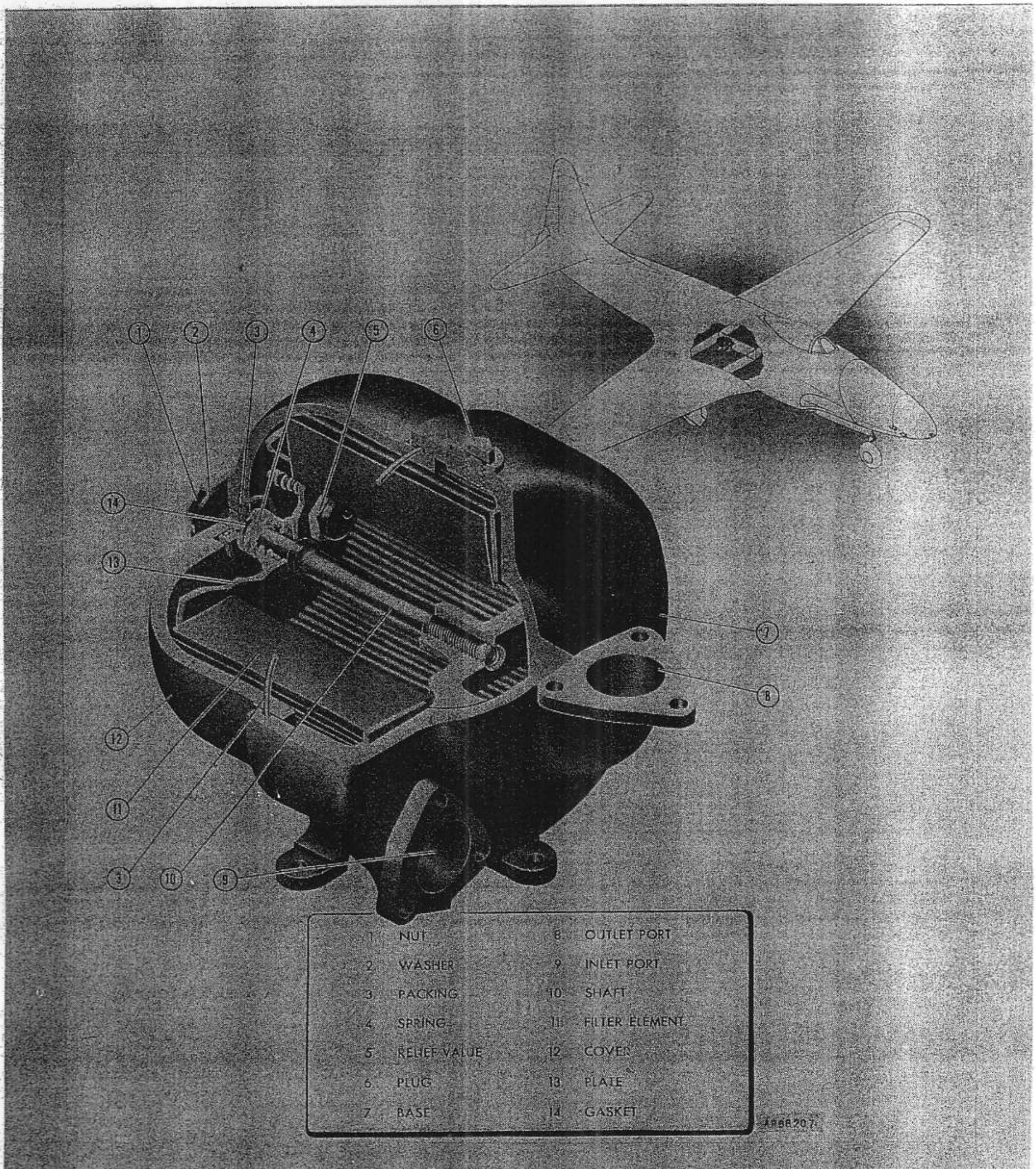
c. Disconnect and cap fuel de-icing fluid injection line (if installed).

d. Remove nuts and bolts attaching filter to structure, and remove filter.

**Note**

A fuel filter air bleed line is installed on AF Serial No. 44-85407 and subsequent, and on airplanes incorporating T.O. No. 1F-80A-33.

PAGE 170A DELETED IN REVISION DATED 15 APRIL 1949.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
1. NUT
2. WASHER
3. PACKING
4. SPRING
5. RELIEF VALVE
6. PLUG
7. BASE
8. OUTLET PORT
9. INLET PORT
10. SHAFT
11. FILTER ELEMENT
12. COVER
13. PLATE
14. GASKET

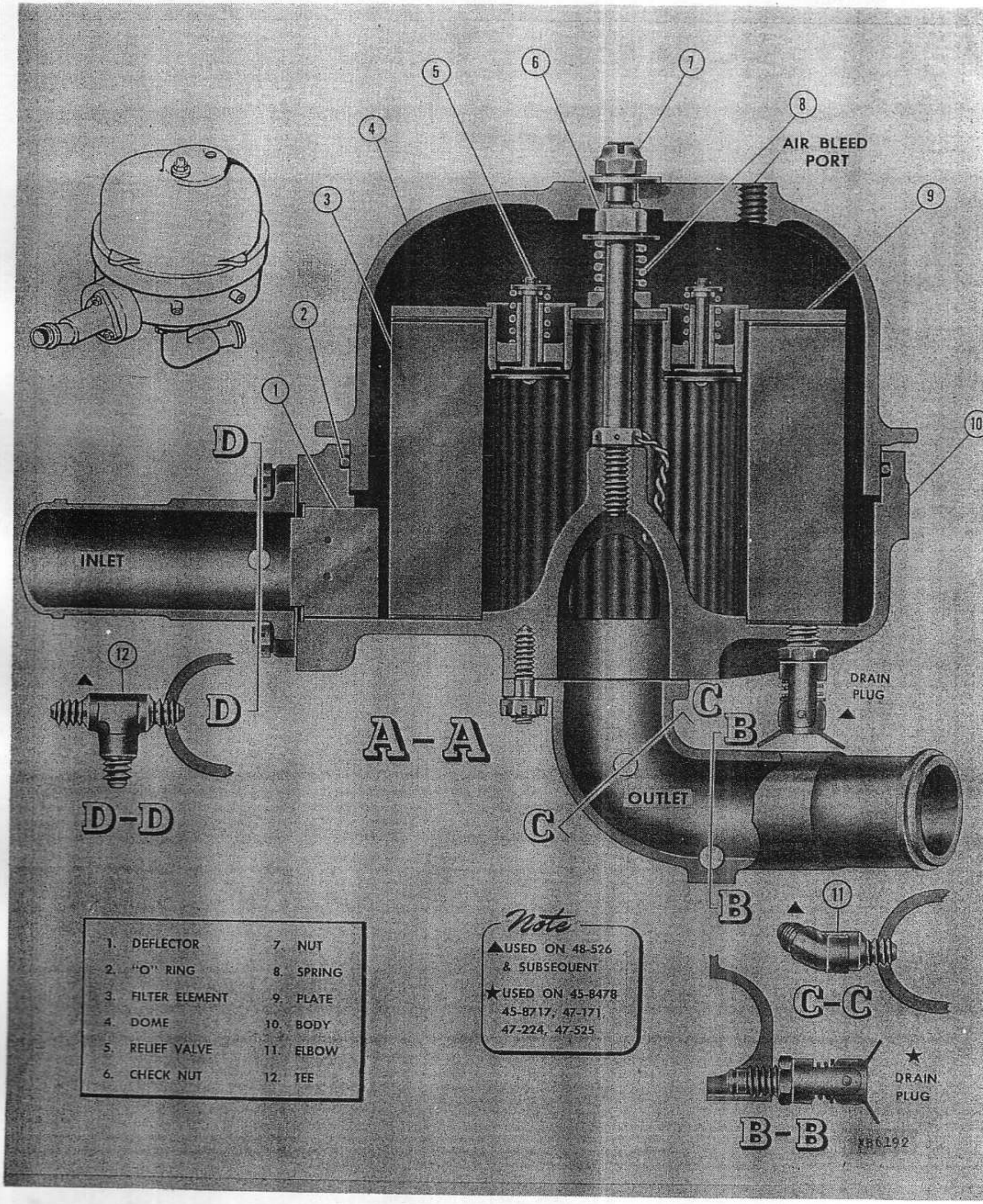



*Figure 112 — Fuel Filter, Serial Nos. AF44-85337 and Subsequent*

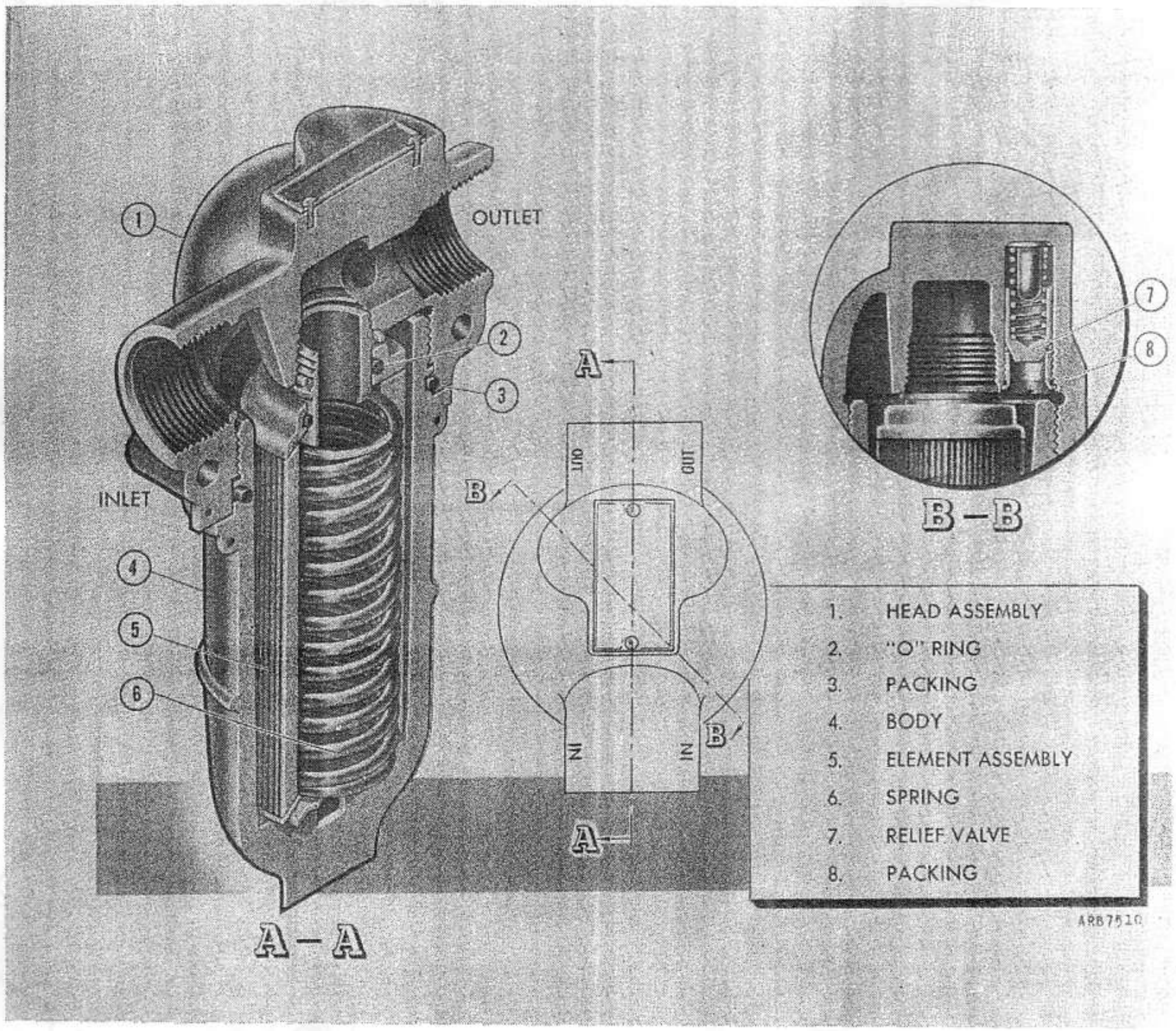



***Figure 113 — High Pressure Fuel Filter***

(11) HIGH PRESSURE FILTER. *(See figure 113.)*

*(a)* DESCRIPTION.—An AN6234-4 filter is installed in the pressure line between the engine-driven pump and barometric in the engine section. The filter is equipped with a relief valve to insure fuel delivery in the event the filter element becomes clogged.

*(b)* REMOVAL.

*1.* FILTER ELEMENT.—Break the safety wire and unscrew the bowl from the filter housing. Remove the paper element.

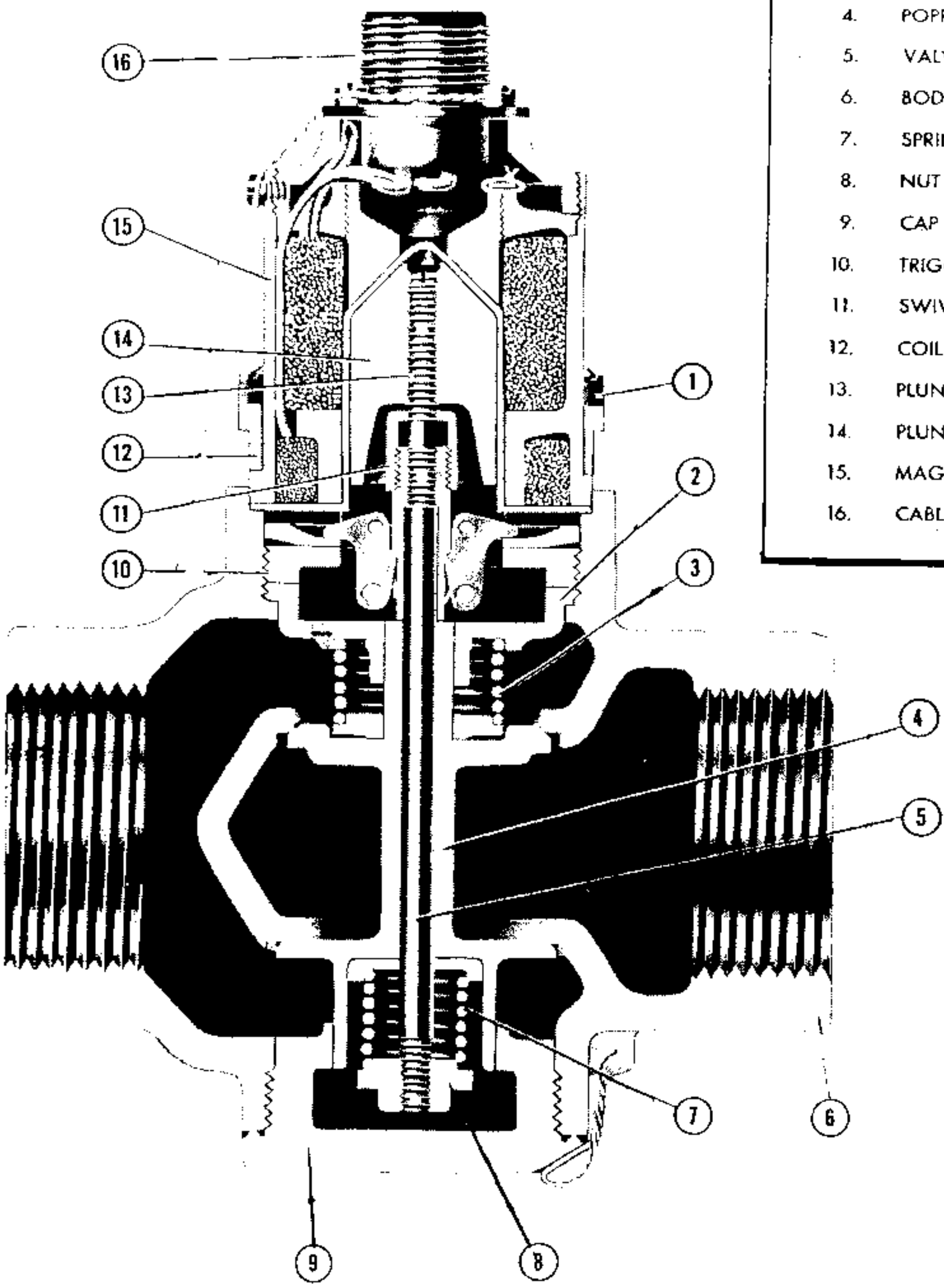
*(c)* CLEANING.—Tape open end of filter element and clean it in a solution of 50% benzene and 50% lacquer thinner.

(12) FUEL TRANSFER AND BYPASS SOLENOID VALVES (Early Airplanes). *(See figure 114.)*

*(a)* DESCRIPTION.—The 40R239A valve is an electrically operated semi-balanced type, manufactured by General Controls.

*(b)* OPERATION.—The valve is actuated by two electromagnets. The smaller magnet, when energized, trips two pawls which allows two springs to force

1. SCREW
2. GUIDE ASSEMBLY
3. SPRING
4. POPPET
5. VALVE STEM
6. BODY
7. SPRING
8. NUT
9. CAP
10. TRIGGER AND ARMATURE ASSEMBLY
11. SWIVEL RETAINER
12. COIL HOUSING FLANGE
13. PLUNGER SCREW STEM
14. PLUNGER
15. MAGNET ASSEMBLY
16. CABLE CONNECTOR



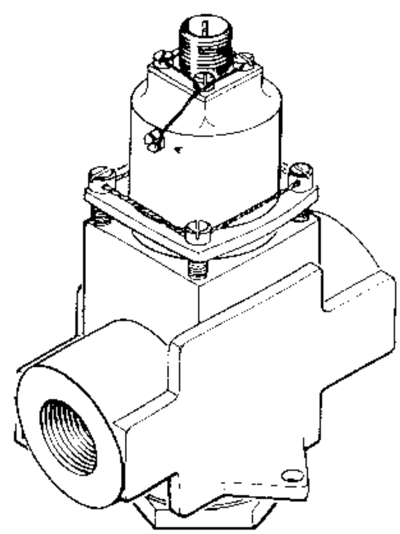




*Figure 114 — Fuel Solenoid Valve, Prior to AF Serial No. 44-85467*

**CAUTION**

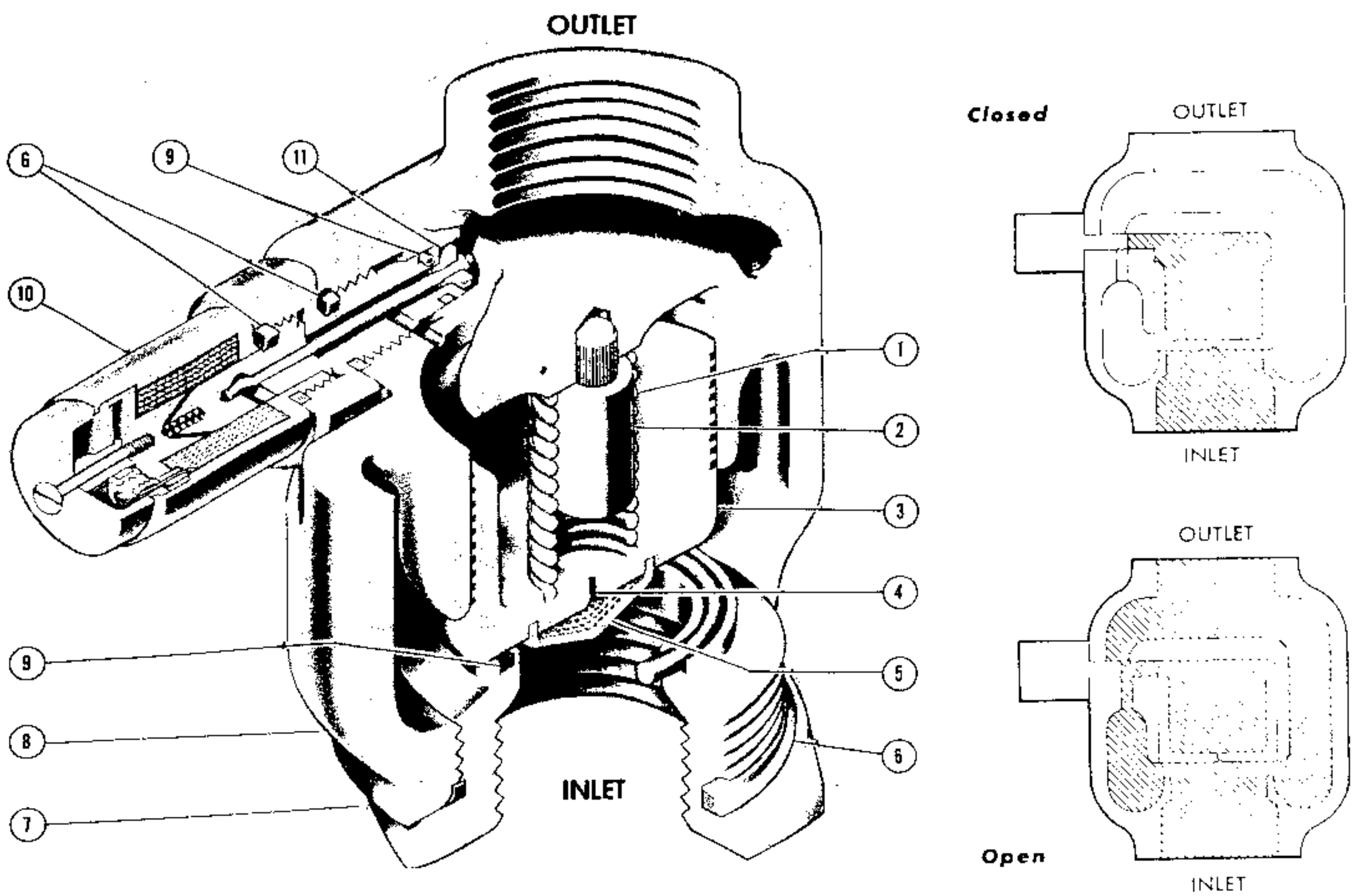
When removing or installing fittings in the inlet and outlet ports, be sure to place a wrench on the flats of the valve body on the same side of the valve where the fitting is being installed or removed. Failure to follow this procedure is likely to cause distortion of the valve seat with resulting leakage.

(*c*) DISASSEMBLY.

*1.* Remove hex cap.

*2.* Remove locking pin, retaining nut, spring, washer, poppet, spring retainer, and spring.

*3.* Remove four internal wrenching screws, and remove solenoid assembly.




| | | | |
|---|---|---|---|
| 1. | SPRING | 7. | FITTING ASSEMBLY |
| 2. | SPRING GUIDE | 8. | BODY |
| 3. | PISTON | 9. | "O" RING PACKING |
| 4. | ORIFICE | 10. | CARTRIDGE ASSEMBLY |
| 5. | SCREEN | 11. | PILOT POPPET |
| 6. | SEAL | | |

FLOW DIAGRAM

ARB 8439

*Figure 115 — Fuel Transfer Solenoid Valve, AF Serial No. 44-85467 and Subsequent*

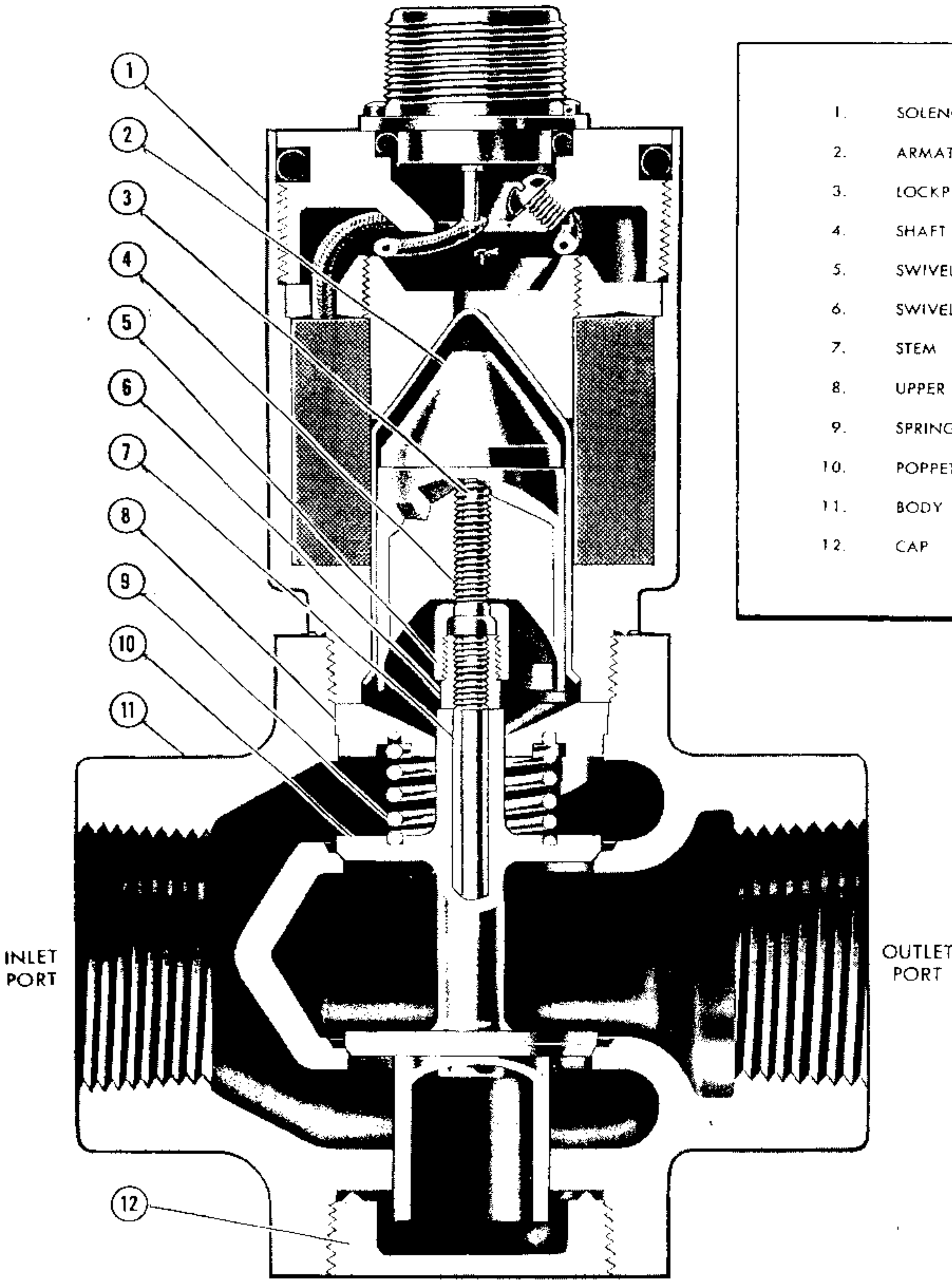
(13) FUEL TRANSFER SOLENOID VALVES (AF SERIAL NO. 44-85467 AND SUBSEQUENT). *(See figure 115.)*

*(a)* DESCRIPTION. — The wing and leading edge tank transfer valves are the Savol 5120 normally open solenoid-actuated pilot poppet type.

*(b)* OPERATION. — Fuel pressure against the nose of the piston overcomes the light spring and pushes creating a low-pressure area back of the piston, causing it to remain open. When the pilot poppet is closed by energizing the solenoid, the piston chamber is closed, and the pressure on the back of the piston becomes greater than that on the nose, causing the piston to be held firmly against the O-ring seat, thus shutting off the flow.

*(c)* DISASSEMBLY.

*1.* Unscrew fitting assembly from the body.




1. SOLENOID ASSEMBLY
2. ARMATURE
3. LOCKPIN
4. SHAFT
5. SWIVEL NUT
6. SWIVEL BUSHING
7. STEM
8. UPPER GUIDE
9. SPRING
10. POPPET
11. BODY
12. CAP

ARB 8239

*Figure 116 — Fuel Bypass Solenoid Valve, AF Serial No. 44-85467 and Subsequent*

*(d)* INSPECTION.

*1.* Check O-rings and gaskets for any surface imperfections. Replace rings and gaskets if necessary.

*2.* Inspect the contact area on the bottom of the piston to see that it is free from nicks and scratches. Replace piston if surface is rough.

*3.* Check the inside diameter of the bore and the outside diameter of the piston for deep scratches or burrs which could cause binding. Replace if necessary.

*4.* Check clearance between piston and valve body. This clearance must not exceed 0.003 inch, or be less than 0.001 inch.

*5.* Check the piston spring for corrosion or deformation. The free length should be 3 $\frac{9}{16}$ ($\pm\frac{1}{16}$) inches. Spring must move freely on its guide pin.

*6.* Inspect pilot poppet and seat for surface imperfections.

*7.* Energize the solenoid with 24 volts d-c and see that the pilot poppet seats tightly against its seat in the end of the cartridge. If the valve does not seat properly, replace the entire cartridge assembly.

*(e)* ASSEMBLY.—Coat O-rings with a light coating of kerosene to facilitate installation. Check all moving parts to see that they move freely in their guides. Reverse disassembly procedure.

(14) FUEL BYPASS SOLENOID VALVE (AF SERIAL NO. 44-85467 AND SUBSEQUENT). *(See figure 116.)*

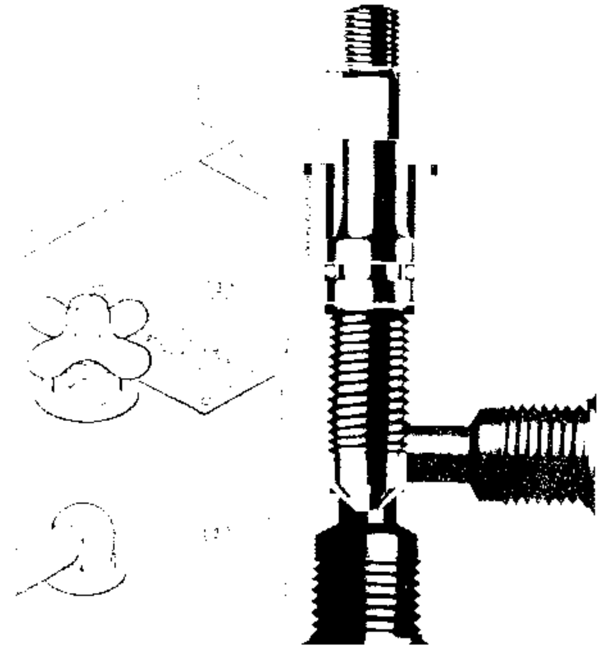
*(a)* DESCRIPTION.—The General Controls 40R733 solenoid valve is similar to the 40R239A valve used in early airplanes, except that it is a normally closed valve with no latching mechanism, and only one electromagnet is used.

*(b)* OPERATION.—The valve remains closed until the electromagnet is energized by putting the fuel bypass switch in the "BYPASS" position. The valve will remain open only as long as electrical energy is applied.

*(c)* DISASSEMBLY.

*1.* Remove the solenoid assembly.

*2.* Remove the armature and valve assembly.



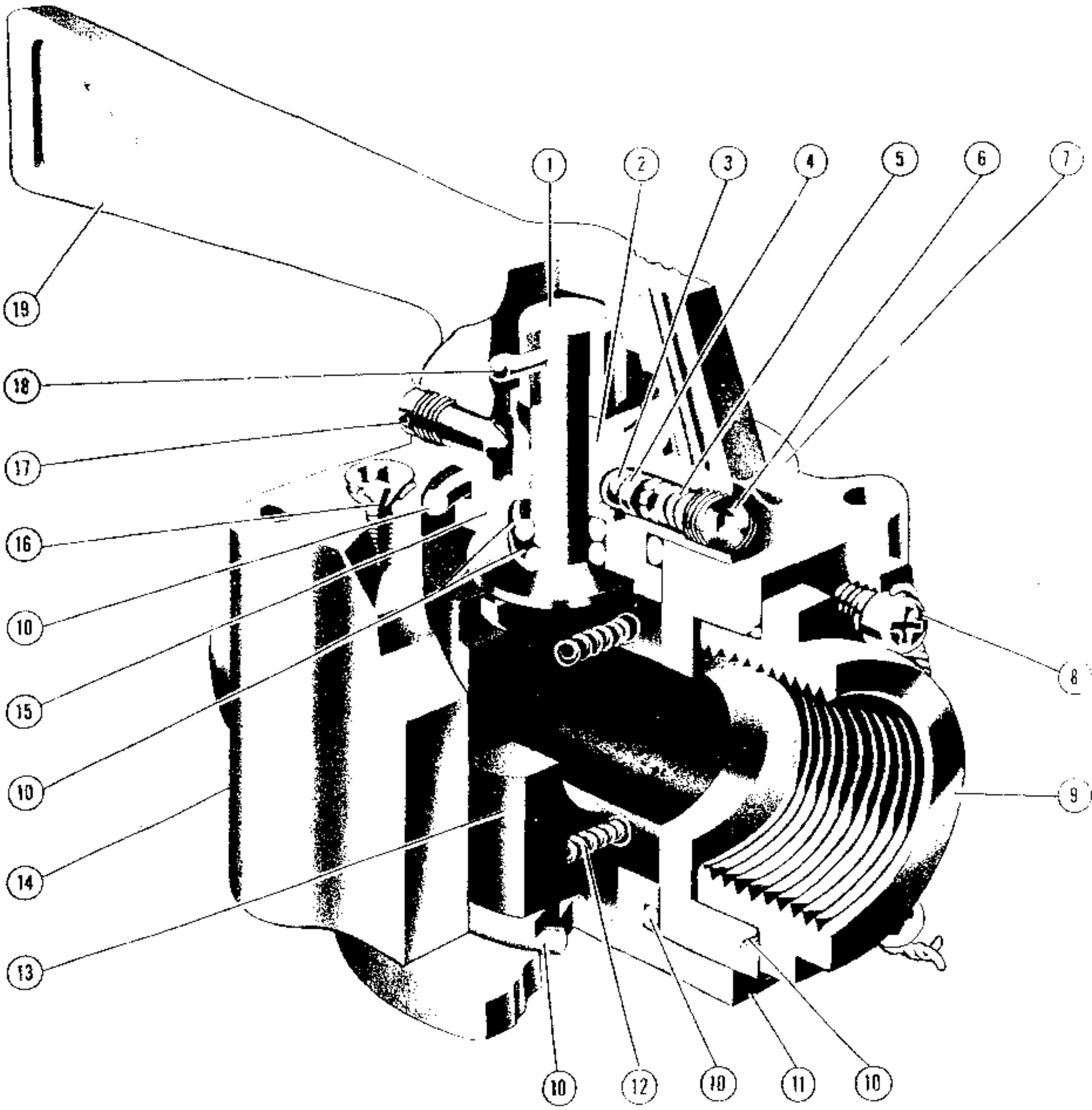
| | | | |
|---|---|---|---|
| 1. | BODY | 4 | PLUNGER HANDLE |
| 2 | PLUNGER | 5 | NUT |
| 3 | PACKING | | |

*Figure 117 — Altitude Idle Valve, AF Serial No. 44-84992 through 44-85336*

*3.* Remove the swivel nut and armature from the valve stem.

*4.* Remove the guide and spring from the valve stem.

(15) ALTITUDE IDLE VALVE. *(See figure 117.)* —The altitude idle valve is a simple plunger-type valve located on the cockpit floor just forward and to the left of the pilot's seat. This valve has been deleted from later airplanes, and rendered inoperative on most of the early airplanes. The purpose of the valve is to enable the pilot to reduce the fuel pressure to the burners when flying at high altitude. When the valve is open, fuel is bypassed from the engine-side of the control valve back to the low-pressure side of the main fuel pump.




| | | | |
|---|---|---|---|
| 1. | ROTOR | 11 | BOTTOM CAP |
| 2. | RATCHET RING | 12. | ROTOR DISC SPRING |
| 3. | INDEX BALL | 13. | ROTOR DISC |
| 4 | INDEX BALL FOLLOWER | 14. | BODY |
| 5 | INDEX SPRING | 15 | INDEX WASHER |
| 6 | INDEX SETSCREW | 16. | SCREW |
| 7. | TOP CAP | 17. | INDEX STOP SCREW |
| 8. | ADAPTER SCREW | 18 | TAPER PIN |
| 9. | PORT ADAPTER | 19. | HANDLE |
| 10. | PACKING | | |

*Figure 118 — Manual Shut-off Valve*

(16) MANUAL SHUT-OFF VALVE (AIRPLANES NOT INCORPORATING T.O. 1F-80A-506). *(See figure 118.)*—The fuel manual shut-off valve is located in the main fuel line between the fuselage tank and the fuel filter. It is a balanced-type Parker valve, part number 4-1544-1. Access to this valve is gained through the dive flaps opening. The purpose of this valve is to shut off the main fuel tank when work is being performed on the fuel system. It is not accessible during flight.

**CAUTION**

Do not scratch, chip, score, or in any other way damage the graphite parts of this valve. If these parts are damaged, they must be replaced.

(16A) MOTOR-OPERATED MAIN FUEL SHUT-OFF VALVE (AIRPLANES INCORPORATING T.O. 1F-80A-506). *(See figure 192F.)*

*(a)* DESCRIPTION.—The motor-operated fuel shut-off valve is located in main fuel line between fuselage tank and micronic fuel filter and is accessible through right dive flap.

*(b)* OPERATION.—The motor-operated fuel shut-off valve is an intermittent duty, slide-type valve operated by a switch in cockpit.

*(c)* REMOVAL.

*1.* Gain access through right dive flap.

*2.* Disconnect electrical lead from valve.

*3.* Disconnect fuel lines at valve.

*4.* Remove two bolts attaching valve to support and remove valve.

*(d)* INSTALLATION.

*1.* Reverse removal procedure.

*2.* Clean exterior of valve at actuator and valve body, and at actuator electrical connector.

*3.* Wrap tape, AF Stock No. 6600-856500, around connector, extending 1½-inches onto electrical wiring and snug against actuator housing.

*4.* Apply a thick coat of varnish, gasoline and oil-resistant, AF Stock No. 7300-968495, to taped portion, valve area adjoining connector, and at actuator and valve body joint.

(17) CHECK VALVE.—There are a number of check valves throughout the fuel system, placed to prevent fuel from flowing in the wrong direction. Each of these check valves consists of a cylindrical body in which is located a spring-loaded flapper disc. Fuel flow in the desired direction forces the flapper to open against the spring pressure. Reversed fuel flow forces the flapper to close against a flange. A small arrow is stamped into the body of each valve to indicate the direction of flow.

**CAUTION**

When replacing tip tank fuel transfer line check valves, assure that both right and left valves bear the same part number. If valves are installed that are not matches, uneven tip tank feeding results.

(18) FUEL PRESSURE TRANSMITTER. *(See figure 120.)*

*(a)* DESCRIPTION.—A fuel pressure transmitter is located in the lower right portion of the engine compartment. The transmitter is a cast aluminum shell divided by a flexible diaphragm into two chambers. The half of the shell to which the transmitting line to the gage is connected is the outlet housing. A diaphragm disc and plunger assembly is incorporated in the pressure inlet housing for the purpose of centering and supporting the diaphragm when the pressure outlet side of the system is being filled with fluid. A spring-loaded ball check valve is installed in the lower port of the pressure-outlet housing to prevent loss of fluid or entry of air when the fluid supply tube is removed after filling. The pressure registering part of the system is filled with compass fluid, Specification AN-C-116.

*(b)* OPERATION.—The fuel pressure transmitter transfers variations in fuel pressure from the fuel to compass fluid. Fuel pressure is transmitted by the fuel from the drip valve to the transmitter. Pressure is then relayed by the diaphragm to compass fluid which transmits it to the pressure indicator on instrument panel.

*(c)* REMOVAL.

*1.* Disconnect pressure inlet line at quick disconnect fitting.

*2.* Disconnect and immediately cap pressure outlet line at the transmitter.

*3.* Remove attaching screws and transmitter.

*(d)* INSTALLATION.—Reverse removal procedure.

**CAUTION**

Do not remove or loosen the mounting spacers or flange screws as they have been tightened to a definite torque.

*(e)* FILLING.

**CAUTION**

Use only aircraft compass fluid conforming to Specification AN-C-116.

*1.* Loosen the lock nut and unscrew it fro[m] threaded portion of the stem. Push the knob in and tur[n] it clockwise (approximately one-half turn) until pla[te] (7) is felt to be firmly in place against diaphragm (9). If knob will not move in readily, tap it lightly with hammer to loosen the gasket which has become seale[d] between the casting and the diaphragm disc. This procedure insures the diaphragm being centered.

*2.* Fill the transmitter and system, using eithe[r] a portable filler gun or the master gage unit from a C- instrument field test set. Do not use a pressure fillin[g] system which has air under pressure in contact with th[e] surface of the compass fluid.

**Note**

Charging equipment must be clean. If equipment is not already filled with compass fluid, it must be thoroughly cleaned before being filled. After charging equipment has been cleaned and filled, attach a tag to indicate that the unit has been filled with compass fluid.

*3.* Remove cap (11) from filler valve (10 marked "F" located in the lower part of the transmitte[r] and connect filling line from the charging apparatus.

*4.* Remove cap from bleeder check valv[e] marked "B" located on the gage fitting, and connect suitable length of tube. Allow the end of the tube t[o] vent under the surface of accumulated fluid in a container, to aid in determining complete elimination of a[ir] from lines. Continue charging until air bubbles n[o] longer appear at the end of the bleeder line.

**CAUTION**

Do not exceed 25 psi on the master pressure gage, as excessive pressure will bend the pressure plate (7) and rupture the diaphragm. Be sure the supply reservoir of the charging equipment does not run out of fluid.

*5.* Remove bleed tube from bleed valve (2) o[n] gage fitting and replace cap when fluid stops flowin[g]. Tighten the cap securely.

*6.* Remove charging line from filling valv[e] (10) on the transmitter and replace cap (11). Tighte[n] the cap securely.

*7.* Turn transmitter knob counterclockwise an[d] pull it out with the fingers as far as it will go. Tighte[n] the lock nut with a wrench.

(*f*) TROUBLE SHOOTING.

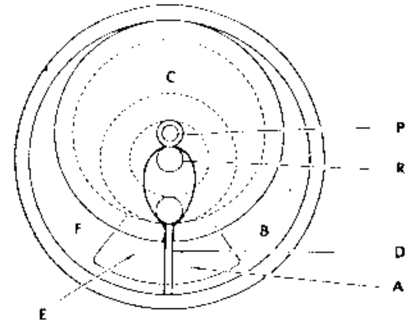
| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Gage fails to show pressure, or pointer rises, then slowly returns to zero. | Leaks in lines or fittings; cap on bleeder or filler valve loose. **Note** Caps should incorporate self-aligning seats. Caps made of one piece are likely to leak due to eccentricity of check valve nipple. | Tighten or replace. |
| | Clogged or crushed line. | Clean or replace line. |
| | Hole in gage fitting plugged. | Clean hole or replace fitting. |
| | Leaks between inlet and outlet housings of transmitter. | Tighten 10 flange screws to 32 inch-pounds torque. If leaks continue, replace transmitter. |
| | Defective gage. | Replace gage. |
| **Gage does not operate in cold weather.** | Unit filled with wrong fluid. | Drain and refill with compass fluid, Spec AN-C-116. If fluid is frozen, thaw and drain. Check for cracks by filling system with 20 psi air pressure and testing for leaks with solution of mild soap and water. |
| **Gage shows pressure reading with temperature rise.** | Unit was filled while diaphragm was back in operating position. | Open instrument line at transmitter. Put diaphragm in filling position. Replace line connection and refill unit. |
| | Bleeder cap replaced while filling pressure was on. | Put bleeder cap in place after all bleeding has stopped. |
| **Diaphragm valve plate assembly will not move forward for filling.** | Gasket sealed to plate. | Tap plunger lightly with hammer. |
| **Leakage at lock nut under knob valve.** | Loose lock nut. | Tighten. |
| | Defective gasket. | Replace transmitter. |
| Leakage through casting. | Porosity or cracks. | Replace transmitter. |
| Impossible to force compass fluid into the transmitter. | Empty or defective filling equipment. | Fill or replace filling equipment. |
| | Transfer holes in transmitter clogged. | Replace transmitter. |
| | Check valve in transmitter or gage clotted or have "B" and "F" valves reversed. | Inspect valves. Replace if necessary. |
| | Line clogged or crushed. | Clean or replace line. |
| | Remove fuel pressure connection on fuel inlet side. If filling liquid runs from opening, diaphragm is broken. | Replace transmitter. |
| | Pressure in filling equipment below minimum required. | Check pressure gage. Maintain 20 to 25 psi pressure. **CAUTION** Do not apply more than 25 psi at any time. |
| Gage will not read zero. | Fluid has leaked from system. | Refill system. |

(19) FUEL QUANTITY TRANSMITTER.—Refer to paragraph 17*g*, this section.

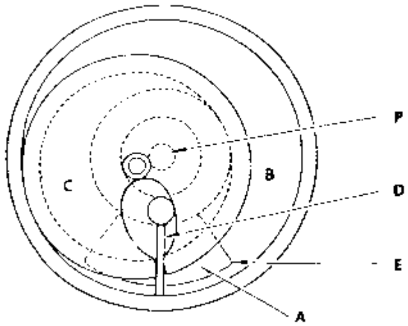
(20) FUEL FLOWMETER.

*(See figures 119 and 119A.)*

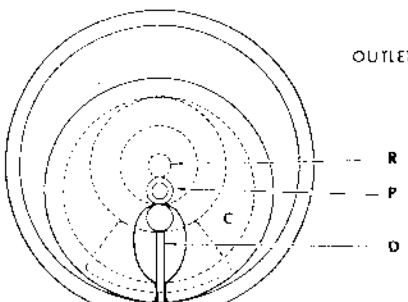
(*a*) DESCRIPTION.—This meter is a volumetric measuring instrument of the oscillating piston type. It is suitable for an operating rate of flow between 20 and 1200 gallons per hour. The registration accuracy of the meter is within plus or minus 1 percent under normal operating temperatures and pressures. The purpose of this meter is to measure the amount of fuel that has passed from the tanks to the engine. The measuring unit electrically actuates a subtracting counter located on the right-hand side of the instrument sub-panel. The counter must always be set to show the exact amount of fuel in the airplane at take-off. The quantity of fuel, as it is used, is continuously subtracted from the original quantity shown on the counter, which therefore al-



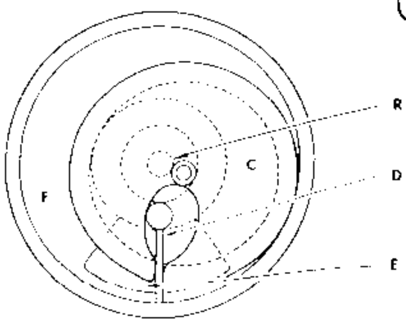

SKETCH 1



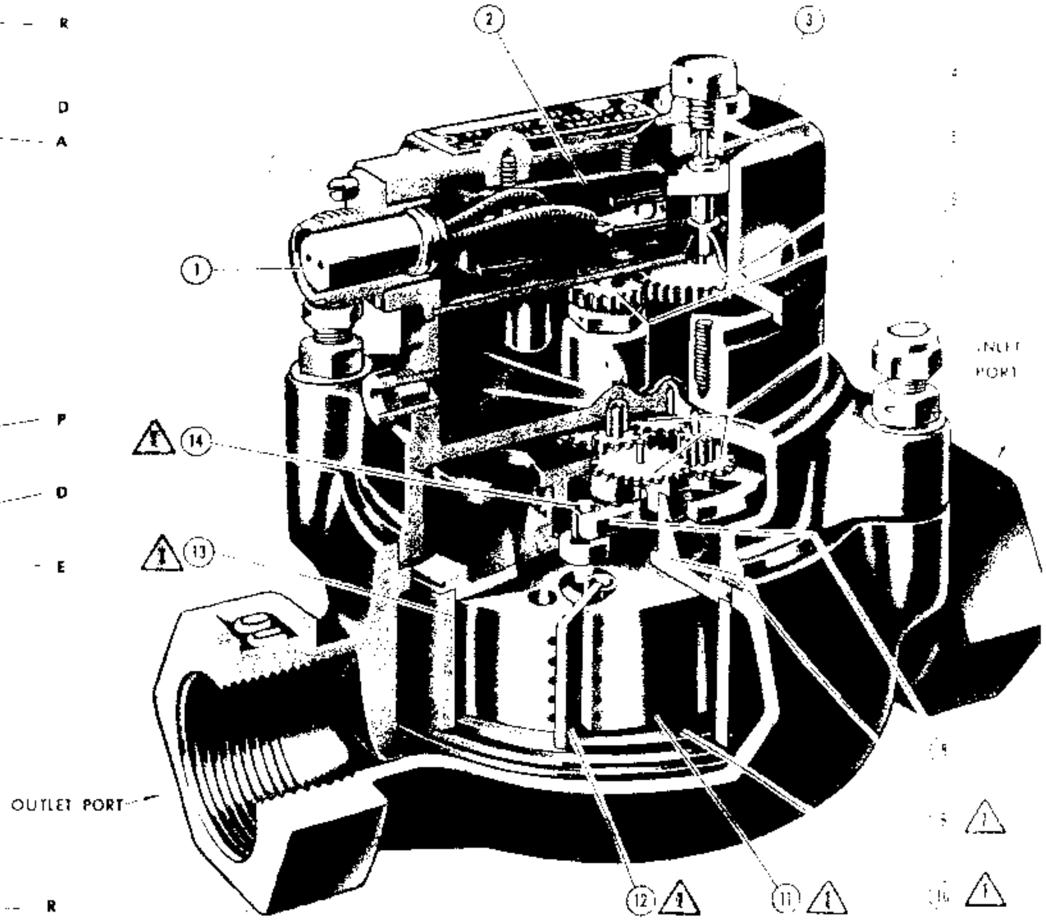

SKETCH 2




SKETCH 3




SKETCH 4

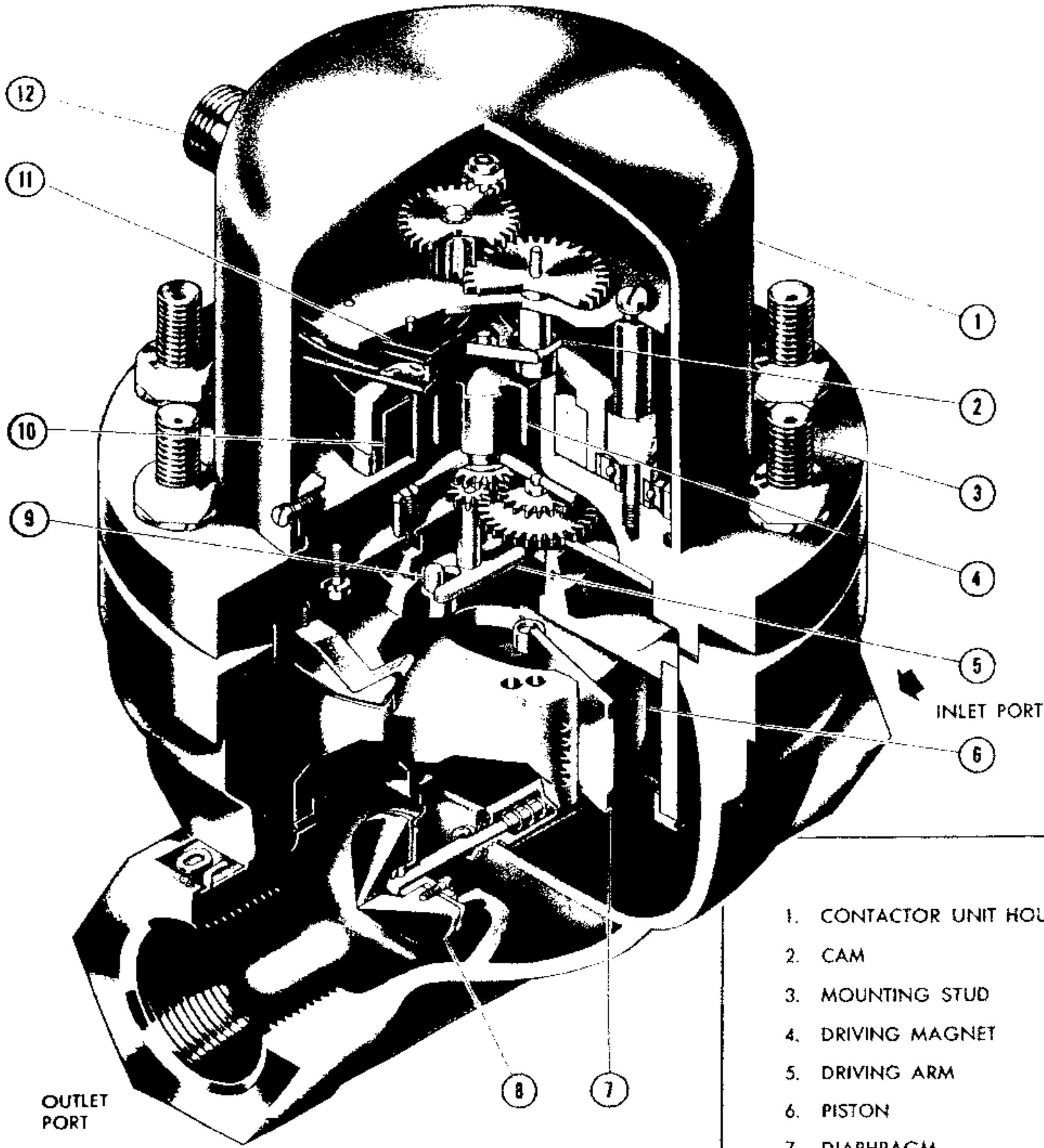



*Note*

△1 DELETED (T.O. 01-75 FJ-75)

| | | |
|---|---|---|
| | 1. | RECEPTACLE |
| | 2. | MICRO SWITCH |
| | 3. | CONTACTOR UNIT HOUSING |
| | 4. | CAM SPINDLE |
| | 5. | CAM SPINDLE CHANGE GEAR |
| | 6. | STUFFING BOX CHANGE GEAR |
| | 7. | CHAIN OF GEARS |
| | 8. | DRIVING ARM |
| △1 | 9. | UPPER CYLINDER HEAD |
| △1 | 10 | LOWER CYLINDER HEAD |
| △1 | 11. | PISTON |
| △1 | 12. | DIAPHRAGM |
| △1 | 13. | MEASURING CYLINDER |
| △1 | 14 | CONTROL ROLLER |

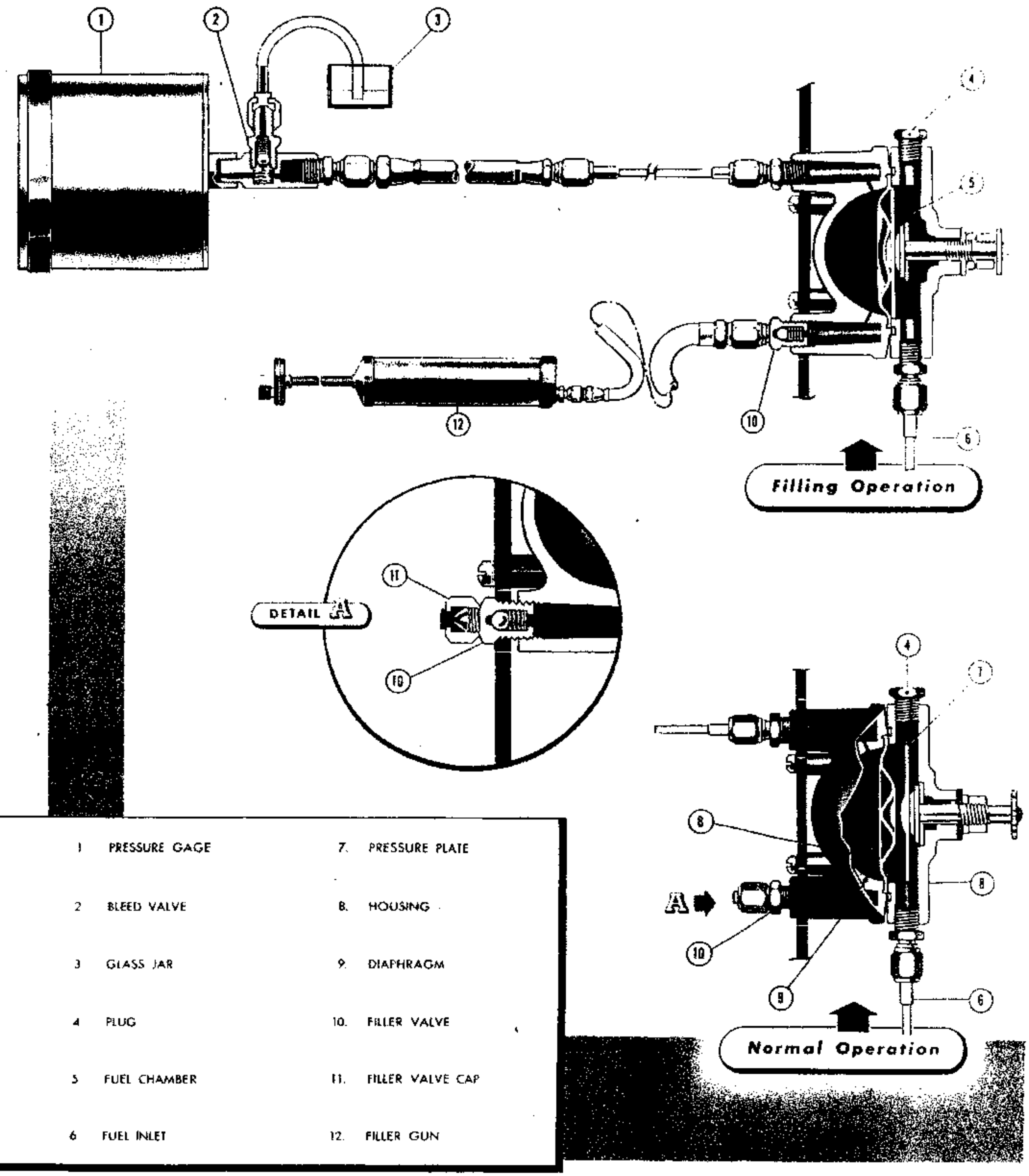
*Figure 119 — Fuel Flowmeter (Unmodified Airplanes)*




1. CONTACTOR UNIT HOUSING
2. CAM
3. MOUNTING STUD
4. DRIVING MAGNET
5. DRIVING ARM
6. PISTON
7. DIAPHRAGM
8. BYPASS VALVE
9. DRIVING PIN
10. FOLLOWER MAGNET
11. MICROSWITCH
12. RECEPTACLE

XB5340

*Figure 119A — H-1 Fuel Flowmeter (Modified Airplanes)*




| | | | |
|---|---|---|---|
| 1 | PRESSURE GAGE | 7. | PRESSURE PLATE |
| 2 | BLEED VALVE | 8. | HOUSING |
| 3 | GLASS JAR | 9. | DIAPHRAGM |
| 4 | PLUG | 10. | FILLER VALVE |
| 5 | FUEL CHAMBER | 11. | FILLER VALVE CAP |
| 6 | FUEL INLET | 12. | FILLER GUN |

AR860-2

*Figure 120 — Fuel Pressure Transmitter*

ways indicates the quantity of fuel remaining in the tanks. This meter does not indicate rate of flow. For electrical information refer to paragraph 17*g*(3), this section.

*(b)* OPERATION.—The motion of the piston is transmitted to a cam-operated micro switch. Electrical impulses from the micro switch actuate a counter mechanism which indicates the quantity of fuel remaining in the tanks.

*(bA)* REMOVAL.

*1.* Disconnect electrical lead at flowmeter.

*2.* Remove high-pressure fuel filter on inlet side of flowmeter.

*3.* Disconnect outlet line at elbow fitting.

*4.* Remove six nuts attaching flowmeter to mounting bracket, and remove unit from engine.

*(c)* DELETED.

*1.* DELETED.

*2.* DELETED.

*3.* DELETED.

*(d)* DELETED.

*(e)* DELETED.

*(f)* DELETED.

(*g*) MAINTENANCE.—Little maintenance is required for this meter other than to see that proper operating conditions are preserved. These conditions consist of merely guarding against foreign matter, such as air, sediment, and water entering the measuring chamber.

*1.* SEDIMENT.—The liquid passing through the measuring chamber must be free of grit and other forms of sediment in order to prevent unnecessary friction and scoring of the piston and chamber walls. Evidence of trouble from this source will be found in the under-registration of the meter.

*2.* AIR.—Inasmuch as this is an instrument which measures by volume, the meter will record passage of air as well as the liquid being measured. Over-registration is the result.

*3.* WATER.—Incidental water will cause no damage to the meter. Trouble from this source may be expected only when water is allowed to stand in the meter for considerable periods of time.

*4.* LEAKAGE AT THE STUFFING BOX.—Leakage just below the switch housing is the sign of a leaking stuffing box. Remove the switch housing. If tightening the packing gland nut by the fingers does not stop the leak, replace the packing. It may also be necessary to replace the spindle.

*5.* LUBRICATION.—Lubrication is required at only one point, the change gears. A drop of high-altitude grease is applied to each of these gears at the factory, and will need renewal only if the unit is disassembled and cleaned, or if new gears are installed.

(*h*) TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Leakage at the stuffing box. | Loose packing gland. | Tighten packing gland or replace packing. |
| | Worn spindle. | Replace spindle and repack. |
| Chronic leakage at the main case gasket. | Excessive line or shock pressure. | Check pressure. |
| | Loose bolts. | Tighten bolts. |
| | Broken gasket. | Replace gasket. |
| Reduction in rate or complete stoppage of discharge. | Pump bypass stuck open. | Inspect pump. |
| | Worn pump. | Inspect pump. |
| | Blocked filter due to sediment. | Replace filter element. |
| | Piston in meter stuck by dirt. | Check strainer and clean measuring chamber. |
| Under-registration; erratic. | Dirt in measuring chamber. | Clean measuring chamber and replace filter element. |
| | Badly worn control roller or diaphragm in measuring chamber. | Replace worn parts. |
| | Main casing distorted or damaged. | Replace casing. |
| | Dirt under seat of measuring chamber at outlet port. | Remove chamber and clean seats. |
| Consistent over- or under-registration. | Meter in need of calibration. | Recalibrate meter. |
| No registration. | Electric current failure. | Check supply. |
| | Sheared change gear key. | Replace gear. |
| | Loose connection in contactor unit. | Remove and inspect contactor unit. |
| | Defective micro switch. | Replace switch. |

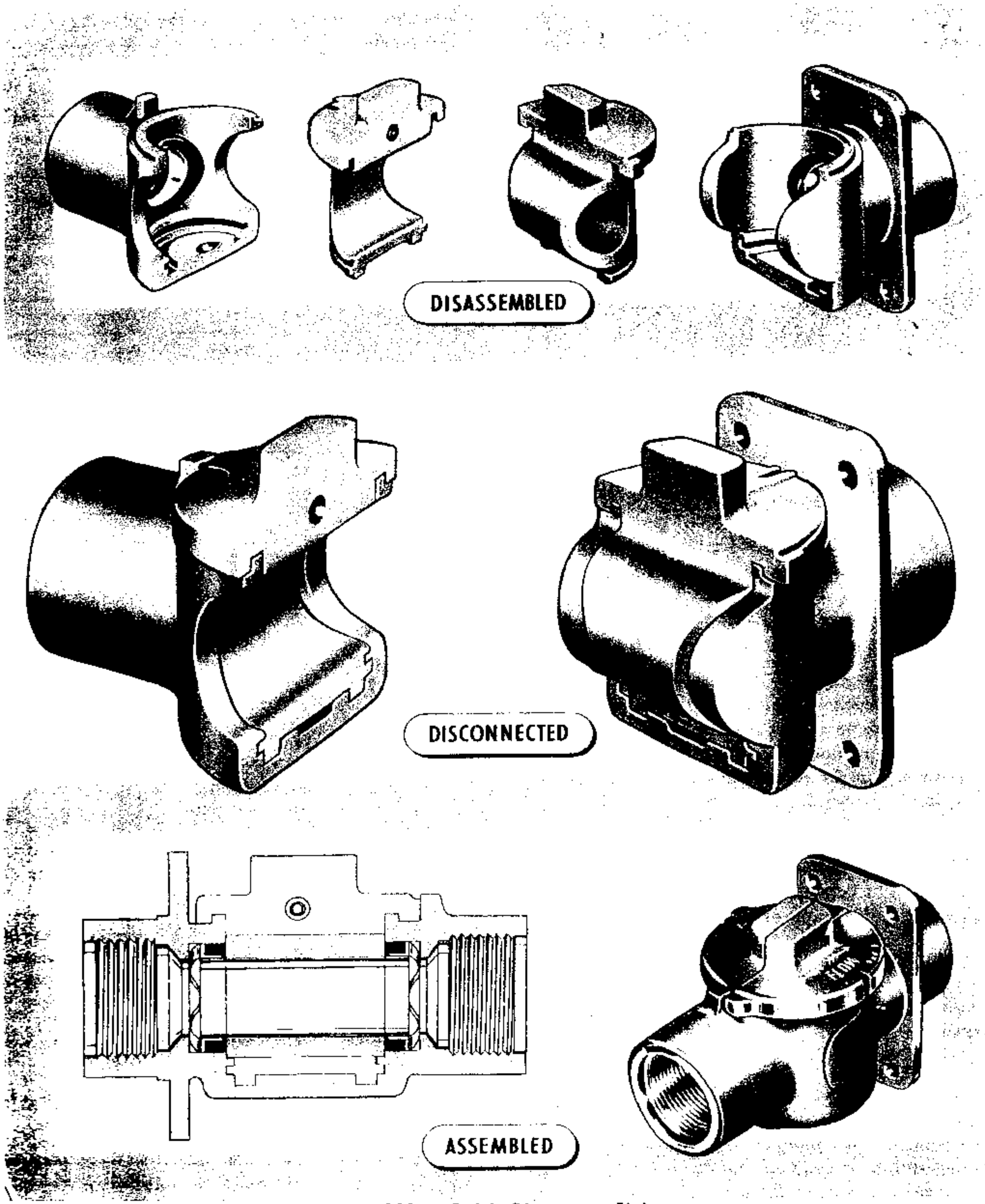



*Figure 121 — Quick Disconnect Fitting*

(21) QUICK DISCONNECT FITTING. *(See figure 121.)*—This fitting is installed in some of the plumbing lines between the engine and the forward fuselage section of the airplane. To disconnect, place a wrench on the wrench flats and turn 90 degrees. To disassemble either half of the fitting, place a wrench on the wrench flats, and while pushing in on the spring located in the hole just below the wrench flat, turn the wrench 90 degrees.

**CAUTION**

If unit has been disassembled, upon assembly torque bolts to between 60 and 70 inch-pounds. Do not overtorque as this will cause leakage.

Another type of quick disconnect fitting used on some of the plumbing lines is the spring-loaded pawl type. This fitting incorporates an "O" ring gasket and if left disconnected for extended periods in damp climates, the "O"ring may swell and prevent connection. If this condition exists, the "O" ring should be replaced to prevent the possibility of small chips of the "O" ring entering the fuel lines if the fitting is forced together.

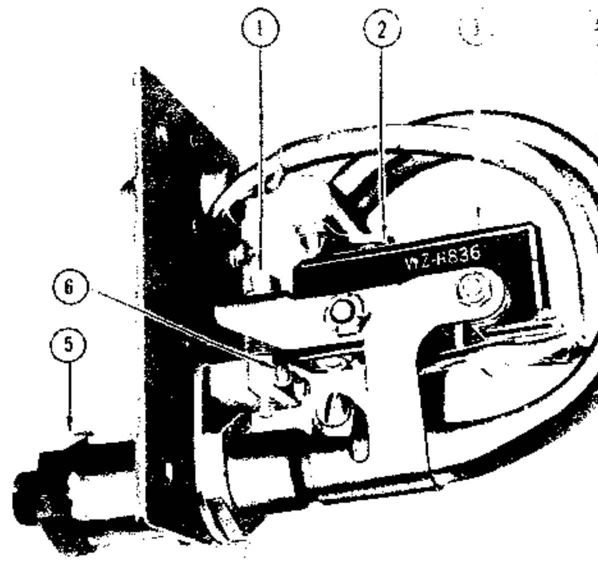
(22) FUEL PRESSURE WARNING SWITCH.—There are three pressure switches (figure 123) in the main fuel system. One is located in the fuel line between the droppable tank and the fuselage tank, the second between the wing leading-edge tank and the fuselage tank, and the third between the aft inboard-wing tank and the fuselage tank. The purpose of these switches is to turn on the fuel-tank lights as the tanks are emptied. The operating parts of these switches are the bellows, plunger, and the micro switch. Fuel pressure is applied to the port where it expands the bellows, which forces the plunger to turn off the micro switch. When the fuel in the tank is exhausted, the pressure drops, and the bellows then contracts and allows the micro switch to turn on the fuel-tank light. These switches are set to turn the lights on when the fuel pressure drops below 5 psi.

A fourth pressure switch (figure 122) is installed on the pressure side of the emergency fuel pump. This unit consists of a micro switch actuated by a bourdon tube. It turns on the emergency fuel system indicator light when pump pressure reaches 240 psi.

On later airplanes the pressure switch is similar to the low-pressure switches described above, and it turns on the emergency fuel system indicator light when pump pressure reaches 30 ($\pm$10) psi.

A differential pressure switch is installed on all F-80A-10 and RF-80A-10 airplanes. This switch is in the right wheel well, and is connected to the low-pressure fuel filter for use with the fuel de-icing system. For information on the fuel de-icing pressure switch, see paragraph 13 A*m*.

c. ENGINE FUEL SYSTEM.



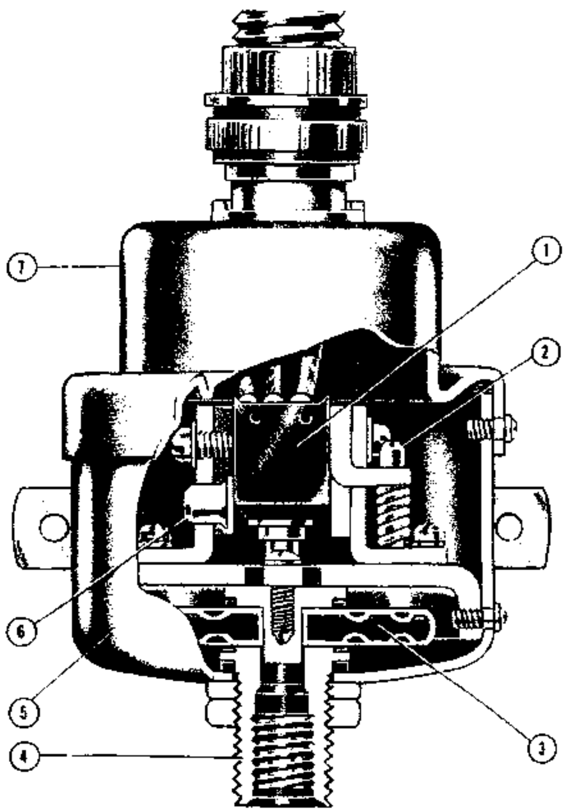

| | |
|---|---|
| 1. | ADJUSTMENT SCREW |
| 2. | CONTACT POINT |
| 3. | MICRO SWITCH |
| 4. | BOURDON TUBE |
| 5. | RESTRICTOR |
| 6. | LOCK SCREW |

AD5493

***Figure 122 — Emergency Fuel System Pressure Switch, Serial Nos. AF44-84992 through 44-85336***

(1) GENERAL.—The engine fuel system consists of all fuel system parts that remain with the engine when it is removed from the airplane. They are: main fuel pump, high pressure filter, check valves, barometric fuel control, governor, engine control valve, drip valve, and drain valve.

(2) OPERATION.—Fuel is forced from the airplane fuel system to the engine main pump which maintains fuel flow under pressure, to the burners during normal operation. When the engine is being started, the main fuel pump is assisted by the emergency pump. This pump is connected in parallel with the main pump and the pressure is regulated by a relief valve on early airplanes, or an unloading valve on later airplanes. During the starting operation, the initial fuel pressure is furnished by the emergency fuel pump. From the main pump the fuel is forced to the barometric and to the governor, which are also connected in parallel with the main fuel pump. The barometric serves to maintain constant fuel pressure regardless of altitude by bypassing excessive fuel back to inlet side of main fuel pump. The governor prevents the engine rotor from revolving faster than 11,500 rpm. This is accomplished by returning excessive fuel to inlet side of main fuel pump. Fuel is metered to burners by control valve which is operated by the throttle lever in the cockpit. On F-80A-5, RF-80A-5, F-80A-10, and




| | |
|---|---|
| 1. | MICRO SWITCH |
| 2. | ADJUSTING SCREW |
| 3. | BELLOWS ASSEMBLY |
| 4. | FUEL PRESSURE CONNECTION |
| 5. | CASE |
| 6. | PIVOT |
| 7. | COVER |

A0452

*Figure 123 — Main Fuel System Pressure Switch*

RF-80A-10 airplanes, stopcock of the control valve shuts off fuel flow when throttle is placed in its farthest aft position while stopping the engine. On F-80A-1 airplanes, a separate stopcock lever is provided for shutting off fuel flow. (See paragraphs (8) and (9) following.) A drip valve is connected to the fuel manifold to pass fuel overboard when the pressure drops below 5 psi. The drain valve which is connected to the combustion chambers prevents accumulation of unburned fuel during starting, stopping, or while the engine is in operation.

(3) MAIN FUEL PUMP.—The main fuel pump is a positive displacement, pressure-loaded, gear-type pump. It is mounted on the accessory gear case adjacent to the generator, and rotates clockwise when viewed from the front. The pump has a rated flow of 20 gallons per minute at 3400 rpm and 500 psi discharge pressure. It is a single-element, gear pump with constant displacement at any one speed, and has no relief valve.

The body of the pump is constructed so that it is eccentric to the mounting flange. The pump is mounted on the accessory drive casing in such a position that the ports are horizontal, and the body of the pump extends below the mounting flange. In this position, the intake port is on the left facing the accessory drive assembly. The intake port can also be identified by the raised boss on its side which contains a spring valve for controlling the pressure loading of the pump's internal bushings. This is not a relief valve.

There are four ⅛-inch pipe taps in the pump mounting flange. These are ported to a drainage ring which collects any fuel that escapes past the pump seal. The lowest of these pipe taps is connected to an atmospheric-pressure drain and the remaining taps are plugged.

No repairs should be made to the pump in the field.

(3A) DUAL FUEL PUMP.—The engine driven gear type dual fuel pump incorporates emergency system gears and main pump gears. The two sets of gears are driven by concentric shafts with the shear section on each shaft located so that should foreign material lodge in either pump, the gear section of the pump can fail without interfering with the operation of the alternate pump.

*(a)* REMOVAL OF DUAL FUEL PUMP.

*1.* Disconnect all fuel lines from pump.

*2.* Disconnect fuel pump drain line.

*3.* Disconnect quick-disconnect electrical lead from pump.

*4.* Disconnect oil lines from oil filter.

*5.* Remove accessory case vent line from oil filter mounting bracket.

*6.* Remove emergency fuel filter from oil filter mounting bracket.

*7.* Remove two upper pump mounting nuts, and remove oil filter bracket from studs.

8. Remove two lower pump mounting nuts, and remove electrical lead bracket and dual fuel pump.

(b) INSPECTION OF DUAL FUEL PUMP.—To determine the serviceability of the dual fuel pump male drive spline and mating female drive spline, proceed as follows:

*1.* Remove fuel pump.

*2.* Remove felt plug from drive shaft recess using a bent end scribe. Immerse plug in a suitable cleaning solvent and thoroughly clean.

*3.* Thoroughly clean external and internal drive splines using Stoddard solvent and a stiff brush.

*4.* Place 0.010-inch feeler gage against worn flank of male drive spline. If wear is greater than 0.010-inch, replace fuel pump with a serviceable unit.

*5.* Gage internal spline for wear using Allison Tool No. 3696. If tool spline enters shaft up to shoulder on tool, reject engine to minor engine repair for shaft replacement.

*6.* If above procedure indicates male and female splines are within tolerance, impregnate felt oiler plug with high temperature lubricant and aintiseize compound, stock No. 7500-435200, and reinstall plug.

(c) INSTALLATION OF DUAL FUEL PUMP. Reverse removal procedure.

**Note**

See Section IX for torque values of nuts and fittings.

Lubricate pump splines with molykote silicone, stock No. 7500-435200.

(4) FUEL CHECK VALVE.—The check valve is a spring-loaded, ball-type valve which is attached to the discharge port of the emergency fuel pump. Its function is to prevent reverse flow of high-pressure fuel through the emergency pump during normal operation. It closes when the speed of the rotor is sufficient to allow the main fuel pump to supply the necessary fuel for combustion. The rated flow of the check valve, when open, is 3.5 gallons per minute.

(5) RESTRICTOR CHECK VALVE (Later Airplanes). *(See figure 100.)*—This is an orifice type check valve having two No. 70 holes drilled through the poppet to allow restricted flow from the main system to the unloading valve in the unloaded condition, and full flow from the unloading valve to the main system when in the loaded condition. The orifices are protected from becoming plugged by any foreign particles present in the fuel by a fine-mesh screen.

(6) BAROMETRIC FUEL CONTROL.— The barometric fuel control is a pressure-regulating valve which automatically provides the control valve with sufficient fuel to maintain constant speed as altitude changes. It is mounted on a bracket in the lower center section of the accessory gear casing at the front of the engine.

(7) GOVERNOR.

*(a)* DESCRIPTION.—The governor is a bypass valve, controlled by centrifugal flyball weights, which acts to prevent overspeed of the engine in excess of 11,500 rpm. At this speed the governor rotates at approximately 3400 rpm. Centrifugal force causes a weight-and-spring assembly to fly outward and contract vertically. In contracting, the spring contacts a spring-loaded spindle which operates a linkage mechanism controlling the bypass valve. The governor is mounted on the accessory gear casing at the front of the engine between the main fuel pump and the starting fuel pump. It rotates counterclockwise, viewed from the front of the engine.

*(b)* OPERATION. — At engine speed under 11,500 rpm, the only discharge from the governor is a slight leakage from the outlet port. At speeds over 11,500 rpm, fuel enters the governor through the inlet port, passes through the rotating plug-type valve, and out the discharge port. That portion of the fuel under pressure which is required to actuate the power-piston mechanism is bled from the inlet port and passes through a strainer to the pilot valve.

Two seals are used in this governor. A cup seal on the linkage shaft prevents excessive leakage from the drained side of the valve housing into the weight-and-spring casing. The weight-and-spring casing is drained to the atmosphere by a ⅛-inch tubing connection, so that it runs empty. The seal on the splined shaft prevents fuel from entering the gear case.

*(c)* INSPECTION AND RESERVICING.

*1.* Remove the oil level plug from the side of the governor weight chamber. The oil level should be flush with the bottom of the hole from which the plug was removed.

*2.* If the oil level is above the oil level hole so that excessive amount of oil runs out of the hole, check for dilution caused by fuel leakage. If there is fuel in the weight chamber of the governor, it is possible that the fuel pump seal is leaking or that the governor drain line is plugged, since the fuel pump and governor are connected to a common drain line. If this drain line becomes plugged or is overloaded by excessive fuel leakage, fuel will back up into the front compartment of the governor to a level above the governor spindle. The oil can then seep through the spindle bushing into the rear chamber of the governor.

3. If the oil in the governor is contaminated or if the type of oil in the assembly is questionable, remove the drain plug in the bottom of the weight chamber and thoroughly flush the chamber. Replace the plug and refill the chamber with oil, Specification No. AN-0-9, Grade 1010.

4. If the oil is below the proper level, remove the plug from the top of the governor weight chamber and refill with clean oil, Specification No. AN-0-9, Grade 1010, until the oil begins to run out of the oil level hole in the side of the weight chamber.

5. Reinstall plugs and then lock wire and seal.

*(d)* ADJUSTMENT. — The adjustment screw, located under the top lug on the side of the governor, is used to establish maximum speed for the engine. One turn of the adjusting screw is equal to a change of 300 rpm in speed. Turning the adjusting screw clockwise reduces speed. Adjustments should be made when the maximum engine speed is below 10,000 rpm. Adjustments made over 10,000 rpm may cause overspeed.

(8) FUEL CONTROL VALVE (F-80A-1 Airplanes).—The control valve is a manually operated, restrictive type valve which controls the amount of fuel being passed to the engine. The valve contains two elements, a stopcock and a throttle, enclosed in a single casing. These elements control the fuel supply during the starting procedure, provide speed control while the engine is in operation, and act as a final seal for the fuel system when the engine is shut down. The control valve is mounted on the accessory gear casing at the front of the engine.

(9) FUEL CONTROL VALVE (F-80A-5 and RF-80A-5 airplanes.) — The control valve on F-80A-5 and RF-80A-5 airplanes is similar to the valve used on F-80A-1 airplanes, except that a single valve is used to perform the functions of the throttle valve and the stopcock valve. This eliminates the separate stopcock lever used on earlier airplanes.

(10) DRIP VALVE.—The drip valve is a spring-loaded, ball-type valve. Its purpose is to drain the fuel manifold of all fuel when fuel pressure within the manifold falls below 5 psi gage pressure. This action relieves pressure in the fuel nozzles before combustion ceases when the engine is stopped. Thus it prevents carbonization of the nozzles and prevents fuel from entering the combustion chambers. The valve is connected to the lower part of the fuel manifold in alignment with combustion chamber No. 8. The connections to the drip valve are fuel supply, drainage, and gage pressure. The drain line dumps into the atmosphere.

(11) COMBUSTION CHAMBER DRAIN VALVE. The combustion chamber drain valve is a spring-loaded, ball-type valve used to drain the combustion chambers of any unburned fuel. It is located under the adapter for combustion chamber No. 8. The valve is connected to a drain manifold which, in turn, is connected to the seven lowest combustion chambers, namely Nos. 5 to 11 inclusive. The upper combustion chambers drain internally to combustion chambers Nos. 5 and 11. The valve is designed to open and allow fuel to drain into the atmosphere when fuel pressure within the combustion chamber falls below 2 psi gage pressure. When raw fuel collects in the air adapters during a false start, or when the engine is stopped, it must be drained before another start is attempted. The chamber-drain manifold and combustion chamber drain valve automatically perform this draining function, thereby preventing a "hot start."

(12) EMERGENCY FUEL SYSTEM CHECK.

*(a)* Set engine speed at 55 percent while operating on the main fuel system.

*(b)* Place starting fuel system switch in "OFF."

*(c)* Place emergency fuel selection switch in "TAKE-OFF AND LANDING."

## WARNING

Operation should not be transferred to the emergency system.

*(d)* Turn emergency fuel selection switch to "OFF."

*(e)* Place emergency fuel check switch in "EMERGENCY CHECK." If cycling occurs, turn airplane boost pumps "OFF."

**Note**

Moving to "EMERGENCY CHECK" position energizes wires "B" and "D," arming the emergency fuel pressure switch and "dumping" the main side of the dual pump. The resulting drop in main system pressure is sensed by the pressure switch which completes the circuit to the emergency control. Engine speed may drop momentarily and then return to a speed near the original setting. However, there is no limit on allowable engine speed drop-off. The maximum engine speed while operating on the emergency fuel system is less than that available from the main fuel system with the same cockpit throttle setting at compressor inlet temperatures below 37.8°C (100°F). This characteristic is necessary because the emergency fuel control does not incorporate a temperature compensating feature nor a governor sensitive to engine speed.

*(f)* Switch engine back to the main system.

**Note**

This switch-back may be made at any speed provided the throttle opening is quickly reduced at the instant of throwing the emergency fuel check switch to "OFF."

*(g)* Turn airplane boost pumps "ON" if they were previously turned "OFF."

*(h)* Advance throttle to the desired speed. The change-over from the emergency to main system may result in a momentary overspeed accompanied by a noticeable "rumble." Switching back from speed between 68 to 77 percent (8000–9000 rpm) will result in less "rumble."

*(i)* If flameout occurs when the emergency check switch is turned "ON" at the specified rpm, repeat the above procedure using a different engine speed until the satisfactory change-over is accomplished.

**Note**

A satisfactory change-over at any speed demonstrates that the pressure switch and associated components are performing satisfactorily. When a satisfactory change-over cannot be accomplished regardless of the engine speed, it is apparent that some malfunction of the pressure switch or other related component has occurred and that corrective action must be taken.

## 13A. FLUID INJECTION AND FUEL DE-ICING SYSTEMS.

*(See figure 123A.)*

*a.* DESCRIPTION OF FLUID INJECTION SYSTEM.—The fluid injection system comprises two tanks, a ground-test shut-off valve for each tank, a drain valve, pump, shut-off valve and strainer, manifold, nozzles, pressure transmitter, restrictor check valve, and an air shut-off valve actuator. A fluid injection system shut-off valve is installed in the pressure line between the pump and engine.

Fluid injection is used to increase the engine thrust output by approximately 20% for short runway take-offs, emergencies during extreme warm weather, and for short duration of flight or climb.

Fluid used in fluid injection system must be clear and free of impurities. Drinking water may be undesirable for use because it may have a high concentration of dissolved minerals. These minerals will result in deposits of scale on engine internal parts and solenoid valves, and so reduce engine efficiency.

Water having a total solids concentration of not more than 50 parts per million is suitable for use in fluid injection system. Such water may be obtained by distillation or by chemical de-mineralization. Zeolite-softened water will not be satisfactory if the original concentration of hardness was high. Information on the analysis of water may be obtained from local water works officials, public health offices, or educational institutions.

If analysis of local water supply cannot be obtained from these sources, a one-pint sample of the water in a clean glass container, rinsed with water from the same source as the sample, should be forwarded to the Air Materiel Command.

For operation at ambient air temperatures of 0° C (32° F) and above, mix alcohol, Specification MIL-A-6091, with water in the proportion of 33⅓ percent (by volume) alcohol and 66⅔ percent water.

At ambient air temperatures of 0° C (32° F) and below, fluid injection should not be used and the system should be prepared for fuel de-icing. (See paragraph 13A *a*C.)

Prior to use of the water-alcohol injection system, the fuel filter de-icing system will be rendered inoperative as follows:

(1) Disconnect the filter de-icing supply line at the fitting installed in the low-pressure fuel filter inlet port.

(2) Cap the tee with cap, Part No. AN929D-4, and plug the line with plug, Part No. AN806-4D.

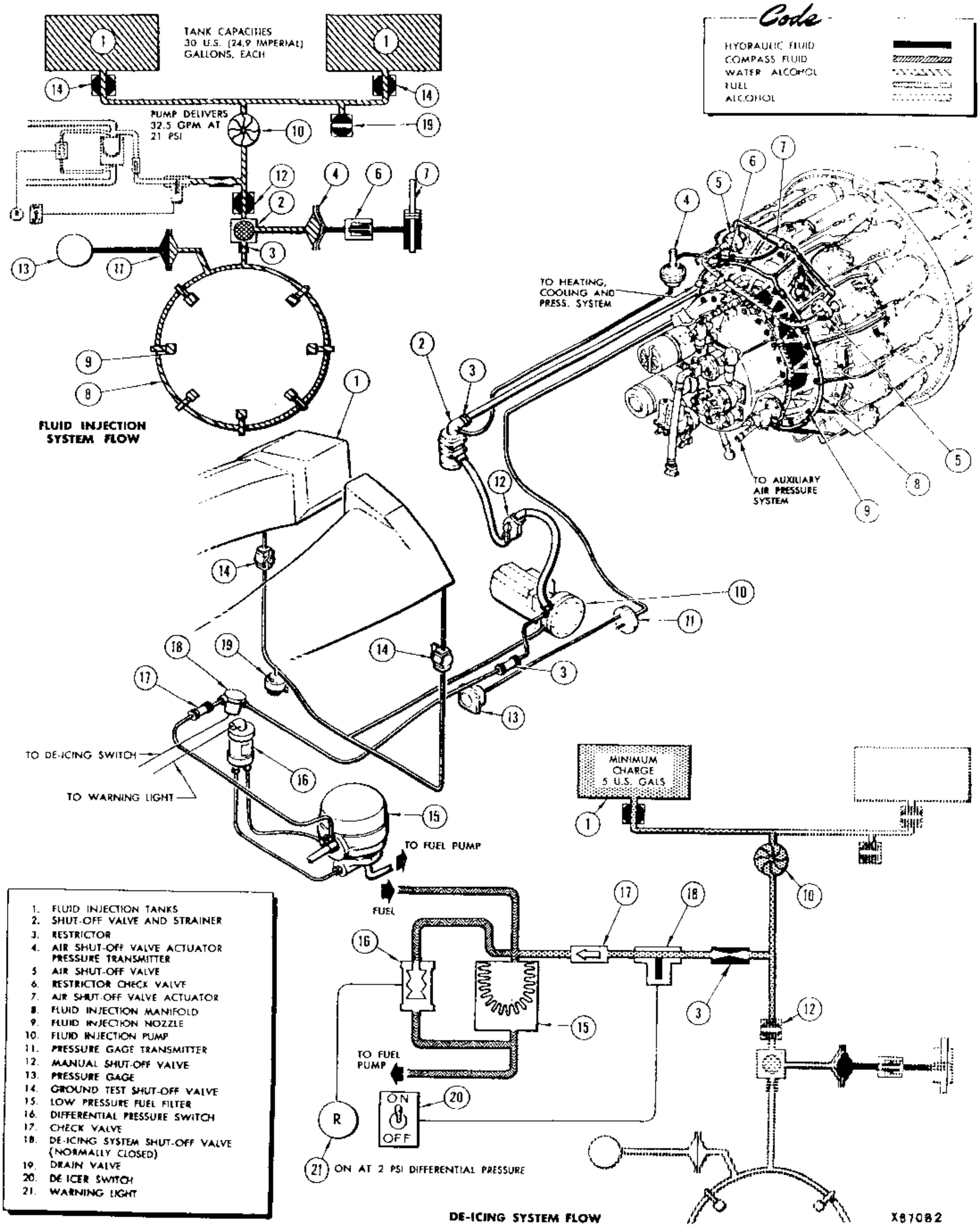
(3) Install placard adjacent to the fuel filter de-icing system switch in the cockpit to indicate that the system is inoperative.

*a*A. DESCRIPTION OF FUEL DE-ICING SYSTEM.—The fuel de-icing system is composed of a restrictor, check valve, solenoid shut-off valve, and a pressure sensing switch. The system uses the right fluid injection tank for storage of the de-icing fluid, and the fluid injection pump for supplying system pressure. Fuel de-icing is used to prevent bypassing of unfiltered fuel through the low-pressure fuel filter resulting from ice crystal formation on the filter element.

Fluid used in the de-icing system is 100% specially denatured alcohol, Specification MIL-A-6091.

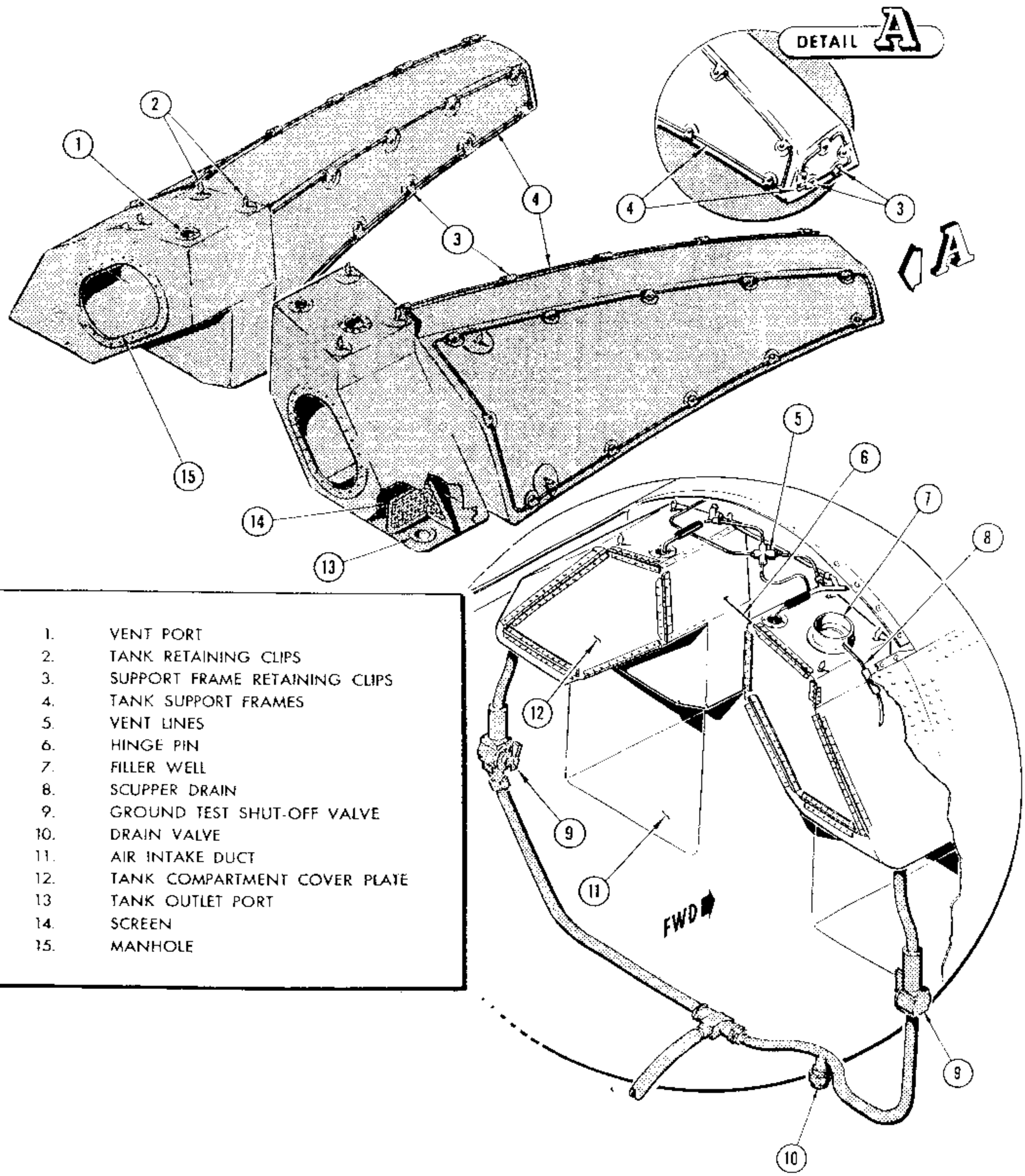
### WARNING

Alcohol, Specification MIL-A-6091, is poisonous and should not be used internally.




1. FLUID INJECTION TANKS
2. SHUT-OFF VALVE AND STRAINER
3. RESTRICTOR
4. AIR SHUT-OFF VALVE ACTUATOR PRESSURE TRANSMITTER
5. AIR SHUT-OFF VALVE
6. RESTRICTOR CHECK VALVE
7. AIR SHUT-OFF VALVE ACTUATOR
8. FLUID INJECTION MANIFOLD
9. FLUID INJECTION NOZZLE
10. FLUID INJECTION PUMP
11. PRESSURE GAGE TRANSMITTER
12. MANUAL SHUT-OFF VALVE
13. PRESSURE GAGE
14. GROUND TEST SHUT-OFF VALVE
15. LOW PRESSURE FUEL FILTER
16. DIFFERENTIAL PRESSURE SWITCH
17. CHECK VALVE
18. DE-ICING SYSTEM SHUT-OFF VALVE (NORMALLY CLOSED)
19. DRAIN VALVE
20. DE ICER SWITCH
21. WARNING LIGHT

*Figure 123A — Fluid Injection and Fuel De-icing Systems Diagram*




1. VENT PORT
2. TANK RETAINING CLIPS
3. SUPPORT FRAME RETAINING CLIPS
4. TANK SUPPORT FRAMES
5. VENT LINES
6. HINGE PIN
7. FILLER WELL
8. SCUPPER DRAIN
9. GROUND TEST SHUT-OFF VALVE
10. DRAIN VALVE
11. AIR INTAKE DUCT
12. TANK COMPARTMENT COVER PLATE
13. TANK OUTLET PORT
14. SCREEN
15. MANHOLE

*Figure 123B — Fluid Injection Tanks*

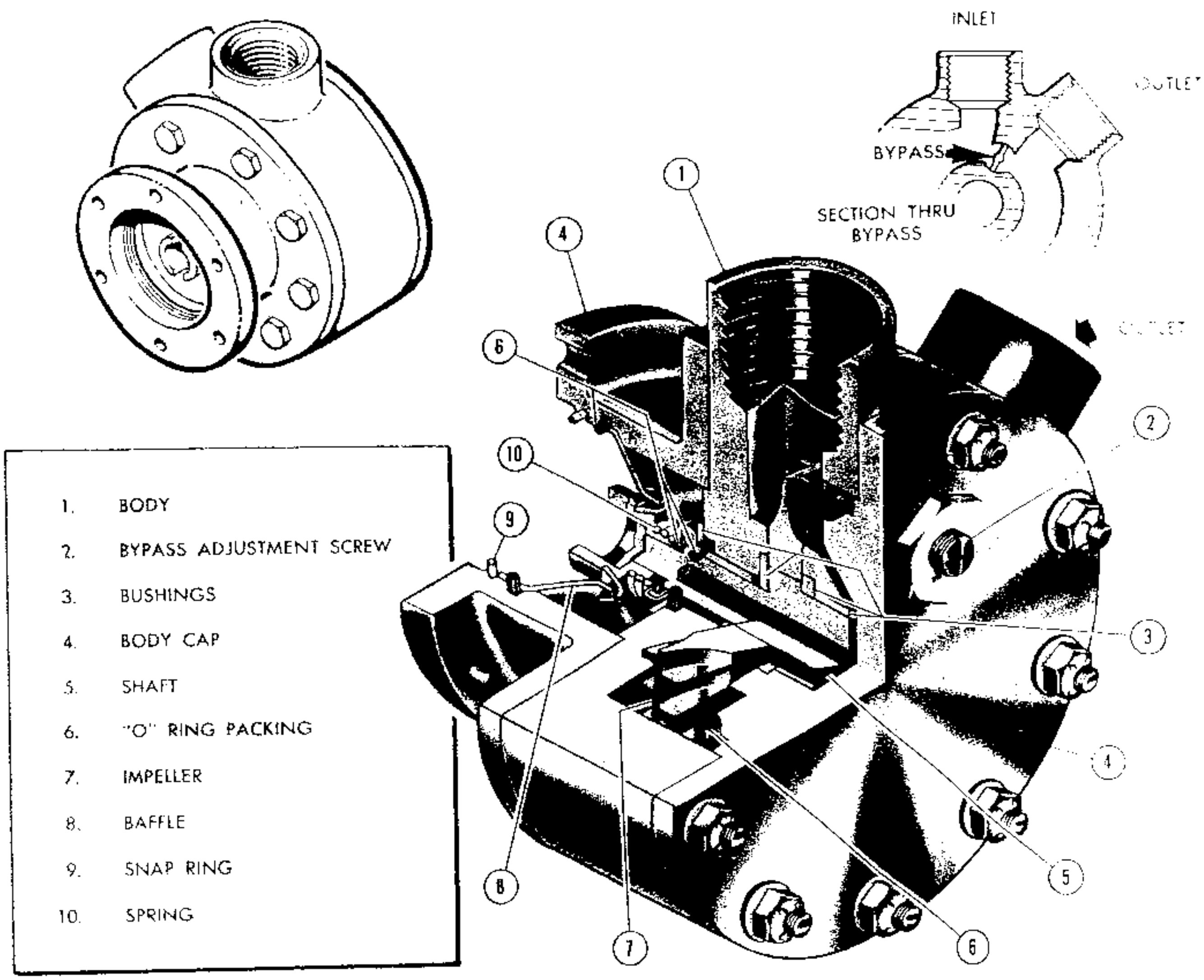



*Figure 123C — Fluid Injection Pump*

The pump and motor assembly is shock mounted to the right side of the fuselage between stations 252 and 263.

(2) REMOVAL OF FLUID INJECTION PUMP.

*(a)* Close both ground test shut-off valves.

*(b)* Disconnect fluid lines at pump.

*(c)* Disconnect pump drain line.

*(d)* Disconnect electrical lead from pump motor.

*(e)* Remove four bolts holding pump and motor assembly to the mounting bracket, or remove four bolts holding assembly and mounting bracket to the shock mount.

(3) INSTALLATION. — Reverse removal procedure. Before mounting a pump to a motor assembly, rotate the pump shaft by hand to ensure that it is free to move without binding.

*f.* FLUID INJECTION SHUT-OFF VALVE AND STRAINER. *(See figure 123D.)*

(1) DESCRIPTION. — The shut-off valve and strainer unit is located on the right side of the fuselage aft of station 238. Fluid pressure acting on a diaphragm opens the valve at 30 to 35 psi. The valve reseats at a minimum pressure of 3 psi. The fluid is strained prior to being released to the engine.

(2) REMOVAL.

*(a)* Close both ground test shut-off valves.

*(b)* Drain shut-off valve and strainer through drain cock at base of unit.

*(c)* Disconnect two fluid lines from shut-off valve and strainer.

*(d)* Remove four bolts holding unit in place, and lift it inboard to remove it.

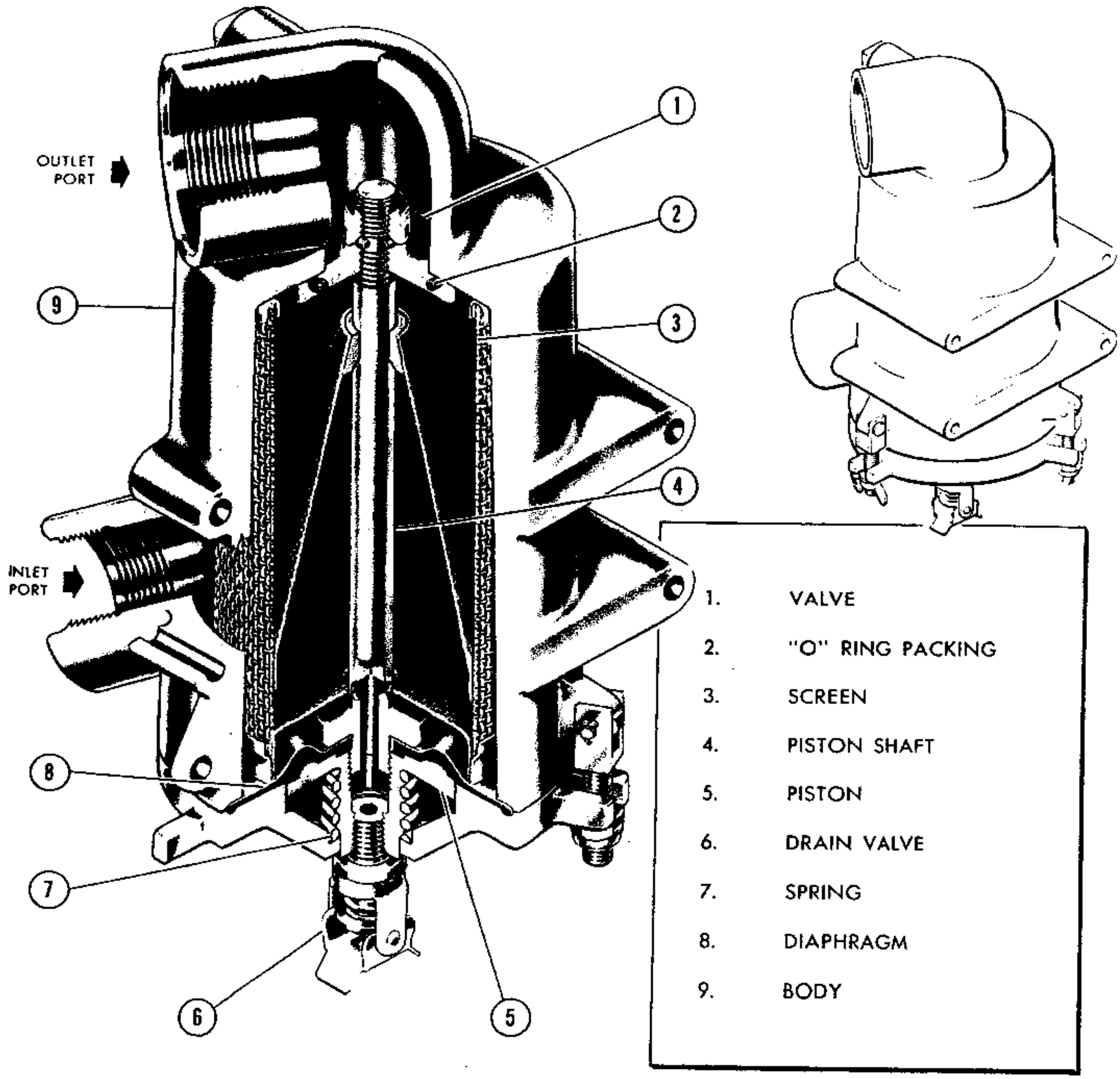



*Figure 123D — Fluid Injection Shut-off Valve and Strainer*

*g.* FLUID INJECTION MANIFOLD.

(1) DESCRIPTION.—The fluid injection manifold is made up of seven sections of aluminum alloy tubing. Each section has provisions for the installation of four nozzles. Two nozzles are on the manifold ring, and the other two are on ends of individual tubes projecting aft from the manifold. The manifold ring is located over the forward air intake screen with the individual tubes and their nozzles located over the aft air intake screen.

(2) REMOVAL.

*(a)* Disconnect fluid inlet line from manifold.

*(b)* Disconnect fluid injection pressure line.

*(c)* Disconnect each section of manifold from its adjacent section.

*(d)* Remove manifold retaining clips, and remove the sections of manifold.

*h.* FLUID INJECTION NOZZLES.—The fluid injection system uses 28 nozzles to distribute the system fluid. Each nozzle is made of corrosion-resistant steel, and is screwed into a fitting on the manifold.

*i.* FLUID INJECTION PRESSURE TRANSMITTER. *(See figure 123E.)*

(1) DESCRIPTION.—The fluid injection pressure transmitter is located on the right side of the engine just forward of the fluid injection manifold. The pressure transmitter is used to send fluid injection system pressure into the air shut-off valve actuator. The lower side of the transmitter contains the water-alcohol mixture, while the portion of the transmitter nearest the air shut-off valve actuator contains hydraulic fluid.

(2) REMOVAL.

*(a)* Drain hydraulic fluid and water-alcohol mixture from pressure transmitter.

*(b)* Disconnect lines to pressure transmitter.

*(c)* Remove retaining clips from either end of transmitter, and remove transmitter.

*j.* RESTRICTOR CHECK VALVE.

(1) DESCRIPTION.—The restrictor check valve is located in the hydraulic line between the fluid injection pressure transmitter and the air shut-off valve actuator. The purpose of the valve is to retard the opening of the air shut-off valves when the fluid injection pressure is cut off.

(2) REMOVAL.

*(a)* Drain hydraulic line between fluid injection pressure transmitter and air shut-off valve actuator.

*(b)* Disconnect lines at both ends of valve.

*k.* AIR SHUT-OFF VALVE ACTUATOR. *(See figure 123F.)*

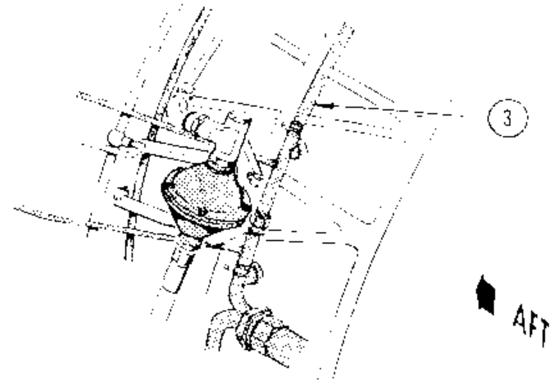
(1) DESCRIPTION.—The air shut-off valve actuator is located at the top and just forward of the engine compressor casing. The unit is actuated by hydraulic pressure and is returned to its original position by a spring.

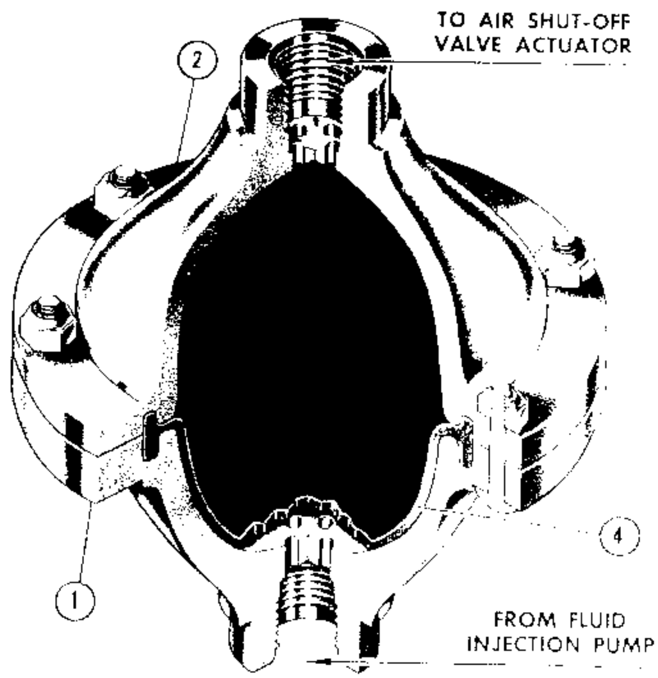
(2) REMOVAL.

*(a)* Drain and disconnect hydraulic line at actuator.

*(b)* Disconnect shut-off valve arms at disconnects on air shut-off valve actuator.

*(c)* Remove bolts holding unit to mounting bracket.




| | |
|---|---|
| 1. | LOWER BODY |
| 2. | UPPER BODY |
| 3. | FLUID INJECTION MANIFOLD |
| 4. | DIAPHRAGM |

*Figure 123E — Fluid Injection Pressure Transmitter*

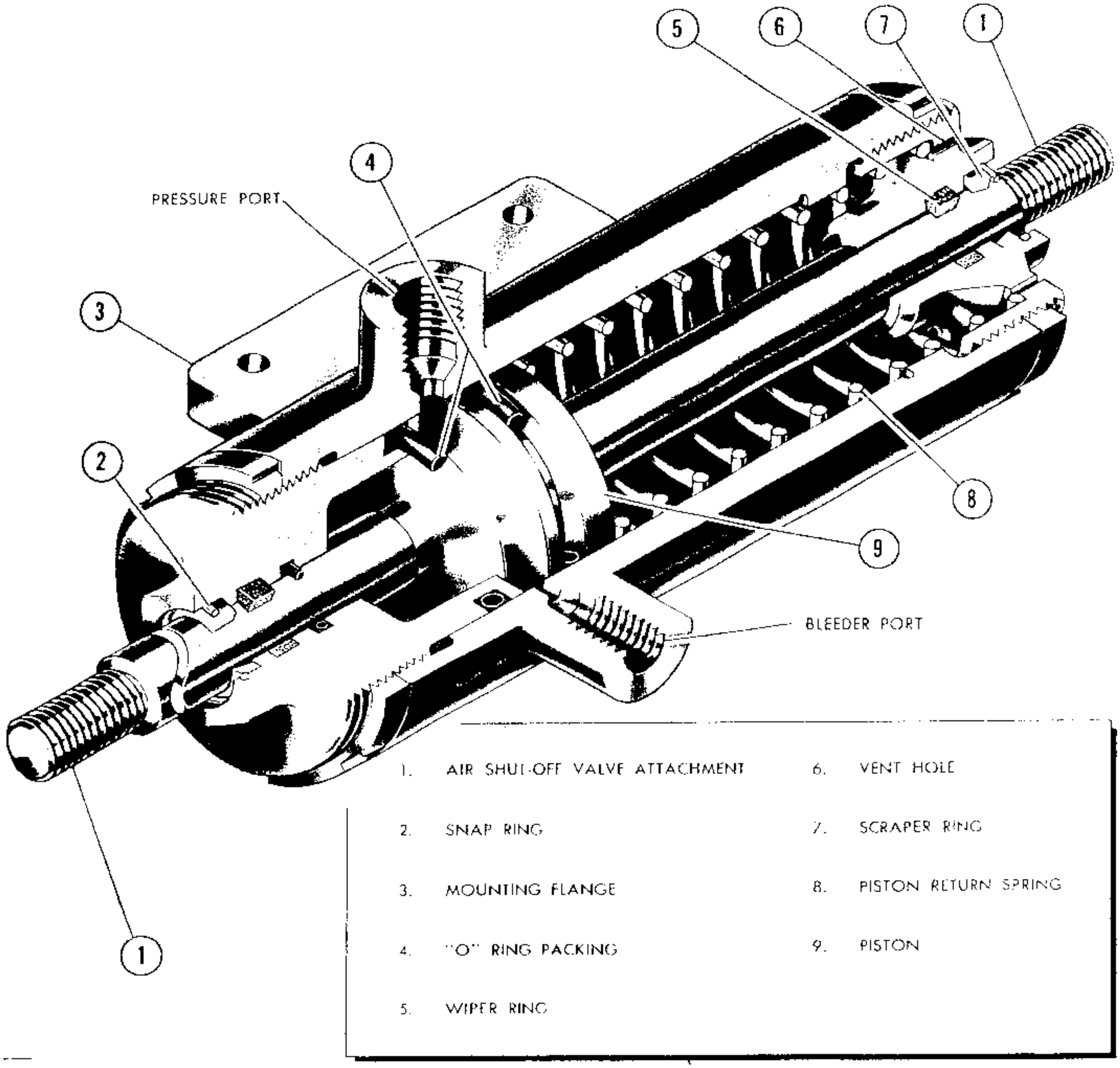



*Figure 123F — Air Shut-off Valve Actuator* *l.* FUEL DE-ICING RESTRICTOR.—A restrictor incorporating a 0.059-inch orifice is installed in the fuel de-icing system pressure line between the pump and the fuel system micronic filter to decrease pump flow to approximately 30 to 45 gallons per hour. The restrictor is just forward of the fluid injection pump.

*m.* FUEL DE-ICING SHUT-OFF VALVE.—A normally closed solenoid-operated shut-off valve is mounted adjacent to the forward face of the wing rear beam, outboard of wing station 32 in the right wheel well. The valve is controlled by the fuel de-icing momentary contact switch in the cockpit.

**Note**

The fuel de-icing shutoff valve is installed with the outlet and inlet ports reversed. De-icing fluid enters the outlet port of the valve and passes out through the inlet port (T.O. No. 1F-80-78).

*n.* FUEL DE-ICING PRESSURE SWITCH.

(1) DESCRIPTION. — The fuel de-icing pressure switch is mounted on the forward face of the wing rear beam in the right wheel well. The switch is normally open, and closes at a differential pressure of 2 ($\pm$0.25) psi. The high-pressure sensing side of the switch is connected to the upstream side of the fuel filter and the low pressure sensing side to the downstream side of the fuel filter. Closing of the pressure switch illuminates the red fuel de-icing warning light in the cockpit.

(2) REMOVAL.

*(a)* Disconnect electrical leads at receptacle.

*(b)* Disconnect and cap high- and low-pressure sensing lines at switch.

*(c)* Remove four bolts holding switch to mounting bracket, and remove switch.

## 13B. JATO SYSTEM.

*a.* DESCRIPTION. — All F-80A-10 and RF-80A-10 airplanes incorporate provisions for the use of two jet-assisted take-off (jato) units. These consist of two sets of jato unit support hooks and release mechanisms, and an ignition system. The hooks are located on the underside of the fuselage, just aft of the dive flaps. The cable-operated release mechanism is connected to a control handle below the engine control lever in the cockpit. The ignition system circuit is described in paragraph 17*dd*, of this section.

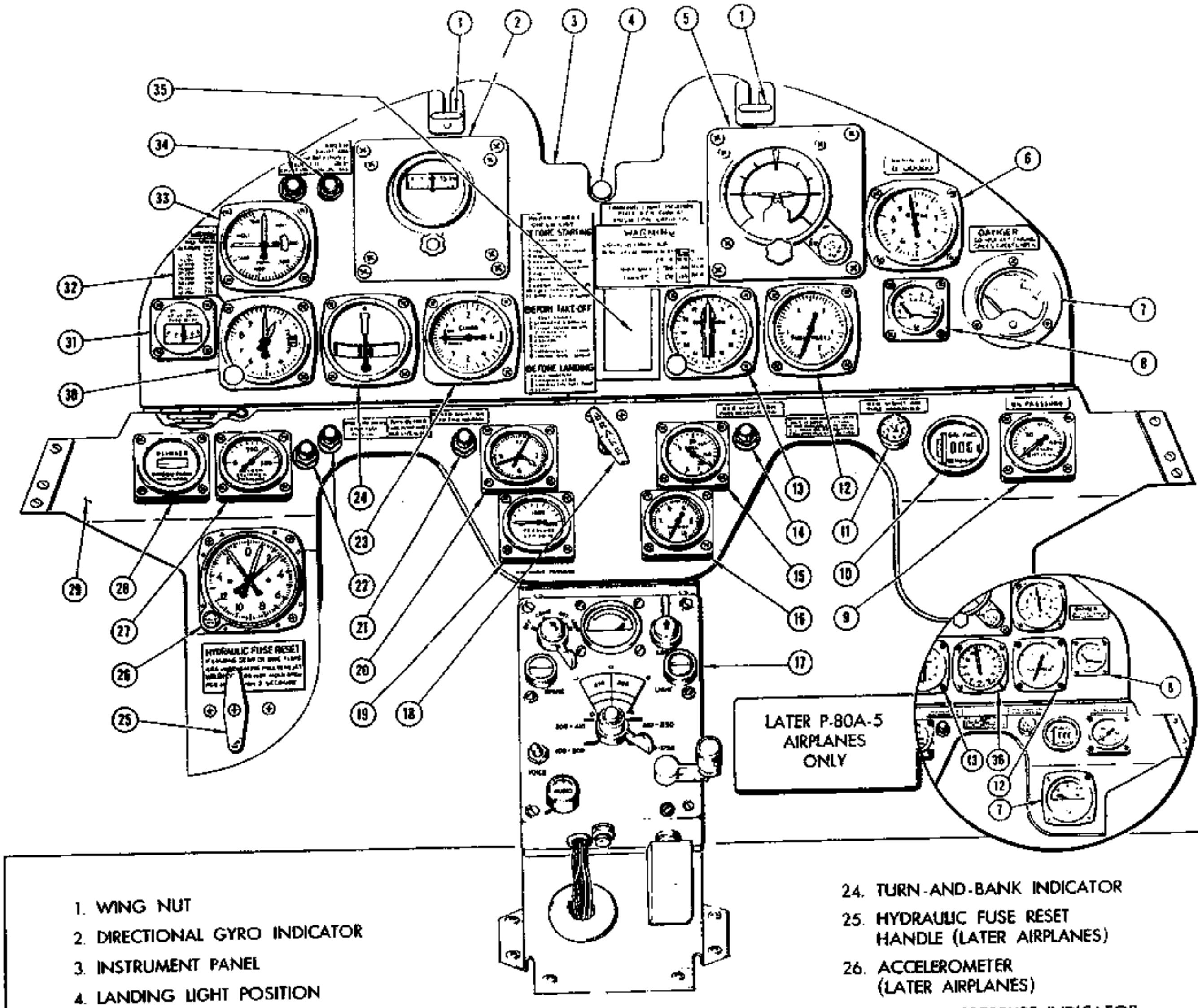
*b.* REMOVAL OF JATO UNITS.

**WARNING**

Do not release units by using cockpit jettison handle, as this will drop both units simultaneously.

(1) Disconnect electrical line to unit.

(2) Support jato units and trip each jettison latch from inside engine compartment. Carefully lower each unit from the airplane.




1. WING NUT
2. DIRECTIONAL GYRO INDICATOR
3. INSTRUMENT PANEL
4. LANDING LIGHT POSITION CONTROL
5. GYRO HORIZON INDICATOR
6. TACHOMETER INDICATOR
7. E-1, G-1, OR J-1 AMMETER
8. TAIL PIPE TEMPERATURE INDICATOR
9. OIL PRESSURE INDICATOR
10. FUEL COUNTER
11. FIRE WARNING LIGHT
12. FUEL PRESSURE INDICATOR
13. REMOTE COMPASS INDICATOR
14. FUEL QUANTITY WARNING LIGHT
15. FUEL QUANTITY INDICATOR
16. INSTRUMENT AIR PRESSURE INDICATOR
17. RADIO COMPASS REMOTE CONTROL BOX (LATER P-80A-5 AIRPLANES ONLY)
18. PARKING BRAKE HANDLE
19. HYDRAULIC PRESSURE INDICATOR
20. CLOCK
21. ELEVATOR TAB NEUTRAL LIGHT
22. EMERGENCY FUEL PUMP WARNING LIGHTS
23. RATE-OF-CLIMB INDICATOR
24. TURN-AND-BANK INDICATOR
25. HYDRAULIC FUSE RESET HANDLE (LATER AIRPLANES)
26. ACCELEROMETER (LATER AIRPLANES)
27. OXYGEN PRESSURE INDICATOR
28. OXYGEN FLOW INDICATOR
29. INSTRUMENT SUB-PANEL
30. ALTIMETER
31. STANDBY COMPASS
32. SPEED WARNING PLACARD (USED ONLY WHEN F-2 AIRSPEED INDICATOR IS INSTALLED)
33. F-2 OR F-4 AIRSPEED INDICATOR
34. ALIGHTING GEAR WARNING LIGHTS (ON EARLY AIRPLANES, LIGHTS ARE ON SUB-PANEL)
35. COMPASS CARD HOLDER
36. RADIO COMPASS INDICATOR (LATER P-80A-5 AIRPLANES ONLY)

*Figure 124 — P-80A-1 and P-80A-5 Instrument Panel*

## 14. INSTRUMENTS.

*a.* INSTRUMENT PANEL.
*(See figures 124 and 125.)*

(1) DESCRIPTION.—The instrument panel consists of two separate panel assemblies. The upper or main instrument panel is attached to the structure by five vibration absorbing mounts. To facilitate instrument maintenance, the bottom of the panel is hinged to three vibration absorbing mounts, and the top is supported from two vibration absorbing mounts by rod assemblies containing spring-loaded wing nuts. A quarter turn of the wing nuts allows the panel to swing outward to a point where it is held by a safety chain.

The sub-panel, immediately below the main instrument panel, is bolted to the airplane structure. On later fighter airplanes, a radio compass remote control box is located below the sub-panel.

In the photographic airplanes, main and sub-panel assemblies are basically the same as in the fighter airplanes. In addition, a section has been attached below the center part of the sub-panel. Below the added section, the radio compass remote control box completely fills the space down to the cockpit floor. Instruments are principally the same as in the fighter airplanes.

Instead of a gun sight and bracket, the photographic airplanes have a camera control box mounted at the top of the instrument panel just below the windshield. Three camera intervalometers are on the instrument panel just below the camera control box. An inclinometer is mounted on the cockpit structure above the forward end of the left-hand shelf. For information on the camera control box and the intervalometers, see paragraph 17*bb*(20), this section. For information on the radio compass remote control, see paragraph 18*d*, this section.

Winterized P-80A-10 airplanes have a bomb or drop tank jettison switch mounted on the panel between the hydraulic pressure and instrument air pressure indicators.

(2) REMOVAL.

*(a)* MAIN INSTRUMENT PANEL.

*1.* Turn wing nuts at top of panel on each side of gun-sight mounting, and allow panel to swing outward.

*2.* Disconnect electrical or plumbing connections of all instruments.

*3.* Disconnect bonding between main panel and sub-panel, behind the rear bearing temperature indicator.

*4.* Disconnect safety chain from left side of panel.

*5.* Remove hinge pins, and lift out panel.

*(b)* INSTRUMENT SUB-PANEL.

*1.* Disconnect electrical or plumbing connections of all instruments.

*2.* Disconnect parking brake at back side of panel.

*3.* On P-80A-5 and FP-80A-5 airplanes, disconnect hydrofuse reset handle.

*4.* On airplanes having a radio compass remote-control box, detach support from sub-panel.

*5.* Remove cockpit trim panels Nos. 2 and 7. (See figure 248.)

*6.* Remove three bolts at each end, and four bolts at center of panel. Lift out panel.

*b.* INSTRUMENTS.—The following instruments are installed in the airplane. Any instrument may be removed without disturbing adjacent instruments.

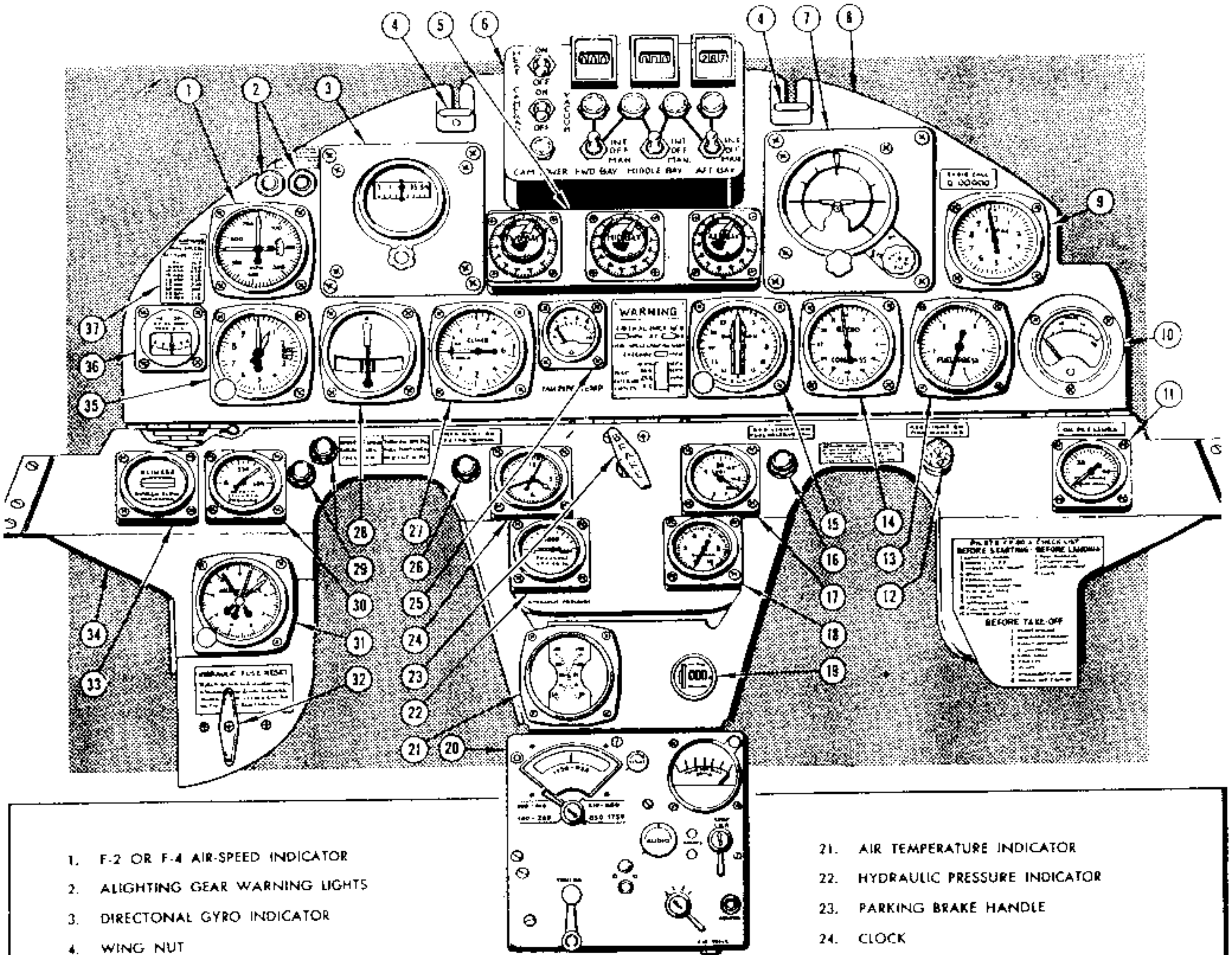
(1) AIR PRESSURE INDICATOR.

*(a)* DESCRIPTION.—The AN5771-5A is a differential suction gage but is used as a pressure gage by reversing the connections to the instrument. Thus, the gage indicates the air pressure being delivered to the gyroscopic instruments from the engine compressor through the instrument pressure regulator. The instrument has a range of from zero to 10 in. Hg. No lubrication is required in service.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Excessive error at zero. | Loose pointer. | Reset pointer and calibrate gage. |
| | Excessive overpressure. | Reset pointer and calibrate gage. |
| | Seasoning of diaphragm. | Reset pointer and calibrate gage. |
| Excessive scale error. | Improper calibration. | Adjust and calibrate. |
| Excessive pointer oscillation. | Faulty relief valve. | Repair or replace relief valve. |

(2) ACCELEROMETER.—A type B-3 (AN5745-2) accelerometer is in the lower left side of the instrument panel (T.O. 01-75FJA-2N-1). Three pointers move concentrically on the face of the instrument, showing accelerations on a common scale. The outer or main pointer records instantaneous acceleration, the middle pointer positive acceleration, and the one nearest the dial negative acceleration. Until reset, the middle and inner pointers indicate and remain at the maximum positive or negative reading for any particular maneuver.



1. F-2 OR F-4 AIR-SPEED INDICATOR
2. ALIGHTING GEAR WARNING LIGHTS
3. DIRECTONAL GYRO INDICATOR
4. WING NUT
5. INTERVALOMETERS
6. CAMERA CONTROL BOX
7. GYRO HORIZON INDICATOR
8. INSTRUMENT PANEL
9. TACHOMETER INDICATOR
10. G-1 OR J-1 AMMETER ★
11. OIL PRESSURE INDICATOR
12. FIRE WARNING LIGHT
13. FUEL PRESSURE INDICATOR
14. RADIO COMPASS INDICATOR
15. REMOTE COMPASS INDICATOR
16. FUEL QUANTITY WARNING LIGHT
17. FUEL QUANTITY INDICATOR
18. INSTRUMENT AIR PRESSURE INDICATOR
19. FUEL COUNTER
20. RADIO COMPASS REMOTE CONTROL BOX
21. AIR TEMPERATURE INDICATOR
22. HYDRAULIC PRESSURE INDICATOR
23. PARKING BRAKE HANDLE
24. CLOCK
25. TAIL PIPE TEMPERATURE INDICATOR ★
26. ELEVATOR TAB NEUTRAL LIGHT
27. RATE-OF-CLIMB INDICATOR
28. TURN-AND-BANK INDICATOR
29. EMERGENCY FUEL PUMP WARNING LIGHTS
30. OXYGEN PRESSURE INDICATOR
31. ACCELEROMETER
32. HYDRAULIC FUSE RESET HANDLE
33. OXYGEN FLOW INDICATOR
34. INSTRUMENT SUB-PANEL
35. ALTIMETER
36. STANDBY COMPASS
37. SPEED WARNING PLACARD (USED ONLY WHEN F-2 AIR-SPEED INDICATOR IS USED)

★ON LATER AIRPLANES ITEM 10 IS LOCATED ON SUB-PANEL ADJACENT TO ITEM 11. ITEM 25 IS IN FORMER SPACE OF ITEM 10.

*Figure 125 — FP-80A-5 Instrument Panel*

There is very little maintenance or repair that can be made other than checking the security of the instrument to the panel. If the accelerometer does not function correctly, replace. No lubrication is required in service.

(3) AIR-SPEED INDICATOR.

(*a*) DESCRIPTION.—The airplane is equipped with a type F-4 air-speed indicator having a range of from 50 to 700 mph with 10-mph-unit scale graduations. The indicator shows the speed of the airplane in relation to the body of air in which it is traveling. Static pressure and pitot pressure are transmitted to the indicator through the connections marked "S" and "P" on the rear of the indicator case. The pitot pressure is transmitted to the inside of a capsule diaphragm within the case; the static pressure is transmitted to the inside of the case and acts on the outside of the diaphragm. The diaphragm responds to the difference in pressure, and a linkage transmits the movement of the diaphragm to the indicator dial, which is mounted on the instrument panel.

The air-speed indicator is a Mach number type indicator, containing two concentric pointers and a Mach number dial. One pointer, designated as the maximum speed pointer, is set at the maximum allowable indicated air speed, .80 Mach number on the dial, and the other pointer is for instantaneous reading of the indicated air speed. To keep the airplane within safe operating limits, the instantaneous reading pointer should never be allowed to pass the maximum speed pointer.

(*b*) TROUBLE SHOOTING (F-2 Indicator).

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Pointer does not move. | Pitot pressure connection not connected properly to line from pitot tube. | Check tubing and connections for leaks. |
| | Pitot or static pressure line clogged. | Disconnect pitot and static pressure lines from all instruments. Drain at lowest point of each tube line. Blow through tubing to remove obstructions. |
| | Defective indicator mechanism. | Replace indicator. |
| Inaccurate reading. | Leak in tubing from pitot or static pressure fittings. | Check lines to external fittings for leaks. |
| | Leak in indicator case. | Replace indicator. |
| | Defective indicator. | Replace indicator. |
| Pointer does not set on zero when airplane is on ground. | Defective indicator. | Replace indicator. |
| Pointer oscillates. | Leak in tubing from pitot or static pressure fittings. | Disconnect lines from indicator. Check lines for leaks. |
| | Leak in indicator case. | Replace indicator. |
| | Leak in rate of climb indicator or altimeter installations. | Check lines for leaks. If an instrument is at fault, replace instrument. |

(4) AIR TEMPERATURE INDICATOR (Photographic Airplanes Only).

(*a*) DESCRIPTION.—The air temperature indicator is a dual reading instrument showing outside air temperature and camera compartment air temperature. The dial has dual graduations and indicating hands. Graduations cover a range of —70° C to +150° C. The unit is designed to give readings proportional to variations in the bulb resistance. It is self-compensated and is unaffected by changes in cockpit temperature. No lubrication is required.

For further information, refer to paragraph 17*bb*(6), this section.

(*b*) TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Pointer stays off low end of scale. | Ground on bulb lead. | Repair or replace lead. |
| | Defective bulb. | Replace bulb. |
| | Defective indicator. | Replace indicator. |
| Pointer stays off high end of scale. | Broken or grounded lead. | Repair or replace lead. |
| | Defective bulb. | Replace bulb. |
| | Defective indicator. | Replace indicator. |
| Indicator oscillates intermittently. Excessive pointer oscillation. | Loose or broken battery lead or ground jumper. | Repair, replace, or tighten lead or jumper. |
| | Defective bulb. | Replace bulb. |
| | Defective indicator. | Replace indicator. |
| Obviously incorrect temperature reading. | Defective bulb. | Replace bulb. |
| | Defective indicator. | Replace indicator. |
| Pointer fails to go off scale with current off. | Defective indicator. | Replace indicator. |

(5) ALTIMETERS.

*(a)* DESCRIPTION.—Two altimeters, AN5760-2, are installed in the airplane, one on the instrument panel to indicate airplane altitude, and one on the left side shelf to indicate cabin pressure in terms of altitude. These instruments have ranges of from zero to 50,000 feet, and scale divisions of 20.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Excessive scale error. | Improper calibration adjustment. | Replace instrument. |
| Excessive pointer oscillation. | Defective mechanism. | Replace instrument. |
| High reading. | Improper venting. | Eliminate leak in static pressure system and check alignment of air speed tube. |
| Setting knob binds. | Wrong lubrication or lack of lubrication. | Replace instrument. |
| Setting-knob lock screw loose or missing. | Excessive vibration; careless maintenance. | Tighten screw if loose. Replace instrument if screw is missing. |
| Reference markers fail to move when setting knob is turned. | Out of engagement. | Replace instrument. |
| Cracked or loose cover glass. | Excessive vibration. | Replace instrument. |
| Dull or discolored luminous markings. | Age. | Replace instrument. |
| Barometric scale and reference markers not synchronized. | Slippage in mating parts. | Replace instrument. |
| Barometric scale and reference markers not synchronized with pointers. | Drift in mechanism or careless maintenance. | Reset pointers. |

(6) AMMETER.

*(a)* DESCRIPTION. — The type E-1 ammeter measures currents up to 300 amperes, direct-current. The assembly consists of an indicator, a shunt, and connecting cable.

On some airplanes the type E-1 ammeter is replaced by a type G-1 ammeter. Other airplanes employ a type J-1 ammeter. These units operate as shunted millivoltmeters in connection with separately mounted resistors which serve as shunts. On each unit the scale is calibrated to read directly as load, and is marked from —.1 to +1.25 (—10% to +125%) of the rated load of the generator. In this way, the instruments interpret amperes in percentage of the rated capacity of the generator. These instruments do not require lubrication.

*(b)* TROUBLE SHOOTING.

*1.* E-1 AMMETER.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| No reading, either permanent or intermittent. | Broken lead. | Repair. |
| | Open circuit in indicator. | Replace indicator. |
| Low reading, either permanent or intermittent. | Poor connection at indicator binding posts. | Clean and tighten connections. |
| | Poor connection in indicator. | Replace indicator. |
| | Poor connections at shunt. | Clean and tighten. |
| | Short circuit at shunt. | Repair. |
| | Short circuit in leads. | Repair leads. |
| | Short circuit at indicator binding posts. | Repair. |
| | Zero correction shift. | Readjust. |
| | Friction in moving element of indicator. | Replace indicator. |
| | Battery charge deficient. | Recharge battery; check generator for proper operation. |

*2.* G-1 AND J-1 AMMETERS.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| No reading. | External wiring open. | Test, and repair break. |
| | Bearing friction. | Replace instrument. |
| | Open circuit inside meter. | Replace instrument. |
| High reading. | Resistance shorted inside meter. | Replace instrument. |
| Low reading. | Coil shorted inside meter. | Replace instrument. |

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Pointer sticks. | Friction. | Replace instrument. |
| Pointer off zero. | Button shifted. | Reset to zero. |
| Irregular or jerky action. | Loose external connection. | Test terminals and wiring. Tighten where necessary. |
| Pointer rubs against glass. | Static on glass. | Blot glass with damp cloth. |
| Other defects. | Mechanical. | Replace instrument. |

(7) BEARING TEMPERATURE INDICATOR.—The temperature of the rear bearing on the engine rotor is shown on a type A-2 temperature indicator (some airplanes only). The instrument has a range of from $-50°$ C to $+300°$ C, and is calibrated for use with 8-ohm iron-constantan leads and thermocouple.

(8) CLOCK.

*(a)* DESCRIPTION.—The clock is an eight-day AN5743-1 instrument mounted on the sub-panel. The dial face is graduated in minutes and seconds.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Incorrect time. | Improperly set. | Reset with master clock. |
| Gain or loss of time. | Improperly adjusted. | Adjust or replace instrument. |
| Clock fails to start when wound. | Excessive friction or congealed oil. | Jar lightly; if trouble persists, replace instrument. |
| Winding knob will not turn. | Wound too tight. | Replace instrument. |
| Loose or cracked glass. | Excessive vibration or sudden jar. | Replace glass. |
| Dull or discolored luminus markings. | Age. | Replace instrument. |
| Winding knob turns freely. | Broken main spring. | Replace instrument. |
| Hands do not move when clock is running. | Hands loose on shaft. | Reset and tighten hands. |

(9) DIRECTIONAL GYRO INDICATOR.

*(a)* DESCRIPTION.—The air-driven directional gyro, AN5735-1, has a range of from zero to 360° with scale unit graduations of 5°. The instrument indicates direction of flight in conjunction with the magnetic compass.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Excessive drift in either direction. | Excessive vibration. | Test with vibrometer. If amplitude is more than 0.004 inch, examine shock mountings and note whether connections are pulling on instrument. |
| | Insufficient pressure. | Adjust pressure regulator. If trouble persists, replace instrument. |
| Dial spins continuously in one direction. | Defective mechanism. | Replace instrument. |
| Instrument lacks sensitivity. | Insufficent speed of gyro rotor; dirty filter. | Clean filter and check suction. |

(10) EXHAUST TEMPERATURE INDICATOR. Temperature in the interior of the tail pipe is shown on a type A-1 temperature indicator. The instrument has a range of from 0° to 1000° C, and is calibrated for use with eight-ohm chromel alumel leads and thermocouple.

For information on the electrical circuit, see paragraph 17*r*, this section.

(11) FUEL COUNTER.—A subtracting type fuel counter is electrically connected to a fuel flowmeter. Upon filling the tanks with fuel, the counter is set to the correct number of gallons. As the fuel supply is used, the counter indicates the quantity of fuel remaining in the fuel system.

For information on the electrical circuit, see paragraph 17*g*, this section.

(12) FUEL PRESSURE INDICATOR. The fuel pressure indicator, type C-16, is a direct indicating, differential type pressure gage with a range of from zero to 500 psi.

(13) FUEL QUANTITY INDICATOR. A Liquidometer type, EA-100-17 fuel gage is mounted on the instrument sub-panel. The instrument indicates contents of the fuselage tank only, no gages being installed for the wing tanks. Maintenance includes only such items that do not involve disassembly of units, such as tightening connections to eliminate leaks, or replacement of entire installation.

For information on the electrical circuit, see paragraph 17*g*, this section.

(14) GYRO HORIZON INDICATOR.

*(a)* DESCRIPTION. — The horizon bar of the gyro horizon indicator, type AN5736-1, furnishes a fixed longitudinal and lateral reference for maintaining level flight, by means of an air-driven gyroscope. The instrument has a pitch range of plus or minus 60° and a bank range of 100° right or left.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Sluggish operation. | Insufficient pressure; dirty filter. | Check and adjust pressure. Clean or replace filter. |
| Failure of horizon bar to settle. | Fouled vanes in rotor. Gimbals out of balance. Worn pivots or bearings. | Replace instrument. |
| | Excessive vibration. | Check mounting-panel shock absorbers. Replace if necessary. |
| | Insufficient pressure. | Check and adjust pressure. |
| Horizon bar oscillates or shimmies constantly. | Excessive vibration. | Check mounting-panel shock absorbers. Replace if defective. |
| | Pressure too high. | Check and adjust pressure. |
| | Worn rotor pivots or bearings. | Replace instrument. |
| Horizon bar does not agree with flight attitude. | Instrument out of alignment on panel. | Correct alignment. |
| Horizon bar and banking indicator not perpendicular to each other. | Mechanism out of alignment. | Replace instrument. |
| Instruments fails on bench test. | Defective internal mechanism. | Replace instrument. |

(15) HYDRAULIC PRESSURE INDICATOR.

*(a)* DESCRIPTION.—An AN5771-4A hydraulic pressure gage having a range of from zero to 2000 psi, with scale graduation in units of 200 psi, is installed.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| No reading on gage. | Pressure line plugged. | Remove foreign matter. |
| | Pressure line broken. | Repair or replace. |
| | Fractured Bourdon tube. | Replace socket assembly. |
| | Broken endpiece. | Replace socket assembly. |
| | Pointer loose on shaft. | Reset pointer. |
| | Movement damaged or corroded. | Replace movement assembly. |
| Pointer fails to return to zero. | Foreign matter in line. | Remove foreign matter. |
| | Foreign matter in Bourdon tube. | Replace socket assembly. |
| | Bourdon tube stretched. | Reset pointer. |
| Does not register properly. | Faulty mechanical adjustment. | Readjust. |
| Gage fails to register full dial reading. | Broken line. | Repair. |
| Sticky action. | Worn or bent movement. | Replace movement assembly. |
| | Scale or foreign matter in Bourdon tube. | Replace socket assembly. |
| | Dirt in movement. | Clean. |
| | Corroded movement. | Clean or replace. |
| | Pointer bent so it rubs on dial, dial screw, or glass. | Straighten pointer. |

(16) INCLINOMETER (Photographic Airplanes Only). — An inclinometer, Air Associates, Inc. No. 1062N, is located in the cockpit above the forward end of the left shelf. The instrument indicates the fore-and-aft attitude of the airplane, and is used when the cameras are to be used. A nose-up or nose-down condition is reflected in the position of the inclinometer ball in the unit.

(17) OIL PRESSURE INDICATOR. — The oil pressure indicator, type O-1, is a direct indicating, differential type pressure gage with a range of from zero to 50 psi. On all winterized airplanes, a 0-200 psi oil

pressure gage (AN5771-2A) must be installed in lieu of the type O-1 (0-50 psi) gage.

**Note**

Airplanes containing both the type O-1 (0-50 psi) and 0-200 psi oil pressure gages as the result of compliance with previous winterization instructions, may be modified to remove the type O-1 (0-50 psi) gage at the discretion of the unit engineering officer.

(18) OXYGEN FLOW INDICATOR.—Refer to paragraph 21*g*, this section.

(19) OXYGEN PRESSURE INDICATOR.—The AN6021-1 oxygen pressure gage indicates the pressure in the oxygen cylinders. Satisfactory operation of the gage requires from 100 to 425 psi pressure in the system. No maintenance is required on this gage. If instrument does not function properly, replace it.

**CAUTION**

Never use oil on an oxygen gage.

(20) RATE OF CLIMB INDICATOR.

(*a*) DESCRIPTION.—The type AN5825-3 rate of climb indicator is used to indicate the vertical component of the airplane's speed, based on the rate of change of atmospheric pressure. Atmospheric pressure is transmitted from the static pressure fitting to the indicator through the connection marked "S" on the rear of the indicator case and acts upon a capsule diaphragm contained within the case. The instrument has a logarithmic (compressed) scale dial with graduations from zero to 6000 feet per minute in a clockwise direction for climb, and in a counterclockwise direction for descent.

(*b*) TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Pointer off the zero position. | Mechanism shift. | Return pointer to zero by means of zero adjusting shaft. |
| Pointer off zero and cannot be brought back by adjusting shaft. | Broken pivot. | Replace instrument. |
| Pointer fails to respond. | Obstruction in static line. | Disconnect all instruments connected to static line. Blow line clear. |
| Instrument indicates less than actual rate of climb. | Case leak. | Replace instrument. |
| Sticky pointer action. | Dirty pivots and jewels. | Replace instrument. |
| | Broken jewels. | Replace instrument. |
| | Improper clearances. | Replace instrument. |
| Pointer oscillates. | Leaks in static line. | Disconnect all instruments connected to static line. Check line and repair leaks. Check individual instruments for case leaks. |

(21) RADIO COMPASS INDICATOR. — Later fighter airplanes have an ID-90 indicator in connection with the AN/ARN-6 radio compass. Photographic airplanes use type I-81-L indicator and an AN/ARN-7 radio compass. Both types of indicator show any deviation from the heading set for the radio compass.

(22) REMOTE INDICATING COMPASS.

(*a*) DESCRIPTION. — The remote indicating system incorporates an indicator, AN5730-2A, mounted on the main instrument panel, a transmitter, AN-5730-3, mounted in a box in the lower fuselage aft section (figure 126) and an inverter for supplying 24 volts at 400 cycles for operation of the system. For information on the electrical circuit, see paragraph 17*p*, this section. Access to the transmitter is through a removable panel directly below the transmitter. The indicator has a range of 360°, with unit graduations of 2°.

(*b*) TRANSMITTER. *(See figure 126.)* — The remote compass transmitter is installed on shockproof mountings in a box between stations 352 and 364. All parts of the mounting platform, including screws, washers, bushings, and the metal parts of shock mounts and brackets, are of non-magnetic material.

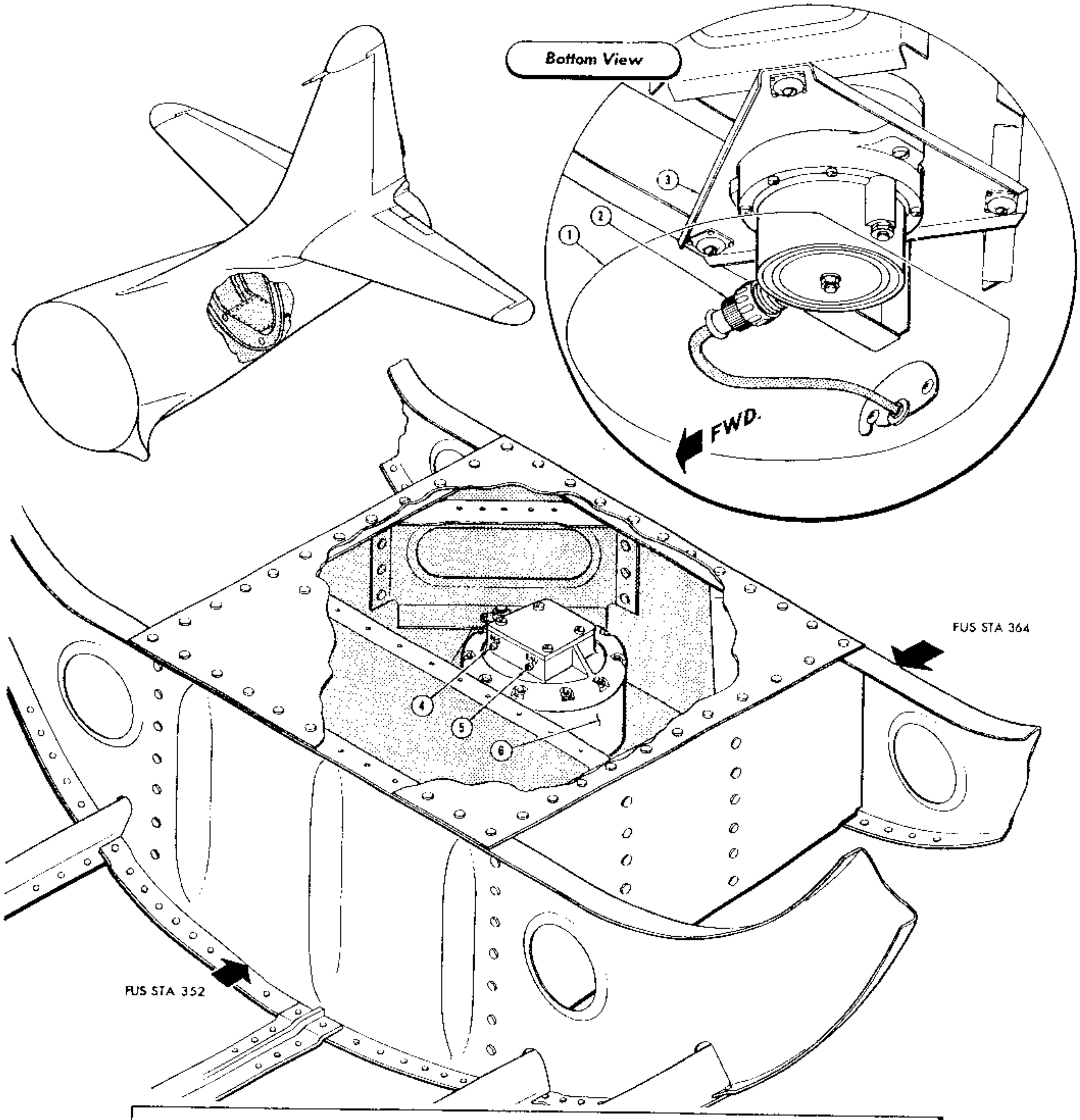
The transmitter is placed in the mounting bracket with the arrow on the compensator housing pointing forward. A vertical plane passing through the center of the electrical receptacle and the rear mounting hole should be parallel to the fore and aft axis of the airplane.

When a transmitter is being installed in the airplane, proper positioning is obtained through repeated trials as follows:

*1.* Mount the transmitter and indicator in their proper locations, and make all electrical connections. Both the transmitter and indicator have standard AN four-terminal receptacles. Each terminal in the receptacle is lettered, and like-designated terminals in the indicator and transmitter must be connected.

*2.* After the installation has been completed and checked, perform a compensation check according to the instructions in paragraph *(d)* following.

(*c*) TROUBLE SHOOTING. — Determine whether the source of trouble is in the indicator or transmitter. Use a master transmitter (13255-1-A) in the following manner: Turn the compass inverter off and disconnect the electrical plug to the installed transmitter. Connect the master transmitter to the disconnected electrical plug of the wiring. Turn on the inverter and manually turn the pointer of the master transmitter. If the




| | | | |
|---|---|---|---|
| 1. | ACCESS DOOR NO. 36 | 4. | N-S COMPENSATING SCREW |
| 2. | ELECTRICAL RECEPTACLE | 5. | E-W COMPENSATING SCREW |
| 3. | MOUNTING BRACKET | 6. | COMPASS BOWL |

*Figure 126 — Remote Compass Transmitter Installation*

indicator follows the master transmitter correctly, the trouble is in the installed transmitter. If it fails to follow, the trouble is in the indicator or the wiring. Check the wiring with an ohmmeter to locate the source of trouble.

Check all wiring against remote compass and inverter circuit, figure 204.

When it has been established that all wiring is correct, check mechanical parts of the units to see that they are in good condition.

*1.* TRANSMITTER.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Swirl of liquid gives erratic indication. | Not enough liquid in bowl. | Forward to repair depot for refilling. |
| Leakage of compass liquid. | Defective gasket. | Forward to repair depot for replacement of gasket. |
| Compensator does not have sufficient effect. | Weak compensator magnets. | Forward to repair depot for remagnetization of compensator magnets. |

*2.* INDICATOR.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Erratic indication. | Loose pointer. | Forward to repair depot for replacement or rework. |
| Sluggish operation. | Dirty jewels or pivots. | Forward to repair depot for cleaning. |

*(d)* COMPASS COMPENSATION — Compensate the remote-reading compass and record readings on AAF Form No. 57 at the end of each 100 hours flying time, at each change of engine, guns, armor plate, or electrical equipment likely to affect the compass, or at least once each three-month period.

*1.* SWINGING PROCEDURE. — Ground swinging of the airplane may be accomplished by means of a swinging compass or a compass base. The swinging compass is a standard aircraft compass, Pioneer type B-16, which has had its compensating assembly removed and a swinging compass sight, Stock No. 7800-725200, attached in its place.

Determine the magnetic heading of the aircraft with the swinging compass by standing at least 50 feet in front of the airplane. Align the point of observation with the airplane's longitudinal axis by reference to any suitable line or pair of objects on the airplane, and with the swinging compass held in cupped hands, look both through and over the lens of the attached sight: through it at the hair line, and over it at the object sighted upon. Align the two by rotating the compass. The reading obtained is the magnetic heading of the airplane plus or minus 180°. Since the observer must stand in front of this airplane, obtain the magnetic heading by adding 180° if the heading is less than 180°, or subtracting 180° if the heading is greater than 180°.

a. Having selected a suitable area for swinging, adjust the compensator on the airplane compass for zero effect.

b. Head the airplane EAST (within 5°) by its own compass. Allow the airplane compass sufficient time to settle, then read. Record reading in its proper space in the second column of the card, AAF Form No. 57. Determine the magnetic heading of the airplane with the swinging compass and record in the proper space in the first column of the card.

c. With the engine running at sufficient speed to show the maximum charge on the ammeter, recheck the compass reading.

## WARNING

Do not stand behind the airplane when the engine is running.

d. Head the airplane SOUTH and repeat steps b and c preceding.

**Note**

If no change is noted in the compass compensation as a result of running the engine, it will not be necessary to keep it running during the remainder of the swing. If a change in the reading results, keep engine running during the swing of the airplane and enter the compass readings thus obtained on the card.

e. Continue the swing on the other two cardinal headings, WEST and NORTH, in that order. A card having the first two columns completed is shown in figure 127, step 1.

*2.* CALCULATIONS AND CARD ENTRIES.

a. Calculate the deviation and its sign for each heading. Determine the deviation and its sign by subtracting the airplane-compass reading from the actual heading; that is, the deviation and its sign indicate the quantity that must be added to or subtracted from the airplane-compass reading to make its value the same as that of the actual heading. If the quantity must be added, the sign is plus (+); if subtracted, the sign is minus (—). Enter the deviations and their signs in the column labeled "Dev'n," as illustrated in figure 127, step 2.

b. Using the recorded deviations, calculate Coefficients A, B, and C according to the formulae on the lower part of the form as shown in figure 127, step 3. All additions and subtractions are algebraic.

Coefficient C is in the deviation on NORTH minus algebraically the deviation on SOUTH, divided by two; that is, the sign of the deviation on SOUTH heading is made opposite to that recorded, and if the signs of both deviations are then the same, the two quantities are added, the sum divided by two, and the result is given that same sign. If the signs of the two deviations are opposite, the smaller quantity is subtracted from the larger, the result divided by two, and given the sign of the larger number.

| | Compensating Swing | | | Residual Swing | | Aircraft Comp. | Date | |
|---|---|---|---|---|---|---|---|---|
| | Actual Head (M) | Aircraft Comp. | Dev'n | Actual Head (M) | Aircraft Comp. | C to M | | M to C |
| N 000 | 005 | 001 | | | | | 000 | |
| NE 045 | | | | | | | 045 | |
| E 090 | 087 | 090 | | | | | 090 | |
| SE 135 | | | | | | | 135 | |
| S 180 | 176 | 180½ | | | | | 180 | |
| SW 225 | | | | | | | 225 | |
| W 270 | 265 | 273 | | | | | 270 | |
| NW315 | | | | | | | 315 | |
| | (1) | (2) | (1)—(2) | (3) | (4) | (3)—(4) | | (4)—(3) |

If swinging compass used ahead of aircraft add or subtract 180 degrees.

Coeff. C $= \frac{N-S}{2} = \frac{(\ )-(\ )}{2} =$

Coeff. B $= \frac{E-W}{2} = \frac{(\ )-(\ )}{2} =$

Coeff. A $= \frac{N+E+S+W}{4} = \frac{(\ )+(\ )+(\ )+(\ )}{4} =$

**Figure 127 — Compass Compensation Step 1**

| | Compensating Swing | | | Residual Swing | | Aircraft Comp. | Date | |
|---|---|---|---|---|---|---|---|---|
| | Actual Head (M) | Aircraft Comp. | Dev'n | Actual Head (M) | Aircraft Comp. | C to M | | M to C |
| N 000 | 005 | 001 | +4 | | | | 000 | |
| NE 045 | | | | | | | 045 | |
| E 090 | 087 | 090 | −3 | | | | 090 | |
| SE 135 | | | | | | | 135 | |
| S 180 | 176 | 180½ | −4½ | | | | 180 | |
| SW 225 | | | | | | | 225 | |
| W 270 | 265 | 273 | −8 | | | | 270 | |
| NW315 | | | | | | | 315 | |
| | (1) | (2) | (1)—(2) | (3) | (4) | (3)—(4) | | (4)—(3) |

If swinging compass used ahead of aircraft add or subtract 180 degrees.

Coeff. C $= \frac{N-S}{2} = \frac{(\ )-(\ )}{2} =$

Coeff. B $= \frac{E-W}{2} = \frac{(\ )-(\ )}{2} =$

Coeff. A $= \frac{N+E+S+W}{4} = \frac{(\ )+(\ )+(\ )+(\ )}{4} =$

**Figure 127 — Compass Compensation Step 2**

| | Compensating Swing | | | Residual Swing | | Aircraft Comp. | Date | |
|---|---|---|---|---|---|---|---|---|
| | Actual Head (M) | Aircraft Comp. | Dev'n | Actual Head (M) | Aircraft Comp. | C to M | | M to C |
| N 000 | 005 | 001 | +4 | | | | 000 | |
| NE 045 | | | | | | | 045 | |
| E 090 | 087 | 090 | −3 | | | | 090 | |
| SE 135 | | | | | | | 135 | |
| S 180 | 176 | 180½ | −4½ | | | | 180 | |
| SW 225 | | | | | | | 225 | |
| W 270 | 265 | 273 | −8 | | | | 270 | |
| NW315 | | | | | | | 315 | |
| | (1) | (2) | (1)—(2) | (3) | (4) | (3)—(4) | | (4)—(3) |

If swinging compass used ahead of aircraft add or subtract 180 degrees.

Coeff. C $= \frac{N-S}{2} = \frac{(+4)-(-4\frac{1}{2})}{2} = +\frac{8\frac{1}{2}}{2} = +4\frac{1}{4}$ OR $+4$

Coeff. B $= \frac{E-W}{2} = \frac{(-3)-(-8)}{2} = +\frac{5}{2} = +2\frac{1}{2}$

Coeff. A $= \frac{N+E+S+W}{4} = \frac{(+4)+(-3)+(-4\frac{1}{2})+(-8)}{4} = -\frac{11\frac{1}{2}}{4} = -3$

**Figure 127 — Compass Compensation Step 3**

| | Compensating Swing | | | Residual Swing | | Aircraft Comp. | Date | |
|---|---|---|---|---|---|---|---|---|
| | Actual Head (M) | Aircraft Comp. | Dev'n | Actual Head (M) | Aircraft Comp. | C to M | | M to C |
| N 000 | 005 | 001 | +4 | 002½ | 001 | | 000 | |
| NE 045 | | | | 040 | 043 | | 045 | |
| E 090 | 087 | 090 | −3 | 095 | 094 | | 090 | |
| SE 135 | | | | 136 | 134 | | 135 | |
| S 180 | 176 | 180½ | −4½ | 185 | 184 | | 180 | |
| SW 225 | | | | 222 | 225 | | 225 | |
| W 270 | 265 | 273 | −8 | 275 | 276 | | 270 | |
| NW315 | | | | 317 | 316 | | 315 | |
| | (1) | (2) | (1)—(2) | (3) | (4) | (3)—(4) | | (4)—(3) |

If swinging compass used ahead of aircraft add or subtract 180 degrees.

Coeff. C $= \frac{N-S}{2} = \frac{(+4)-(-4\frac{1}{2})}{2} = +\frac{8\frac{1}{2}}{2} = +4\frac{1}{4}$ OR $+4$

Coeff. B $= \frac{E-W}{2} = \frac{(-3)-(-8)}{2} = +\frac{5}{2} = +2\frac{1}{2}$

Coeff. A $= \frac{N+E+S+W}{4} = \frac{(+4)+(-3)+(-4\frac{1}{2})+(-8)}{4} = -\frac{11\frac{1}{2}}{4} = -3$

**Figure 127 — Compass Compensation Step 4**

| | Compensating Swing | | | Residual Swing | | Aircraft Comp. | Date | |
|---|---|---|---|---|---|---|---|---|
| | Actual Head (M) | Aircraft Comp. | Dev'n | Actual Head (M) | Aircraft Comp. | C to M | | M to C |
| N 000 | 005 | 001 | +4 | 002½ | 001 | +1½ | 000 | −1½ |
| NE 045 | | | | 040 | 043 | −3 | 045 | +3 |
| E 090 | 087 | 090 | −3 | 095 | 094 | +1 | 090 | −1 |
| SE 135 | | | | 136 | 134 | +2 | 135 | −2 |
| S 180 | 176 | 180½ | −4½ | 185 | 184 | +1 | 180 | −1 |
| SW 225 | | | | 222 | 225 | −3 | 225 | +3 |
| W 270 | 265 | 273 | −8 | 275 | 276 | −1 | 270 | +1 |
| NW315 | | | | 317 | 316 | +1 | 315 | −1 |
| | (1) | (2) | (1)—(2) | (3) | (4) | (3)—(4) | | (4)—(3) |

If swinging compass used ahead of aircraft add or subtract 180 degrees.

Coeff. C $= \frac{N-S}{2} = \frac{(+4)-(-4\frac{1}{2})}{2} = +\frac{8\frac{1}{2}}{2} = +4\frac{1}{4}$ OR $+4$

Coeff. B $= \frac{E-W}{2} = \frac{(-3)-(-8)}{2} = +\frac{5}{2} = +2\frac{1}{2}$

Coeff. A $= \frac{N+E+S+W}{4} = \frac{(+4)+(-3)+(-4\frac{1}{2})+(-8)}{4} = -\frac{11\frac{1}{2}}{4} = -3$

**Figure 127 — Compass Compensation Step 5**

Coefficient B is the deviation on EAST minus algebraically the deviation on WEST, divided by two; that is, the sign of the deviation on WEST is made opposite to that recorded. If the signs of both deviations are then the same, the two quantities are added, the sum divided by two, and the result given the same sign. If the signs of the two deviations are opposite, the smaller quantity is subtracted from the larger, the result divided by two, and given the sign of the larger number.

Coefficient A is the sum of the deviations on NORTH, EAST, SOUTH, and WEST divided by four; that is, all plus (+) recorded deviations are added and all the minus (—) deviations are added, the smaller quantity subtracted from the larger, the result divided by four, and given the sign of the larger number.

3. ADJUSTMENT OF COMPASS.

a. With the airplane headed magnetic NORTH within 5° by its own compass, determine what the instrument should indicate when compensated by adding Coefficient C algebraically to the compass reading; that is, add to or subtract from the compass reading the amount of Coefficient C on that heading as indicated by the sign of the coefficient. Adjust the NORTH-SOUTH compensator screw (using non-magnetic screw driver) to make the compass indicate the compensated value. For example, the airplane compass reads 1° and Coefficient C is + 4°. To correct for Coefficient C, the compass should be made to read $1° + 4° = 5°$, by rotating the NORTH-SOUTH compensator screw.

b. With the airplane headed magnetic EAST within 5° by its own compass, add Coefficient B algebraically to the compass reading. Determine what the instrument should indicate when compensated by adding Coefficient B, as indicated by its sign, to the compass reading on the EAST heading. Make the compass indicate the compensated value by adjusting the EAST-WEST compensator screw (using non-magnetic screw driver). For example, the airplane compass reads 90° and Coefficient B is $+ 2\frac{1}{2}°$. To correct for Coefficient B, make the compass read $90° + 2\frac{1}{2}° = 92\frac{1}{2}°$, by rotating the EAST-WEST compensating screw.

c. With the airplane on any heading, determine what the instrument should read when corrected for Coefficient A by adding Coefficient A algebraically to the reading of the compass on that heading; that is, add or subtract the value of Coefficient A as indicated by its sign. Make the compass indicate the corrected value by rotating the compass bowl bodily.

**Note**

When the pilot's compass is mounted on an instrument board, the correction for Coefficient A may be omitted.

For example, the compass reads $92\frac{1}{2}°$ after the correction for Coefficient B, and Coefficient A is — 3°. To correct for Coefficient A, make the compass read $92\frac{1}{2}° - 3° = 89\frac{1}{2}°$, by rotating the compass bowl counterclockwise 3°.

d. The correction for the three coefficients, A, B, and C, completes the compensation of the compass.

4. TEST FOR RESIDUAL ERROR. Securely fasten the compass and swing for residual errors. The residual errors result from causes other than those which give rise to Coefficients A, B, and C, and no provision is made to compensate for these errors. Accomplish the residual swing in the same manner as the swing before compensation, but use eight headings instead of four. Place the airplane on the cardinal and quadrantal magnetic headings (EAST, SOUTHEAST, SOUTH, SOUTHWEST, WEST, NORTHWEST, NORTH, and NORTHEAST) and enter the magnetic headings and the corresponding compass readings in their proper spaces on the card. The card will appear as shown in figure 127, step 4, after the data from the residual swing are entered.

5. COMPLETION OF FORM. - Complete AAF Form No. 57 by filling in the remaining two columns from data obtained in the residual swing. The entries for the left-hand column "C to M" are obtained by subtracting Column 4 from Column 3 for each heading. The "C to M" column indicates that the tabulated corrections are to be added to or subtracted from the compass reading to obtain the magnetic heading. The entries for the right-hand column "M to C" are obtained by subtracting Column 3 from Column 4 for each heading. The completed form labeled "M to C" indicates that the corrections are added to or subtracted from the magnetic heading to obtain the compass reading. For example, using the card shown in figure 127, step 5, if the compass reading is 225°, subtract 3° (C to M column) to determine the corresponding magnetic heading of 222° M. If the magnetic heading is 45°, add 3° (M to C column) to determine the corresponding compass reading of 48° C.

Complete the correction card, adding the information required in the blanks on the rear of the card. Detach the compass card and insert it in the compass-card holder in the airplane. Place the remainder of the form in a permanent file.

**Note**

To swing the airplane on a prepared base, the airplane is turned to the desired headings as determined by the base. These magnetic headings are entered in the column "Actual Head (M)." In every respect, the compensation and swinging are the same as when using the swinging-compass method.

(23) STANDBY COMPASS.

*(a)* DESCRIPTION. — The type B-21 standby compass is designed as an emergency compass to be used in the event the remote indicating compass system fails, or as a check on the operation of the remote indicating compass. It is a short-period magnetic compass and is intended to indicate continuously the heading of the aircraft with reference to the earth's magnetic field. No lubrication is required.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Discolored liquid. | Age. | Replace instrument. |
| Discolored luminous markings. | Age. | Replace instrument. |
| Air bubble. | Leak around mounting flange or in case. | Replace instrument. |
| Sluggish action. | Friction or a damaged pivot or jewel. | Replace instrument. |
| | Weak directive magnets. | Replace instrument. |

(24) TACHOMETER INDICATOR.—The tachometer indicator, General Electric type 8DJ13AFN, or Chicago Flexible Shaft Company type X70BP, or Kollsman Instrument Company type 1159CU8-04, is a remote indicating instrument with a range from zero to 110 percent speed of the engine rotor. The indicator incorporates a logarithmic scale dial and two indicator pointers. The short pointer indicates from zero to 50 percent of engine speed; the larger pointer, overlapping the smaller, indicates from 50 to 110 percent of engine speed. This arrangement provides a wide scale at higher percentages to permit easier adjustment and reading of the higher power settings.

For information on the electrical circuit, see paragraph 17*i*, this section.

(25) TURN AND BANK INDICATOR.

*(a)* DESCRIPTION.—The turn and bank indicator, AN5820-1, is a combination of two flight instruments, the turn indicator and the bank indicator. The turn indicator unit consists of an air-driven gyroscope and registers not only a turn, but also the rate at which the turn is being made. The bank indicator unit is a ball type inclinometer. The ball rolls in a curved glass tube filled with damping liquid, and gives an indication of the lateral stability of the airplane in straight flight and in turns.

*(b)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Pointer does not set on zero; otherwise smooth pointer operation. | Gimbal and rotor assembly out of balance. | Replace instrument. |
| | Pointer incorrectly set on shaft. | Replace instrument. |
| | Sensitivity spring adjustment pulls pointer off zero. | Replace instrument. |
| Incorrect sensitivity. | Pressure too high or too low. | Examine tubing, connections, control valve, etc., for leaks or stoppage. |
| | Air inlet cap or screen clogged. | Remove cap or screen; clean and replace. |
| | Misadjustment of sensitivity spring. | Adjust sensitivity by means of screw on right side of instrument. |
| Pointer vibrates. | Excess vibration in mounting. | Check instrument panel for excessive vibration and correct if found necessary. |
| | Damping screw misadjusted. | Adjust damping screw on left side of instrument until proper operation is obtained. |
| | Lack of oil. | Lubricate instrument through plug on right side. |
| Pointer sluggish in returning to zero, or does not return to zero; erratic operation. | Oil or dirt between damping piston and cylinder. | Replace instrument. |
| | Excessive clearance between rotor and rotor pivots. | Replace instrument. |

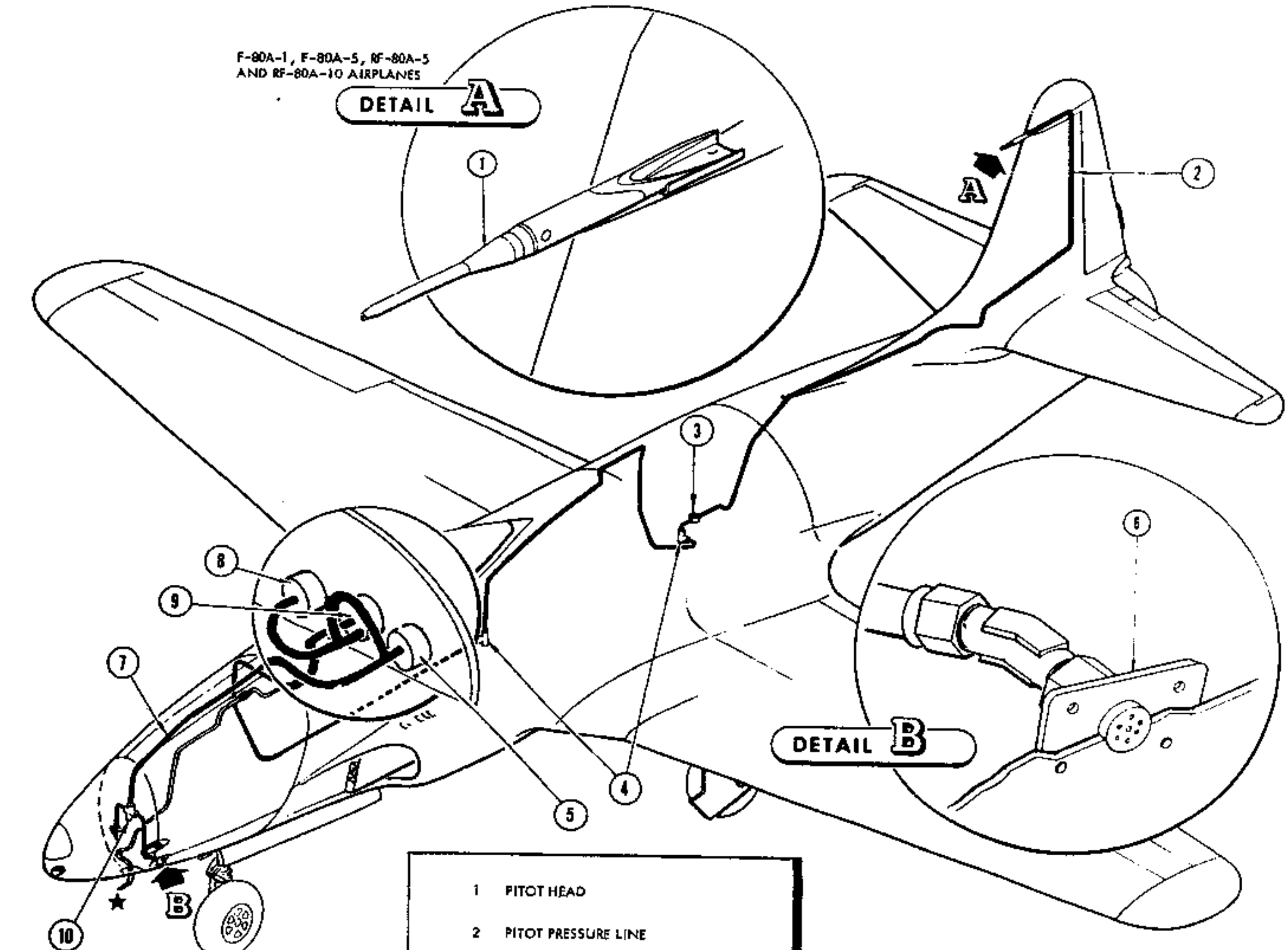
(26) WING-FLAP POSITION INDICATOR.

*(a)* DESCRIPTION. — A mechanically operated indicator on the left side of the cockpit is connected by a flexible shaft to the left flap and indicates flap position at all times. Four screws mount the instrument to the cockpit side shelf.

*(b)* ADJUSTMENT. — Adjust the indicator by repeated trials as follows:

*1.* Adjust bracket on the flap to a forward position.

2. With flap down, attach the flexible shaft to the bracket so the indicator shows "FLAPS DOWN."




★ *Note*

USED ON F-80A-10 AIRPLANES

| | |
|---|---|
| 1 | PITOT HEAD |
| 2 | PITOT PRESSURE LINE |
| 3 | DISCONNECT FITTING |
| 4 | DRAIN FITTINGS |
| 5 | ALTIMETER |
| 6 | STATIC PRESSURE FITTING |
| 7 | STATIC PRESSURE LINE |
| 8 | RATE-OF-CLIMB INDICATOR |
| 9 | AIR SPEED INDICATOR |
| 10 | TEST CONNECTION (T.O. 1F-1-62) |

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M39-14-4-128

*Figure 128—Pitot Static System*

*3.* Run flap through full travel and check for agreement of indicator with flap position.

*4.* Repeat steps *1*, *2*, and *3* until proper readings are obtained on the indicator.

*c.* INSTRUMENT AIR PRESSURE SYSTEM. — In lieu of an instrument vacuum system, an air pressure system utilizing pressure from the engine compressor is installed for operation of gyro type instruments. See paragraph 24, this section, for detailed information.

*d.* PITOT SYSTEM. *(See figure 128.)*—Three external fittings for the pitot-static system are installed on the airplane.

The type G-1 air-speed pitot tube is mounted near the fin tip, and extends forward from the fin leading edge. The pitot tube employs a heater to prevent or remove accumulation of ice. For information on the heater circuit and removal of the pitot tube, see paragraph 17*n*, this section. A tubing line is routed from the pitot tube down through the fin, forward to a disconnect coupling at the fuselage aft-section disconnect joint, and forward to the air-speed indicator on the instrument panel.

F-80A-10 airplanes have the pitot mast mounted on the under side of the nose section.

Two drain fittings provide means for drainage of the system. One fitting is located in the sub-cockpit area and is accessible through the right-hand dive flap opening; the other fitting is accessible through the external power receptacle access door.

Two flush static-pressure fittings are located, one on each side, in the forward end of the nose. The lines from the two external-opening fittings run inboard to a "T" connection or cross, and then to the rate of climb indicator, the air-speed indicator, and the altimeter on the main instrument panel.

On airplanes incorporating T.O. 1F-1-62, a ground test gage connection is located at the cross.

*e.* STATIC PRESSURE LEAK TEST.

(1) Cover static pressure openings with tape.

(2) Connect a suitable source of vacuum to the static system.

(3) Slowly apply vacuum (not to exceed the range of the rate of climb indicator) until the altimeter reads 10,000 feet above field elevation; close valve on vacuum source.

(4) The altimeter must not change indication more than 3,000 feet for a period of one minute. Tap instrument case to keep pointer free.

**Note**

Do not apply pressure to static lines.

*f.* PITOT PRESSURE LEAK TEST.

(1) Cover pitot tube drain holes with tape.

(2) Connect a suitable source of pressure to the pitot system.

(3) Slowly apply pressure until aircraft air speed indicator reads three-fourths full scale; close valve of pressure source.

(4) For a period of one minute, the indicated air speed shall not decrease more than five knots or five miles per hour.

**Note**

Do not apply vacuum to pitot lines.

## 15. SURFACE CONTROLS.

*a.* GENERAL.

(1) DESCRIPTION. — The ailerons are operated by the control stick through a hydraulic booster which augments the force applied by the pilot. The aileron tab is provided to aid in maintaining lateral stability, and is actuated by an electric motor controlled by a switch on the left shelf of the cockpit.

The elevators are controlled by the stick through a system of push-pull tubes and bell cranks. The force supplied by the pilot is supplemented by the tabs to reduce elevator stick forces. There are two separate sets of elevator tabs. One set operates in conjunction with the elevators, while the other is operated independently by an electric motor controlled by a switch on the control stick.

The rudder is actuated by rudder pedals through a coventional cable system.

Cable assemblies are treated with corrosion-preventive compound, Specification MIL-C-6708. Terminals are swaged to cable ends. (See figures 268 and 269.) Cables are identified by bands of colored cellulose tape wrapped around both ends of each cable as shown by the cable color code in figure 267.

Those push-pull tubes that require adjustment are equipped with threaded terminals. Terminals are fitted with self-aligning ball bearings.

(2) MAINTENANCE REPAIRS, REPLACEMENT, AND ADJUSTMENT.

*(a)* Restake loose bearings. If bearing does not turn freely in race after staking, replace bearing.

*(b)* Replace frayed cables when more than six wires are broken in any inch length of cable. (The 7 x 19 cable is composed of 7 strands of 19 wires each.)

*(c)* Replace cracked or damaged fittings and push-pull tubes.

*(d)* Replace push-pull tubes that are dented or noticeably bowed.

*(e)* There must be no twist in the cables.

*(f)* No more than one-degree pull-off is permitted; i.e., there must be no less than 0.003-inch clearance between pulley flange and cable. (See figure 129.)

*(g)* Make sure all control rod jam nuts on rod ends are tight.

*(h)* Check all control rod attaching bolts for clearance. Make sure push-pull tubes attaching bolts are installed in such a manner as to assure maximum clearance between the bolts, the aircraft structure, or between control rods.

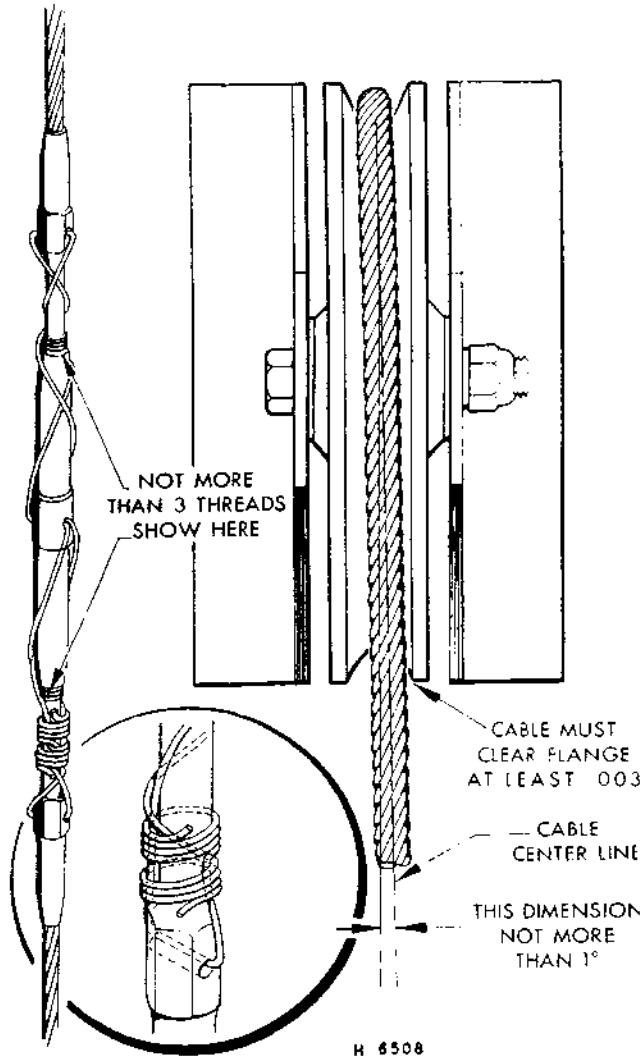



***Figure 129 — Cable Pull-off and Turnbuckle Adjustment***

*b.* CONTROL STICK. *(See figures 130 and 131.)*

(1) DESCRIPTION. — The control stick fits into a socket of the aileron-elevator control assembly in front of the pilot's seat. The stick consists of a 1¼ x 0.091 24S-T aluminum alloy tube to which is fitted a plastic pistol grip. The ailerons and elevators are operated by the control stick. The elevator trim tabs are controlled by a switch mounted on the control stick.

(2) REMOVAL AND DISASSEMBLY.

*(a)* Disconnect electrical wiring.

*(b)* Detach stick by removing bolt through the socket.

*(c)* Detach grip by removing bolt at bottom of the grip.

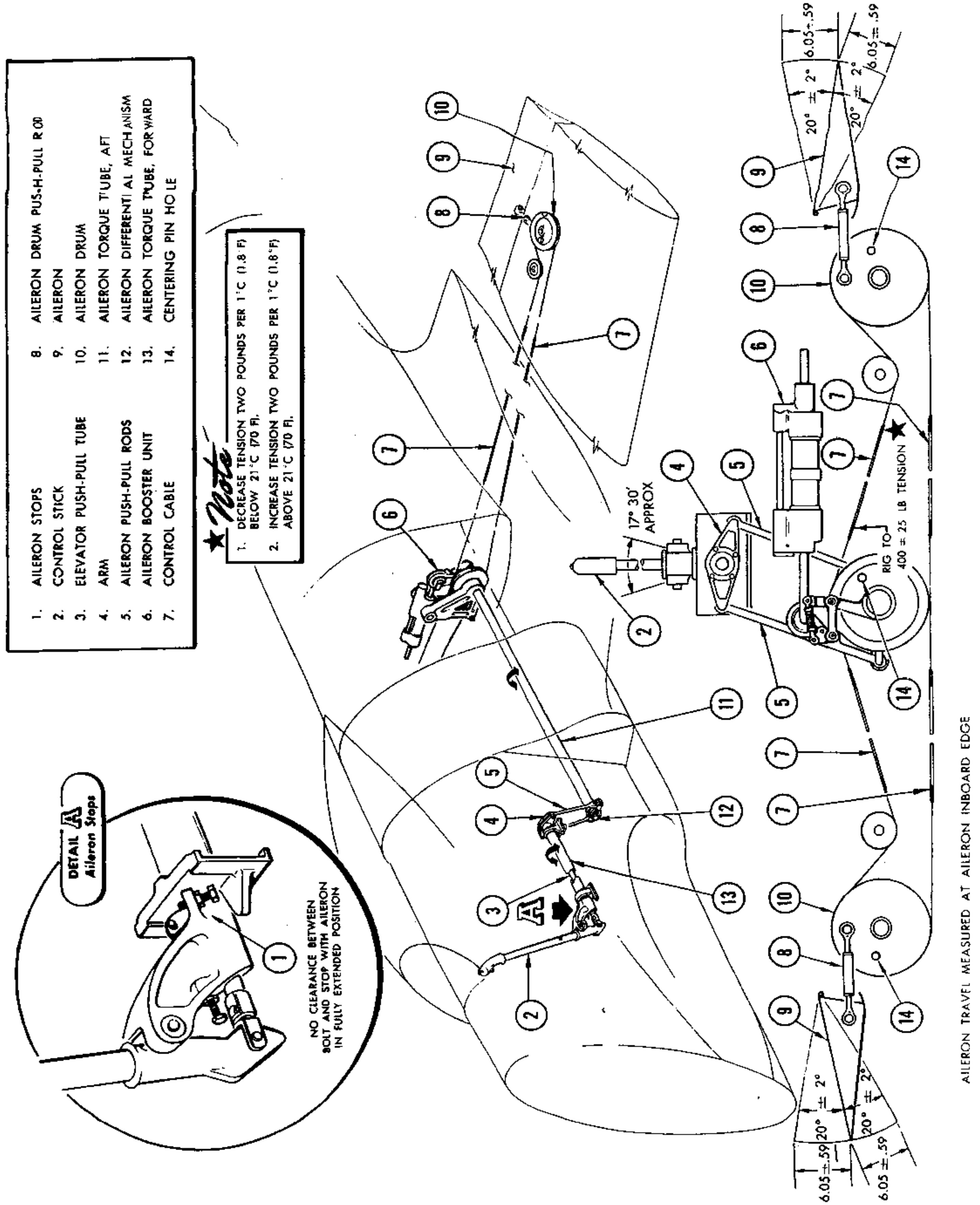



*Figure 130 — Aileron Control System*

(3) INSTALLATION OF CONTROL STICK.

*(a)* Thread wire from stick grip down through control stick. Install stick grip on control stick and tighten set screw. Install lock-wire between control stick and stick grip.

*(b)* Attach lower end of control stick to elevator push-pull tube. Install AN 176H36 bolt through control column and control stick socket.

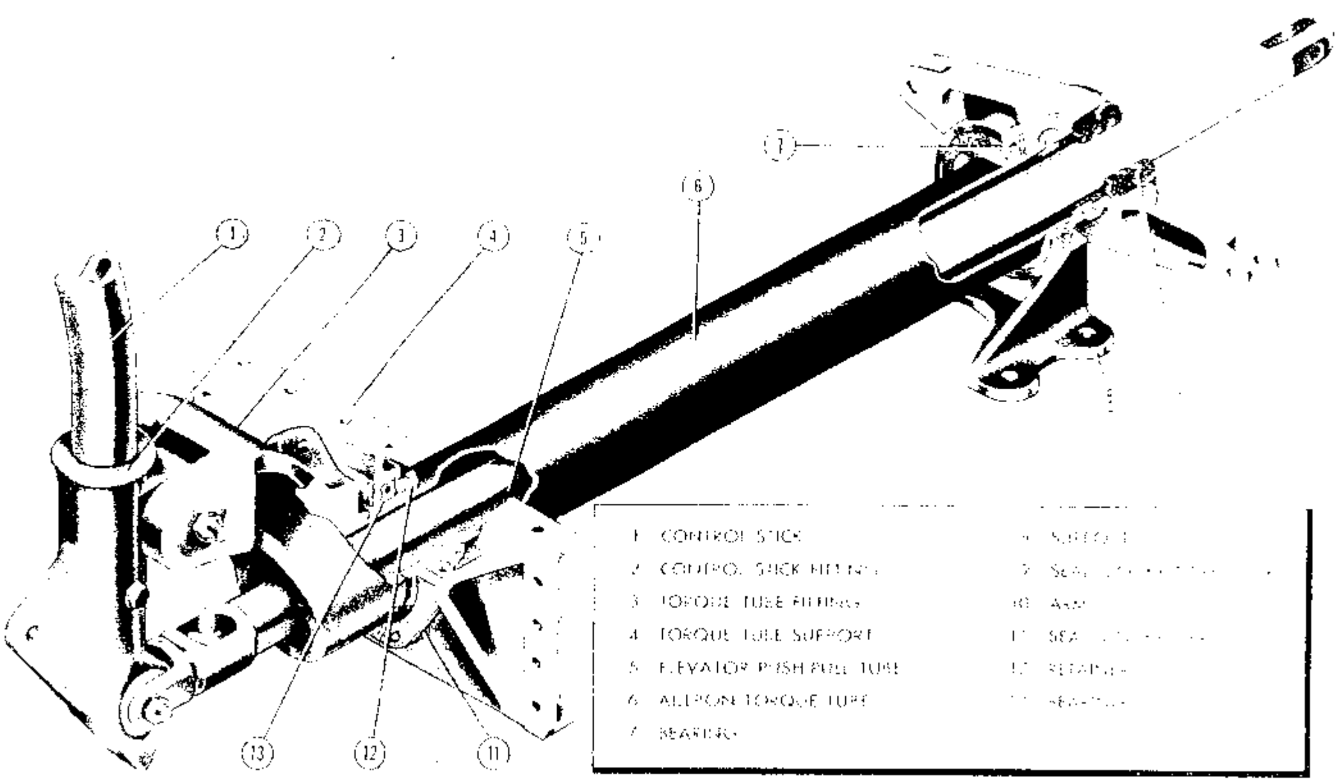



***Figure 131 — Aileron-elevator Control Assembly***

*(c)* Connect electrical wiring to terminal strip below control stick assembly.

(4) ADJUSTMENT.

*(a)* NEUTRAL POSITION.—There is no provision for lateral adjustment. Fore-and-aft adjustment is as follows: Set elevator push-pull system in neutral as described in paragraph *d*(6) following. Adjust terminals of push-pull rod (5, figure 131) until control stick is 5 degrees 40 minutes forward of vertical.

*(b)* STICK TRAVEL FOR ELEVATOR CONTROL.

*1.* Adjust the elevator stops at the elevator horn. (See paragraph *d*(6) following.)

*2.* With the elevator spring tab in full down position (22 degress from neutral), and elevator up stops contacting the elevator horn assembly, adjust the up-position elevator stop in the cockpit to 1/16 inch (± 1/32 inch) clearance between stop and stick.

*3.* With the elevator spring tab in full up position (10 degress from neutral) and elevator stops contacting elevator horn assembly, adjust down-position elevator stop in the cockpit to 1/16 inch (± 1/32 inch) clearance between stop and stick.

*c.* AILERON CONTROL SYSTEM.

(1) DESCRIPTION.—The aileron control system consists of four main components: control stick to booster unit, booster unit, booster unit to ailerons, and aileron tabs.

**Note**

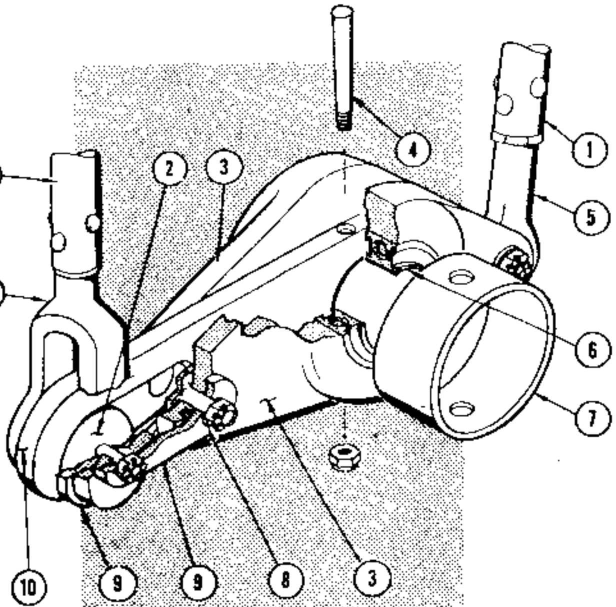
Lock the booster in neutral before attempting adjustment or repair of the aileron control system. (See paragraph *c*(5) following.)

(2) CONTROL STICK TO BOOSTER. *(See figure 130.)*

*(a)* DESCRIPTION.—This part of the aileron control system consists of a series of torque tubes and push rods. A differential device, installed at fuselage station 158, provides reduced stick sensitivity near the neutral position. (See figure 132.)

*(b)* OPERATION.—Control-stick side motion rotates torque tube (13) and torque arm (1). The torque arm operates the push-pull tubes (5).

The purpose of the aileron differential mechanism is to reduce the aileron control sensitivity near the aileron neutral position. This is accomplished by varying the length of the lever arm in the attachment of the push-pull tubes to the torque tube. Figure 132 shows the differential mechanism in both the neutral and full-left aileron positions. The push-pull tubes (1) have moved bell cranks (3) counterclockwise. The bell cranks do not operate shaft (7) directly, but are connected with arm (10) by links (9) through a roller bearing attached to




| | | | |
|---|---|---|---|
| 1. | PUSH-PULL TUBE | 6. | BEARING |
| 2. | ROLLER | 7. | STUB SHAFT |
| 3. | BELL CRANK | 8. | BOLT |
| 4. | TAPER PIN | 9. | LINK |
| 5. | CLEVIS | 10. | ARM |

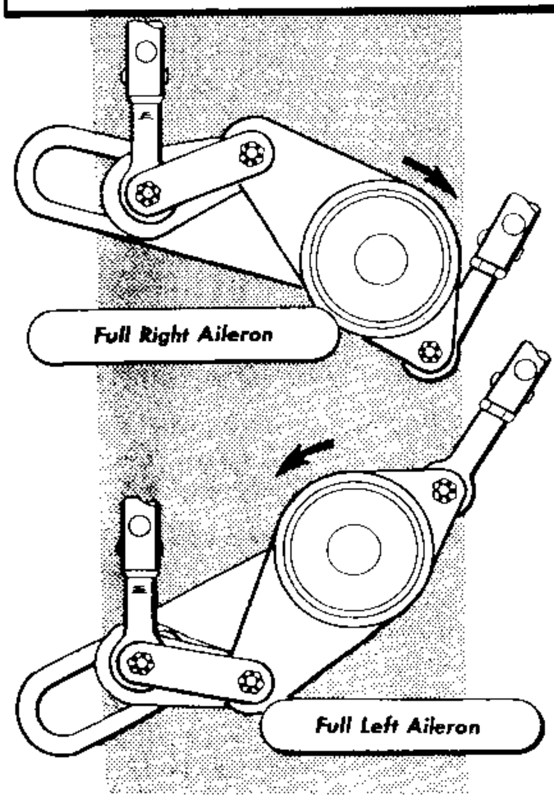



*Figure 132 — Aileron Differential Mechanism*

the push-pull tube clevis bolt. Arm (10) is attached directly to stub shaft (7). As the mechanism rotates, the bell cranks and links jackknife and the roller bearing on the push-pull tube clevis moves toward the center of rotation. This action progressively shortens the moment arm of the bell cranks to the position shown in figure 132. The moment arm of bell cranks (3) is longest with the mechanism in neutral, and shortest at either full right or full left aileron. More stick movement is required to move the ailerons a given distance from neutral than from any other position. The movement of the ailerons is gradually accelerated with constant movement of the control stick.

(*c*) REMOVAL.

*1.* AILERON-ELEVATOR CONTROL ASSEMBLY.

a. Remove boot around control stick (20 screws).

aA. Remove the pilot's seat. (See paragraph 22*a*, this section.)

b. Remove the tunnel cover.

c. Remove the screws securing the front bearing support.

d. Remove the bolts securing the rear bearing support.

e. Disconnect the vertical push-pull tubes (5, figure 130).

f. Disconnect the elevator push-pull tube (5, figure 135).

g. Remove the unit through the cockpit.

2. AILERON DIFFERENTIAL MECHANISM. (*See figure 132.*)

a. Detach push-pull tubes (1).

b. Remove nuts and washers from the two taper pins attaching the stub shaft to the torque tube, and drive out the pins.

c. Remove six screws attaching the stub shaft bearing to its bracket.

d. Remove bolts attaching bearing support bracket, and remove the bracket.

e. Remove differential mechanism by pulling it forward. The stub shaft bearing may be removed from the assembly by removing the snap ring.

f. Remove aileron torque tube by pulling it forward to disengage the splines in the tube from the splines on the aileron booster drive shaft. This should be done whenever the differential mechanism is removed to prevent the unsupported tube from bending the aileron booster drive shaft.

(*d*) DISASSEMBLY, AILERON-ELEVATOR CONTROL. (*See figure 131.*)

*1.* Remove the bolt attaching the elevator push-pull tube to the control-stick fitting.

*2.* Pull the elevator push-pull tube out of the torque tube. Pull from the forward end.

*3.* Remove the four nuts and take off the rear pressure seal retainer, seal, and gasket.

*4.* Remove cotter pin and the front-bearing retainer nut.

*5.* Remove the six screws from the front bearing support through the bearing. Remove the bearing, both retainers, and the leather seal.

*6.* Slide the supports and the bearing aft to remove them from the spacer.

*7.* Drill out eight AN430DD6 rivets and remove the aft arm.

*8.* Remove the aft bracket. To remove bearing from bracket, remove the snap ring.

*9.* Drill out two AN426AD4 rivets and remove the rear-bearing spacer.

*10.* Remove the forward bearing and the support from the torque tube.

*11.* Drill out four AN426AD5 rivets and remove the forward-bearing spacer.

*12.* If removal of the torque tube fitting is necessary, drill out 12 AN430DD6 rivets.

(*e*) CLEANING AND INSPECTION.—Wipe off accumulated dirt and grease. Inspect for cracks in castings, and for bowed or bent tubes. Do not immerse ball bearings in cleaning fluid or solvent. Wipe them off with a clean dry cloth. These bearings are packed with grease on assembly, and will require no lubrication.

(*f*) MAINTENANCE REPAIRS AND REPLACEMENTS.—Do not repair any parts of the control assembly. Replace worn or damaged parts.

(*g*) ASSEMBLY, AILERON-ELEVATOR CONTROL ASSEMBLY.—Reverse disassembly procedure, paragraph (2)(*d*) preceding. Identical rivets must be used in assembling the riveted parts. Before installation of rubber rear pressure seal, fill area between fins on inside of seal with grease, Specification AN-G-6. Install seal on elevator push-pull tube from forward end with fins of seal pointing forward.

(3) BOOSTER UNIT. (*See figure 133.*)

(*a*) DESCRIPTION.—The aileron booster unit consists of an actuating cylinder, a control valve, a filter, and a mechanical linkage. These are mounted on a triangular casting which is attached to the wing rear beam with three bolts. The unit is connected to the control stick by torque tubes and push rods. (See figure 130.) Access to the booster unit is through the engine compartment lower access doors. During normal operation, the booster cylinder exerts most of the operating force. A small amount of stick force imparts a slight movement to the ailerons and starts the booster in operation. This direct movement provides "feel" of the aileron for the pilot.

(*b*) NORMAL OPERATION. See paragraph 16*f*(2), this section.

(*c*) MANUAL OPERATION.—See paragraph 16*f*(2), this section.

(*d*) REMOVAL. (*See figure 133.*)

*1.* Discharge the hydraulic pressure in the accumulator by operating the ailerons.

*2.* Switch off the booster shut-off valve.

*3.* Loosen aileron cables at the turnbuckles adjacent to the control unit.

*4.* Remove the booster shield, if one is installed.

*5.* Remove the fuselage fuel tank vent line.

*6.* In the right main wheel well, remove nuts from two bolts attaching booster unit to the wing rear beam. Unscrew one bolt attaching left side of the booster unit to the beam. Bolt is held by an internal threaded plate attached to the beam.

*7.* Pull unit and bolts from the beam.

(*e*) DISASSEMBLY.

*1.* Remove all hydraulic tubing from the booster unit.

*2.* Remove the filter from the aft casting.

*3.* Remove the bolt attaching the linkage to the control valve.

*4.* Remove the nuts attaching the control valve to the supports, and remove the valve.

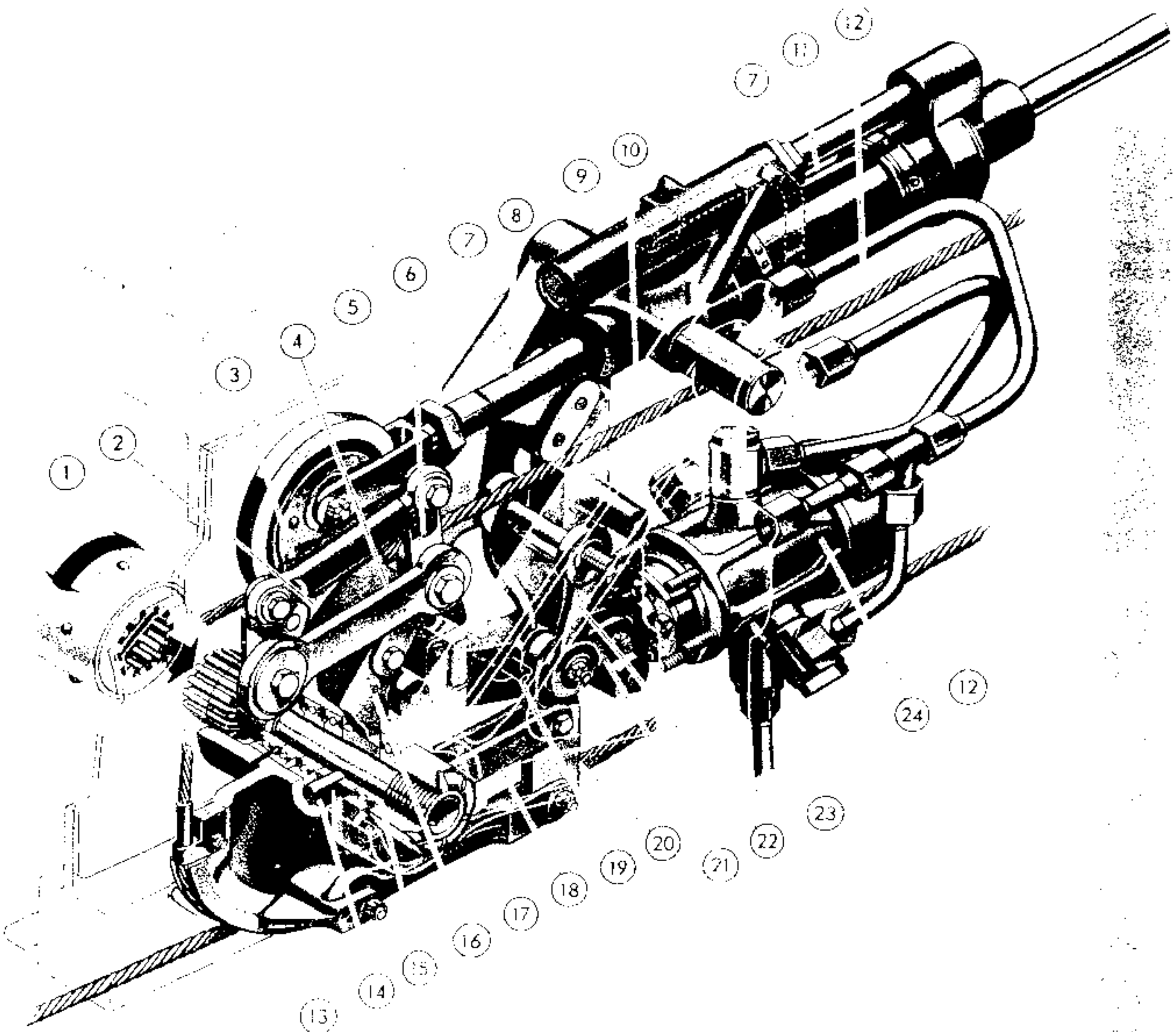
*5.* Remove the bolt holding the valve-shaft alignment link to the supports.

*6.* Remove the bolts that hold the two halves of the triangular support together, and remove the aft half of the support.

*7.* Remove the cylinder and drain the assembly.

*8.* Remove the bolt attaching the piston rod clevis to the drum, and separate the cylinder from the drum assembly.

*9.* Remove the bolts at each end of the spring cartridge and the feel linkage.



| | | | |
|---|---|---|---|
| 1 | AILERON TORQUE TUBE | 13 | WING REAR BEAM |
| 2 | FEEL ARM | 14. | TAPER PIN |
| 3 | SPRING CARTRIDGE | 15. | SHAFT |
| 4 | FEEL LINK | 16. | OPERATING ARM |
| 5. | DRUM | 17. | VALVE LINK, LOWER |
| 6 | OPERATING ARM EXTENSION | 18. | VALVE LINK, UPPER |
| 7 | JAM NUT | 19 | CENTERING PIN |
| 8 | ACTUATING CYLINDER PISTON ROD | 20 | VALVE LINK, VERTICAL |
| 9 | SUPPORT CASTING, FORWARD | 21. | LINK |
| 10 | SUPPORT CASTING, AFT | 22 | SUPPORT LINK |
| 11 | ACTUATING CYLINDER | 23 | FLUID FILTER |
| 12 | AILERON CABLE | 24 | CONTROL VALVE |

*Figure 133 — Aileron Booster Unit*

*10.* Remove the bolts from the parallel linkage.

*11.* Remove the bolts from the drum cable locks, and remove the cables.

**Note**

For disassembly of the booster control valve and cylinder, see paragraphs 16*c*(3) and (4), this section.

*(f)* CLEANING.—Wipe accumulated dirt and grease from all parts. Inspect all parts for wear. Do not use cleaning fluids to clean parts equipped with sealed ball bearings. Mask off bearings to prevent entrance of dirt and foreign matter during cleaning operation.

*(g)* MAINTENANCE REPAIRS AND REPLACEMENTS.—Do not attempt to repair the mechanism. Replace all damaged or worn parts. Bearing races must be securely staked. All bearings must turn freely in their races. Repack spring cartridge (figure 167) at booster overhaul, with grease, Specification AN-G-15. See paragraphs 16*f*(3)*(d)* and 16*f*(4)*(d)* for maintenance of the control valve and booster cylinder.

(4) BOOSTER TO AILERONS. *(See figure 130.)*

*(a)* DESCRIPTION.—Cables and pulleys are employed for this portion of the aileron control system. All cables are ¼-inch 7 x 19 extra flexible.

*(b)* REMOVAL.

*1.* Detach the turnbuckles.

*2.* Remove the clips attaching cables to the aileron drum and the booster drum.

*3.* Remove the metal-clad cables through inspection door No. 19. (See figure 7.)

*4.* Remove pulleys and the push-pull tube.

**Note**

If more than six wires are broken in any inch length of cable, replacement of the cable is mandatory.

*(c)* INSTALLATION.—Reverse removal procedure. See paragraph *c*(5) following for adjustment.

(5) ADJUSTMENT OF AILERON CONTROL SYSTEM.

*(a)* Lock the control stick in vertical position and insert a ⅜-inch diameter centering pin through the booster assembly bracket and booster drum.

*(b)* Disconnect the pressure port fitting from the booster valve, and center the valve piston with a ¼-inch diameter centering pin.

*(c)* Insert a ¼-inch diameter centering pin in the aileron drums in the wing. (See figure 130.)

*(d)* Rig the aileron control cables to 400 ($\pm$25) pounds tension, and adjust the cables so that all centering pins slide in and out of the holes freely.

*(e)* With the centering pins still in place, adjust the aileron push-pull rod (8, figure 130) so that the aileron control surfaces are in neutral position.

*(f)* Unlock the control stick and remove the centering pins from the booster assembly bracket and the aileron drum. Leave the centering pin in the booster valve.

*(g)* Set the cockpit stops to limit aileron travel to 20 degrees ($\pm$2 degrees) up from neutral and 20 degrees ($\pm$2 degrees) down from neutral. After setting the stops, inspect aileron counterweights with aileron in both the up and down positions to be sure the counterweights do not strike the wing skin. If a counterweight strikes the wing skin, readjust the stop to restrict the aileron travel enough so the counterweight will not strike the wing skin. Total allowable play in aileron is 1/16 inch measured at trailing edge of surface.

*(h)* Disconnect the booster piston clevis from the booster drum.

*(i)* Move the control stick to the extreme left position, and with the booster cylinder piston fully extended to the left, adjust the clevis on the piston so that the attaching bolt slides into place freely.

*(j)* Move the control stick to the extreme right to see whether full travel is obtained. If it is not, adjust the cylinder barrel length to give correct travel. To do this, loosen the cylinder barrel lock nuts with hook spanner wrench No. S-20612-2, and turn the cylinder barrel with a strap wrench to increase or decrease the distance between the end caps.

*(k)* Lock the clevis with the jam nut, remove the centering pin from the booster valve, and connect pressure line to port.

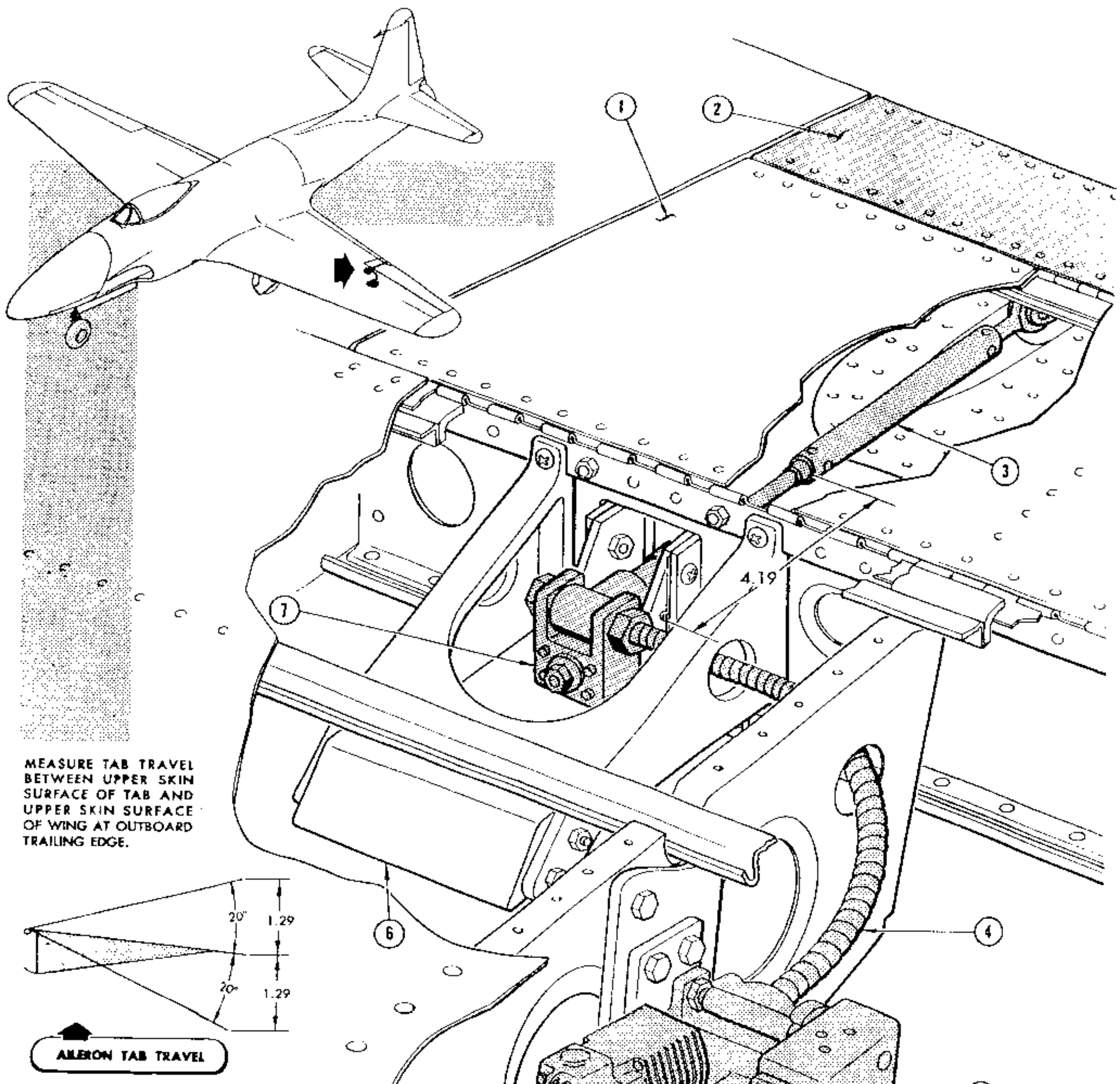
(6) AILERON TAB CONTROL. *(See figure 134.)*

*(a)* DESCRIPTION.—The left aileron is equipped with an electrically operated trim tab. Tab movement is controlled by a two-way switch on the left side shelf of the cockpit. The actuating motor on the wing rear beam is described in paragraph 17*m*(2), this section. The actuating unit is mounted on the front face of the aileron beam with the inboard balance-weight bracket. The motor actuates the unit by means of a flexible shaft. A worm-and-pinion gear unit (7) extends and retracts shaft (3) which operates the trim tab. Tab travel is controlled by limit switches described in paragraph 17*m*(2)*(b)*, this section.

*(b)* REMOVAL OF TAB JACK UNIT.

*1.* Remove the aileron from the wing. (See paragraph 1*e*(2), this section.)

*2.* Remove the inboard balance-weight bracket.




| | |
|---|---|
| 1. | AILERON |
| 2. | AILERON TAB |
| 3. | AILERON TAB JACK SCREW |
| 4. | FLEXIBLE DRIVE SHAFT |
| 5. | ACTUATOR UNIT |
| 6. | AILERON COUNTERWEIGHT |
| 7. | RIGHT ANGLE DRIVE |

*Figure 134 — Aileron Tab Actuator System*

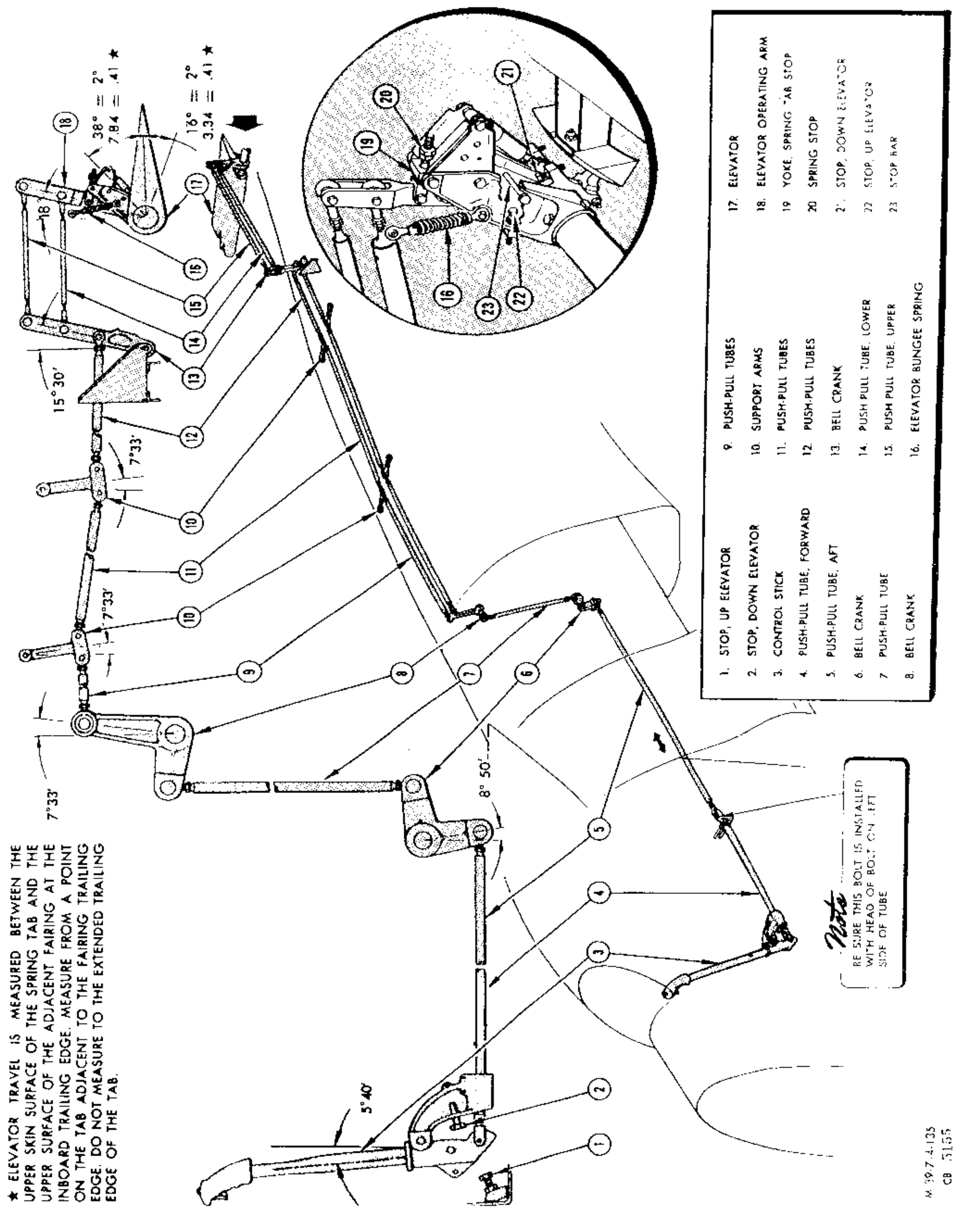



*Figure 135 — Elevator Control System*

*3.* Detach shaft (3) from aileron tab.

*4.* Remove counterweight bracket by removing four screws.

*5.* Remove tab jack unit from the aileron.

*(c)* MAINTENANCE REPAIRS AND REPLACEMENTS.—Do not repair damaged tubes (3), but remove attaching rivets and install a new tube. Replace with ⅝ x 0.065 24S-T aluminum alloy tubing the length of the original tube.

*(d)* INSTALLATION AND ADJUSTMENT.

*1.* The dimension from mounting lugs to the forward end of the riveted tube on the jack screw shaft should be 4$\frac{3}{16}$ inches.

*2.* If the distance is not 4$\frac{3}{16}$ inches, adjust as follows: Unscrew cap and lift out the key. Turn operating shaft (3) until the dimension is 4$\frac{3}{16}$ inches. Replace the key in the slot so that the shaft will not turn, and replace cap.

*3.* Place unit in position in aileron, and secure it to the forward face of aileron beam with brackets.

*4.* Replace the inboard aileron balance weight.

*5.* Mount the aileron on the wing. (See paragraph 1*e*(3), this section.)

*6.* Clamp tab in neutral so that trailing edge of aileron is even with trailing edge of aileron tab.

*7.* Rotate shaft until the attaching bolt will slide freely through the holes in shaft and the tab horn.

*8.* Insert the attaching bolt and safety it in place.

*9.* Remove the clamp installed in step 6 preceding.

*10.* Adjust both limit switches to open the motor circuit so that tab travel will be 20 degrees up and 20 degrees down.

*11.* Maximum allowable tab play (measured at outboard trailing edge) is $\frac{1}{16}$ inch for new units, ⅛ inch for service units.

(7) AILERON BEND TAB. — The right-hand aileron is equipped with a fixed bend tab. This tab is set at the factory and should require no further adjustment. If wing heaviness occurs in service, all rigging should be thoroughly checked to determine the cause. The left-hand aileron trim tab may be offset up to ¼ inch in either direction (measured at the aileron outboard trailing edge) to compensate for wing heaviness. If it becomes necessary to adjust the bend tab, the aileron trailing edge must be firmly supported to prevent warping. The tab must not be bent to more than 45 degrees off the aileron chord line.

*d.* ELEVATOR CONTROLS. *(See figure 135.)*

(1) DESCRIPTION.—The elevators are controlled by a series of push-pull tubes and bell cranks. A bungee spring device (16) provides supplemental boost to the elevators, coincident with stick action, at elevator positions above or below neutral. All push-pull tubes are 24S-T aluminum alloy with the exception of push-pull tubes (4 and 15) which are NE8630 steel. Terminals at tube ends have self-aligning sealed ball bearings. A $\frac{3}{16}$-inch diameter drain hole is drilled through one wall of the bungee body, centered approximately 1.25 inches from the flanged end and 90 degrees from the slot in the body.

(2) OPERATION.—Fore-and-aft motion of the stick moves push-pull tube (4). Push-pull tube (4) moves within the aileron torque shaft and is held in alignment by two rollers. Motion is transmitted through push-pull tubes (4, 5, 7, 9, 11, 12, 14, and 15). Push-pull tubes are suspended by bell cranks (6 and 8) and arms (10) at points of direction change. The parallel push-pull tubes (14 and 15) connect bell crank (13) to operating arm (18) which in turn is connected to the elevators through a spring-loaded linkage. Elevator movement is restricted by stops at the elevator horn assembly and at the base of the control stick.

(3) QUICK DISCONNECT. — Remove bolts attaching tubes (9) to arms (10) before detaching the aft fuselage.

(4) REMOVAL AND DISASSEMBLY.

*(a)* REMOVAL OF PUSH-PULL TUBES.—Remove tubes (5, 7, 9, 11, 12, 14, and 15) by removing the attaching bolts. Removal of tube (4) is described in paragraph *c*(2)*(c)* preceding.

**Note**

Upon reassembly of tubes, make sure all attaching bolts are installed to give maximum clearance between bolts and the aircraft structure, or between control rods.

*(b)* REMOVAL OF BELL CRANKS AND ARMS.—Remove any bell crank or arm by disengaging the attaching bolt.

*(c)* REMOVAL OF ELEVATOR BUNGEE SPRING.

*1.* Place elevator in down position.

*2.* Remove push-pull tubes connected to elevator actuator arm.

*3.* Compress spring slightly and remove spring assembly by removing screws through upper and lower attaching brackets.

**CAUTION**

Full control of the spring must be maintained at all times in order to avoid possible injury to personnel.

(5) ELEVATOR TAB CONTROLS.

*(a)* DESCRIPTION.—Two sets of elevator tabs are provided. One set is electrically operated and used primarily for trim purposes, although there is some servo action. The other set is spring-loaded to apply servo assistance to the elevators during certain conditions of elevator travel.

*(b)* ELECTRICALLY OPERATED TABS. *(See figure 136.)*

*1.* DESCRIPTION.—The electrically operated tabs are mounted outboard of the spring-loaded tabs, and are operated by an electric motor and flexible shafts. The motor is mounted on the right side of the aft fuselage at fuselage station 344. Power from the motor is transmitted by a single flexible shaft to a "T" drive at the stabilizer rear spar. Flexible shafts extend from the "T" drive to the right and left tab actuating units. The tab actuating units are mounted on brackets on the aft side of the stabilizer rear spar, and are worm-and-pinion driven. The tab actuating motor is controlled by a switch mounted on the control stick. For electrical information on the actuator, see paragraph 17*l*, this section.

*2.* OPERATION.—DELETED.

*3.* REMOVAL AND DISASSEMBLY.

a. Remove the elevator. (See paragraph 2*b*(2), this section.)

b. Remove the bolt that attaches the end of the actuating shaft to the elevator tab.

c. Detach flexible shaft from the elevator.

d. Detach flexible shaft and "T" from the structure.

e. Remove electrical units. (See paragraph 17*l*(2)*(c)*, this section.)

*4.* MAINTENANCE REPAIR AND REPLACEMENT.—Do not repair damaged shafts, but remove the attaching rivets and install new tubes. Replace with 5/8 x 0.065 24S-T aluminum alloy tubing the length of the original part.

*(c)* SPRING-LOADED TABS. *(See figure 137.)*

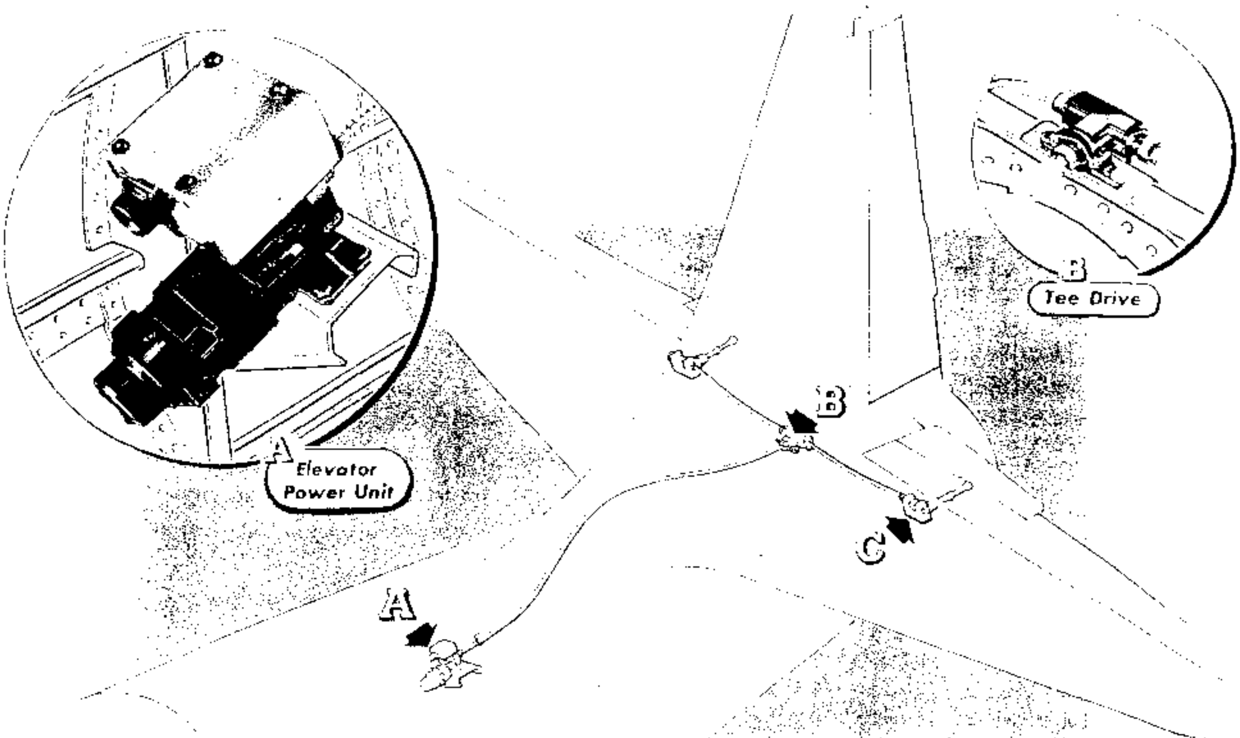
*1.* DESCRIPTION.—These tabs are adjacent to and inboard of the electrically operated tabs and are operated by control-stick action through the spring-loaded elevator control linkage. The purpose of the tabs is to apply servo assistance to the elevator when stick pressure is 5½ (±1) pounds. As the elevator air load increases, the deflection angle of the tab increases.

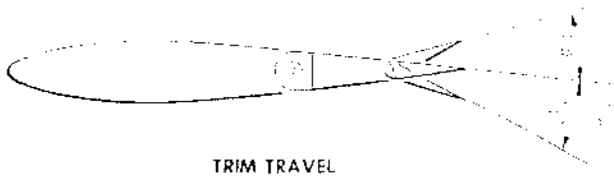
*2.* OPERATION.—Control-stick operation for elevator up or down position moves the elevator operating arm. Motion of the elevator operating arm actuates the tab horns through a link and bell crank, and simultaneously tends to compress the spring in the spring assembly. If the elevator air load is less than the compression value of the spring assembly, force is transmitted through the spring assembly to the elevator horn and bracket, thus operating the elevators and spring tab simultaneously. If elevator air loads begin to exceed the compression value of the spring assembly, continued motion of the elevator operating arm gradually compresses the spring and operates the tabs until the tabs deflect enough to develop the necessary boost to the elevator controls. If elevator air loads are strong enough to compress the spring fully, jam nuts engage the yoke, and stick pressure is transmitted directly to the elevator horns.

*3.* REMOVAL AND DISASSEMBLY.

a. Remove the elevator. (See paragraph 2*b*(2), this section.)

b. Remove the spring tabs. (See paragraph 2*b*(3), this section.)




ELEVATOR TRIM TAB TRAVEL IS MEASURED BETWEEN THE UPPER SKIN SURFACE OF THE TAB AND THE UPPER SKIN SURFACE OF THE ELEVATOR AT THE OUTBOARD TRAILING EDGE. MEASURE TO A POINT ON THE TAB ADJACENT TO THE ELEVATOR TRAILING EDGE, NOT TO THE EXTENDED TRAILING EDGE.

| | |
|---|---|
| 1 | GEAR NUT |
| 2 | CAP |
| 3 | OPERATING SHAFT |
| 4 | ACTUATING SHAFT |
| 5 | MOUNTING LUGS |
| 6 | BRACKETS |

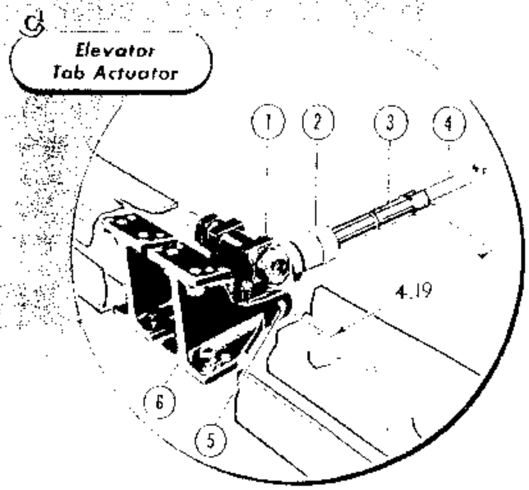
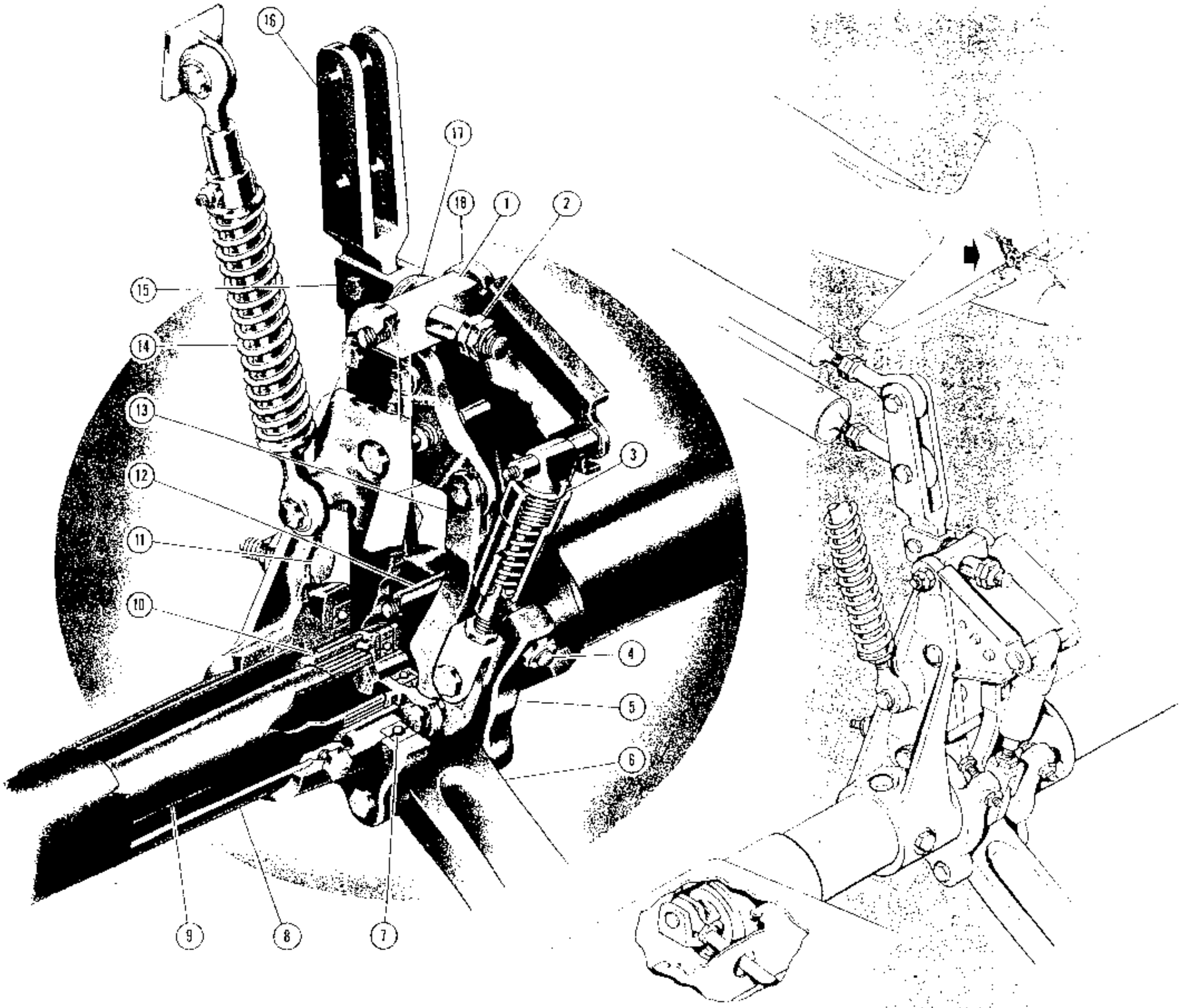
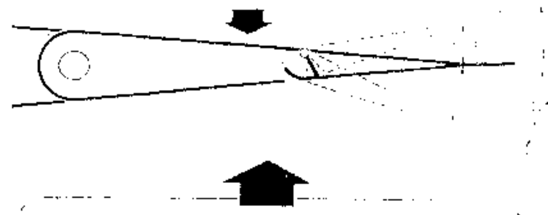



Figure 136 — Elevator Tab Actuator System




SPRING TAB TRAVEL



| | | | |
|---|---|---|---|
| 1. | STOP YOKE | 10 | NEEDLE BEARING |
| 2. | SPRING STOP | 11. | BOLT, ELEVATOR UP STOP |
| 3. | SPRING ASSEMBLY | 12 | STOP BAR |
| 4 | BOLT, ELEVATOR DOWN STOP | 13 | BELL CRANK |
| 5 | SUPPORT, TORQUE TUBE | 14 | BUNGEE SPRING |
| 6 | BRACE | 15 | CLEVIS BOLT |
| 7 | BALL BEARING | 16 | ELEVATOR OPERATING ARM |
| 8. | ELEVATOR TORQUE TUBE | 17 | WASHERS |
| 9 | SPRING TAB TORQUE TUBE | 18 | ELEVATOR HORN |

MEASURED BETWEEN UPPER SURFACE OF TA[illegible] UPPER SURFACE OF ADJACENT FAIRING AT IN[illegible] TRAILING EDGE

ALLOWABLE PLAY IN ELEVATOR SPRING TAB [illegible] 1.0[illegible] FORWARD OF INBOARD TRAILING ED[illegible] TOTAL - TOTAL PLAY MUST BE FROM ACCUMULATED TOLERANCES, BUT WILL NOT BE ACCEPTABLE IF RESULTING FROM LOOSENESS IN ONLY ONE CONNECTION

*Figure 137 — Elevator Spring Tab Mechanism*

c. Disconnect push-pull tubes from the elevator actuating arm.

d. Remove the bungee spring.

**CAUTION**

Be careful to maintain control of bungee spring during its removal.

e. Disassemble the elevator spring-tab mechanism by removing four bolts through the elevator horns, four elevator stop bolts, and then remove elevator horns, sheet-metal brackets, spring assembly, elevator operating arm, and tab horns, in that order.

*4.* INSTALLATION. — Reverse removal procedure. When installing the elevator, hold the spring tab in neutral so that the serrations line up when the four attaching holes in the elevator torque tube and elevator horn are in line.

(6) ELEVATOR CONTROL SYSTEM ADJUSTMENT. *(See figure 135.)*

*(a)* ELEVATOR CONTROLS.

*1.* Lock the control stick in neutral (5 degrees 40 minutes forward of vertical, and 90 degrees to the floor laterally).

*2.* Lock elevator control surface and spring tabs in neutral.

*3.* Adjust push-pull tube (5) so that bell crank (6) is 8 degrees 50 minutes aft of vertical.

*4.* Adjust push-pull tube (7) so that bell crank (8) is 7 degrees 33 minutes aft of vertical.

*5.* Adjust push-pull tubes (9) so that support arms (10) are 7 degrees 33 minutes aft of lateral.

*6.* Adjust push-pull tubes (12) so that bell crank (13) is 15 degrees 30 minutes aft of vertical.

*7.* Adjust push-pull tubes (15 and 14) so that attaching bolts slide freely in place at both bell cranks.

*(b)* ELEVATOR SPRING TAB CONTROLS. *(See figure 137.)*

*1.* Secure elevator control surface in neutral position.

*2.* Adjust spring-tab push rods so that the spring tab surfaces are in neutral.

*3.* Adjust clevis (15) to allow 10 degrees tab up travel from neutral, and 22 degrees tab down travel from neutral. Adjust tab up travel by adding or removing washers (17) at the forward end of the clevis bolt. Adjust the tab down travel by changing the position of the spring stop jam nuts (2) on the aft end of the clevis bolt.

*4.* With tab in neutral, set stops (4 and 11) to allow 38 degrees ($\pm 2$ degrees) elevator up travel and 16 degrees ($\pm 2$ degrees) elevator down travel.

*5.* Set stops in cockpit to allow clearance of $\frac{1}{16}$ inch ($\pm\frac{1}{32}$ inch) after stops (4 and 11) have been contacted for up and down elevator travel, and after spring tab has been fully deflected.

*6.* Block elevator control surface in neutral, and move the control stick slightly to determine the force necessary to start movement of the spring tab. Use a spring scale. The force required should be $5\frac{1}{2}$ pounds ($\pm 1$ pound). If the force required is more than $6\frac{1}{2}$ pounds, check the entire system for excessive friction.

*7.* If replacement of the bungee spring is necessary, adjust the spring assembly so that the distance from the center of the bolt on the rod end to the shoulder of the sleeve is 1.02 inches. No other adjustment is necessary.

*8.* Maximum allowable play (measured one inch forward of the inboard trailing edge) is $\frac{1}{16}$ inch total. Total must be from accumulated tolerances, and will not be acceptable if resulting solely from looseness in any one connection, particularly at push-rod end to tab connection.

*(c)* ELEVATOR TRIM TAB CONTROLS.

*1.* Turn battery switch "ON."

*2.* Hold trim-tab switch forward (nose down) until actuator reaches its fixed limit (tab up). If necessary, disconnect the flexible drive shaft at the actuator and turn shaft by hand until 15 degrees tab up travel (from neutral) is obtained (measured at the inboard end of the tab with the elevator in neutral).

*3.* With the flexible shaft connected, operate the tab switch aft (nose up) until 25 degrees tab down travel from neutral is obtained, and set the limit switch in the actuator. (See paragraph 17*l*(2)*(b.)*

*4.* Run the tab back to neutral with the tab switch, and set the tab neutral switch in the actuator so that the tab neutral light is on.

*5.* Maximum allowable tab play (measured at the outboard trailing edge) is $\frac{3}{64}$ inch for new units, $\frac{1}{8}$ inch for service units.

*e.* RUDDER CONTROL SYSTEM. *(See figure 138.)*

(1) RUDDER PEDALS. *(See figures 139 and 140.)*

*(a)* DESCRIPTION. — The rudder pedals are suspended from two outboard brackets attached to the upper fuselage longerons, and two inboard brackets attached to the pedal support bracket. Two arms (13)

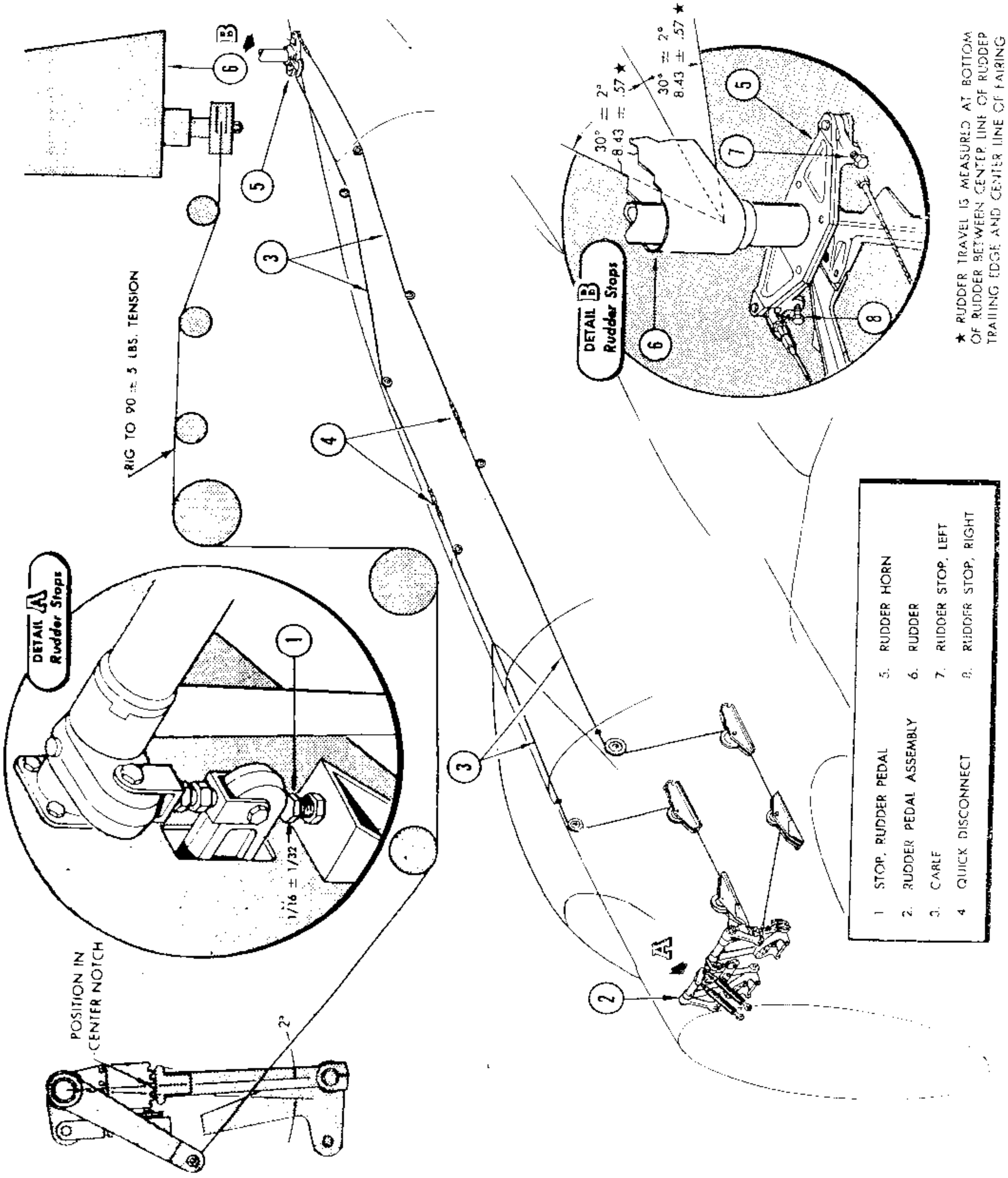
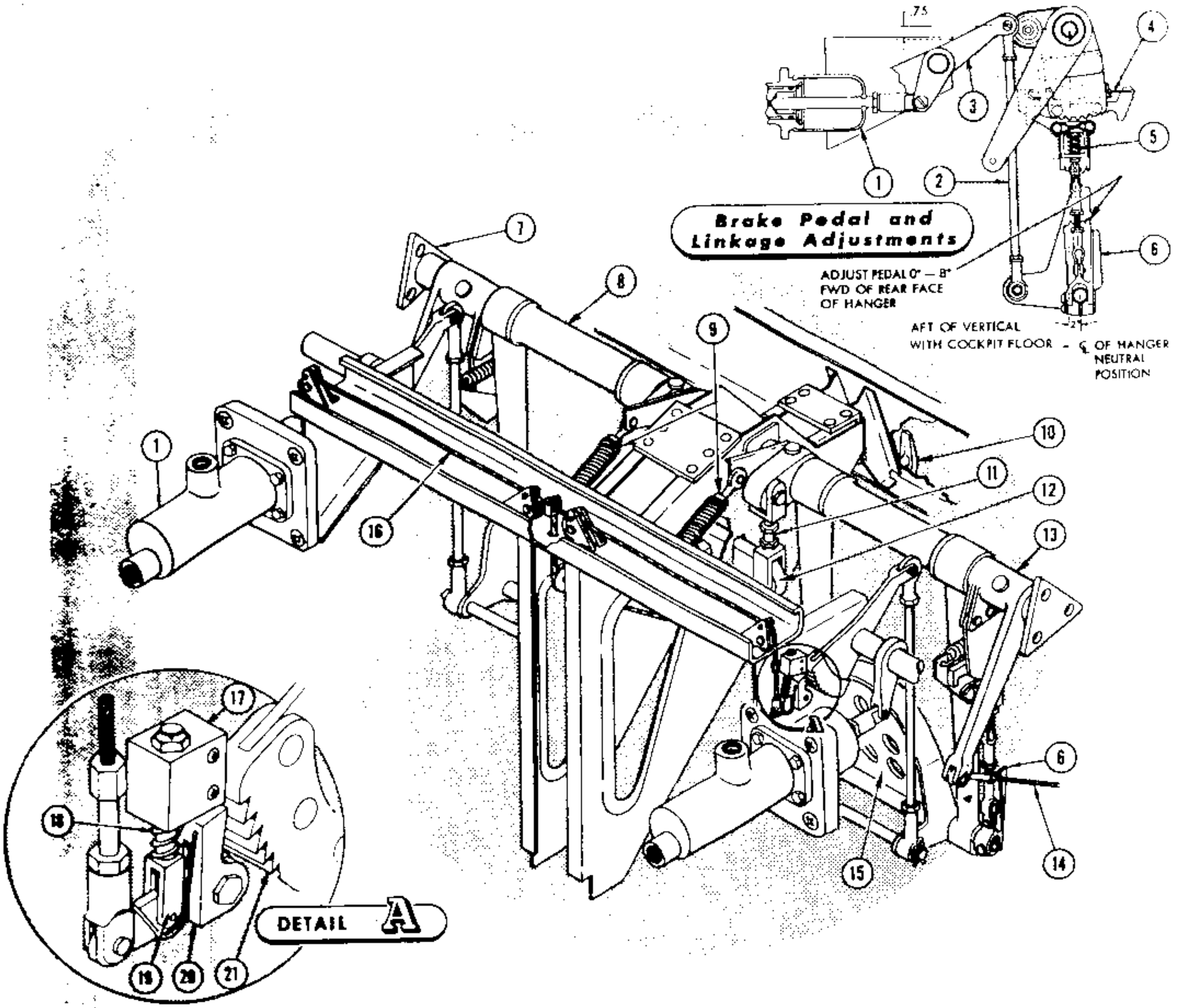



*Figure 138 — Rudder Control System*




| | | | |
|---|---|---|---|
| 1 | BRAKE CYLINDER | 12. | WALKING BEAM |
| 2. | BRAKE ROD | 13. | ARM ASSEMBLY |
| 3 | BELL CRANK | 14. | CABLE |
| 4. | SPRING | 15. | RUDDER PEDAL |
| 5 | LOCK ASSEMBLY | 16. | PARKING BRAKE CABLE |
| 6. | PEDAL ADJUSTING LEVER | 17. | GUIDE BLOCK |
| 7. | BRACKET | 18. | SPRING |
| 8 | PEDAL HANGER | 19. | CLEVIS |
| 9 | CENTERING SPRINGS | 20. | PAWL |
| 10 | PARKING BRAKE HANDLE | 21. | RATCHET |
| 11. | CONNECTING LINK | | |

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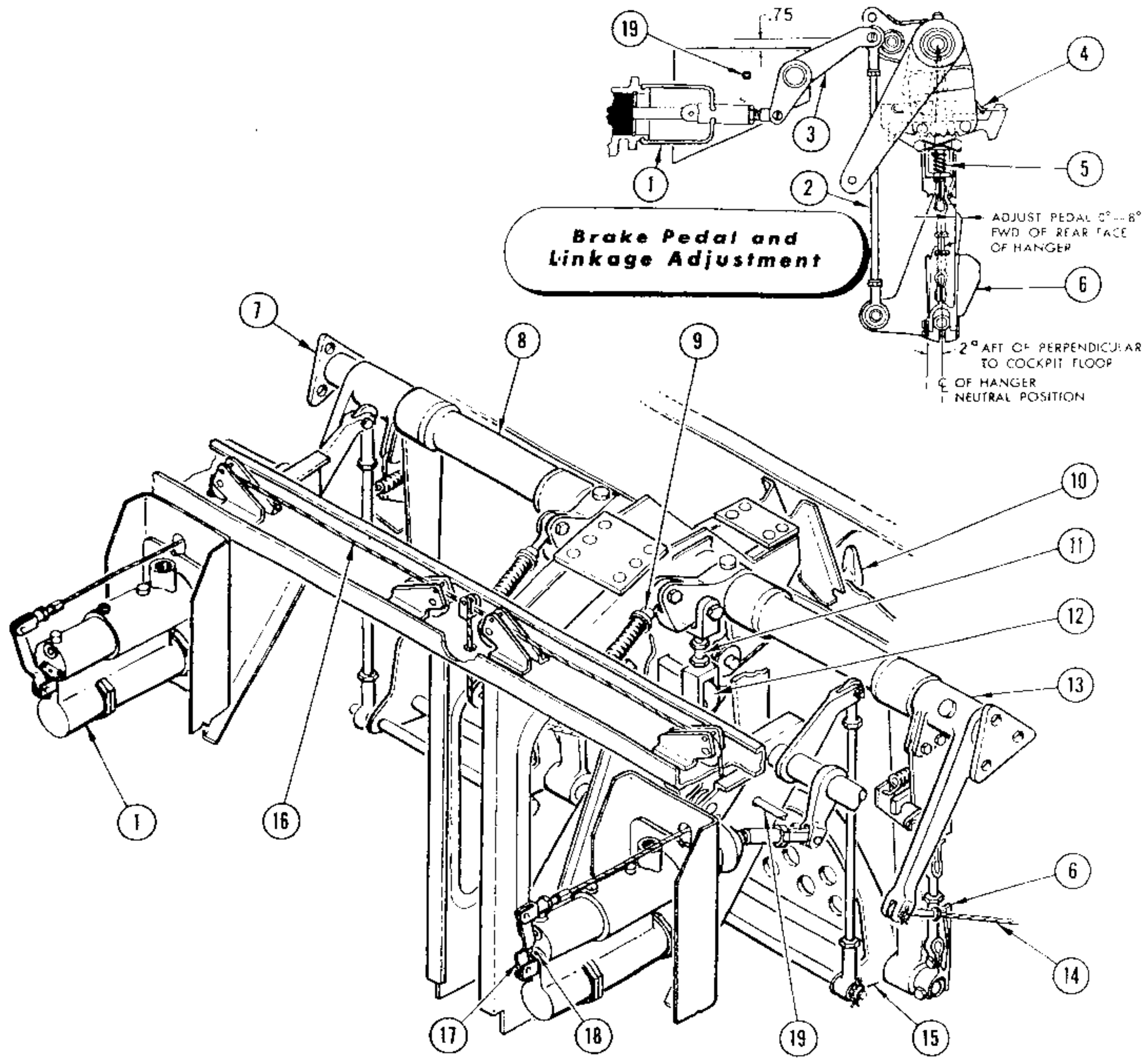
*Figure 139 — Rudder Pedal Installation, F-80A-1 Airplanes*




| | | | | | |
|---|---|---|---|---|---|
| 1. | BRAKE CYLINDER | 8. | PEDAL HANGER | 15. | RUDDER PEDAL |
| 2. | BRAKE ROD | 9. | CENTERING SPRINGS | 16. | PARKING BRAKE CABLE |
| 3. | BELL CRANK | 10. | PARKING BRAKE HANDLE | 17. | LEVER |
| 4 | SPRING | 11. | CONNECTING LINK | 18. | VALVE — PARKING BRAKE |
| 5. | LOCK ASSEMBLY | 12. | WALKING BEAM | 19. | STOP — BELL CRANK |
| 6. | PEDAL ADJUSTING LEVER | 13. | ARM ASSEMBLY | | |
| 7. | BRACKET | 14. | CABLE | | |

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*Figure 140 — Rudder Pedal Installation, F-80A-5 and RF-80A-5 Airplanes*

are riveted to hangers (8). The hangers are interconnected by links to the walking beam (12). Two spring assemblies (9) provide a centering device which automatically returns the rudder pedals to neutral when pressure is released. The pedals may be adjusted fore-and-aft by a side motion of the pilot's foot which moves lever (6) outboard. The lock assembly (5) may then be inserted in any of the five notches to accommodate the pilot's leg length.

*(b)* OPERATION. — The following describes the cycle of operation for left-rudder motion as viewed from the pilot's seat.

*1.* Depress left rudder pedal.

*2.* Left rudder arm (13) rotates forward, placing a tension load in cable (14).

*3.* Walking beam (12) rotates clockwise.

*4.* Right rudder arm and pedal swing back, since they are connected to the left pedal by walking beam (12).

*5.* Release pressure on the left pedal.

*6.* Neutralizing springs (9) return pedals to neutral.

*(c)* REMOVAL AND DISASSEMBLY.

*1.* Detach cables (14) from arms (13) by unscrewing turnbuckles and removing bolts.

*2.* Detach centering springs (9).

*3.* Disconnect rod (2) at the lower end.

*4.* Remove bolts that attach clevis to walking beam (12).

*5.* Remove bolts that attach inboard and outboard hanger-attaching brackets.

*6.* Swing walking beam attaching clevises out, then back and up.

*7.* Remove the rudder pedal assemblies by pulling them straight down.

(2) MAINTENANCE REPAIRS AND REPLACEMENTS, RUDDER CONTROLS.

*(a)* Inspect all parts for cracks, nicks, or bent tubes.

*(b)* Restake loose bearings. If the bearing does not turn freely in the race after staking, replace the bearing.

*(c)* Replace frayed cables when more than six wires are broken in any inch length of cable. (The 7 x 19 cable is composed of 7 strands of 19 wires each.)

*(d)* Replace cracked or damaged fittings and push-pull tubes.

*(e)* Replace push-pull tubes that are dented or noticeably bowed.

*(f)* There must be no twist in the cables.

*(g)* No more than one-degree pull-off is permitted; i.e., there must be no less than 0.003-inch clearance between the pulley flange and the cable. (See figure 129.)

*(h)* No more than three threads may show at either end of a turnbuckle. (See figure 129.)

(3) RUDDER CONTROLS, PEDALS TO RUDDER HORN. *(See figure 138.)*

*(a)* DESCRIPTION.—The rudder controls, from pedals to rudder horn, consist of a system of cables and pulleys. Pulleys are positioned at each point where the cable changes direction. Pulleys in the cockpit are made of micarta, and the pulleys aft of the cockpit aft bulkhead are made of aluminum alloy. A quick-disconnect fitting (4) connects the front and rear cables of each cable assembly at fuselage station 245. All cables are $\frac{3}{16}$-inch 7 x 19 extra flexible steel with swaged end fittings. Pressure seals are installed at the points where the cables pass through the cockpit aft bulkhead, to prevent loss of pressure in the cockpit.

*(b)* QUICK DISCONNECT. (See figure 141.)—A tension release fitting is installed in each rudder cable assembly to facilitate removal of the aft fuselage section.

*(c)* REMOVAL OF CABLES.

*1.* Detach the quick disconnect.

*2.* Disconnect forward cables at the rudder pedals.

*3.* Remove the pressure seals.

*4.* Remove the rudder cables.

*5.* Disconnect the aft cables at the rudder horn, and remove them.

*(d)* INSTALLATION. — Reverse removal procedure. Be sure that pressure seals are lubricated according to requirements on figure 26, and that the seal prevents leakage of air from the cockpit.

**Note**

Rudder cables must clear empennage fillets by $\frac{1}{8}$ inch.

(4) ADJUSTMENTS.

*(a)* Set walking beam parallel to the floor.

*(b)* Adjust walking-beam links to position pedal hangers 2 degrees ($\pm\frac{1}{2}$ degree) aft of perpendicular to cockpit floor.

**Note**

The pilot's leg-length adjustment must be in the center notch.

*(c)* Hold pedals in place with control lock. Loosen turnbuckles to relieve tension in cables.

*(d)* Secure rudder in neutral.

*(e)* Adjust cable turnbuckles and tension release fitting to 90 pounds (±5 pounds) tension.

*(f)* Safety the turnbuckles.

*(g)* Remove control lock from pedals.

*(h)* Release the rudder.

*(i)* Adjust rudder stops to allow 30 degrees (±2 degrees) travel in each direction from neutral.

*(j)* Place rudder against left-hand stop and adjust left-hand pedal stop at the walking beam to a clearance of 1/16 inch (± 1/32 inch).

*(k)* Repeat step *(j)* preceding for the right-hand stops.

*(l)* Lock rudder pedals in neutral.

*(m)* Adjust rudder centering springs so that the spring attaching bolts slide in place freely with the spring holding assembly in the fully extended position with no initial compression on the spring. The centering springs are adjusted by unscrewing the rod end which attaches to the bulkhead at fuselage station 103. Adjust in increments of 1/2 turn.

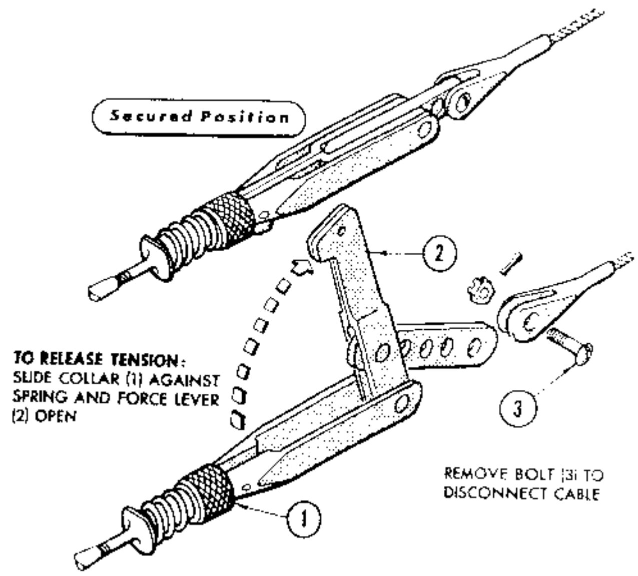



*Figure 141 — Rudder Cable Tension Release Fitting*

(5) RUDDER TAB.—The rudder is equipped with a fixed bend tab. Adjust this tab so that the airplane maintains a straight course, by bending the tab at its juncture with the rudder. Maximum allowable deflection of the tab is 3/16 inch in either direction, measured at the trailing edge.

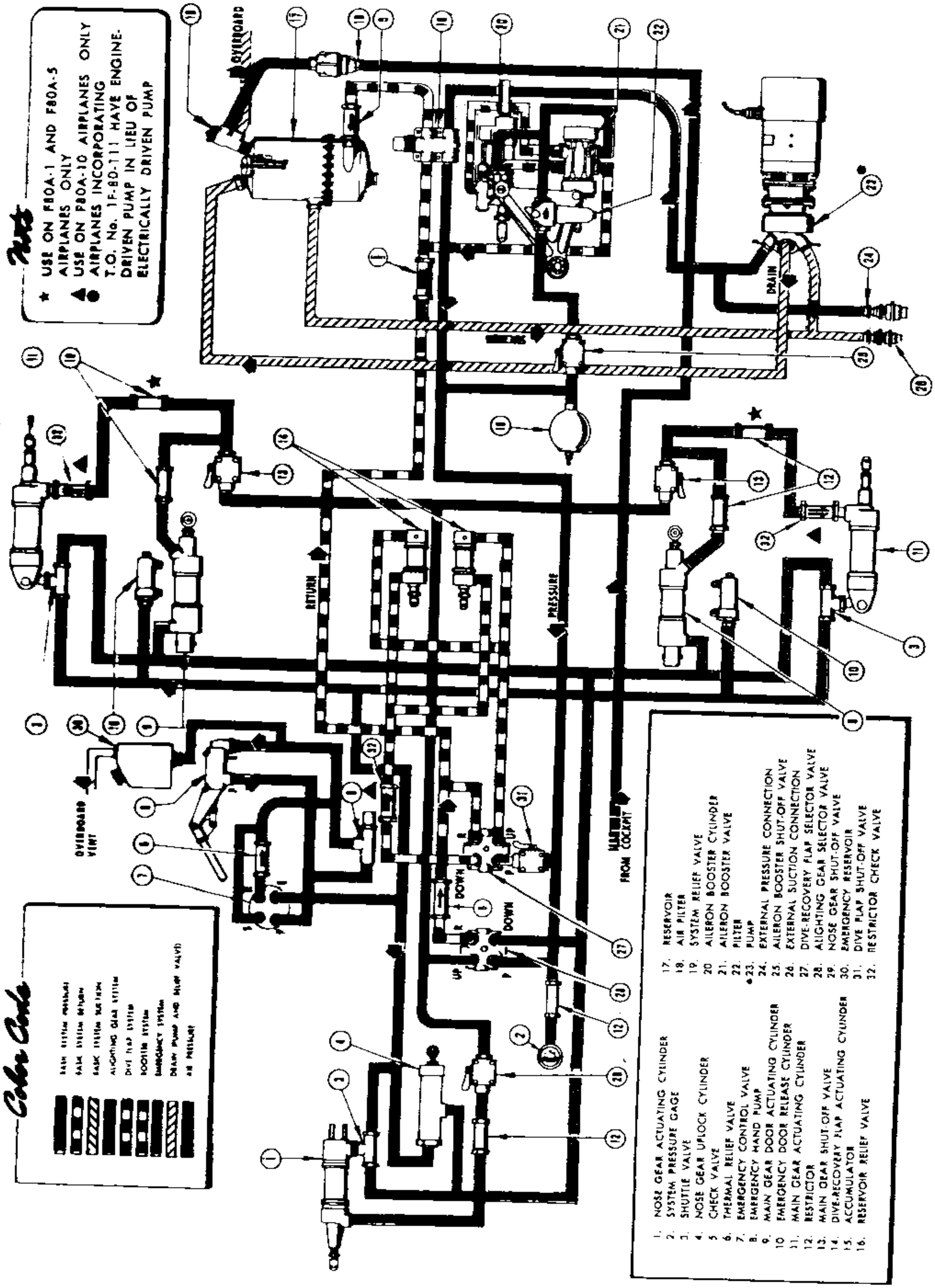



*Figure 142 — Hydraulic System Schematic Diagram, AF Serial No. 44-84992 through 44-85336*

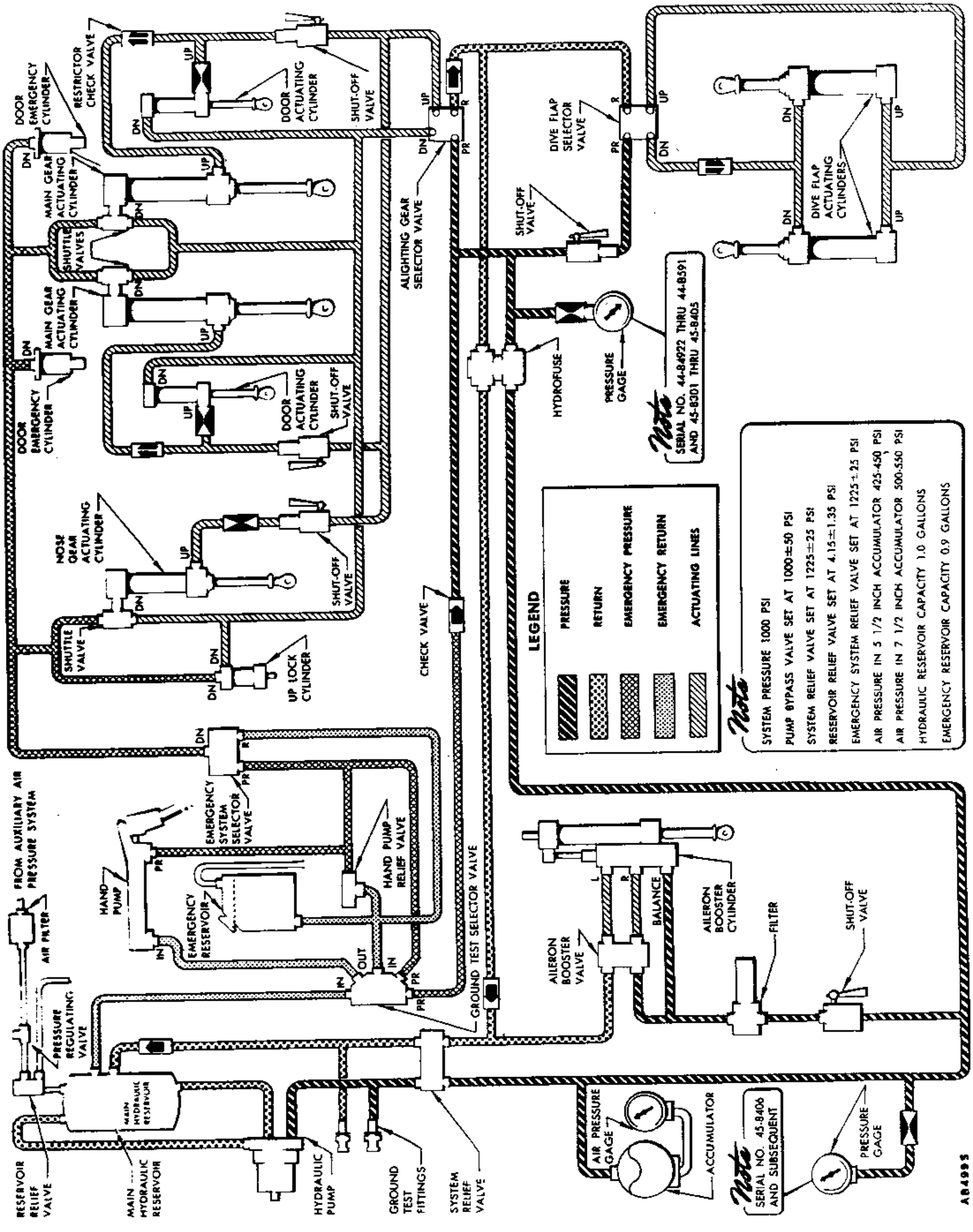



*Figure 142A — Hydraulic System Schematic Diagram, F-80A-10 and RF-80A-10 Airplanes*

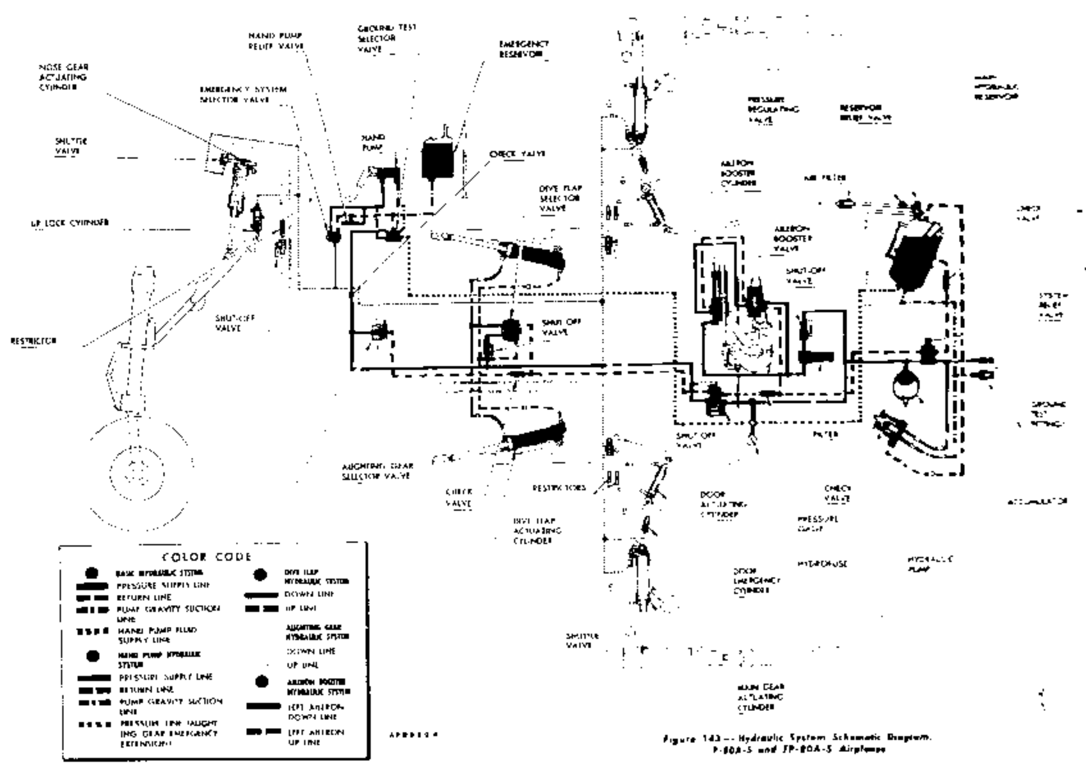
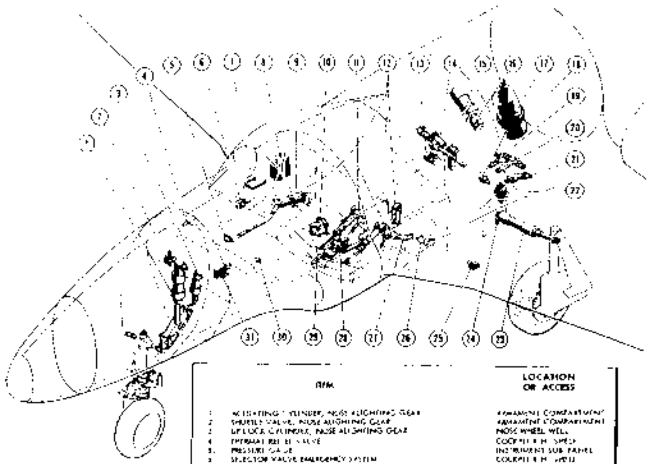



Figure 143 — Hydraulic System Schematic Diagram, P-80A-5 and FP-80A-5 Airplanes



| | ITEM | LOCATION OR ACCESS |
|---|---|---|
| 1 | ACTUATING CYLINDER, NOSE ALIGHTING GEAR | ARMAMENT COMPARTMENT |
| 2 | SHUTTLE VALVE, NOSE ALIGHTING GEAR | ARMAMENT COMPARTMENT |
| 3 | UPLOCK CYLINDER, NOSE ALIGHTING GEAR | NOSE WHEEL WELL |
| 4 | THERMAL RELIEF VALVE | COCKPIT R.H. SHELF |
| 5 | PRESSURE GAGE | INSTRUMENT SUB PANEL |
| 6 | SELECTOR VALVE EMERGENCY SYSTEM | COCKPIT R.H. SHELF |
| 7 | GROUND TEST SELECTOR VALVE (LATER AIRPLANES) | COCKPIT R.H. SHELF |
| 8 | EMERGENCY SYSTEM RESERVOIR | COCKPIT |
| 9 | EMERGENCY SYSTEM HAND PUMP | COCKPIT |
| 10 | SELECTOR VALVE, ALIGHTING GEAR | COCKPIT L.H. SHELF |
| 11 | ACTUATING CYLINDERS, DIVE FLAPS | DIVE FLAPS |
| 12 | [illegible] (LATER AIRPLANES ONLY) | L.H. WHEEL WELL |
| 13 | CONTROL VALVE, AILERON BOOSTER | PANELS [illegible] AND [illegible] |
| 14 | ACTUATING CYLINDER, AILERON BOOSTER | PANELS [illegible] AND [illegible] |
| 15 | FILTER, AILERON BOOSTER | PANELS [illegible] AND [illegible] |
| 16 | MAIN SYSTEM PUMP (ELECTRICALLY DRIVEN, AIRPLANES PRIOR TO AF SERIAL NO. [illegible] PRIOR TO [illegible] T.O. NO. [illegible]; ENGINE DRIVEN, AF SERIAL NO. [illegible] AND SUBSEQUENT AND PRIOR AIRPLANES, INCORPORATING T.O. NO. [illegible]) | PANEL [illegible] |
| 17 | SHUT-OFF VALVE, AILERON BOOSTER | PANEL [illegible] |
| 18 | MAIN SYSTEM RESERVOIR | PANEL [illegible] |
| 19 | GROUND TEST CONNECTION, PRESSURE | PANEL [illegible] |
| 20 | GROUND TEST CONNECTION, SUCTION | PANEL [illegible] |
| 21 | SYSTEM RELIEF VALVE | PANEL [illegible] |
| 22 | ACCUMULATOR | PANEL [illegible] |
| 23 | ACTUATING CYLINDERS, MAIN ALIGHTING GEAR | MAIN WHEEL WELL |
| 24 | SHUTTLE VALVE, MAIN ALIGHTING GEAR | MAIN WHEEL WELL |
| 25 | SHUT-OFF VALVE, MAIN ALIGHTING GEAR | MAIN WHEEL WELL |
| 26 | EMERGENCY RELEASE CYLINDER, MAIN GEAR DOORS | MAIN WHEEL WELL |
| 27 | ACTUATING CYLINDER, MAIN GEAR DOOR | MAIN WHEEL WELL |
| 28 | SELECTOR VALVE, DIVE FLAPS | DIVE FLAPS |
| 29 | SHUT-OFF VALVE, DIVE FLAPS | DIVE FLAPS |
| 30 | HYDRAULIC PRESSURE GAGE (LATER AIRPLANES) | INSTRUMENT SUB PANEL |
| 31 | SHUT-OFF VALVE, NOSE ALIGHTING GEAR | NOSE WHEEL WELL |

*Figure 144 — Hydraulic Units Location Diagram*

## 16. HYDRAULIC SYSTEM.

*(See figures 142, 142A, 143, and 144.)*

*a.* GENERAL DESCRIPTION.—The hydraulic system operates the nose and main alighting gears, the main gear inboard enclosure doors, the dive flaps, and the aileron booster. During system normal operation, hydraulic fluid is supplied by an engine-driven pump at 1000 ($\pm$ 50) psi pressure. A hand pump, with reserve supply of hydraulic fluid and separate lines, is provided for emergency extension of the alighting gear. On all F-80A- and RF-80A airplanes except the F-80A-1, the hand pump may also be used to supply pressure to all hydraulic units for ground testing. The system is serviced with hydraulic fluid, Specification MIL-O-5606. Capacity of the main system is approximately four gallons. The main system reservoir on airplanes serial Nos. AF44-84992 through 44-85336 is pressurized at cockpit pressure; on all other airplanes, it is pressurized from the engine compressor.

**Note**

Airplanes prior to AF Serial No. 44-85337 not incorporating T.O. No. 1F-80-111 have an electrically driven hydraulic pump.

If operation at ground temperature of less than —40° C ( —40° F) is expected, replace gland packings on hydraulic actuating cylinder piston rods with AN6227 packings.

### *b.* BASIC SYSTEM.

(1) DESCRIPTION.—The hydraulic basic system includes a pressurized fluid reservoir, a reservoir relief valve, a hydraulic pump, a system relief valve, an accumulator, external pressure and suction connections, and a pressure gage.

(2) RESERVOIR, AIRPLANES SERIAL NOS. AF44-84992 THROUGH 44-85336. *(See figure 145.)*

*(a)* DESCRIPTION.—The hydraulic fluid reservoir is located on the left side of the engine compartment. The reservoir is constructed in two detachable sections. A filter element is installed in the lower section to filter the return fluid. A spring-loaded poppet valve is provided to bypass the returned fluid should the filter become clogged. The suction outlet for the supply of fluid to the pump is located approximately midway up the tank. Two transparent plugs in the reservoir upper section give visual indication of "full" and "refill" fluid levels. A check valve installed at the return port prevents reverse flow of fluid at this port.

Access to the reservoir is through the left-hand auxiliary engine-air inlet door.

*(b)* REMOVAL AND DISASSEMBLY.

*1.* Drain fluid from reservoir by removing the plug in the bottom of the reservoir.

*2.* Disconnect all lines at the reservoir.

*3.* Remove bolts which attach reservoir to the mounting bracket, and remove the reservoir.

*4.* Remove relief valve at top of reservoir by loosening lock nut and unscrewing the valve.

*5.* Remove bolts which attach upper and lower sections of reservoir, and separate the two sections.

*6.* Remove diaphragm, gaskets, and seal rings.

*7.* Lift out filter element.

*8.* Disassemble poppet valve by removing two bolts at upper end of the valve.

*9.* Lift out guard and strainer at filler hole.

*(c)* CLEANING, INSPECTION, AND REPLACEMENTS.

*1.* Clean all parts, except filter element, with kerosene or naphtha.

*2.* Inspect gaskets and seal rings for deterioration or damage, and replace as required.

*3.* Replace filter element as necessary.

**Note**

In case of emergency when a new element is not available, the old element may be reinstalled after processing as follows:

Cover holes at each end of element with masking tape to prevent entrance of dirt while cleaning. Clean exterior of element with a solution of 50 percent benzine and 50 percent lacquer thinner, or with 100 percent chloroform. Use a soft hair brush and mild air blast. Do not use a wire brush or scraper. Take care not to damage convolutions of the element.

Inspect element for damage or holes by inserting a small light in the center and observing outer surface of element.

*4.* Inspect poppet valve for proper seating.

*(d)* MAINTENANCE REPAIRS. — The reservoir is lagged with $\frac{1}{16}$-inch thick, inch-wide asbestos strip which is coated with sodium silicate (water glass) U. S. Army Specification 4-1035A. This material must be replaced after repairing the reservoir.

*(e)* ASSEMBLY, TEST, AND INSTALLATION.

*1.* During assembly, be sure that seal rings are properly positioned in the baffle grooves.

*2.* Tighten external bolts evenly until they are snug.

*3.* Pressure-test reservoir at 30 psi.

*4.* Install reservoir and connect all lines.

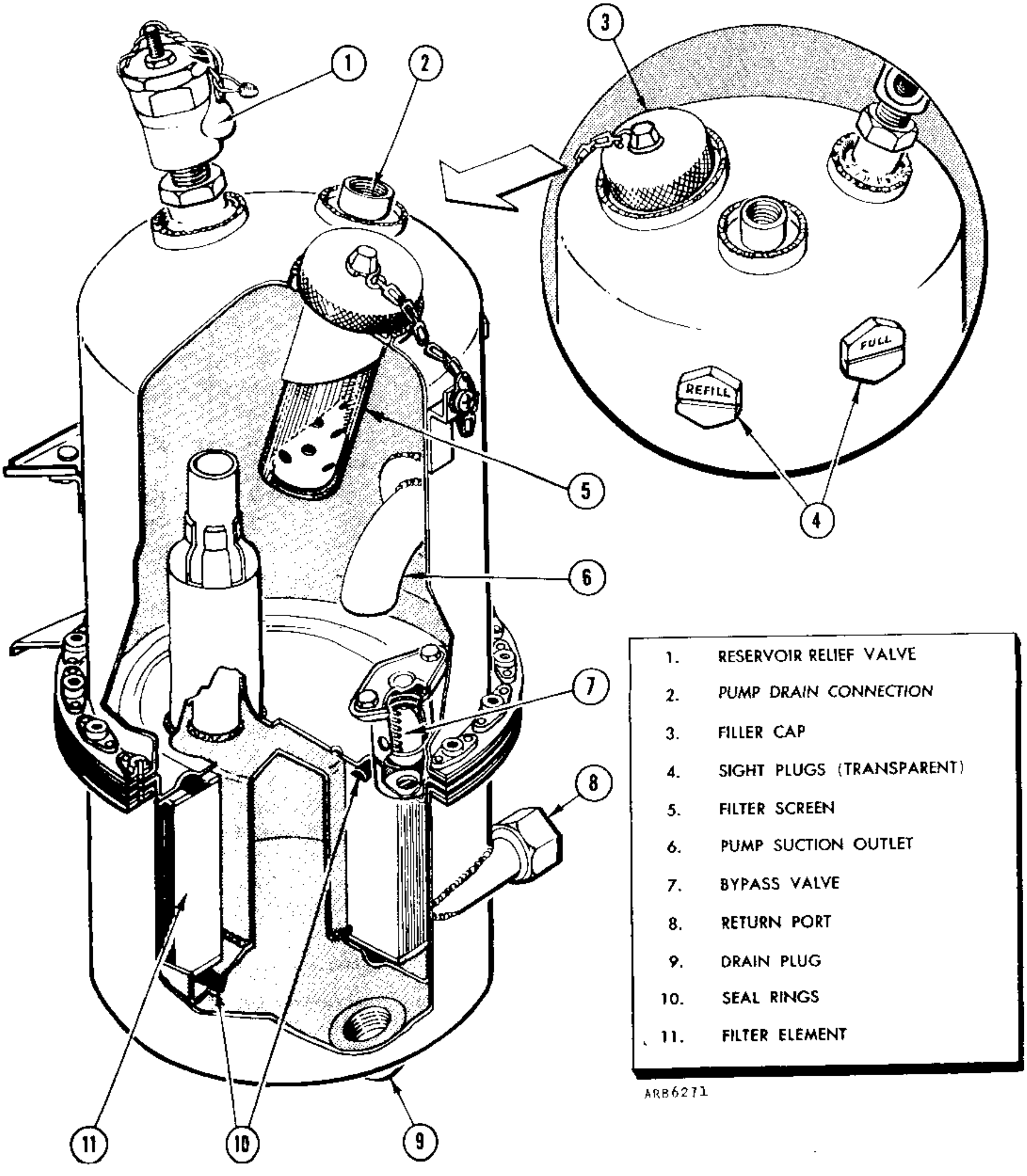
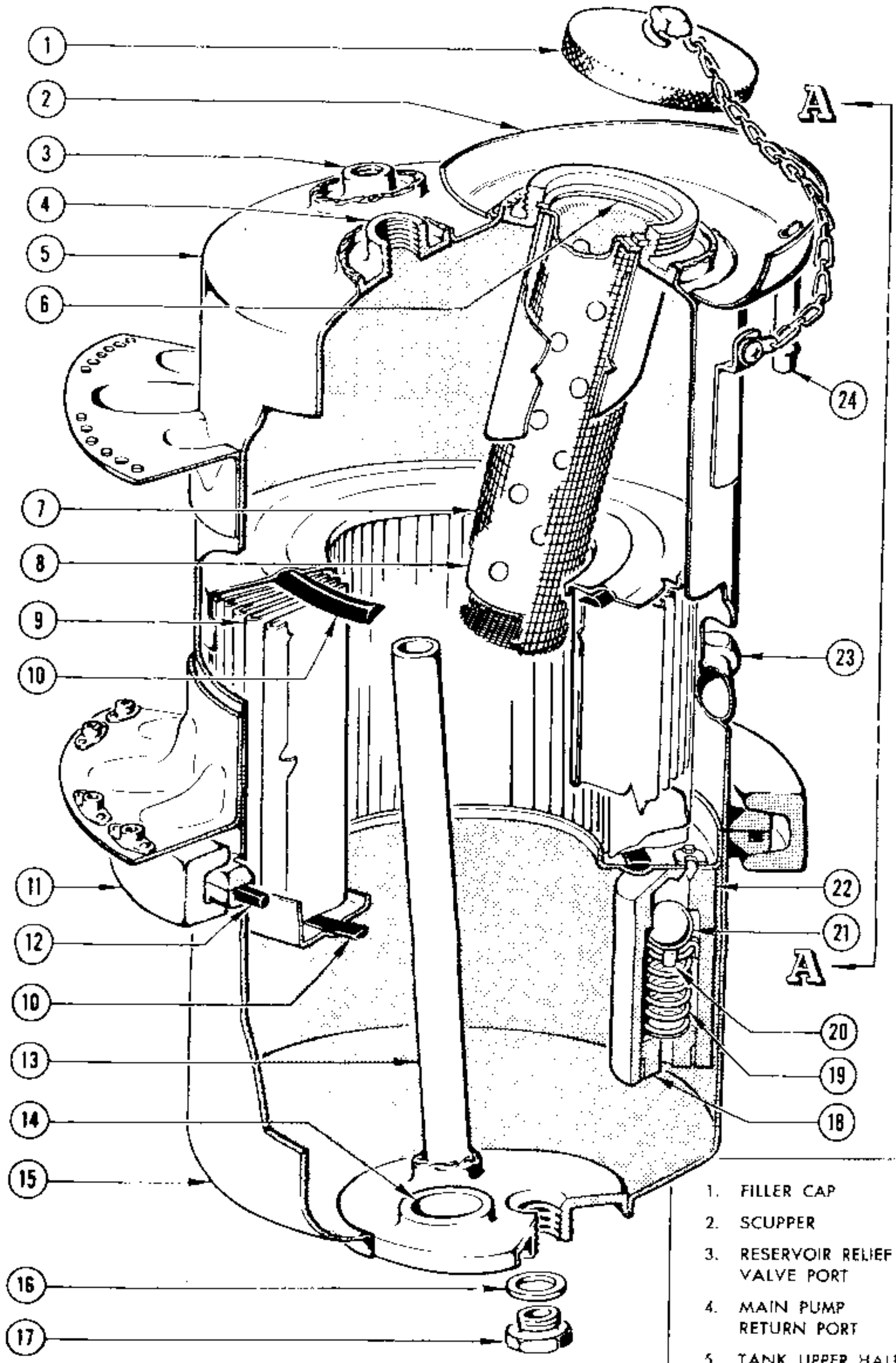
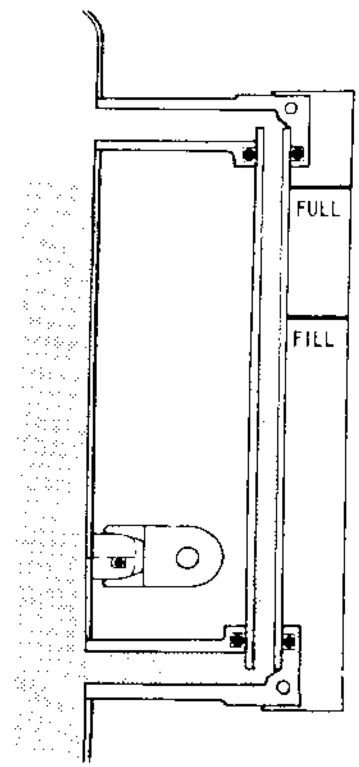



*Figure 145 — Main Hydraulic System Fluid Reservoir, Airplanes Serial Nos. AF44-84992 through 44-85336*




**FLUID LEVEL SIGHT GAGE VIEW A-A**

1. FILLER CAP
2. SCUPPER
3. RESERVOIR RELIEF VALVE PORT
4. MAIN PUMP RETURN PORT
5. TANK UPPER HALF
6. SNAP RING
7. STRAINER
8. GUARD
9. FILTER ELEMENT
10. SEAL
11. CLAMP
12. PACKING
13. STAND PIPE - HAND PUMP OUTLET
14. MAIN PUMP OUTLET
15. TANK LOWER HALF
16. GASKET
17. DRAIN PLUG
18. RETAINER
19. SPRING
20. BALL GUIDE
21. BALL (FILTER RELIEF VALVE)
22. BODY (FILTER RELIEF VALVE)
23. FLUID RETURN PORT
24. SCUPPER DRAIN TUBE

*Figure 146 — Main Hydraulic System Fluid Reservoir, Airplanes Serial Nos. AF44-85337 and Subsequent*

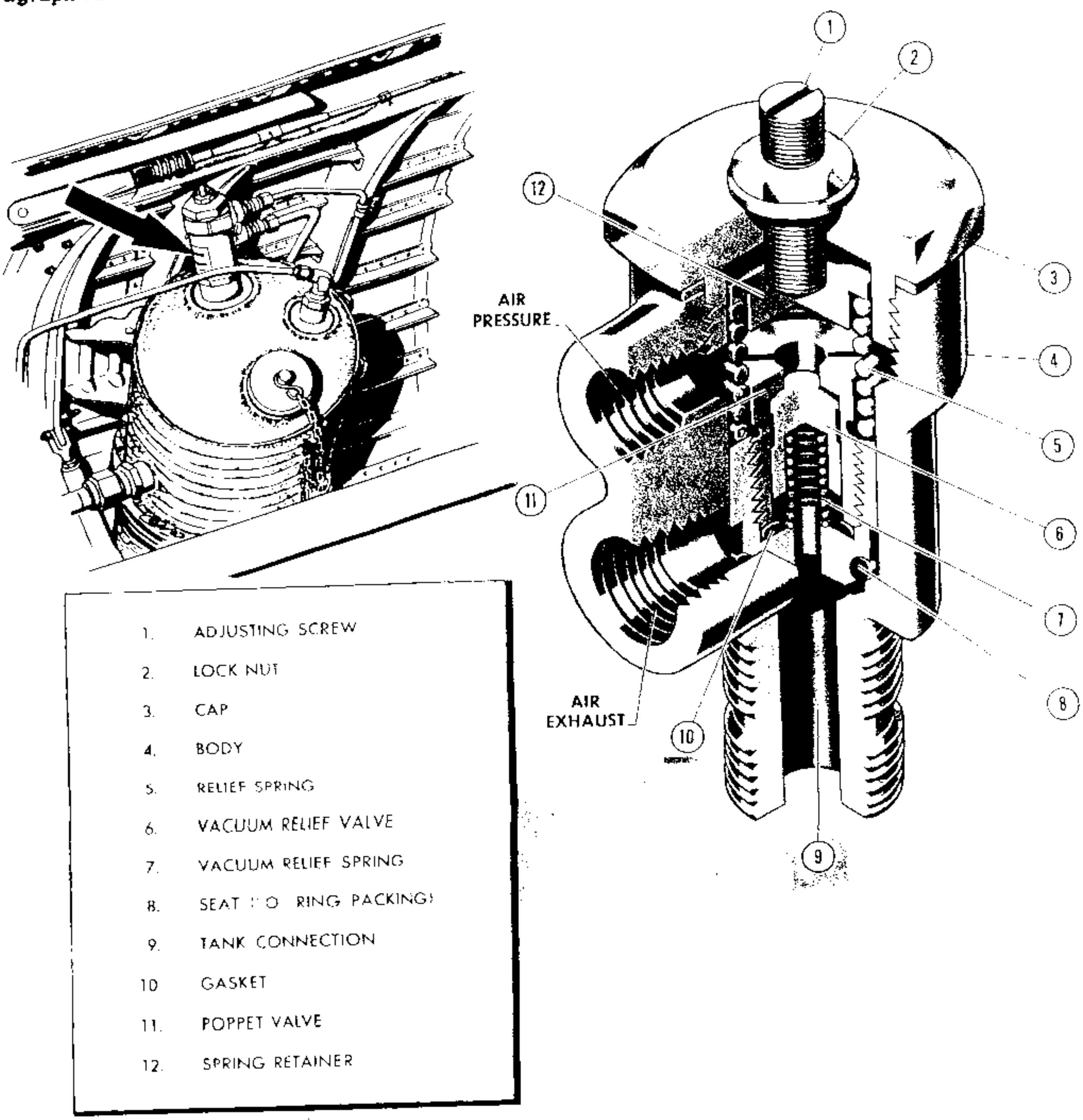



*Figure 147 — Hydraulic Reservoir Relief Valve*

(2) RESERVOIR, AIRPLANES SERIAL NOS. AF44-85337 AND SUBSEQUENT.
*(See figure 146.)*

*(a)* DESCRIPTION.—The hydraulic fluid reservoir is located on the left side of the engine compartment. It is constructed in two detachable halves which are held together by a clamp. A filter element is installed in the middle of the reservoir to clean the return fluid. A relief valve is installed to bypass fluid around the filter should it become clogged. The suction outlet for the pump is located in the bottom of the tank. The suction outlet for the hand pump is connected to a standpipe inside the tank. The return line enters the side of the tank. The pump bypass line enters the top of the tank. The relief valve is installed on the top of the tank and is connected to an air pressure line and a vent line. A sight gage on the side of the tank indicates the fluid level inside the tank. A check valve is installed at the return port to prevent reverse flow of fluid. Access to the reservoir is through the left-hand auxiliary engine-air inlet door.

*(b)* REMOVAL AND DISASSEMBLY.

*1.* Drain fluid from reservoir by removing the plug in the bottom of the reservoir.

*2.* Disconnect all lines at the reservoir.

*3.* Remove the bolts that attach the reservoir to its bracket.

*4.* Remove relief valve from top of reservoir.

*4A.* Remove sight glass name plate.

*5.* Unscrew clamp bolts and clamps, and separate the two sections.

*6.* Remove seal ring and gasket.

*7.* Lift filter element out of lower section.

*8.* Unscrew two bolts that attach filter bypass valve, and remove valve.

*9.* Remove filler cap and remove snap ring, filler screen guard, and filler screen.

*(c)* CLEANING, INSPECTION, AND REPLACEMENT.—Refer to paragraph (2)*(c)* preceding.

*(d)* MAINTENANCE REPAIRS. — Refer to paragraph (2)*(d)* preceding.

*(e)* ASSEMBLY, TEST, AND INSTALLATION.

*1.* During assembly, be sure ring seals are properly located in their grooves.

*2.* Tighten clamp bolts evenly, not to exceed a maximum torque of 70 lb in.

*3.* Plug all openings except one and pressure test at 15 psi.

*4.* Install reservoir and connect all lines.

(4) RESERVOIR RELIEF VALVE. *(See figure 147.)*

*(a)* DESCRIPTION.—The reservoir relief valve is installed on top of the reservoir. The upper port is connected to an air pressure line from the engine. (See figure 255.) The lower port is connected to a line which is routed overboard.

*(b)* DISASSEMBLY, INSPECTION, AND TEST.

*1.* Disassemble by removing lock nut on adjusting stem and unscrewing cap.

*2.* Clean all parts with kerosene or unleaded gasoline.

*3.* Inspect "O" ring for scuffing, cuts, or other damage, and replace if required.

*4.* Assemble valve and adjust to open at 2¾ to 3½ psi with pressure through tank connection.

(5) HYDRAULIC PUMP. *(See figure 148.)*

*(a)* DESCRIPTION. — The hydraulic pump (New York Airbrake Model L682C1) is a variable-volume pump. On F-80A-1 airplanes (not modified according to T. O. 01-75FJA-2H-1) the pump is in the lower righthand portion of the engine compartment, and is driven by an electric motor. On modified F-80A-1 airplanes and on airplanes Serial Nos. AF44-85337 and subsequent, the pump is mounted on the accessory gear case, and is driven by the engine.

*(b)* OPERATION. *(See figure 149.)* — Nine spring-loaded pistons (21) arranged in a cylinder block (20) concentric with the drive shaft (2) are actuated by a wedge-shaped drive cam (4). The piston bearing against the thin section of the drive cam is fully extended, and the piston bearing against the thick section of the drive cam is fully depressed. As the drive cam rotates, the pistons are alternately extended and depressed as the thin or thick section of the drive cam passes each cylinder.

As each piston extends, it uncovers a suction port through which the hydraulic fluid flows from the hydraulic tank. The bottom of each cylinder contains a spring-loaded check valve (16) which opens as the piston creates pressure, and allows fluid to flow through passages in the valve body to the pressure port.

A spring-loaded pressure regulating valve is operated by fluid pressure actuating a piston which closes the pump suction port. The spring (10) is adjustable and is set to close the suction port at 1000 (± 50) psi pressure.

*(c)* REMOVAL.

*1.* Disconnect pressure, suction, and relief lines.

*2.* Place a container under the suction port to catch fluid from the reservoir, and disconnect the reservoir line.

*3.* Remove four attachment bolts and pull the pump straight out from motor until the drive coupling is freed.

*(d)* DISASSEMBLY.

**Note**

The pump must not be disassembled unless provisions for testing are available. Before disassembly, bench-test the pump and determine the cause of trouble. (See paragraph *(h)* following.)

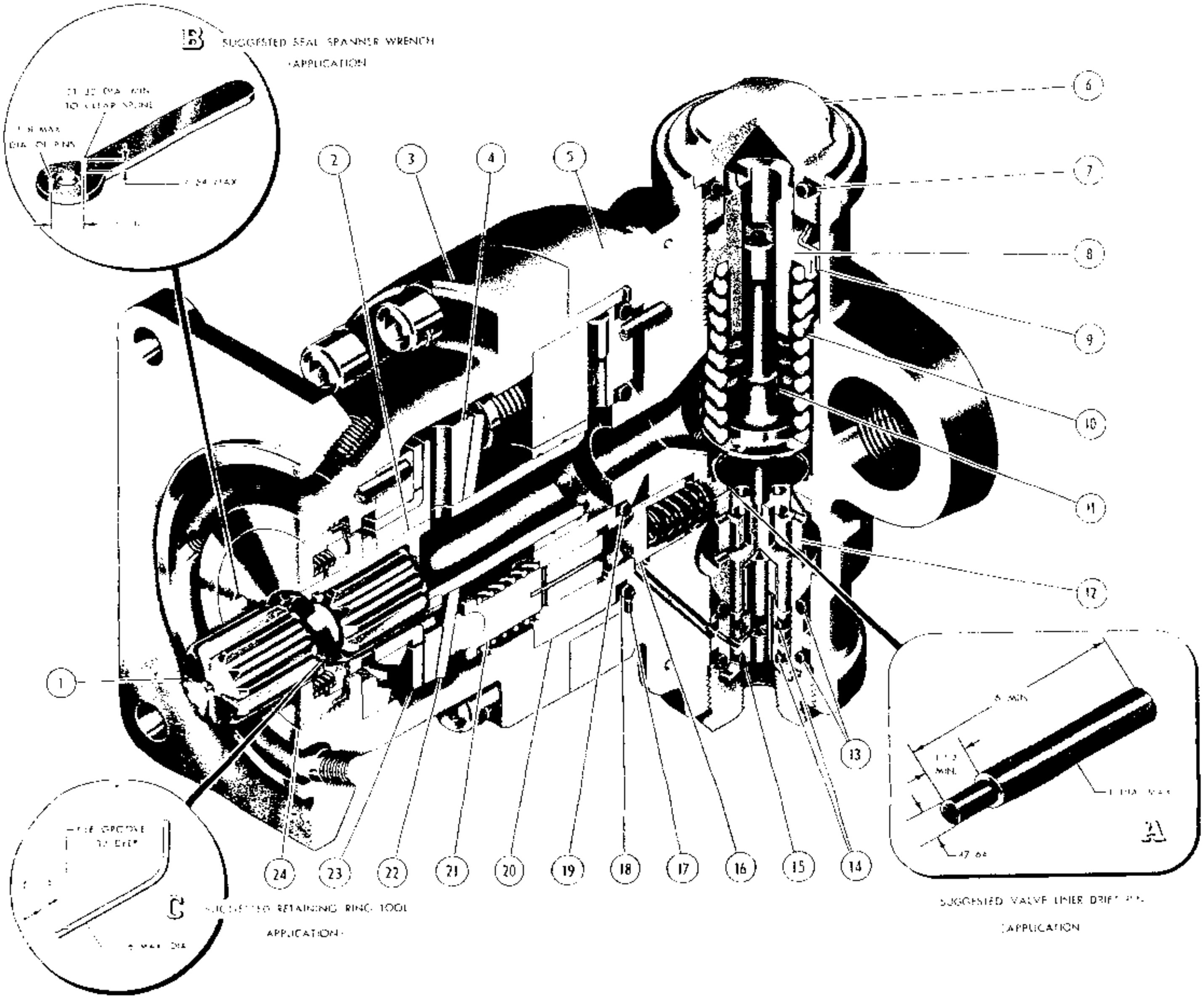
*1.* PUMP. *(See figure 148.)*

a. Remove internal wrenching screws. The washers are special and must not be lost. Tap the cover (5) flange lightly with a soft hammer and give the housing (3) a slight twist.

**CAUTION**

Excessive twisting will shear block-locating pin which is in cover.

b. Lift housing (3) straight up from cover (5) and at the same time press with thumbs against spline (1) to prevent shaft from being removed with housing.




1. SPLINE
2. SHAFT ASSEMBLY
3. HOUSING ASSEMBLY
4. DRIVE CAM
5. COVER
6. SEAL NUT
7. "O" RING
8. SPRING ADJUSTING NUT
9. LOCK WIRE
10. SPRING
11. SPRING GUIDE
12. VALVE LINER
13. "O" RING
14. "O" RING
15. PILOT PISTON LINER
16. CHECK VALVE
17. GASKET
18. "O" RING
19. "O" RING
20. CYLINDER BLOCK
21. PISTON ASSEMBLY
22. REAR CREEP PLATE
23. FRONT CREEP PLATE
24. SEAL ASSEMBLY

*Figure 148 — Hydraulic Pump*

c. Mark creep plates (22 and 23), so they can be assembled with same face out, and remove plates.

d. Lift off radial creep bushing, remove shaft assembly (2), and rear creep plate (22).

e. Lift cylinder block (20) with piston (21) and springs from cover (5).

**CAUTION**

Cylinder block face toward cover (5) is highly finished and must not be scratched.

f. Remove pistons (21) and using locating pin in cover (5) as reference point, number each piston as it is removed to permit reassembly in the same cylinder.

g. Remove shaft seal (24) with spanner wrench.

**Note**

Do not remove seal from housing unless test indicates leakage.

h. Remove safety wire and with spanner wrench, unscrew the seal.

2. CONTROL VALVE.

a. Remove seal nut (6).

b. Measure and record distance from top of adjusting nut (8) to finished shoulder of barrel.

c. Remove adjusting-nut safety wire (9) with long-nosed pliers or hooked wire, and remove adjusting nut.

d. Lift out spring (10) and spring guide (11).

e. Remove pressure-seal nut at opposite end of barrel.

f. Remove valve liner (12). Use a tool similar to that shown in detail A. Insert tool through spring chamber and tap lightly until "O" rings are free of barrel.

g. Withdraw valve piston and sleeve from valve liner.

h. Remove pilot piston from the pilot-piston sleeve by lightly striking the piston face-down against the bench.

*(e)* MAINTENANCE.

*1.* Examine cylinder bores for evidence of scoring. If scoring is sufficient to cause loss of compression, replace with a new set of pistons and cylinder block.

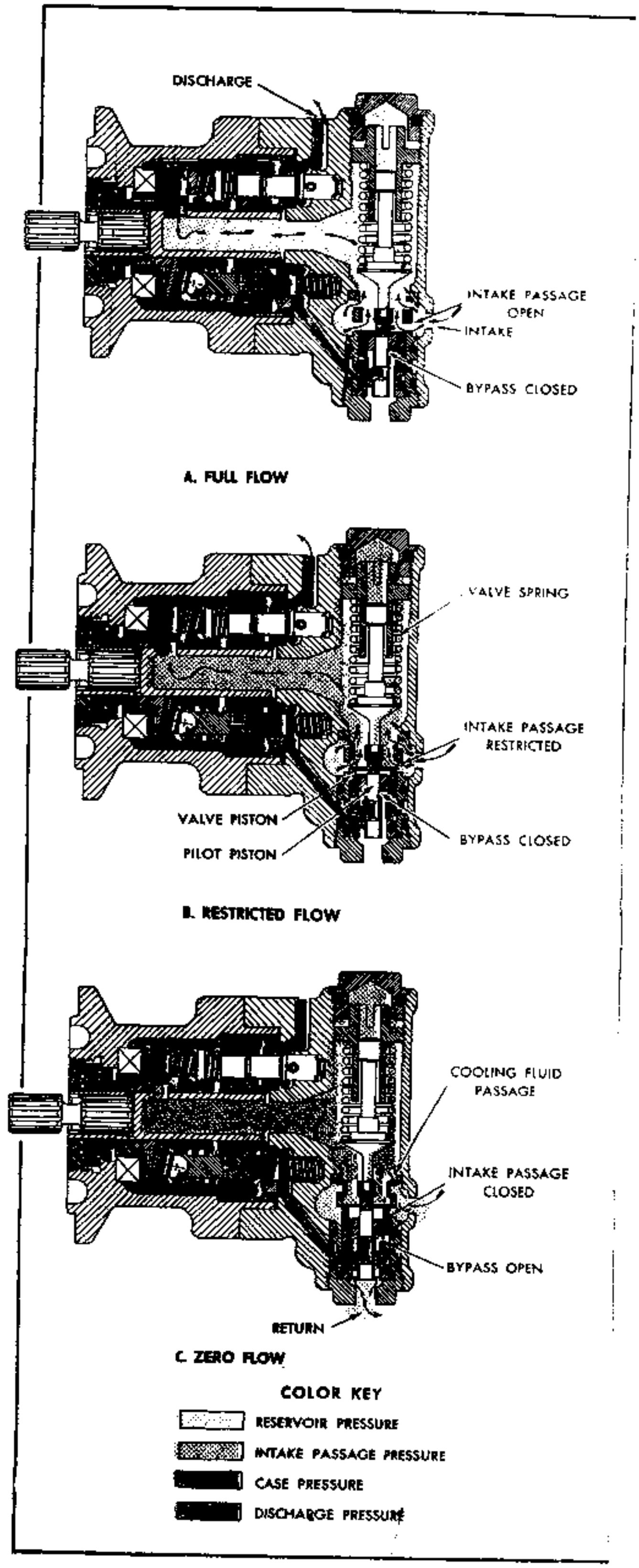



*Figure 149 — Hydraulic Pump Flow Diagram*

*2.* Inspect pistons for burrs and scoring. Remove burrs with crocus cloth and replace scored pistons.

*3.* With springs installed, press each piston into its cylinder several times. Correct any tendency to bind, or replace parts.

*4.* Measure wear of bearing surfaces.

a. Reassemble pistons without springs in their respective piston bores.

b. Assemble the front creep plate over the shaft and insert the shaft journal into shaft bearing of cylinder block.

c. Place rear creep plate on rear face of cam and slip housing, with seal removed, over assembly.

d. Lift assembly, invert it, and carefully clamp it in a vise.

**CAUTION**

Protect housing against damage from vise.

e. Press down on shaft so that rear creep plate and shaft assembly rest on thrust bearing in the housing.

f. Press the cylinder block firmly into the housing until it bears on internal shoulder of housing.

g. Rotate shaft until any one piston is at the top of its forward stroke.

h. Measure distance from lapped surfaces of the cylinder block to the piston face with a depth micrometer. If depth is greater than 0.010 inch but less than 0.015 inch, replace front creep plate with an oversize plate (part L-67A39 + 0.015).

**Note**

After installation of an oversize creep plate, measure distance piston protrudes from cylinder block. This must not be more than 0.005 inch.

*5.* Inspect each check valve seat, and if necessary, lap the upper cylinder-block face to restore flatness and relap the face of the check valve.

*(f)* REPLACEMENTS.

*1.* Inspect each "O" ring and gasket for scuffing, cuts, or other damage, and install new rings if required.

*2.* If leakage has occurred around shaft, replace shaft seal (24) as a unit.

*(g)* ASSEMBLY.

*1.* Clean all parts with solvent such as trichlorethylene or clean unleaded gasoline, and lubricate with hydraulic fluid, Specification AN-VV-O-366.

*2.* Reverse disassembly procedure.

*3.* Safety-wire cap screws in five sets of two each.

*4.* Mask all openings.

*(h)* ADJUSTMENT AND TEST.—Provide a simple hydraulic system with reservoir, suction line to pump with restrictor valve, vacuum gage or a manometer between restrictor valve and pump, discharge line from pump to reservoir with a restriction valve to build up pressure, and a pressure gage in the discharge line between the pump and the restrictor valve.

*1.* CONTROL VALVE ADJUSTMENT.

a. Attach pump to test equipment.

b. Start pump and read pressure gage.

c. Stop pump and remove seal nut (6). Adjust spring (10) by removing safety wire (9) and turning adjusting nut (8) in or out.

**Note**

Each half-turn of adjusting nut (8) changes pump delivery pressure approximately 30 psi.

d. Replace safety wire (9) and seal nut (6).

e. Repeat steps b, c, and d until pressure gage reads 1000 ($\pm$50) psi.

**CAUTION**

Seal nut (6) must be installed with metal-to-metal contact whenever pump is in operation, to prevent loss of suction.

*2.* TEST FOR LOSS OF SUCTION.

a. Operate pump with suction and discharge lines open until it has picked up its prime and is discharging a full stream of fluid.

b. Close suction-line restricting valve and stop the motor; close pump bypass port and pump-discharge restricting valve.

c. Vacuum should be maintained for a period of 15 minutes. If vacuum holds constant, rotate pump shaft 180 degrees and continue test an additional 15 minutes. If vacuum holds in one shaft position and decreases in another, it indicates leakage from the pressure side to the suction side through a fouled check valve. If vacuum is not held in either shaft position, check suction line and shaft seal for leakage.

**Note**

To check shaft seal leakage, either immerse seal in hydraulic fluid or apply heavy grease on external threads at shaft seal, spanner-wrench recesses, and at clearance between shaft and seal assembly. If vacuum is maintained with grease applied, a shaft-seal leak is indicated.

*3.* TEST FOR PUMP CAPACITY. Operate pump with suction and discharge valves open. Gradually close discharge valve and adjust pressure to 1000 psi. A pump in serviceable condition will discharge 2 gallons per minute at 1500 rpm, or proportionately higher at higher speeds.

*4.* TEST FOR VALVE SPRING ADJUSTMENT.—Throttle discharge restrictor valve until control valve limits further increase. (See paragraph *1* preceding.) Measure bypass discharge.

**Note**

Flow from bypass port should be between 0.4 and 0.8 gallon per minute. If less than 0.4 gallon per minute, disassemble control valve (paragraph *(d)2* preceding) and clean hole in valve liner (12). Check for suction leaks.

*(i)* INSTALLATION.

*1.* Reverse removal procedure.

*2.* Check suction line for possible air leaks.

**Note**

Be sure pump control valve has been adjusted for the required pressure.

(6) SYSTEM RELIEF VALVE. *(See figure 150.)*—The system relief valve is located on the left side of the engine compartment adjacent to the hydraulic reservoir, and it is adjusted to relieve at 1225 (±25) psi. Adjustment is made by removing the cap and turning the spring-adjusting screw clockwise to increase relief pressure, or counterclockwise to reduce the relief pressure. This valve, AN6200-8A8 with or without cap (1), meets the specification.

(7) ACCUMULATOR.

*(a)* DESCRIPTION.—A 7½ inch spherical accumulator is installed in the main pressure line to absorb surges in the system and to supply auxiliary pressure during short peak demands. The accumulator is mounted in a bracket on the left side of the engine compartment near the left intake duct. An accumulator air-pressure gage is mounted on the airplane structure aft of the accumulator.

**Note**

Airplanes prior to AF Serial No. 44-85337 not incorporating T. O. No. 1F-80-111 or 1F-80-112 have 5-inch accumulators installed.

The accumulator shell contains a synthetic rubber bladder which separates the air and fluid compartments. When the accumulator is charged with air against no hydraulic pressure, the bladder is fully extended against the walls of the shell. As fluid is admitted through the fluid port, the top hemisphere of the bladder is forced toward the bottom, further compressing the air in the bladder. When actuation of a hydraulic cylinder allows the accumulator to discharge into the system, the compressed air forces the fluid out of the accumulator until all of the fluid is expelled.

*(b)* SERVICING.

*1.* Relieve hydraulic system pressure by operating the aileron booster.

*2.* Charge the accumulator with air to 500 ± 25 psi.

*(c)* REMOVAL.

*1.* Relieve hydraulic system pressure by operating ailerons.

*2.* Discharge air from accumulator. Air valve is in the line at the bottom of the accumulator which connects to the air pressure gage. To discharge air, remove cap from valve, loosen ⅝-inch hexagonal nut on air valve assembly not more than one full turn, and depress valve core until air is exhausted.

## WARNING

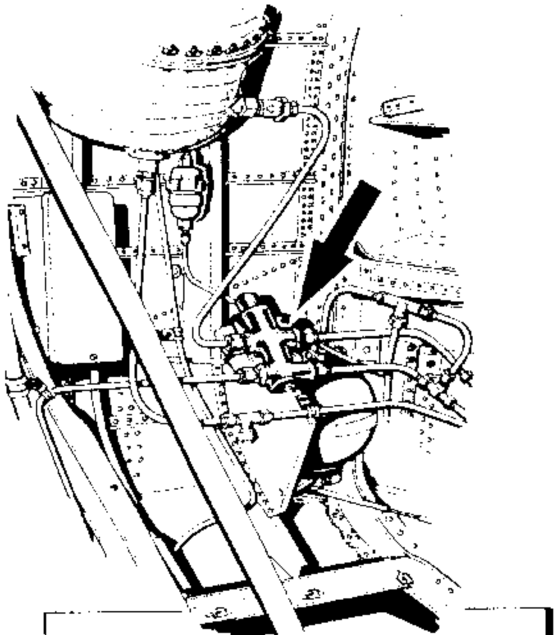
Do not loosen ⅝-inch hexagonal nut more than one complete turn. Further loosening may cause valve assembly to be blown out, possibly resulting in serious bodily injury or damage to equipment.

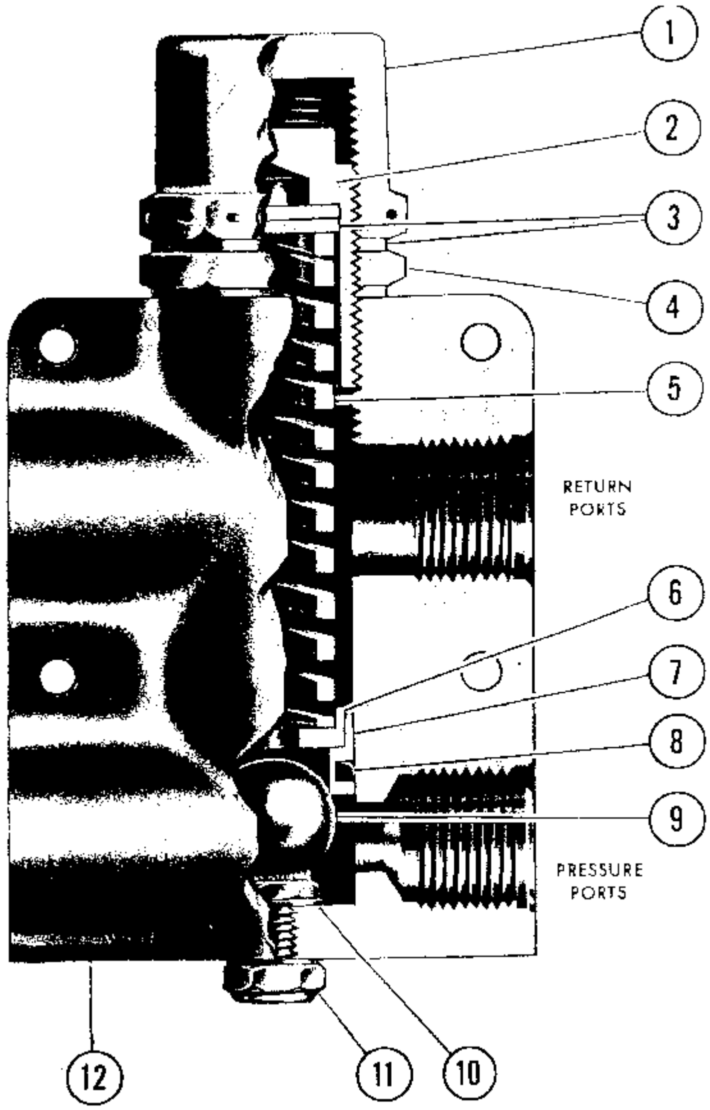
*3.* Disconnect air line from bottom of accumulator.

*4.* Disconnect hydraulic line from top of accumulator.

*5.* Remove clamps at top and bottom of accumulator.

*6.* Lift out accumulator.






| | |
|---|---|
| 1. | CAP |
| 2. | ADJUSTING SCREW |
| 3. | WASHERS |
| 4. | CHECK NUT |
| 5. | SPRING |
| 6. | SPRING SPACER |
| 7. | PISTON |
| 8. | "O" RING SEAL |
| 9. | SEAT |
| 10. | WASHER |
| 11. | NUT |
| 12. | BODY |

*Figure 150 — Main Hydraulic System Relief Valve*

(*d*) TROUBLE SHOOTING.

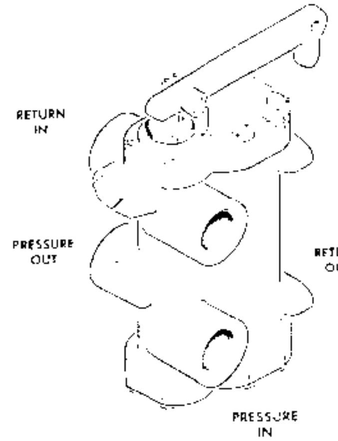
| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Fluid or air leak above cap (10). | Retainer (6) not tightened sufficiently. | Remove cotter (5), tighten retainer (6) with spanner wrench. |

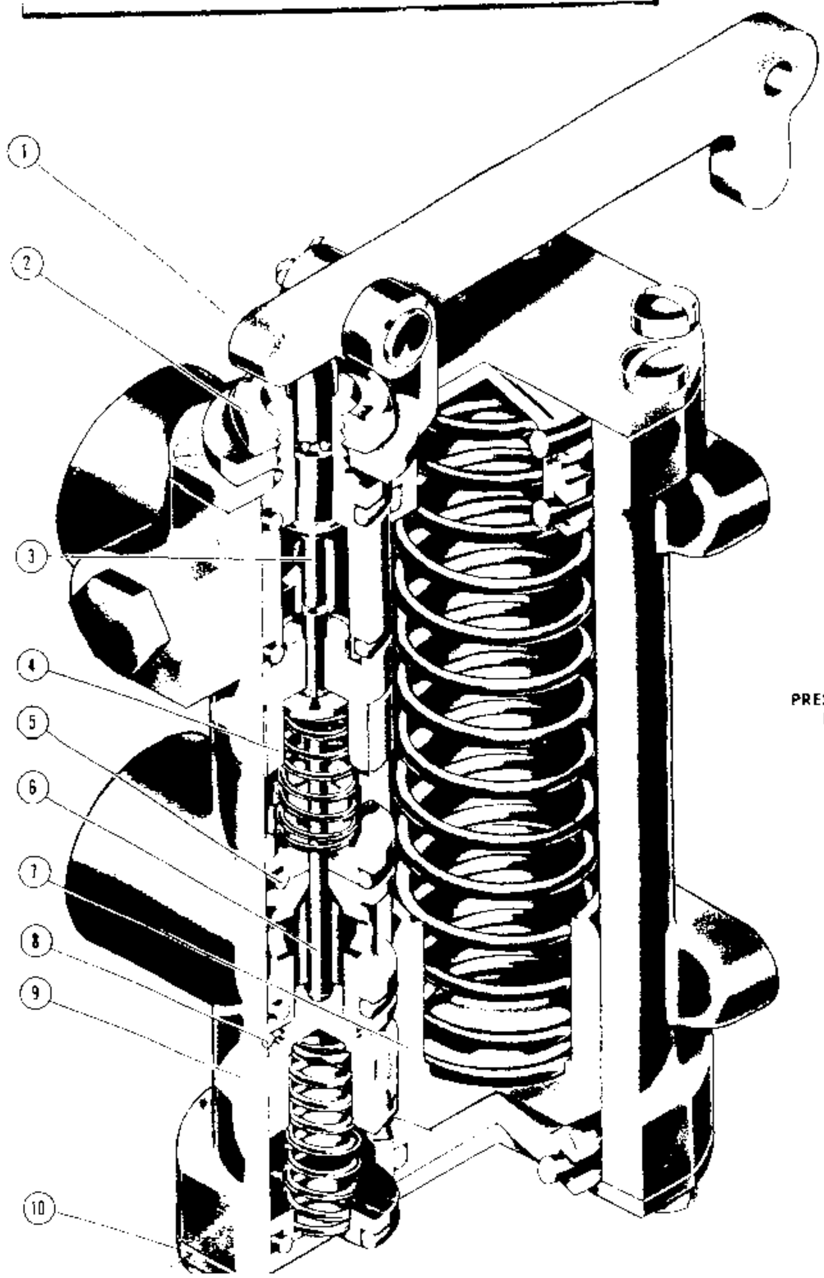
FIGURE 151 DELETED

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Loss of cushion effect and extreme pressure drops when system is operated. | Loss of air from accumulator. | Check for leaks. |
| | Air pressure too high or too low. | Charge air chamber to 500 (±25) psi. |
| Loss of air in air chamber. | Punctured or torn bladder; air leakage about air fittings. | Check for air leakage at air valve core and air valve gaskets. |

(8) EXTERNAL PRESSURE AND SUCTION CONNECTIONS.—The fittings for connection of external pressure and suction lines are located immediately inside the engine compartment left-hand access door No. 38 (figure 7). They are directly connected to the system pressure and suction lines so that the ground pump replaces the airplane pump and utilizes fluid supply from the airplane reservoir. The fitting must be capped and safetied when not in use.

| | |
|---|---|
| 1. RESET LEVER | 6. PUSH ROD |
| 2. LOCK NUT | 7. SAMPLING PISTON |
| 3. RESET STEM | 8. SNAP RING |
| 4. PISTON | 9. POPPET |
| 5. "O" RING PACKING | 10. END PLATE |



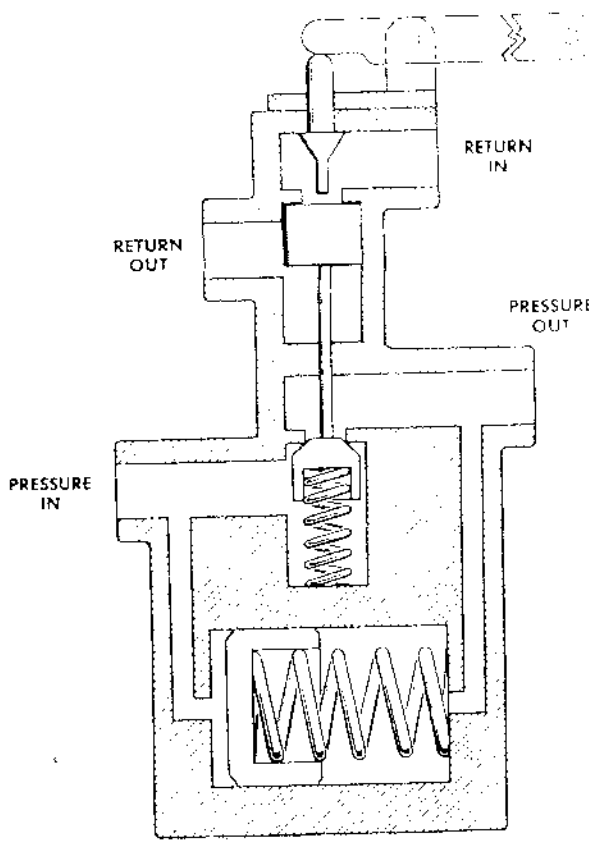




*Figure 152 — Hydraulic Fuse*

(9) HYDRAULIC FUSE.
*(See figures 143 and 144.)*

*(a)* GENERAL.—A hydraulic fuse is installed in the basic system pressure and return lines, just downstream of the aileron booster system. The function of the unit is to prevent complete loss of system fluid in event of line breakage down-stream of the fuse. Thus if either or both of the dive flaps system or alighting gear system should become inoperative the aileron booster system would continue to function.

*(b)* OPERATION. *(See figure 152.)*—When the dive flap or alighting gear selector valve is operated, flow in the basic system pressure line is temporarily checked by the poppet (9) and acts upon the sampling piston (7), forcing the small volume behind the piston to flow to the actuating cylinder. This small volume of fluid causes a like amount of fluid to flow out of the actuating cylinder, through the return line to act upon the piston (4). This opens poppet (9) allowing basic system pressure to flow directly through the fuse. If the line to or from the actuating cylinder had been broken, the original sample fluid would have been lost and not available to act upon piston (4), thus leaving poppet (9) closed and preventing any further loss of fluid. A reset handle on the left side of the instrument subpanel acts as an override control for the fuse. If either the alighting gear or dive flap system should fail to operate due to "fusing," the selector valve should be returned to the opposite position, and the reset handle pulled out momentarily to reset the fuse. Then it may be possible, depending upon the location and extent of the line damage, to make use of the other system. The reset handle must be held in the reset position through several cycles in order to bleed the system after any unit has been replaced, or any lines of the system opened.

**Note**

Airplanes with hydraulic fuses installed must have the fuse wired in the reset "OPEN" position, making the fuse inoperative. The hydraulic fuse return spring, 178716, is removed and stored in the armament compartment.

**CAUTION**

Make certain that 0.0625-inch diameter steel safety wire, Specification AN-W-22, is used to safety-wire the hydraulic fuse, and that the fuse is wired in the full reset "OPEN" position.

*(c)* REMOVAL.

*1.* Disconnect cable control at reset lever.

*2.* Disconnect and cap the plumbing lines.

*3.* Remove mounting bolts, and remove unit.

*(d)* SERVICE.—This part is not repairable in the field, and must be replaced when found to be defective.

*c.* ALIGHTING GEAR SYSTEM.

(1) DESCRIPTION.—The alighting gear hydraulic system consists of the alighting gear selector valve in the left side of the cockpit, three actuating cylinders, a nose up lock cylinder, and on each main gear an inboard door actuating cylinder and emergency release cylinder. The gear-up line from each actuating cylinder incorporates a manual shut-off valve. All units except the selector valve are located in their respective wheel wells.

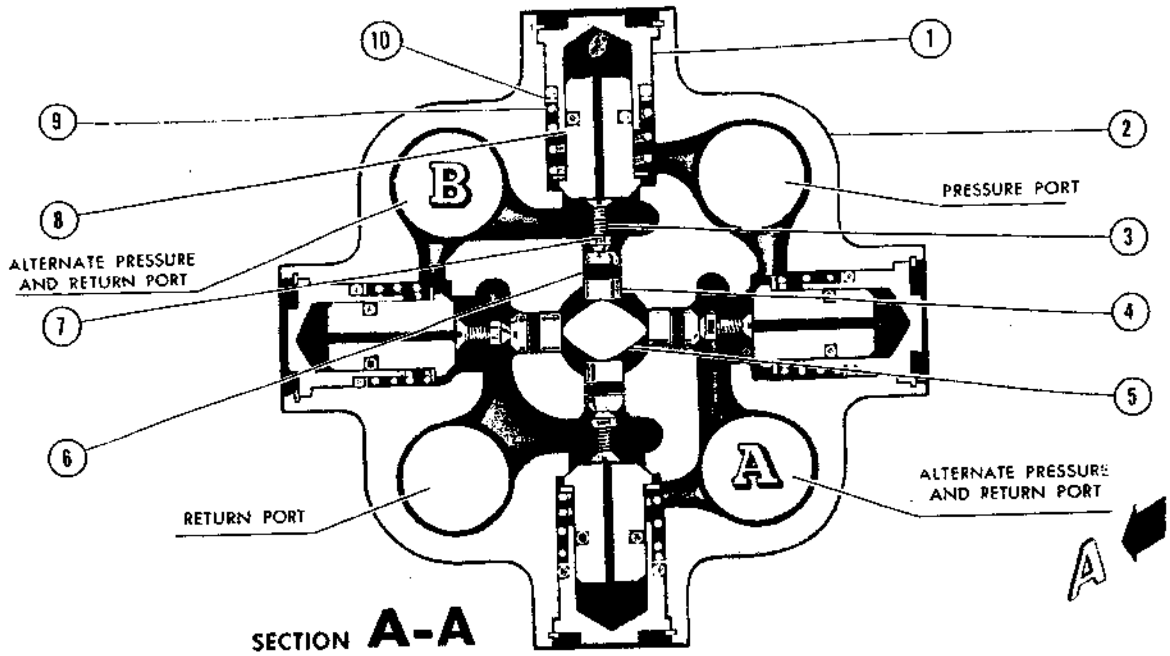
(2) SELECTOR VALVE.
*(See figures 153 and 154.)*

*(a)* DESCRIPTION.—The alighting gear selector valve has four spring-loaded poppet valves spaced radially around a camshaft. The valve body has a pressure port, a return port, and two cylinder ports. Rotation of the camshaft opens two of the valves and closes the other two. This connects the pressure to one or the other cylinder port. At the same time, the return port is connected to the cylinder return port.

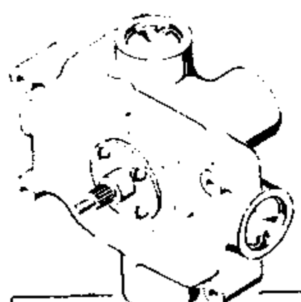
A safety device is incorporated in the selector valve installation which prevents inadvertent movement of the control lever to "UP" position when the airplane is on the ground. The device consists of a solenoid-released latch which engages with an arm attached to the control lever shaft. A switch mounted on the torque arm of the left main gear controls the electric current which energizes the unlocking solenoid. When the shock strut is compressed (airplane on ground) the solenoid is de-energized, as the torque arm switch is open. The switch is closed by the torque arms when the weight of the airplane is off the shock strut, and the solenoid then energized, releases the latch so that the lever can be moved to "UP" position. In case of electrical system failure, the pilot can reach the emergency release lever through a hole in the cockpit shelf and release the latch manually. The latch is released manually when ground-checking the alighting gear, if the electrical system is inoperative. A micro switch, mounted on the selector valve cover plate, interrupts the gun firing circuit so that guns cannot be fired when selector valve lever is down. (See figure 153A.) Access to the selector valve is gained by removing a portion of the left-hand trim panel.

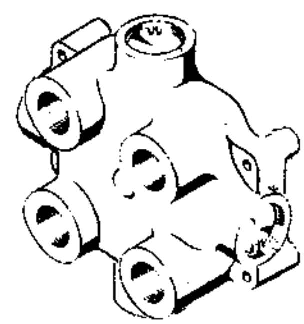
*(b)* REMOVAL.

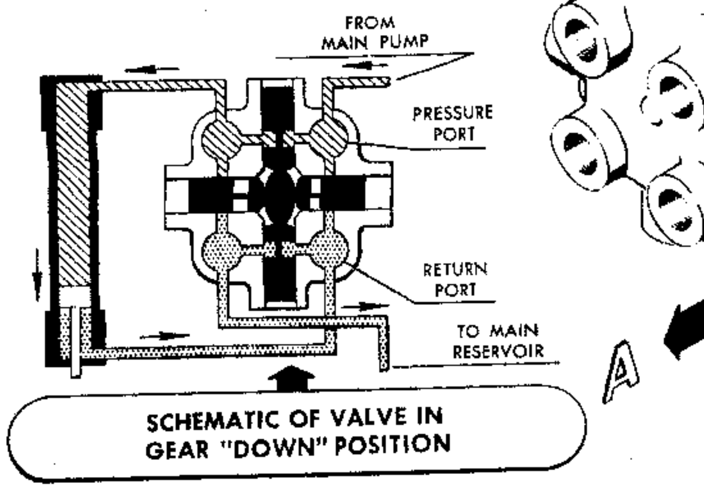
*1.* On early airplanes, mark the valve-end of the alighting gear control lever with a heavy scribed line. The line must be a continuation of the slot in the valve shaft. The slot in the valve shaft indicates the position of the cam lobes. (See detail A, figure 154.)

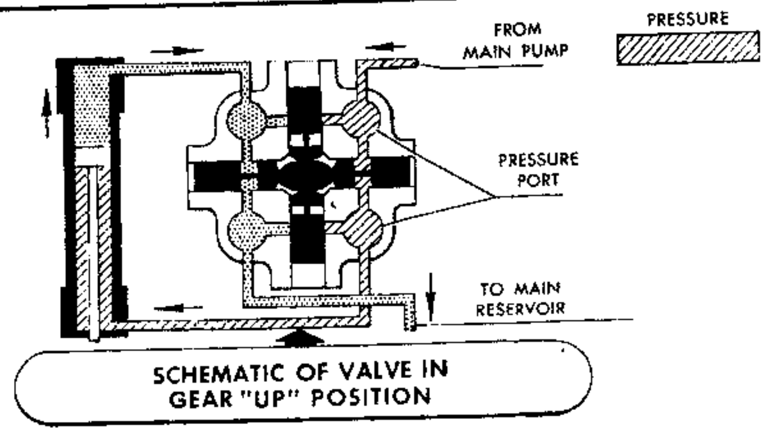



VALVE SHOWN IN NORMAL POSITION








1. GUIDE
2. BODY
3. ADJUSTING SCREW
4. PISTON
5. CAM
6. PACKING
7. LOCK NUT
8. VALVE
9. SPRING
10. RETAINER

*Figure 153 — Alighting Gear Selector Valve*

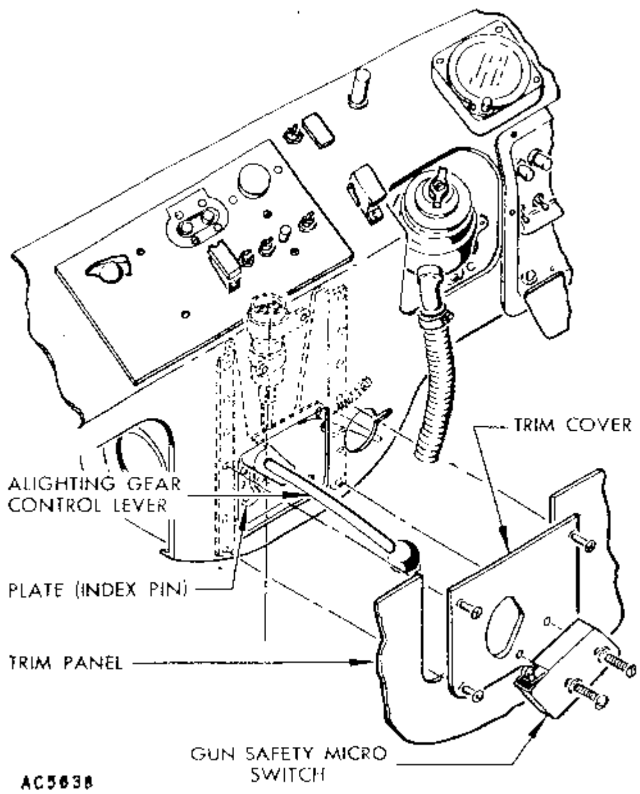



*Figure 153A — Alighting Gear Selector Valve Control Lever (T.O. 01-75FJA-2G-02)*

**Note**

On later airplanes it is unnecessary to mark lever, as correct positioning is insured by a taper pin through the lever and shaft.

2. Remove lever.

3. Remove trim panel No. 9. (See figure 248.)

4. Remove screws attaching valve to bracket, and remove valve.

5. Disconnect plumbing lines.

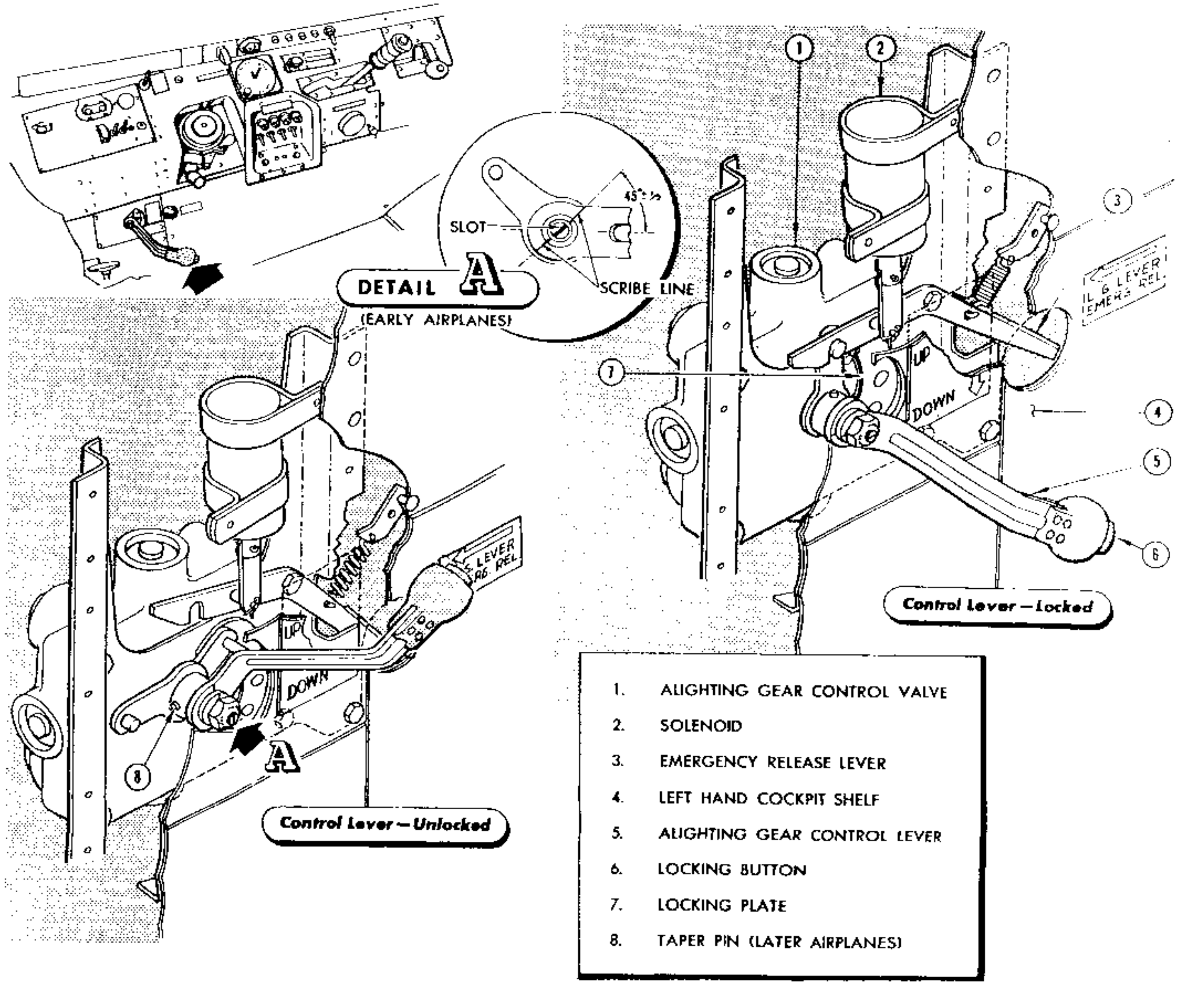



*Figure 154 — Alighting Gear Selector Valve Lock*

(*c*) DISASSEMBLY.

*1.* Remove the snap ring on each side of the body and take out the guide, seal washers, spring, and poppet.

*2.* Pull out the setscrew and piston with long-nosed pliers.

*3.* Remove the snap ring that holds the cam in the body, and take off the washer.

*4.* Remove cam and inner washer from the other side of the body.

(*d*) REPLACEMENTS.

*1.* Examine piston packing for scuffing, cuts, or other damage, and if found faulty, replace the "O" rings.

*2.* Examine valves for evidence of leakage; tap leaky valves lightly, or replace with new valves.

(*e*) ASSEMBLY.

*1.* Place setscrews in pistons and secure with lock nuts.

*2.* Place a seal on each piston and push pistons into their chambers.

*3.* Place a seal on each poppet and place a washer on the flat of each poppet.

*4.* Push each poppet into its chamber.

*5.* Place springs on poppets.

*6.* Place seals and washers on the guides and install guides in the chambers. Secure guides with snap rings.

*7.* Place washer in cam chamber and install cam in the side opposite the ports.

*8.* Secure cam with washer and snap ring on same side as the ports.

(*f*) ADJUSTMENT.—Attach a pointer to lever shaft so that pointer is aligned with 1/16-inch notch in top of cam (notch indicates center of cam lobe).

*1*. Remove two adjacent pistons.

*2*. Set pointer between two remaining pistons.

*3*. Move pointer gently back and forth so that cam lobe touches first one piston then the other.

*4*. Note number of degrees through which shaft must move from just contacting one piston to just contacting the other. If shaft rotation is greater than 8 degrees, turn setscrews out of piston. If rotation is less than 4 degrees, turn setscrews into piston.

*5*. Remove one piston and install another piston in position opposite one removed, and repeat steps 3 and 4. Adjust setscrew in newly installed piston.

*6*. Repeat steps 3, 4, and 5 for remaining unadjusted piston and setscrew.

(*g*) INSTALLATION.

*1*. Attach plumbing lines to the valve.

*2*. Attach valve to its bracket.

*3*. Install trim panel No. 9 (See figure 248).

*4*. Install lever so that scribed mark is in alignment with the slot on the valve shaft.

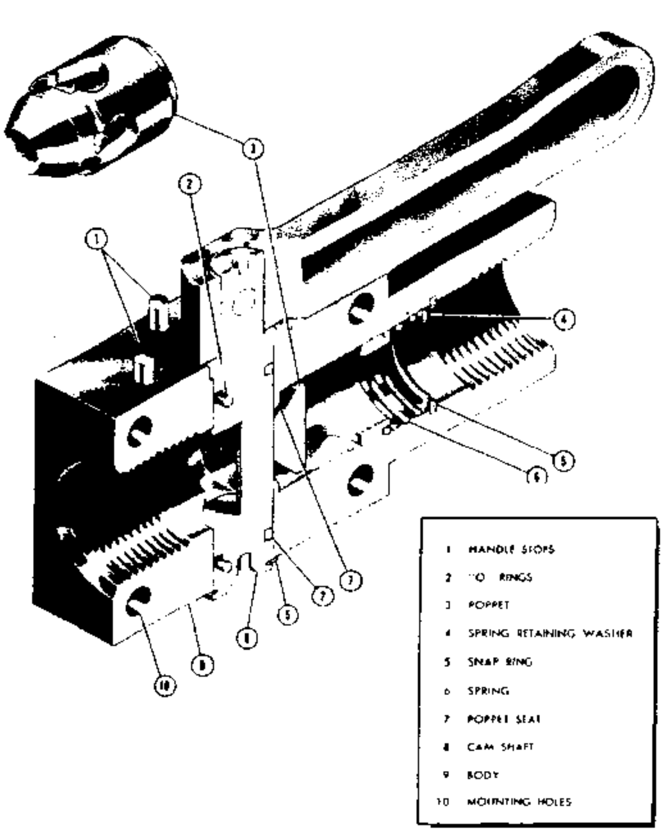



***Figure 155 — Ground Check Shut-off Valve***

(3) GROUND CHECK SHUT-OFF VALVES. (*See figure 155.*)—A normally open, manually operated, cam-actuated poppet type shut-off and check valve with an aluminum alloy body and steel cam is located in each wheel well in the alighting gear up line. When closed, the valve operates as a check valve, and will permit alighting gear to be extended, but not retracted.

**CAUTION**

Before flight, safety all shut-off valves in open position.

(4) RESTRICTORS.—On P-80A-1, P-80A-5, and FP-80A-5 airplanes, five restrictor valves are installed in the alighting gear hydraulic system to regulate fluid flow to up lines on the main gear and door actuating cylinders, and the nose gear actuating cylinder. The restrictors for the main gear and door actuating cylinders are located two in each main gear wheel well adjacent to the wing center rib. The nose gear restrictor is located to the left of the uplock cylinder on the rear face of fuselage station 103 bulkhead. On P-80A-10 and FP-80A-10 airplanes, three restrictors are used, one in each main-gear-door actuating cylinder closing line, and one in the nose-gear actuator "up" line.

(4A) RESTRICTOR CHECK VALVES.—These are standard poppet type check valves with a hole drilled through the poppet so the valve restricts in one direction only. In all P-80A-10 and FP-80A-10 airplanes, a restrictor check valve having a No. 55 (.052) hole in the poppet is installed in each main gear "up" line to restrict flow during the gear down cycle. On airplanes incorporating T.O. 1F-1-507, the restrictor check valves incorporate a screened orifice.

(5) MAIN GEAR ACTUATING CYLINDER.

(*a*) DESCRIPTION (Early Airplanes). (*See figure 156.*)—The actuating cylinder for the main gear consists of the piston assembly, barrel, and two end caps. The piston-rod end is fitted with an adjustable clevis terminal. Foreign matter is excluded from the cylinder by a scraper ring in the piston-rod bearing. All packings are the O-ring type. The cylinder is designed with provisions for 1/8-inch overtravel so the piston is not bottomed against the cap when the gear is up. This ensures a firm contact between gear doors and wing structure before the piston has reached the end of its stroke. When the gear is down, the piston causes the downlock to be engaged the required amount. See paragraph 4*b*(6), this section, for details on adjustment.

(*b*) DESCRIPTION (Later Airplanes). (*See figure 157.*)—The cylinder used on later airplanes is similar to that used on early airplanes except that the piston diameter is enlarged to increase operating speed.

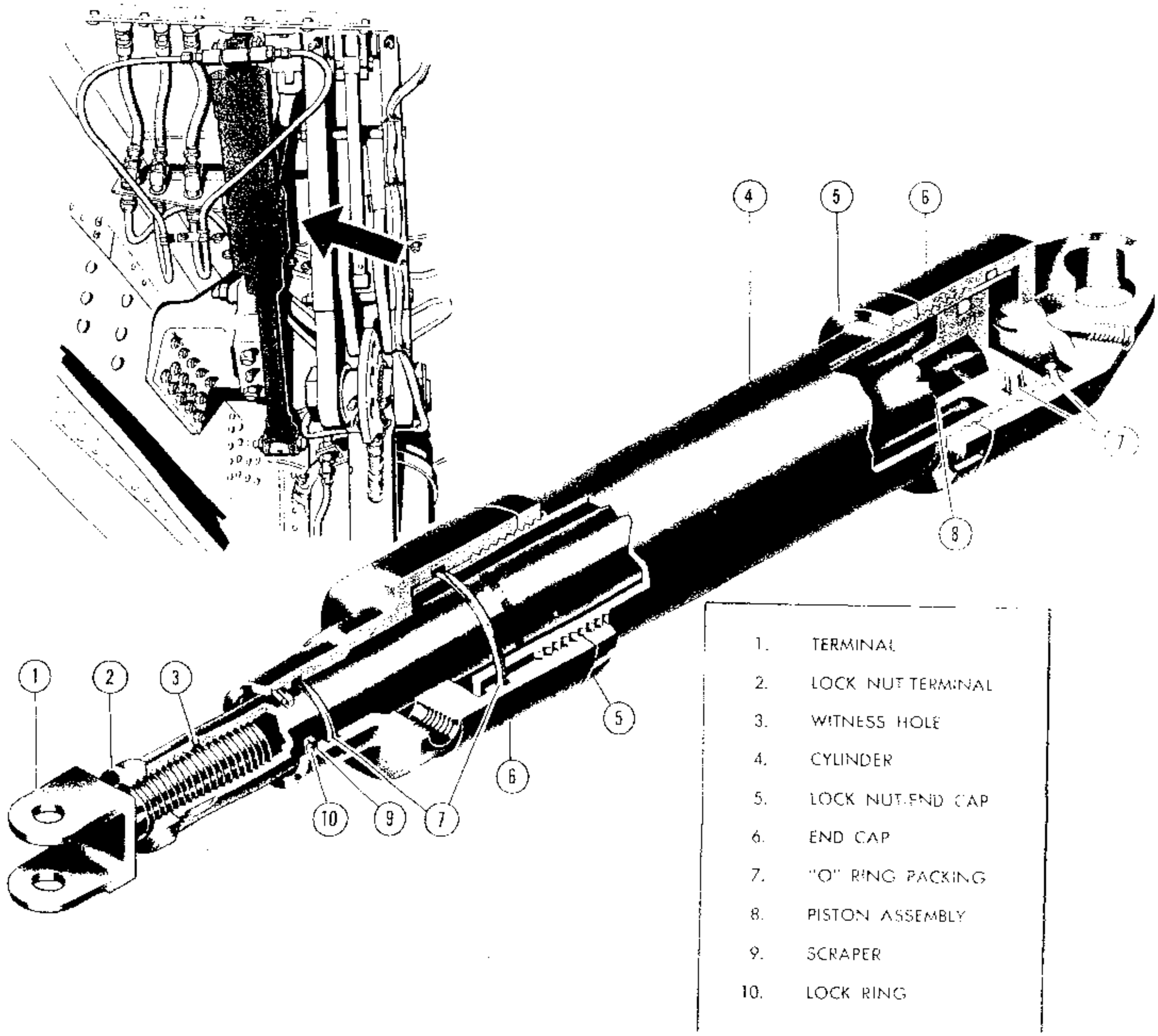



***Figure 156 — Main Alighting Gear Actuating Cylinder, Early Airplanes***

*(c)* REMOVAL AND DISASSEMBLY.
*(See figure 156 for early airplanes; 157 for later airplanes.)*

*1.* Jack the airplane.

*2.* Disconnect hydraulic lines from cylinder, and cap the openings.

*3.* Disconnect piston rod from shock strut by removing terminal fitting which extends vertically through lugs of the fulcrum.

*4.* Detach upper cylinder end at crank assembly, and remove cylinder.

*5.* With piston retracted and bottomed, measure accurately and record the distance between hole in clevis terminal and hole in end cap. This should be 15.25 ($\pm$0.06) inches. Also measure and record the distance between the two caps. These measurements will enable maintenance of proper stroke and piston-rod length upon reassembly of the cylinder.

*6.* With tool No. S-20614-20 (figure 29) loosen nuts (5) from end caps (6).

*7.* On later airplanes, use tool No. 20618-20 (figure 29) to loosen lock nuts (9) from end caps (7).

*8.* With strap wrenches remove both caps from the cylinder barrel.

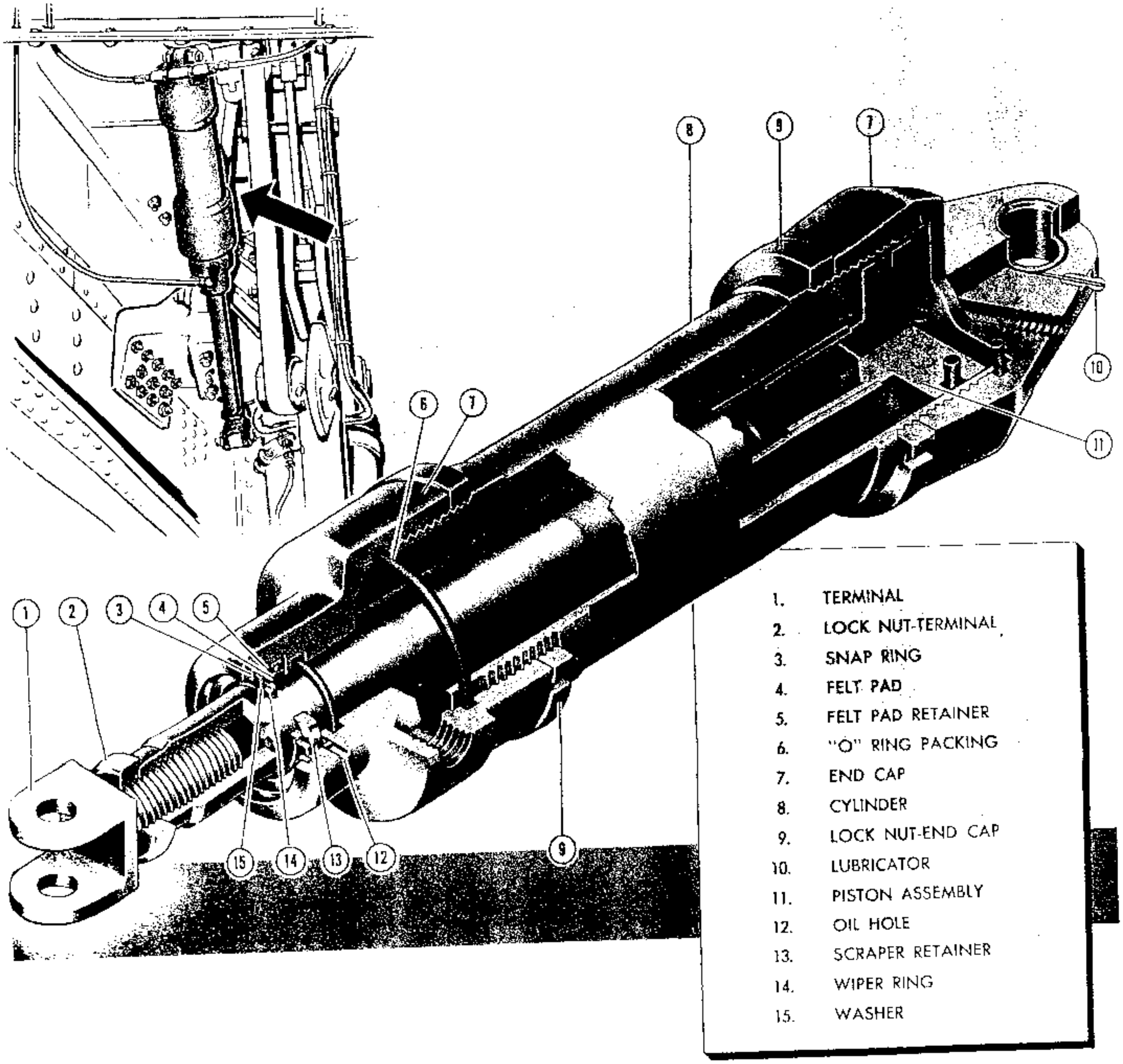



***Figure 157 — Main Alighting Gear Actuating Cylinder, Later Airplanes***

*9.* Loosen lock nut and remove clevis terminal from piston rod. Slide cap off piston rod.

*10.* Remove lock ring (10) and scraper (9) from cap.

*11.* On later airplanes, remove snap ring (3), washer (15), wiper ring (14), scraper retainer (13), felt pad (4), and retainer (5).

*12.* Remove all "O" ring packings.

*13.* Thoroughly clean all parts.

*(d)* INSPECTION AND REPLACEMENTS.

*1.* Inspect cylinder bore for scoring, worn spots, or roughness. Inspect piston rod for continuity of plating and for pitted condition. Remove small scratches or roughness with fine emery paper, and smooth by buffing.

*2.* Replace all "O" ring packings with new parts.

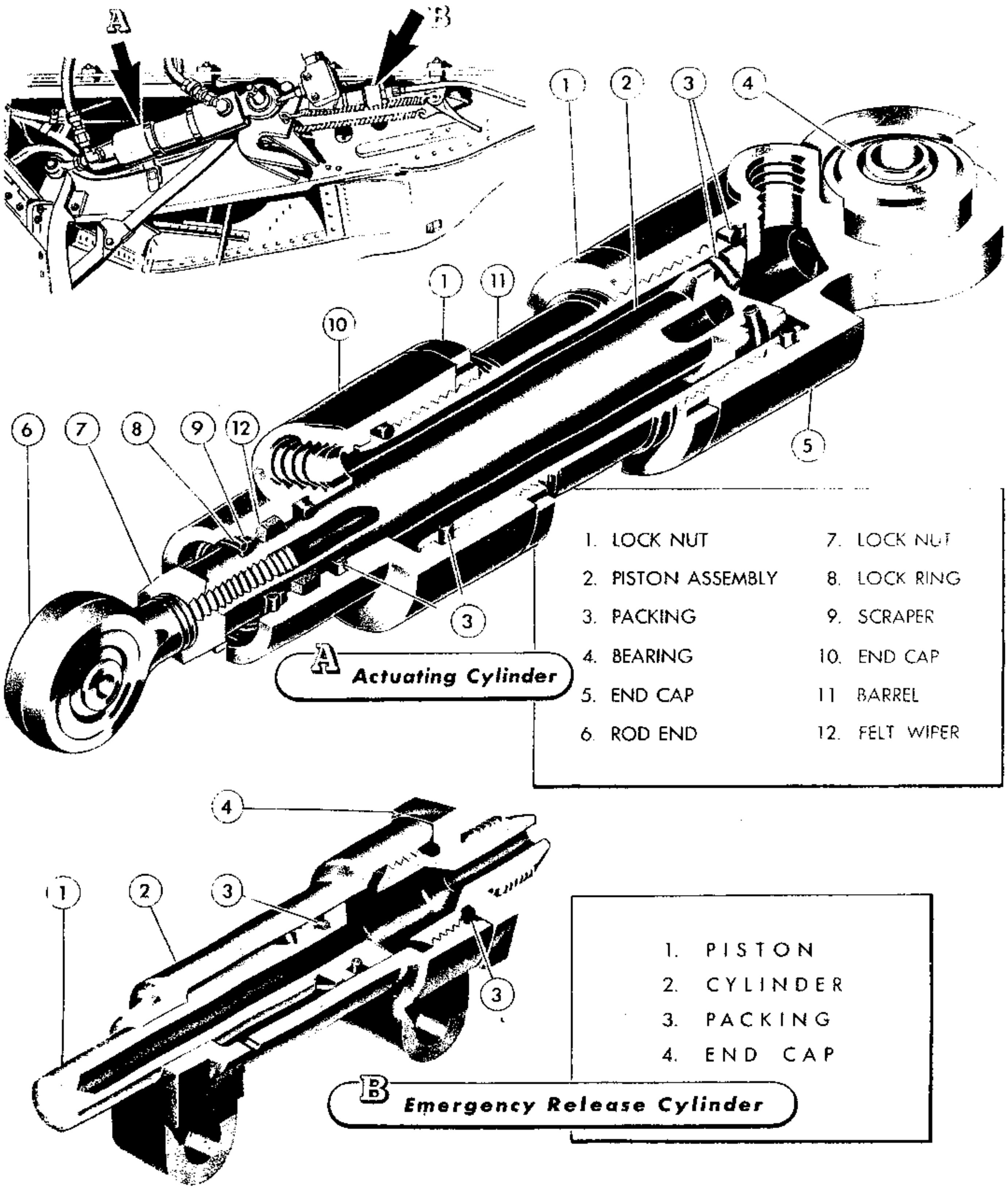



*Figure 158 — Main Alighting Gear Door Actuating Cylinder*

*(e)* ASSEMBLY, TEST, AND INSTALLATION.

*1.* Lubricate all "O" ring packings, cylinder bore, and piston rod with hydraulic fluid, Specification AN-VV-O-336.

*2.* Assemble end caps on piston rod and cylinder barrel.

*3.* Assemble piston rod and end cap on cylinder.

*4.* Tighten end cap on cylinder barrel until barrel is bottomed in cap. Adjust piston stroke with other cap to length recorded in paragraph *(c)5* preceding.

*5.* Tighten lock nuts snugly against caps.

*6.* Assemble clevis terminal on piston rod, and with piston bottomed, adjust over-all length to dimension recorded in paragraph *(c)5* preceding.

**Note**

When adjusting clevis terminal, be sure threads of clevis are showing in witness hole of piston rod to insure sufficient threads are engaged. Tighten lock nut when adjustment is complete.

*7.* If bench-testing equipment is available, operate cylinder under 1200 psi pressure through several cycles and check for leaks. If such equipment is not available, install cylinder and test for leaks by operating the alighting gear.

*(6)* MAIN GEAR DOOR ACTUATING CYLINDER. *(See figure 158.)* — This cylinder which actuates the inner door segment of the main gear, is connected to the door and door mechanism by sealed anti-friction bearings located one at each end of the cylinder. One bearing is pressed in a lug which extends from the end cap; the other bearing is incorporated in the piston-rod end fitting. The cylinder end caps are removable from the barrel for complete disassembly of the unit. A scraper is provided at the piston rod bearing to exclude foreign matter from the cylinder. "O" ring packings are used throughout.

**CAUTION**

To eliminate the possibility of damaging the "O" ring packing upon reassembly of the actuating cylinder, care must be exercised to prevent excessive clearance between the bottom of the cylinder end caps and the actuating cylinder barrel. The location of the end caps on the actuating cylinder assembly is critical to the packing seal, so that when the cylinder barrel is centered between the end caps, there shall be no more than six (6) exposed threads at each end after the required stroke is established.

Maintenance operations for the door cylinder are similar to those for the main gear actuating cylinder, except that wrench No. S-20608-6 (figure 29) is used on the lock nuts.

(7) NOSE GEAR ACTUATING CYLINDER. *(See figure 159.)*—The nose gear actuating cylinder is similar in design to the main gear cylinder, and maintenance instructions given for the latter are applicable, with the exception of the removal procedure. The machine guns must be removed to provide access for removal of the nose gear actuating cylinder. Use tool No. S-20617-21 (figure 29) for disassembly of the end cap lock nuts.

(8) NOSE GEAR UP LOCK CYLINDER. *(See figure 160.)*

*(a)* DESCRIPTION.—This cylinder is mounted vertically on the rear face of fuselage station 103 bulkhead, immediately behind the nose gear actuating cylinder. The cylinder incorporates two pistons, one of which is spring loaded. The other piston rides on the spring-loaded piston.

*(b)* OPERATION.—When the gear is extended, fluid forces the piston against the spring, and the piston rod travels down to release the up lock hooks. Main system fluid enters the side port and acts upon the bottom piston only. During emergency operation, the emergency fluid enters the top port. The fluid acts upon the top piston which forces the bottom piston down against the spring to release the up lock hooks.

*(c)* REMOVAL.

*1.* Disconnect piston rod.

*2.* Disconnect hydraulic lines.

*3.* Remove attaching bolts, and remove cylinder.

*(d)* DISASSEMBLY.

*1.* Remove both end caps.

*2.* Remove two pistons and two springs.

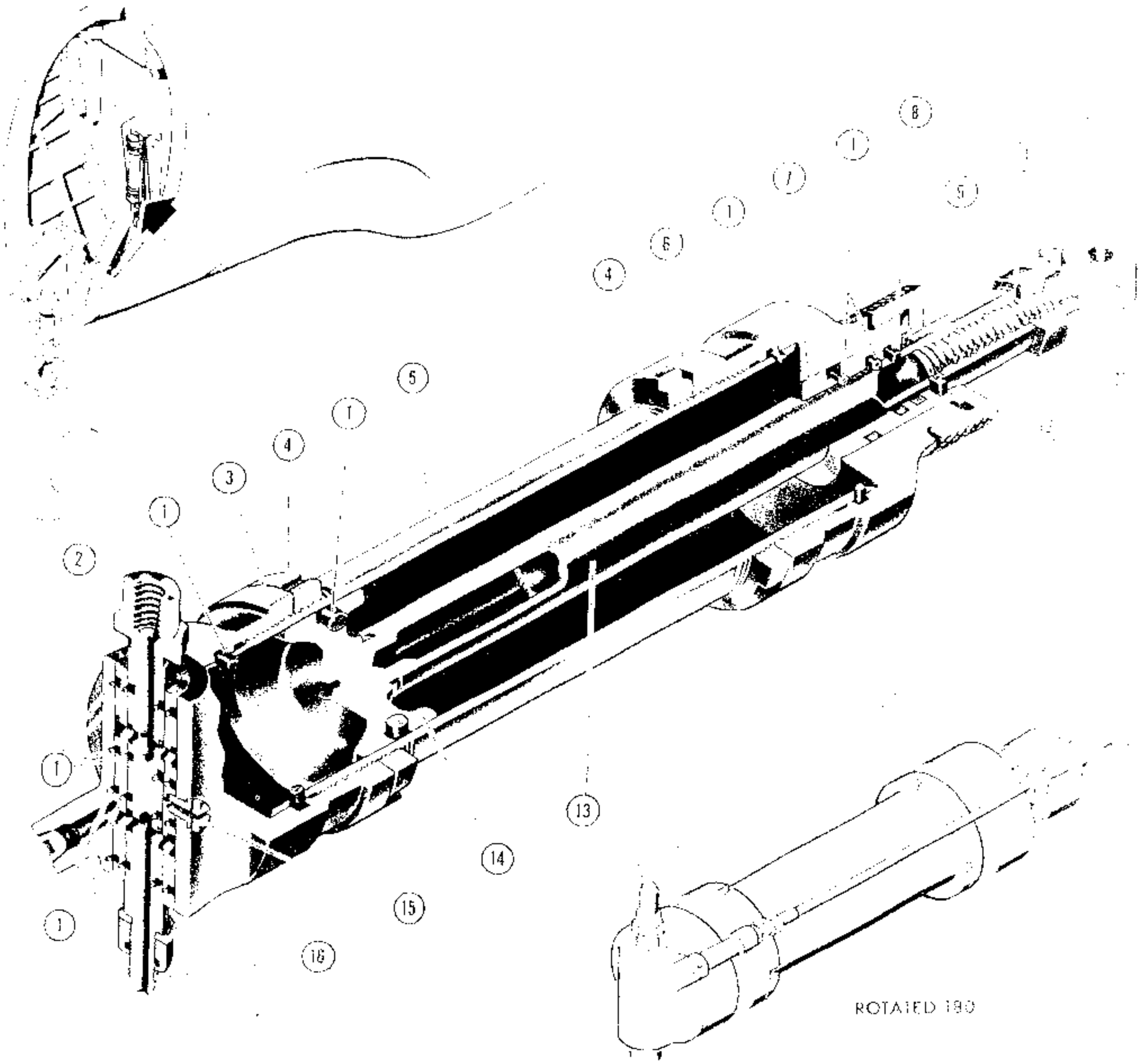
*(e)* INSPECTION AND REPLACEMENTS.

*1.* Inspect cylinder for corrosion, wear, and scoring. Inspect piston rod for continuity of plating, wear, or other damage.

*2.* Replace "O" ring packing and gasket with new parts.

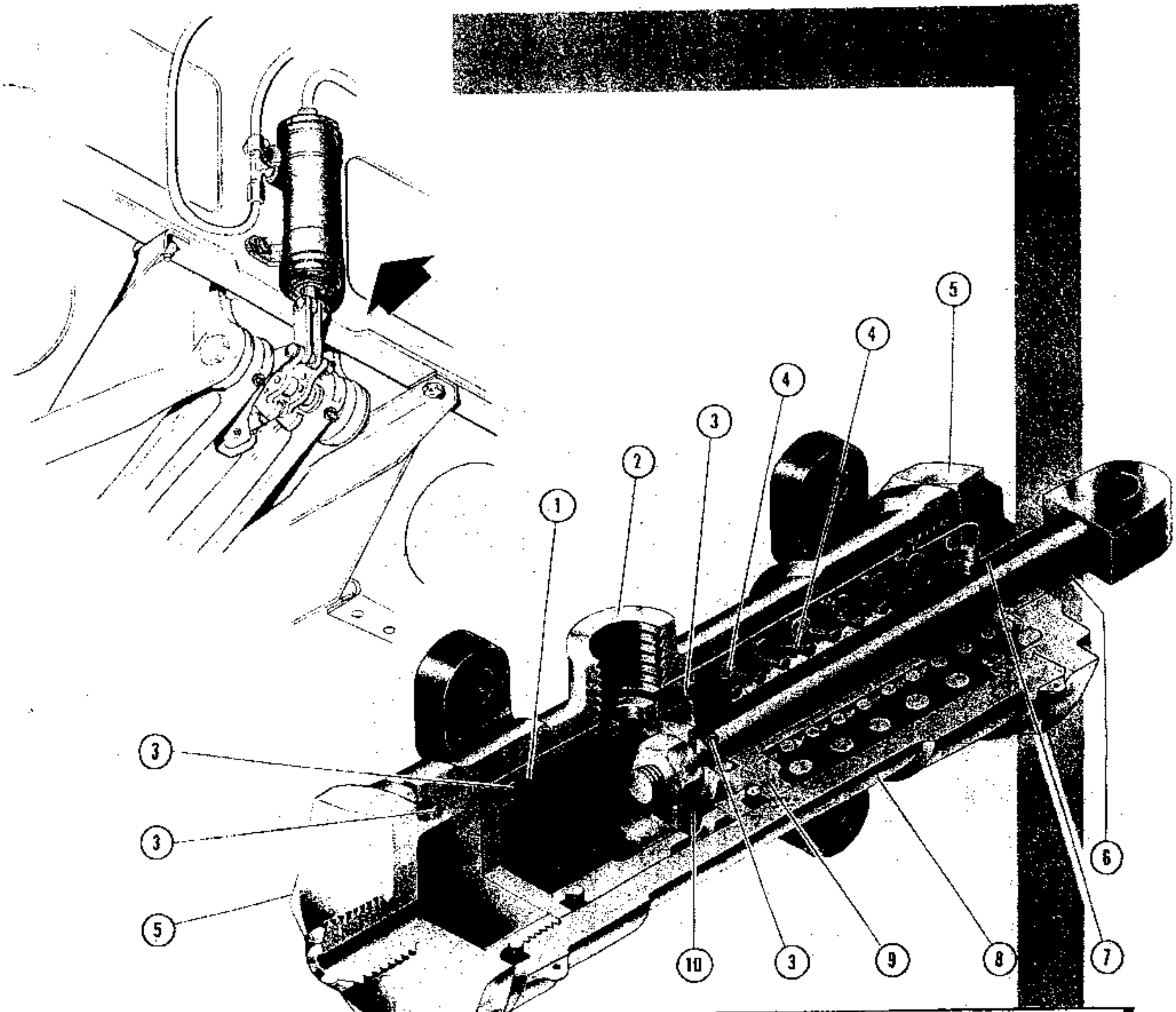
(9) SHUTTLE VALVE. *(See figure 161.)*

*(a)* DESCRIPTION.—The shuttle valves serve to prevent the emergency-system hydraulic fluid from entering the main system, and the main system fluid from entering the emergency system. These valves are located at the extension side of the main gear actuating cylinders.




| | | | |
|---|---|---|---|
| 1 | PACKING | 9 | SCRAPER RING |
| 2 | SWING COUPLING DOWN PORT | 10 | GREASE FITTING |
| 3 | CYLINDER END BLOCK | 11 | END FITTING, PISTON ROD |
| 4 | JAM NUT | 12 | NUT, BUSHING RETAINER |
| 5 | CYLINDER | 13 | PISTON ROD |
| 6 | CYLINDER END FITTING | 14 | PISTON |
| 7 | BUSHING | 15 | LOCK SCREW |
| 8 | FELT WIPER RING | 16 | SWING COUPLING, UP PORT |

*Figure 159 — Nose Alighting Gear Actuating Cylinder*



| | | | |
|---|---|---|---|
| 1. | PISTON | 6. | PISTON ROD |
| 2. | PORT | 7. | BEARING |
| 3. | PACKING | 8. | CYLINDER BODY |
| 4. | SPRING | 9. | PISTON |
| 5. | END CAP | 10. | WASHER |

*Figure 160 — Nose Alighting Gear Up Lock Cylinder*

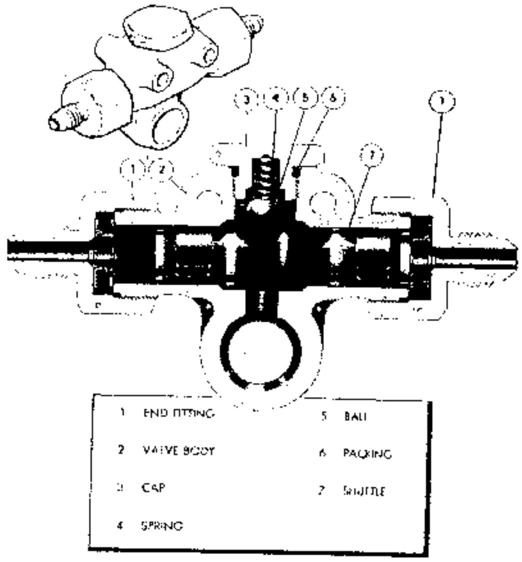



***Figure 161 — Shuttle Valve***

*(b)* OPERATION.—One port of the valve is connected with the main hydraulic system; the other port to the emergency system. When the gear is extended by the main hydraulic system, the shuttle of the valve is forced, by system pressure, to close off the emergency fluid port. When the emergency system extends the gear, emergency fluid pressure forces the shuttle to close off the main system port. The shuttle is held in either position by a spring-loaded ball.

*(c)* DISASSEMBLY.

*1.* Remove cap and take out detent spring and ball.

*2.* Remove port-end fitting and push shuttle out.

*d.* ALIGHTING GEAR EMERGENCY SYSTEM.

(1) DESCRIPTION.—The alighting gear emergency extension system consists of an auxiliary reservoir, a hand pump, an emergency control valve, door emergency release cylinders, a thermal relief valve, and check valves. The door release cylinders are located in the main gear wheel wells near the inner door mechanism. The emergency hydraulic system may be used only for alighting gear extension.

(2) OPERATION.

*(a)* GEAR EXTENSION.—Place the alighting gear lever in the down position and push the emergency extension lever forward until it engages the catch. Operate emergency pump until the alighting gear indicator lights show the gear to be down and locked.

When the pump is operated, fluid is drawn from the emergency reservoir and is directed to the actuating cylinders through the emergency control valve. The fluid, upon reaching the cylinders, enters the shuttle valves and forces them into the emergency position. It then enters the cylinders and forces them to extend the gears. By first "kicking" the shuttle valve with main system pressure, return fluid from the actuating cylinders is discharged into the main system reservoir through the alighting gear selector valve. (See paragraph *(b)* following.)

*(b)* TO RETURN SYSTEM TO NORMAL OPERATION AFTER EMERGENCY EXTENSION.—When the alighting gear has been extended by the emergency system and after the cause of the hydraulic system failure has been corrected, the gear must be retracted by the following procedure to prevent rupturing the emergency reservoir:

*1.* Jack the airplane.

*2.* Move alighting gear emergency selector valve handle to the normal position.

*3.* With the main system pressure on, move the alighting gear selector valve lever to the "GEAR DOWN" position momentarily, to return all shuttle valves to their normal positions.

*4.* Move the alighting gear selector valve lever to the "GEAR UP" position to retract the gear.

**Note**

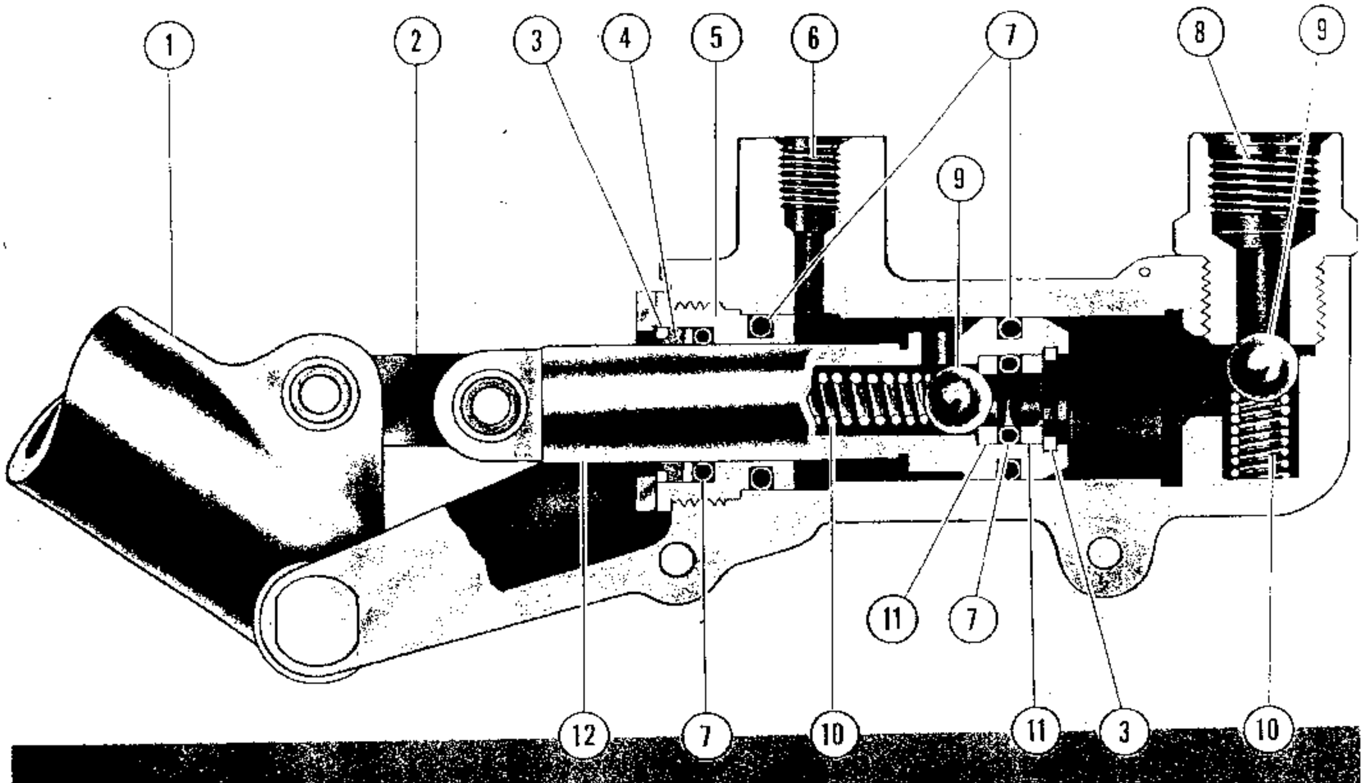
The hydraulic fluid which entered the cylinders from the emergency reservoir will be returned to the main reservoir. Place a container under the reservoir overflow.

*5.* Drain excess hydraulic fluid from the main reservoir, and fill the emergency reservoir with hydraulic fluid, Specification AN-VV-O-366.

*6.* Operate the gears up and down several times to check their operation.

(3) RESERVOIR.

*(a)* DESCRIPTION.—The emergency reservoir supplies hydraulic fluid to the emergency system. It is located in the right aft corner of the cockpit between the pilot's seat and the shelf. The supply of fluid must be replenished after each operation of the emergency system. Fill with fluid, Specification AN-VV-O-366. Access to the reservoir of early airplanes is through the cockpit; on later airplanes, access is gained through panel No. 77. (See figure 7.)




| | | | |
|---|---|---|---|
| 1. | HANDLE FITTING | 7. | PACKING |
| 2. | LINK | 8. | INLET PORT |
| 3. | LOCK RING | 9. | BALL |
| 4. | SCRAPER RING | 10. | SPRING |
| 5. | NUT | 11. | SPACER |
| 6. | OUTLET PORT | 12. | PISTON |

*Figure 162 — Hydraulic Hand Pump*

*(b)* REMOVAL.

*1.* Remove pilot's seat. (See paragraph 22*a* (2), this section.)

*2.* Remove armor plate aft of pilot's seat. *(See* paragraph 22*b*, this section.)

*3.* Disconnect vent and fluid outlet lines. Place a small container under outlet to catch draining fluid.

*4.* Remove screws that attach tank brackets to airplane structure, and remove reservoir.

(4) HAND PUMP. *(See figure 162.)*

*(a)* DESCRIPTION.—This pump is a double-acting piston type. It is composed of a case containing a port at each end, two ball check valves, and a piston. The pump is located on the cockpit floor at the right of the pilot's seat.

*(b)* OPERATION.—As the handle is pushed down, the piston moves aft. The ball check valve in the piston opens and allows fluid in the aft part of the cylinder to flow through the piston. At the same time, the ball check valve in the cylinder intake port closes to prevent fluid from flowing back to the emergency reservoir. When the handle is pulled up, the piston starts forward. The ball check valve in the piston closes and the piston forces the fluid through the outlet port. At the same time, the ball check valve in the inlet port

opens and lets the suction created by the forward motion of the piston pull more fluid into the aft port of the cylinder.

*(c)* DISASSEMBLY.

*1.* Remove cotter pin and pin securing link to piston rod.

*2.* Remove piston rod packing nut and withdraw piston.

*3.* Remove snap ring from piston, and take out retainer, ball, and spring.

*4.* Remove intake port fitting and take out ball and spring.

*(d)* MAINTENANCE AND INSPECTION.

*1.* Wash all parts with kerosene or unleaded gasoline.

*2.* Inspect cylinder bore and piston rod for scoring, worn spots, and corrosion.

*3.* Inspect check balls for roughened, pitted, or ringed condition.

*4.* Inspect bushings and bolts in piston rod linkage for looseness or wear.

*5.* Inspect packings for wear, roughness, scuffing, or cuts.

*6.* Replace all damaged parts.

(5) EMERGENCY SELECTOR VALVE, AIRPLANES SERIAL NOS. AF44-84992 THROUGH 44-85336. *(See figure 163.)*

*(a)* DESCRIPTION.—This valve is used to direct the emergency fluid from the pump to the actuating cylinders. It is a poppet valve consisting of four identical poppet elements arranged radially about the operating cam within an aluminum alloy body. The poppet element consists of a piston and packing, adjusting screw and lock nut, and a phenolic poppet and return spring. All four poppet element details are identical.

*(b)* OPERATION. *(See figure 142.)*—Fluid is forced to the pressure port of the valve by the hand pump. With the valve in the normal position, fluid is bypassed back to the suction side of the pump. With the valve in the emergency position, the fluid flows in through the pressure port of the valve, and out through the cylinder-down port.

*(c)* REMOVAL.

*1.* Remove valve lever.

*2.* Remove trim panel No. 4. (See figure 243.)

*3.* Disconnect piping from back of valve.

*4.* Remove screws attaching valve to structure and remove the valve.

*(d)* DISASSEMBLY.

*1.* Remove four caps on each side of body, and remove springs and poppets.

*2.* Pull out the adjusting screw and piston with long-nosed pliers.

*3.* Remove the four screws holding the bearing, and take out the cam.

*(e)* ASSEMBLY.

*1.* Place the setscrews in the pistons and secure them with lock nuts.

*2.* Install seals on pistons and push each piston into its chamber in the body.

*3.* Insert the poppets and springs, and secure with seals and caps.

*4.* Install the cam and bearing and secure the bearing with four screws.

*(f)* ADJUSTMENT.—Attach a pointer to the lever shaft so the pointer is aligned with the 1/16-inch notch in the top of the camshaft (notch indicates center of the cam lobe).

*1.* Remove two adjacent pistons.

*2.* Set the pointer between the two remaining pistons.

*3.* Move pointer gently back and forth so that the cam lobe touches first one piston and then the other.

*4.* Note the number of degrees through which the shaft must move from just contacting one piston to just contacting the other. If the shaft rotation is greater than 6 degrees, turn setscrews out of the pistons. If shaft travel is less than 4 degrees, turn setscrews into the piston.

*5.* Remove one of the pistons and install another piston in position opposite to the one removed, and repeat steps *3* and *4*. Adjust the setscrew in the newly installed piston.

*6.* Repeat steps *3*, *4*, and *5* for the remaining unadjusted piston and setscrew.

(6) EMERGENCY SELECTOR VALVE, SERIAL NOS. AF44-85337 AND SUBSEQUENT. *(See figure 164.)*

*(a)* DESCRIPTION. — This is a two-position, three-port selector valve of the poppet type with a single-lobe cam. When the valve is in the "EMERGENCY" position, it serves to direct emergency system fluid to the gear actuating cylinders; when the valve is returned to "NORMAL" position, it serves to return fluid to the emergency system reservoir. The valve handle is safetied in the "NORMAL" position with light-gage wire.

*(b)* REMOVAL, DISASSEMBLY, AND ASSEMBLY.—Refer to paragraph (5) preceding.

*(c)* ADJUSTMENT.—Install the valve lever so that the lever is pointing directly opposite a $\frac{1}{16}$-inch notch in the cam shaft. The notch indicates the position of the cam lobe.

*1.* Adjust flat-head screws in the pistons to give a lift of 0.032 inch minimum, and shaft rotation of 5 degrees ($\pm$1 degree) each side of center, before opening the valve.

*2.* Tighten caps to 30 ($\pm$3) foot-pounds torque after final adjustment.

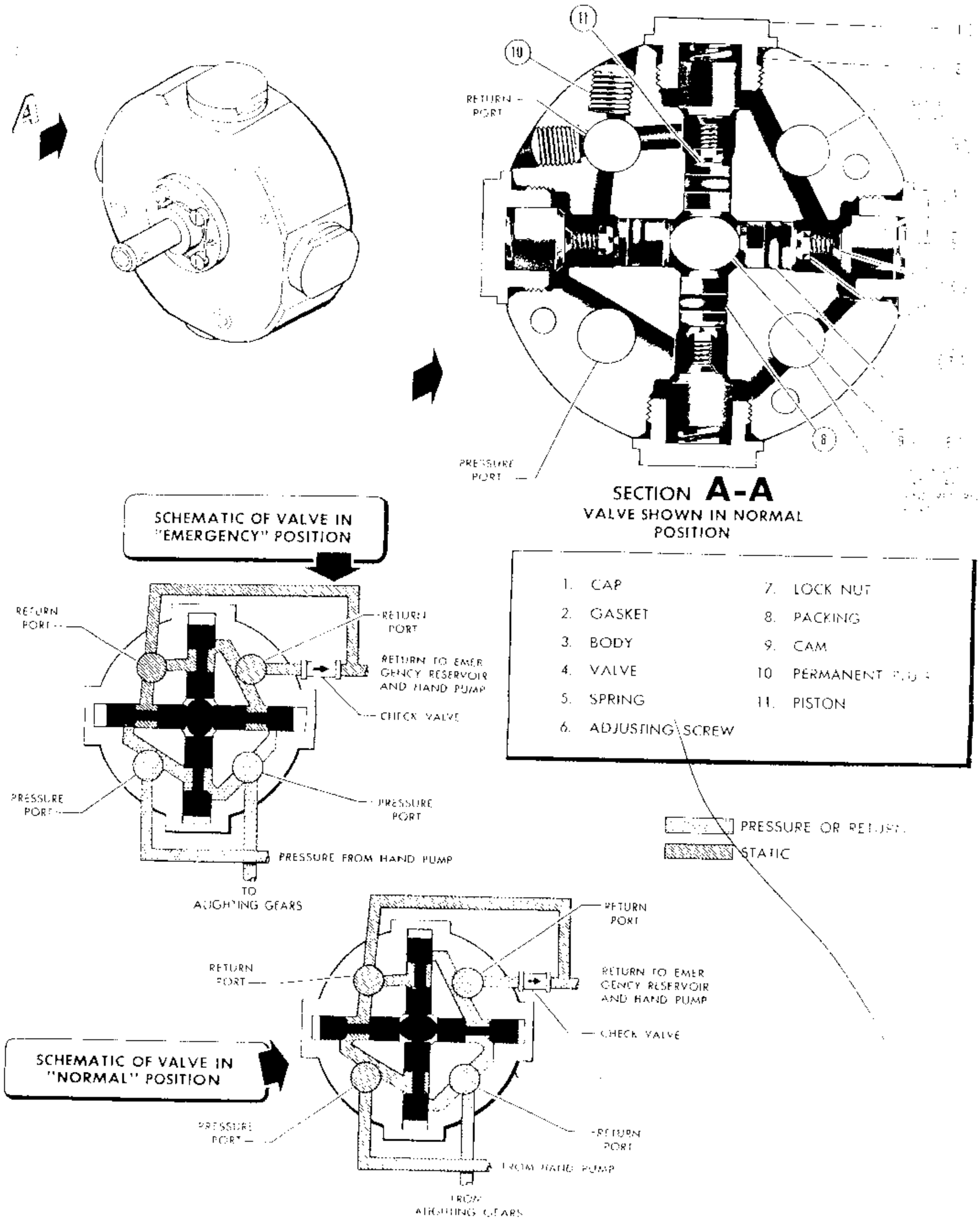
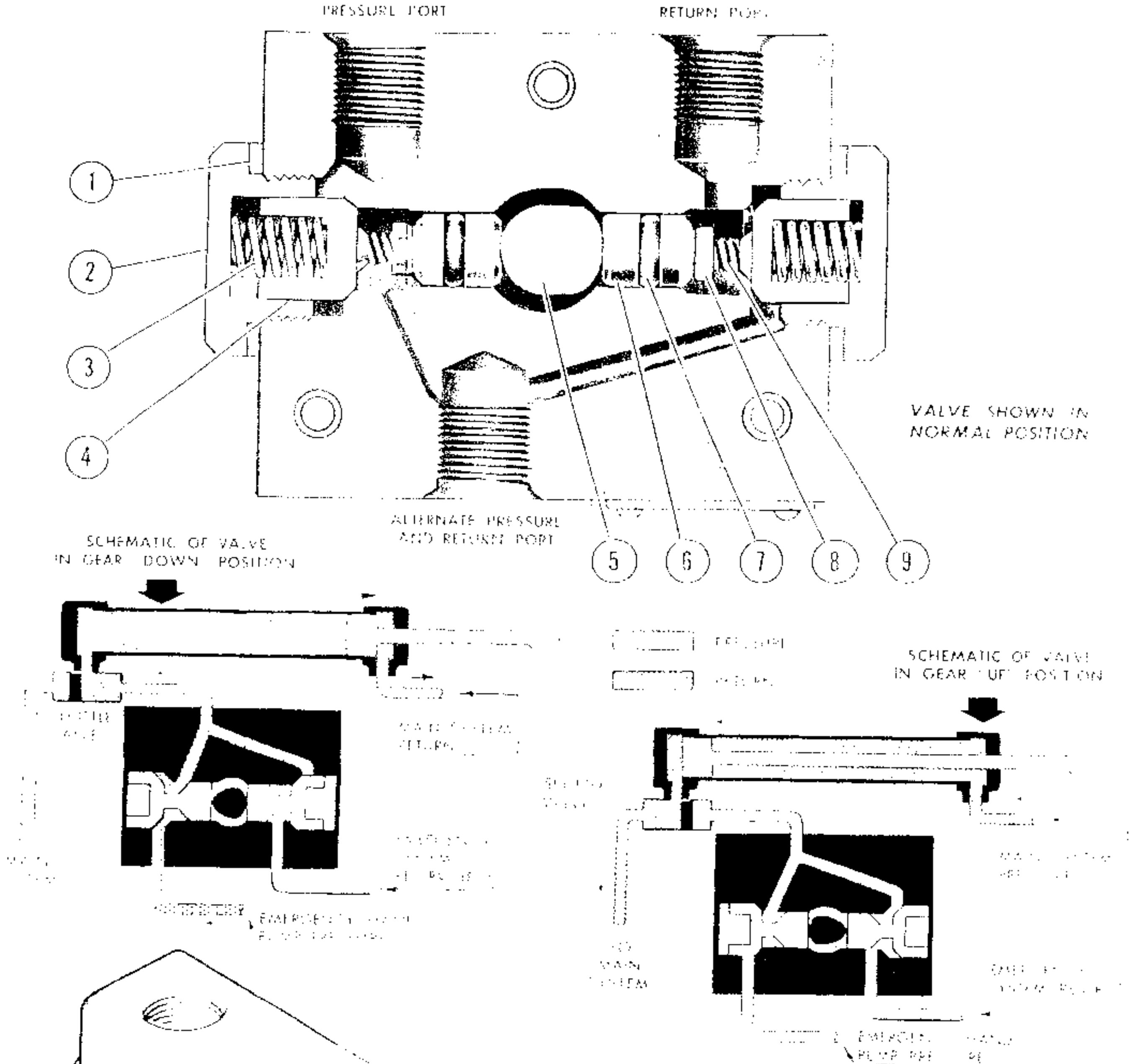
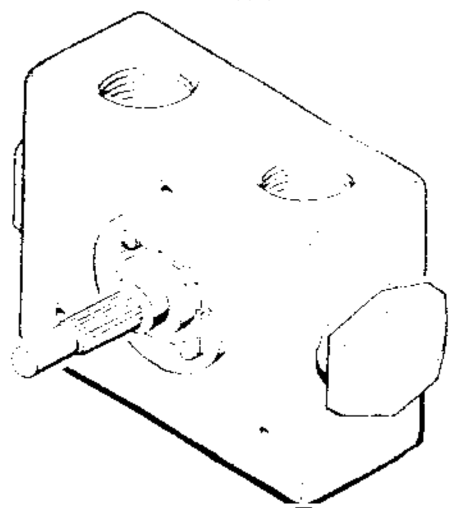



*Figure 163 — Alighting Gear Emergency Selector Valve, Airplanes Serial Nos. AF44-84992 through 44-85336*



| | | | |
|---|---|---|---|
| 1 | GASKET | 6 | PISTON |
| 2 | CAP | 7 | PACKING |
| 3 | SPRING | 8 | LOCK NUT |
| 4 | VALVE | 9 | ADJUSTING SCREW |
| 5 | CAM | | |

*Figure 164 — Alighting Gear Emergency Selector Valve, Airplanes Serial Nos. AF44-85337 and Subsequent*

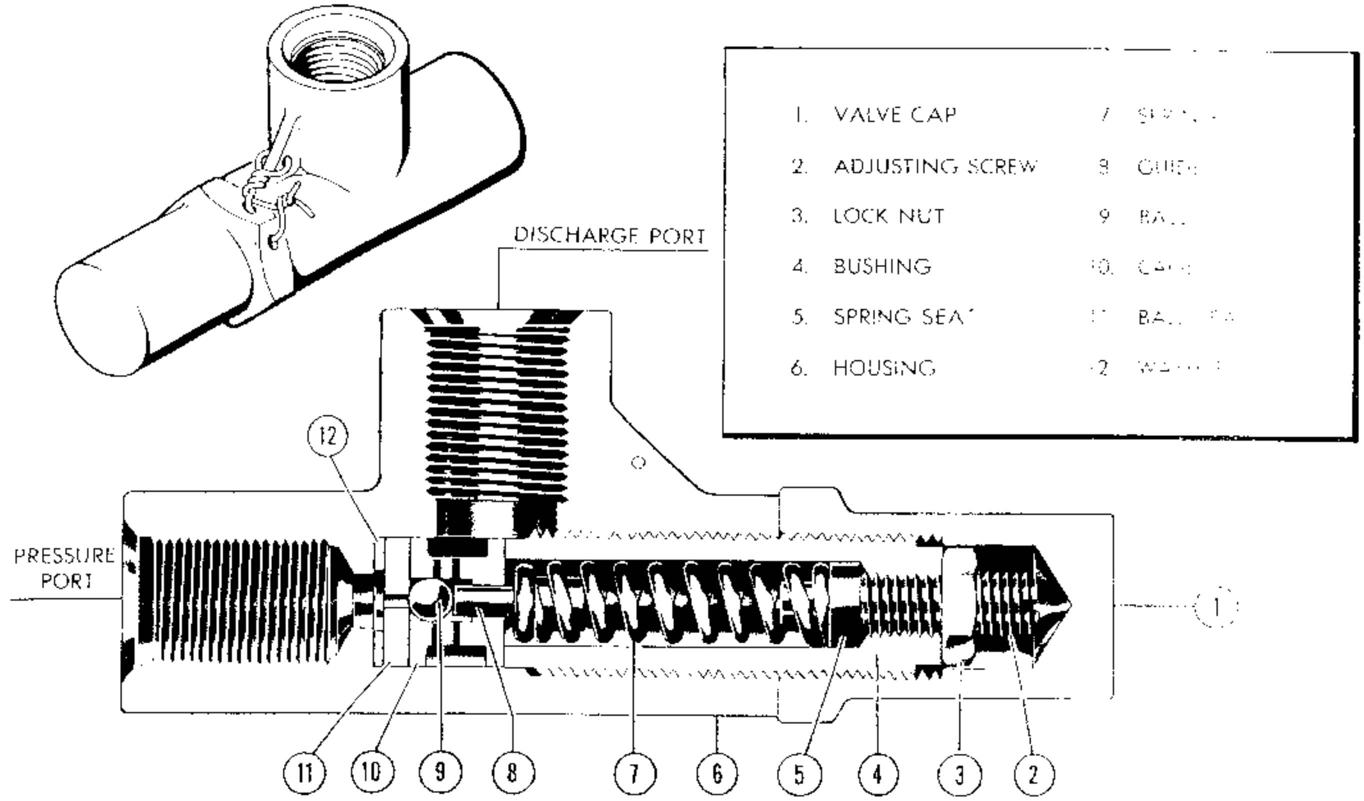



*Figure 165 — Thermal Relief Valve*

(7) DOOR EMERGENCY RELEASE CYLINDER. *(See figure 158.)*—Two small actuating cylinders are employed, one at each main gear door mechanism, to unlock the inner door segments when the emergency system is used. The cylinders are hydraulically operated in one direction only. After operation they are returned to their normal position by the door mechanism when the door closes. The cylinder may be disassembled by removing the tube connector fitting which forms the cylinder end cap and pushing the piston out.

(8) THERMAL RELIEF VALVE. *(See figure 165.)*—A thermal relief valve is connected to the emergency system pressure line to protect it from excessive pressure induced by thermal expansion of the fluid. Fluid under pressure of 1225 (± 25) psi or more is bypassed to the hand-pump suction line. The valve is adjusted by removing the cap and turning the adjusting screw clockwise to increase the pressure setting or counterclockwise to decrease the pressure setting.

*e.* GROUND TEST SYSTEM, AIRPLANES SERIAL NOS. AF44-85337 AND SUBSEQUENT.

(1) GENERAL.—The emergency system hand pump is connected to the main hydraulic reservoir and to the basic hydraulic system by the ground test selector valve to facilitate ground testing of the units of the main system.

(2) GROUND TEST SELECTOR VALVE. *(See figure 166.)*

*(a)* DESCRIPTION.—This valve is a five-port, two-position, poppet type selector valve with a two-lobe cam.

*(b)* OPERATION.—With the valve lever turned directly inboard for ground testing of hydraulic units, the hydraulic hand pump is connected into the main system, drawing fluid from the main system reservoir and supplying pressure for operation of all units. The aileron booster must be shut off due to its high volume requirements, and the alighting gear emergency selector valve must be in the aft, or normal, position. Return fluid from all units enters the main system reservoir.

With the valve lever in the forward (or normal) position, the hand pump is disconnected from the main system and is connected into the alighting gear emergency system.

*(c)* REMOVAL.

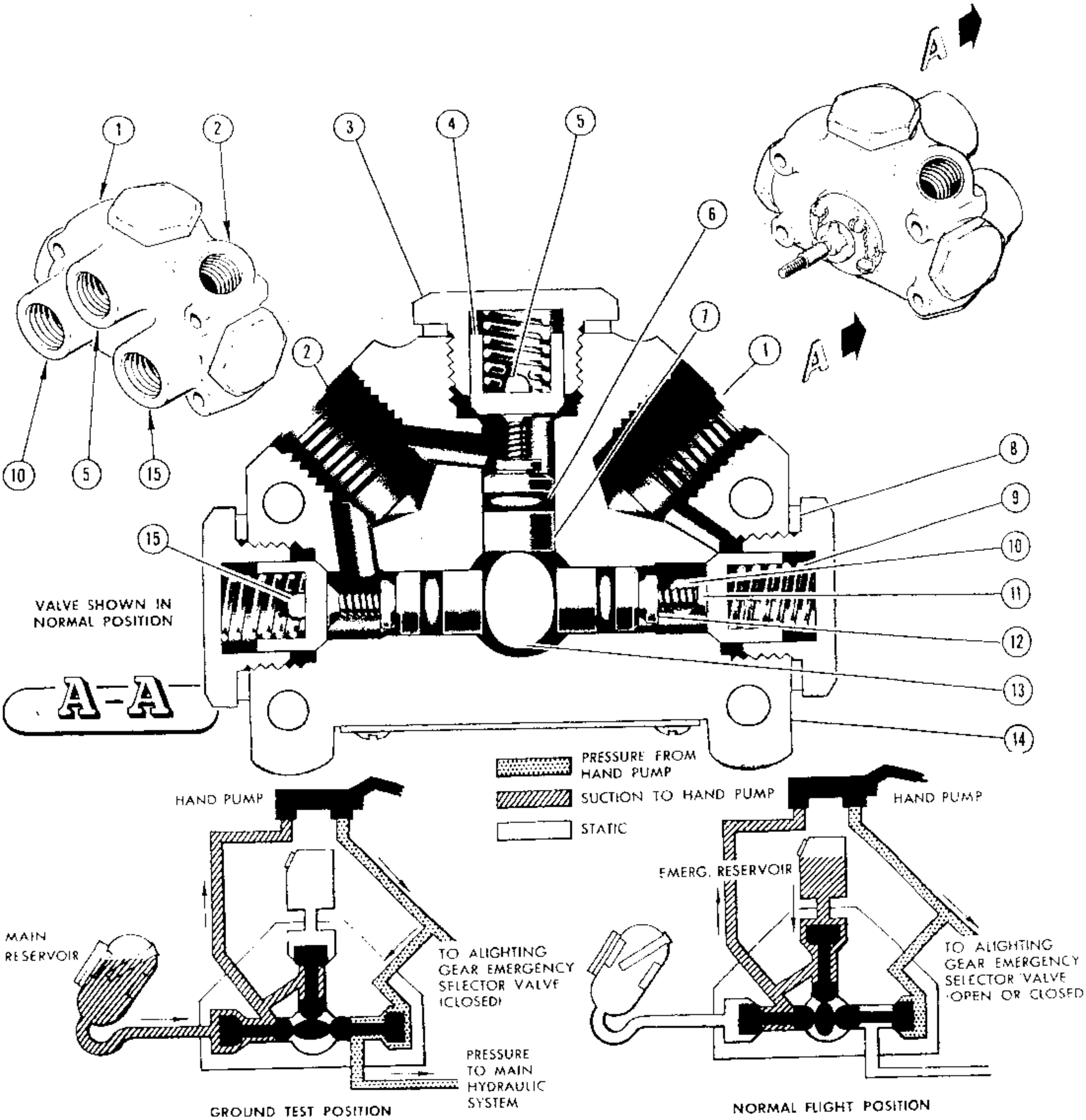
*1.* Remove the right-hand cockpit trim panel.

*2.* Disconnect plumbing from valve.

*3.* Remove screws attaching valve to structure, and remove valve.

*(d)* DISASSEMBLY.

*1.* Remove the three caps, springs, and valves from the valve body.




| | | | | | |
|---|---|---|---|---|---|
| 1. | PRESSURE INLET | 6. | PACKING | 11. | ADJUSTING SCREW |
| 2. | HAND PUMP SUCTION | 7. | PISTON | 12. | LOCK NUT |
| 3. | CAP | 8. | GASKET | 13. | CAM |
| 4. | VALVE | 9. | SPRING | 14. | BODY |
| 5. | EMERG. RESERVOIR SUCTION | 10. | PRESSURE OUTLET | 15. | MAIN RESERVOIR SUCTION |

*Figure 166 — Ground Test Selector Valve, Airplanes Serial Nos. AF44-85337 and Subsequent*

2. Remove the adjusting screws and the pistons, using long-nosed pliers.

3. Remove the bearing retainer screws, and remove the cam.

(e) ASSEMBLY.

1. Place the setscrews with lock nuts in the pistons.

2. Install seals on pistons, and push each piston into its chamber in the body.

3. Install the cam and bearing, and secure the bearing with four screws.

4. Insert valves and springs, and secure them with gaskets and caps.

(f) ADJUSTMENT.—Adjust setscrews in pistons to give a minimum valve lift of 0.025 inch, and tighten the lock nuts. After final adjustment, tighten valve caps to 30 (±3) foot-pounds torque.

## WARNING

The ground test selector valve handle must be safetied in the forward position.

f. AILERON BOOSTER SYSTEM.

(1) DESCRIPTION.—The aileron booster system utilizes main system hydraulic pressure to supplement manual pressure on the aileron control. Operation is such that the pilot retains the feel of the control, yet is able through servo action to produce a much greater force at the control surface than is applied at the control stick. The booster utilizes a control valve actuated by a mechanical linkage connected to the aileron control system. The valve directs hydraulic pressure to either side of the actuating cylinder, depending on movement of the control stick. The actuating cylinder contains a bypass valve which automatically opens upon loss of hydraulic pressure to allow flow from end to end of the cylinder, thus permitting manual operation of the ailerons in case the hydraulic system fails or is shut off during flight. On the ground, the booster may be shut off for maintenance testing by a manual shut-off valve in the hydraulic pressure line in the engine compartment. On airplanes not modified according to T.O. 01-75FJA-22, the shut-off valve is electrically operated and controlled from the cockpit.

The booster unit incorporates a low-boost ratio spring cartridge (figure 167) to reduce stick sensitivety at low control-surface loads, particularly near the neutral position. With aileron loads sufficient to cause complete compression of the spring, the booster operates as explained in paragraph (2)(b) following.

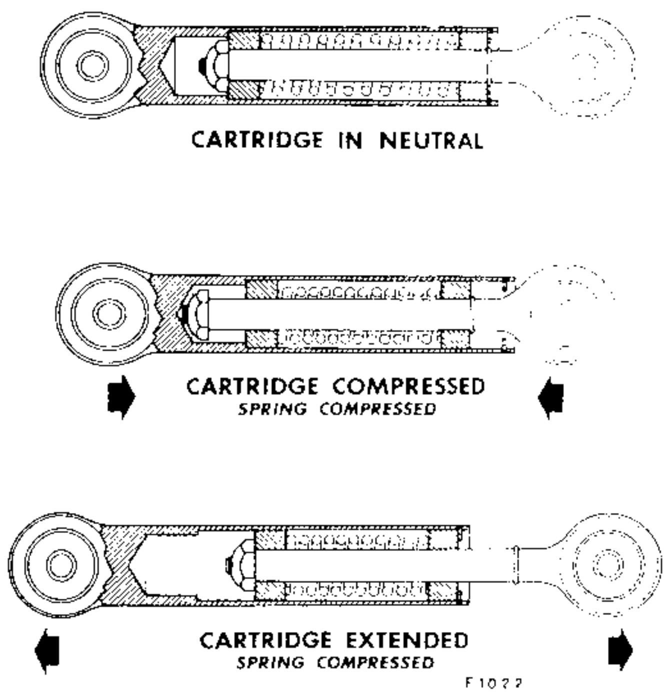
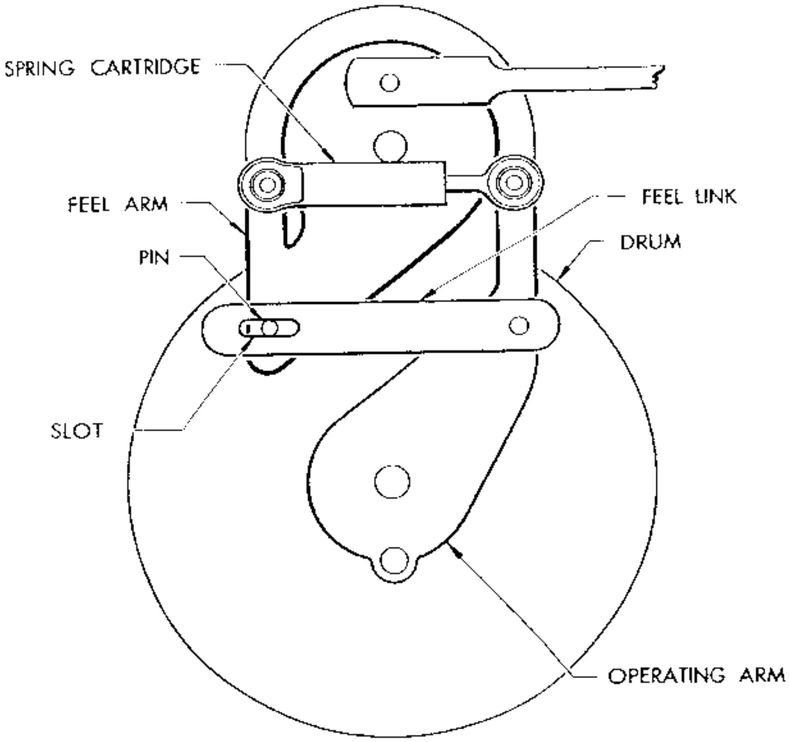



Figure 167 — Aileron Booster Spring Cartridge Operation

(2) OPERATION.

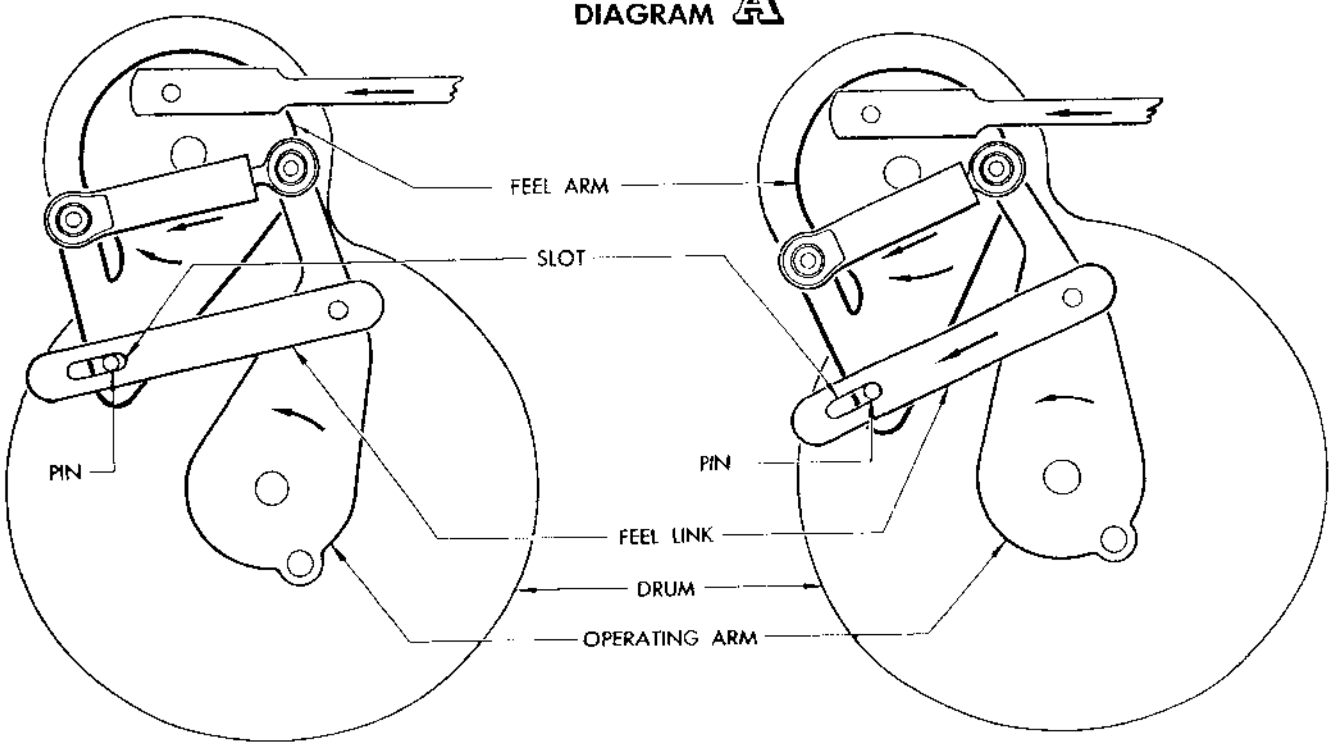
(a) LOW RATIO. *(See figure 168, Sheet 1.)*—Diagram A shows the linkage in the neutral position. Note that the pin is in the center of the slot. With low aileron loads, left stick force applied through the torque tubes to the operating arm moves it counterclockwise (diagram B). The force is then transmitted to both the feel link and the spring cartridge. Due to the low resisting loads on the ailerons, the spring does not compress sufficiently to allow the pin to bottom in the feel link slot. Since the pin does not bottom in the slot, the force from the operating arm is transferred through the spring cartridge. The spring cartridge is attached to the feel arm at a point of low leverage. Because the force is transferred to a point of little leverage, a low boost ratio results.

When high aileron loads are present the force applied to the operating arm is transferred to both the spring cartridge and the feel link. Since the resisting load on the ailerons is sufficient to compress the spring, the pin bottoms in the feel link slot and the load is transferred through the feel link (diagram C). The feel link is attached to the feel arm at a point of greater leverage, thereby giving a greater boost ratio.




SPRING NEUTRAL

DIAGRAM A




SPRING BEING COMPRESSED—LOW RATIO

DIAGRAM B

SPRING FULLY COMPRESSED—HIGH RATIO

DIAGRAM C

*Figure 168 (Sheet 1 of 4 Sheets)—Aileron Booster Operation*

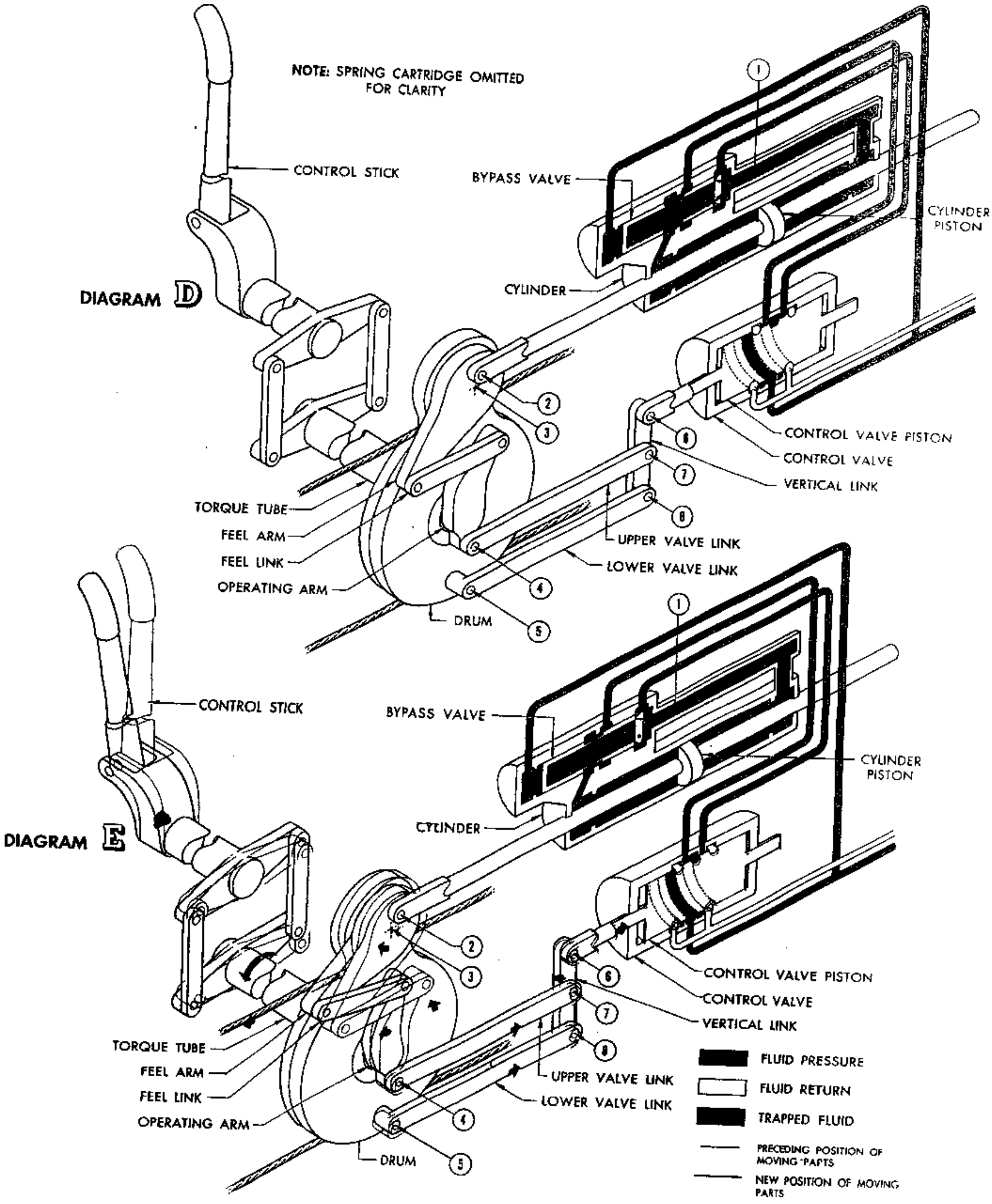
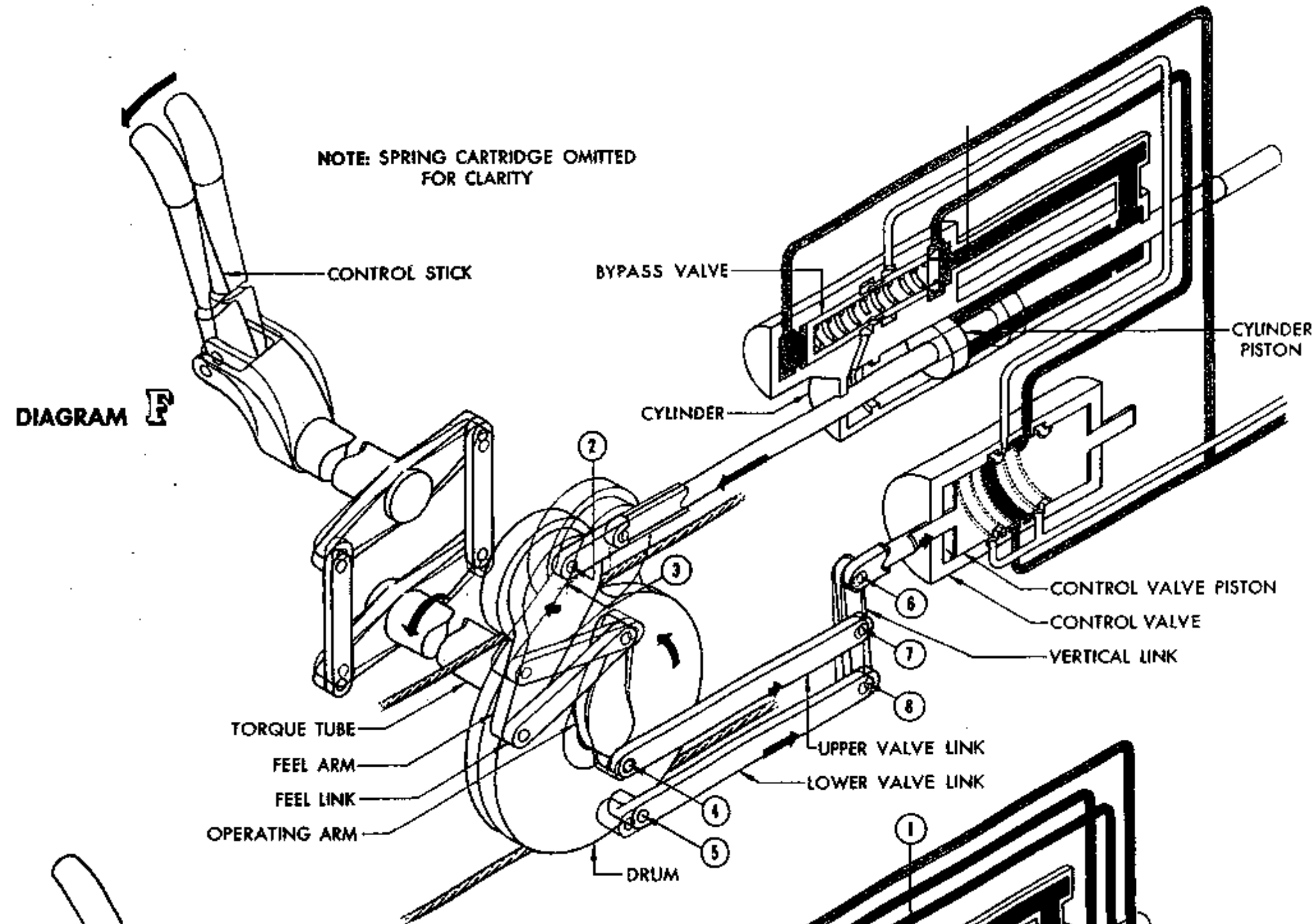



*Figure 168 (Sheet 2 of 4 Sheets) — Aileron Booster Operation*



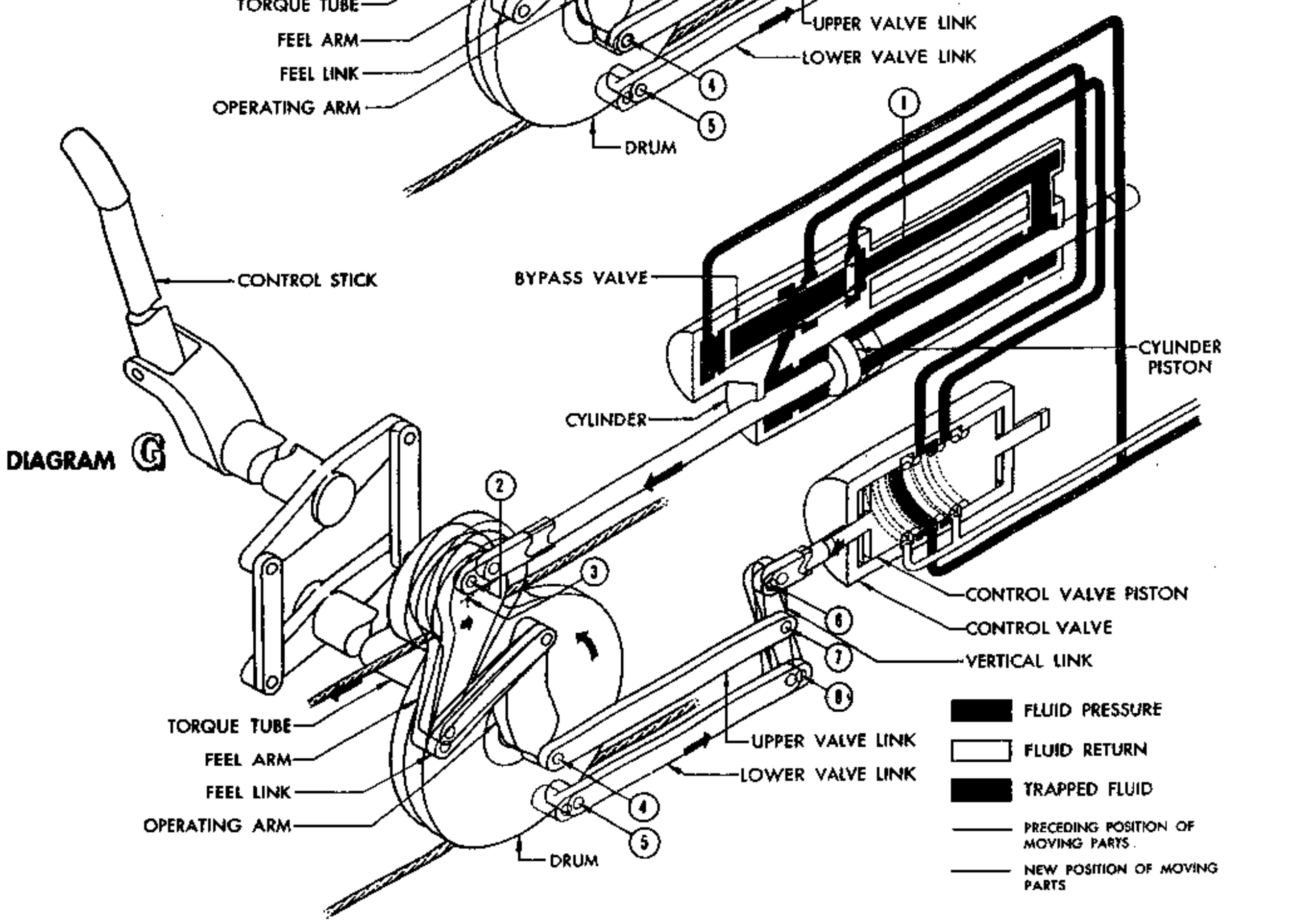




*Figure 168 (Sheet 3 of 4 Sheets)—Aileron Booster Operation*

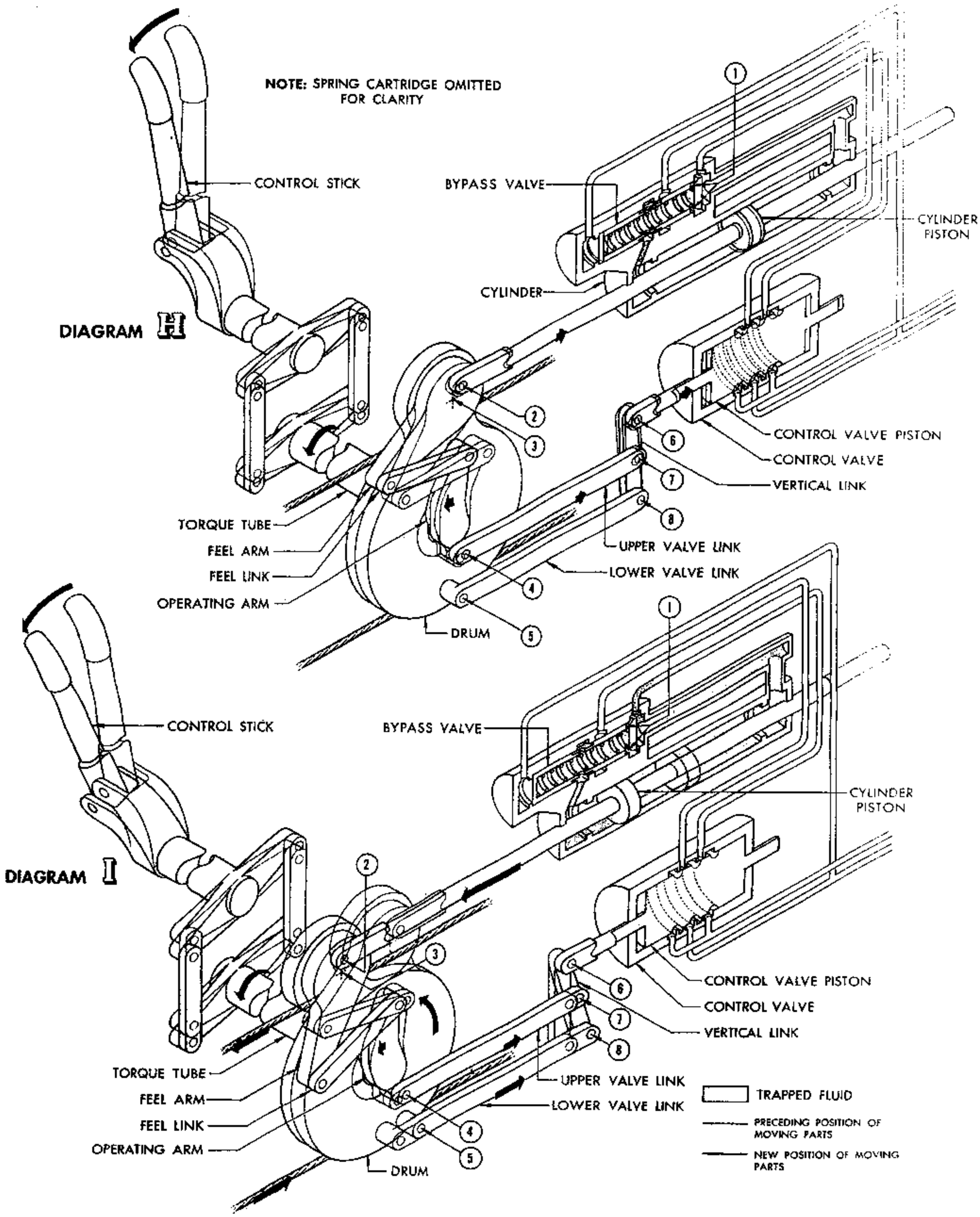



*Figure 168 (Sheet 4 of 4 Sheets) — Aileron Booster Operation*

Linkage motion for left aileron up is shown in diagrams A, B, and C. Linkage motion for left aileron down is similar but opposite. Instead of the operating arm pushing the spring cartridge to compress the spring, it pulls the ends apart and compresses the spring as shown in figure 167.

*(b)* HIGH RATIO. *(See figure 168.)*—Diagrams D, E, F, and G show, schematically, the operation of the aileron booster unit in supplementing the force applied to the control stick when the stick is moved to the left. In each succeeding diagram, the black lines show the progressive positions of the various moving parts of the system; the red lines indicate the positions from which the parts have moved.

The low-boost ratio spring cartridge has been omitted for clarity. It is assumed that a sufficient load is on the ailerons to cause compression of the spring.

Diagram D shows the booster unit in the neutral position. Points (2, 3, 4, and 5) are in alignment vertically, and the control valve piston is centered. When this piston is centered, fluid is trapped on both sides of the cylinder piston, thereby preventing movement of the piston. At the same time fluid under pressure holds the bypass valve closed. The bypass valve seat is at point (1).

Movement of the stick to the left is started in diagram E. This movement is transmitted to the operating arm which is attached to the aft torque tube. As the operating arm moves counterclockwise it pushes the feel link to the left rotating the feel arm center (3) clockwise about center (2). Rotation of center (3) about center (2) moves the drum slightly to the left due to the eccentricity of center (2). This slight movement of the drum, without the aid of the cylinder, deflects the ailerons against the resistance of the air stream to produce feel at the control stick.

With additional movement of the stick and operating arm (diagram F) the valve linkage begins to push the control valve piston to the right. Point (4) on the bottom of the operating arm and point (5) on the bottom of the drum move counterclockwise. The movement of point (4) is in advance of the movement of point (5). This pushes the upper valve link which applies force at point (7) and causes the vertical link to rotate clockwise about point (8). The force transmitted by the vertical link at point (6) to the valve piston pushes it to the right.

The control valve is a hydraulic four-way valve designed for use with the booster unit. As the piston is pushed to the right it connects the hydraulic fluid pressure line with the right-hand side of the cylinder and the hydraulic fluid return line with the left-hand side of the cylinder. Thus, fluid under pressure forces the cylinder piston and drum to the left which, through cables, moves the aileron to bank the airplane to the left.

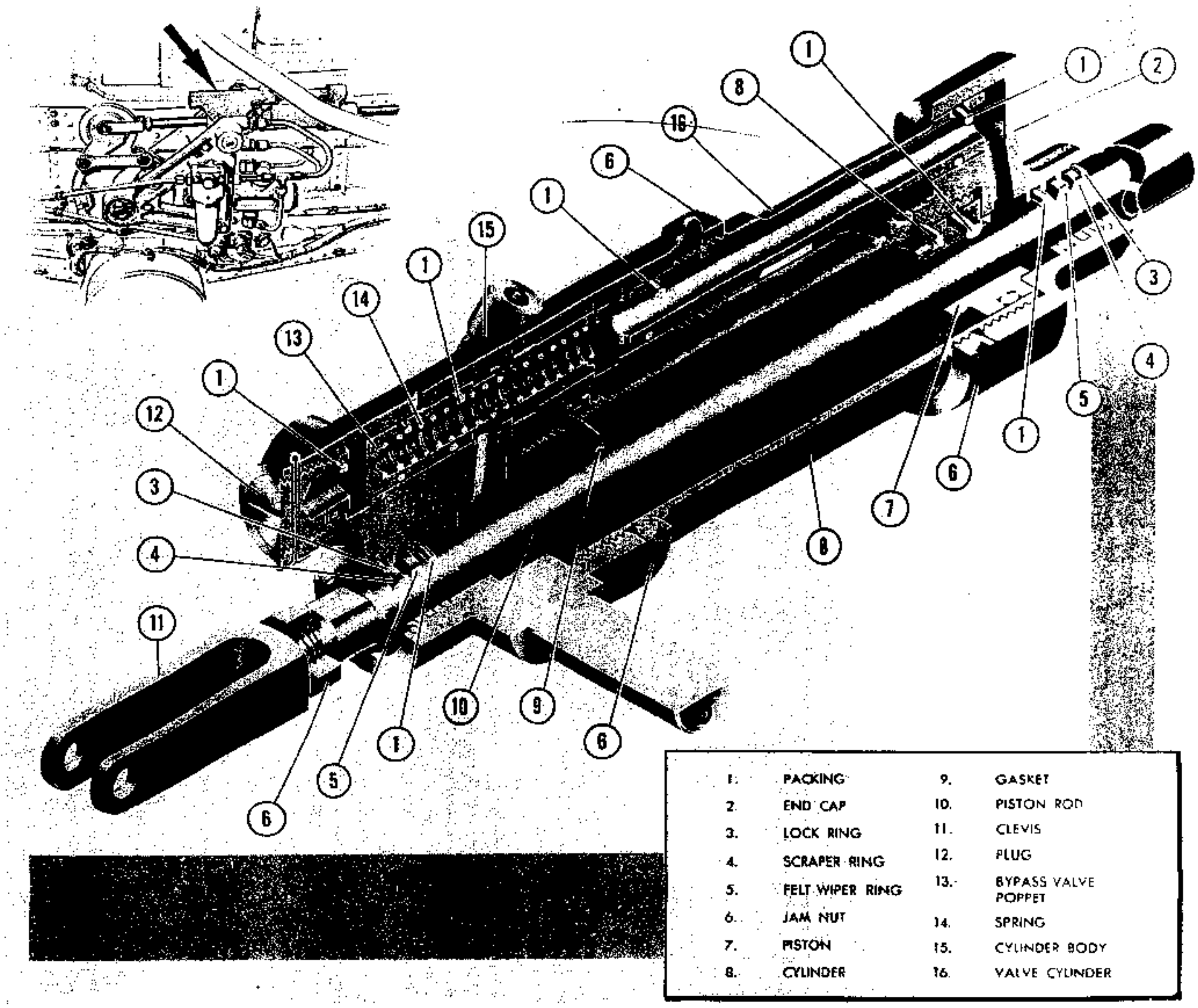
When movement of the control stick to the left is stopped, the operating arm is stopped in a corresponding position (diagram G). The cylinder piston continues to move to the left rotating the drum counterclockwise. Because the operating arm cannot move, the upper valve link is held stationary. Hence the drum pushes the lower valve link to the right so that the force applied at point (8) pivots the vertical link about point (7) to pull the valve piston to the left and to neutral. When the valve piston is in neutral both the pressure and return ports are blocked, thereby trapping fluid on both sides of the cylinder piston and holding it in left position. Movement of the stick back to neutral reverses the preceding movements.

*(c)* WITHOUT HYDRAULIC SYSTEM PRESSURE. *(See figure 168.)*—Diagrams H and I illustrate the operation of the booster unit in the event of failure of the hydraulic system. In each diagram, the black lines show the progressive positions of the various moving parts of the system; the red lines indicate the positions from which the parts have moved.

When the system pressure fails, the bypass valve spring opens the valve at point (1, diagram H). This permits the trapped fluid to flow freely from one side of the cylinder to the other as the piston moves back and forth. When the stick is moved to the left as shown in diagram H, the operating arm rotates counterclockwise pushing the feel link to the left, which rotates feel arm center (2) clockwise about stationary point (3). This moves the cylinder piston slightly to the right. At the same time rotation of the operating arm moves the upper valve link to the right where it applies force to the vertical link at point (7). This causes the vertical link to rotate clockwise about point (8) and push the valve piston to the right-hand end of its travel. The process of moving the valve piston to the end of its travel results in the stick play that is evident during manual operation of the ailerons.

As movement of the stick continues to the left as shown in diagram I, the operating arm pushes the upper valve link to the right where it forces the vertical link to rotate counterclockwise about point (6). The vertical link pulls the lower valve link to the right and aids in rotating the drum counterclockwise. At the same time, the upper end of the operating arm pushes the feel link to the left which pulls the feel arm and drum to the left, resulting in movement of the ailerons by means of the cable system.

Return of the control stick to the neutral position reverses the preceding movements.



| | | | |
|---|---|---|---|
| 1. | PACKING | 9. | GASKET |
| 2. | END CAP | 10. | PISTON ROD |
| 3. | LOCK RING | 11. | CLEVIS |
| 4. | SCRAPER RING | 12. | PLUG |
| 5. | FELT WIPER RING | 13. | BYPASS VALVE POPPET |
| 6. | JAM NUT | 14. | SPRING |
| 7. | PISTON | 15. | CYLINDER BODY |
| 8. | CYLINDER | 16. | VALVE CYLINDER |

*Figure 169 — Aileron Booster Actuating Cylinder*

(3) AILERON BOOSTER ACTUATING CYLINDER, *(See figure 169.)*

*(a)* DESCRIPTION.—The aileron booster actuating cylinder is a balanced, piston type cylinder. It is mounted on the booster assembly bracket with swivel mountings in which are drilled the cylinder pressure passages. A poppet bypass valve and passages are integral parts of the cylinder assembly.

*(b)* REMOVAL.—See paragraph 15*c*(3)*(d)*, this section.

*(c)* DISASSEMBLY.

*1.* Loosen jam nut and remove clevis.

*2.* Loosen cylinder jam nuts.

*3.* Unscrew cylinder until end block comes free from bypass tube. Unscrew end block from cylinder.

*4.* Pull piston and rod from cylinder.

*5.* Unscrew and remove cylinder.

*6.* Unscrew and remove bypass tube.

*7.* Remove snap ring and unscrew end cap of bypass valve.

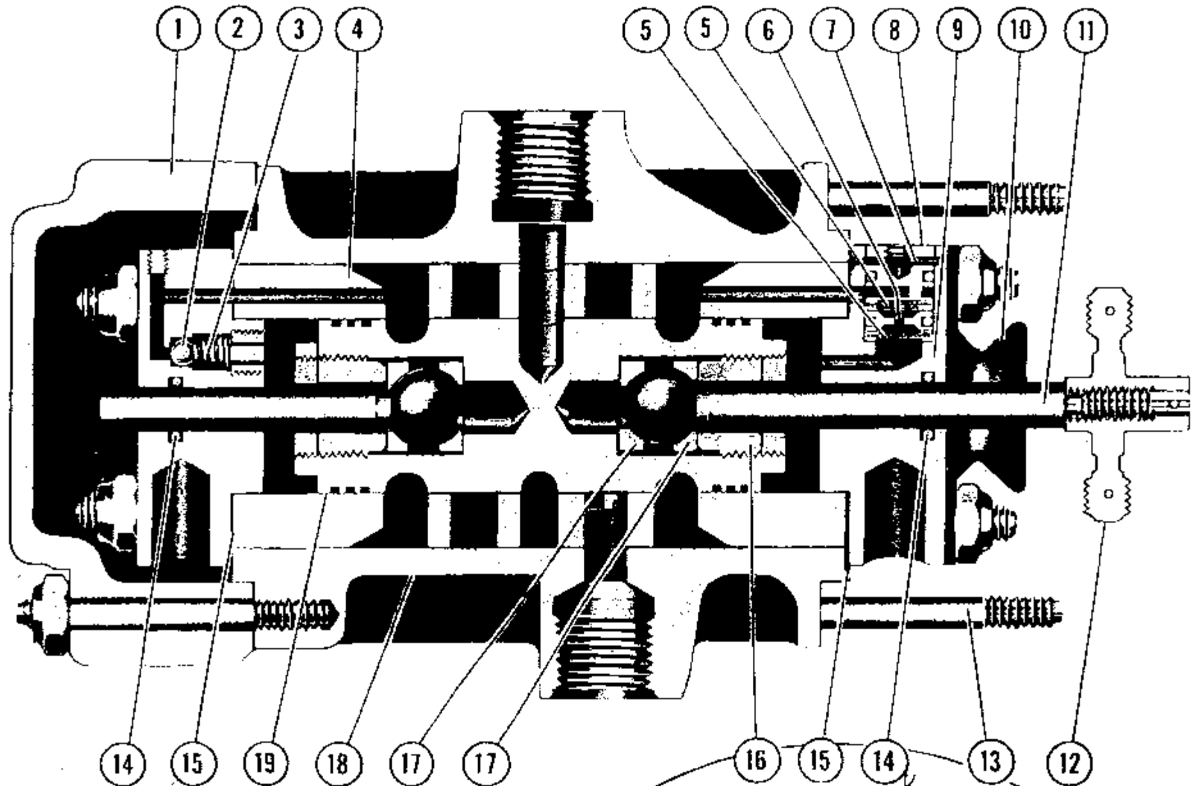
*8.* Remove bypass valve and spring.

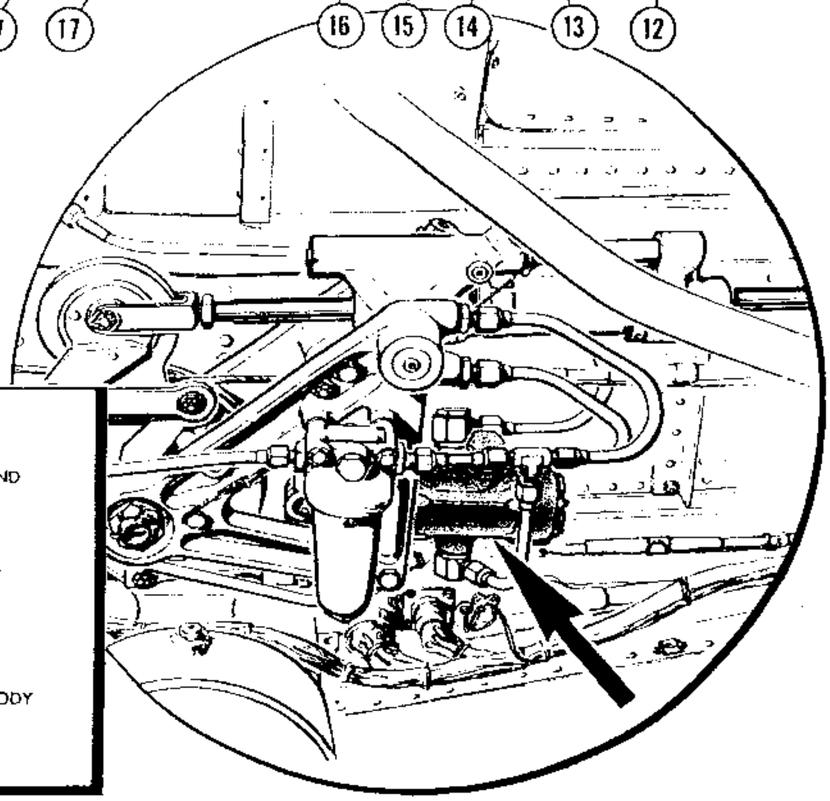
*(d)* MAINTENANCE AND OVERHAUL.

*1.* CLEANING.—Clean all parts thoroughly using clean kerosene or unleaded gasoline.

*2.* PISTON AND CYLINDER BARREL.

a. Carefully inspect cylinder barrel bore for scratches, score marks, or other damage. Remove light marks with crocus cloth. If seriously damaged, replace the barrel assembly.





1. CAP
2. BALL
3. SPRING
4. SLEEVE
5. SCREEN
6. ORIFICE
7. PIN
8. PLUG
9. BLOCK
10. DUST BOOT
11. SHAFT
12. SHAFT END FITTING
13. STUD
14. PACKING
15. GASKET
16. NUT
17. WASHER
18. VALVE BODY
19. PISTON

*Figure 170 — Aileron Booster Control Valve*

b. Inspect surface of piston rod for damage which might cause binding or leakage. Remove light surface marks or scratches with fine crocus cloth. If seriously damaged, or appreciably worn, replace parts.

3. END ASSEMBLIES.

a. Remove "O"-ring packings from end assemblies and install new parts.

b. Check condition of wiper rings. See that scraping edge is not nicked or cut, and that fit on piston rod is not excessively loose. Install new rings at overhaul.

c. Inspect cylinder barrel seal "O" rings for cuts, nicks, or other damage. Replace if necessary.

d. Check bypass valve poppet for freedom of movement in bore, and valve face for damage which might cause leakage.

e. Check condition of bypass valve seat in end assembly. If valve poppet or seat is damaged, lap poppet to seat using suitable valve grinding compound. Use oscillating motion to avoid ringing seat.

f. Replace poppet valve packing ring.

g. Inspect bypass tube and packings. Replace if damaged.

h. Inspect packing rings in swivel bearings and replace if necessary.

*(e)* ASSEMBLY.—Reverse disassembly procedure. Lubricate all packings and bores prior to assembly to prevent damage to packing rings. When installing valve cylinder (figure 169, reference 16), screw cylinder in until it bottoms, then back it out one to two turns, wherever booster operates best, tighten jam nut, and lockwire in position.

*(f)* TEST AFTER ASSEMBLY.

*1.* Apply 2300 psi pressure to extending port. Leakage at opposite port shall not exceed 10 drops per minute.

*2.* Apply 2300 psi pressure to retracting port. Leakage at opposite port shall not exceed 10 drops per minute.

*3.* Plug extending port and apply 2300 psi pressure to the retracting port for five minutes. Then plug the retracting port and apply 2300 psi pressure to the extending port. There shall be no external leakage or distortion.

(4) AILERON BOOSTER CONTROL VALVE. *(See figure 170.)*

*(a)* DESCRIPTION.—The aileron booster control valve provides control of the hydraulic pressure flow to the booster actuating cylinder. The control valve is essentially a balanced piston type, four-way valve, having an orifice and check valve hydraulic damper in each end of the piston chamber.

The piston seal is metal-to-metal, and requires extreme cleanliness during overhaul and assembly operation.

*(b)* REMOVAL.—See paragraph 15c(3)*(c)*, this section.

*(c)* DISASSEMBLY.

**CAUTION**

This is a precision valve; therefore, disassembly requires extreme cleanliness and care, and should be undertaken only by a specialist.

*1.* Remove end cap.

*2.* Remove nuts securing end block on attaching end of valve, and remove boot and block.

*3.* Pull piston from valve.

*4.* Remove the other end block.

*(d)* MAINTENANCE AND OVERHAUL.

*1.* CLEANING.—Clean all parts thoroughly. Wash in clean kerosene or unleaded gasoline and blow dry with compressed air. Use extra care to see that restrictor fittings and check valves in end blocks are free from dirt or other foreign matter. Protect disassembled parts from dust and dirt.

*2.* VALVE BODY AND PISTON.

a. Carefully inspect bore of control valve body insert and surface of piston for scoring, scratches, nicks, or other damage.

b. Do not attempt to remove any marks by use of abrasives. These parts are nitrided and microfinished to a tolerance of ± 0.0001 inch. Therefore, any use of abrasives would probably cause excessive leakage and improper functioning of the control valve. The following tolerances are allowable before replacement is required. If the given tolerances for either the valve body or the piston are exceeded, both parts should be replaced.

| *Part* | *Allowable Tolerance* |
|---|---|
| Valve body bore, ID | $0.9989^{+0.0001}_{-0.0004}$ |
| Piston, OD | $0.9982^{+0.0001}_{-0.0004}$ |

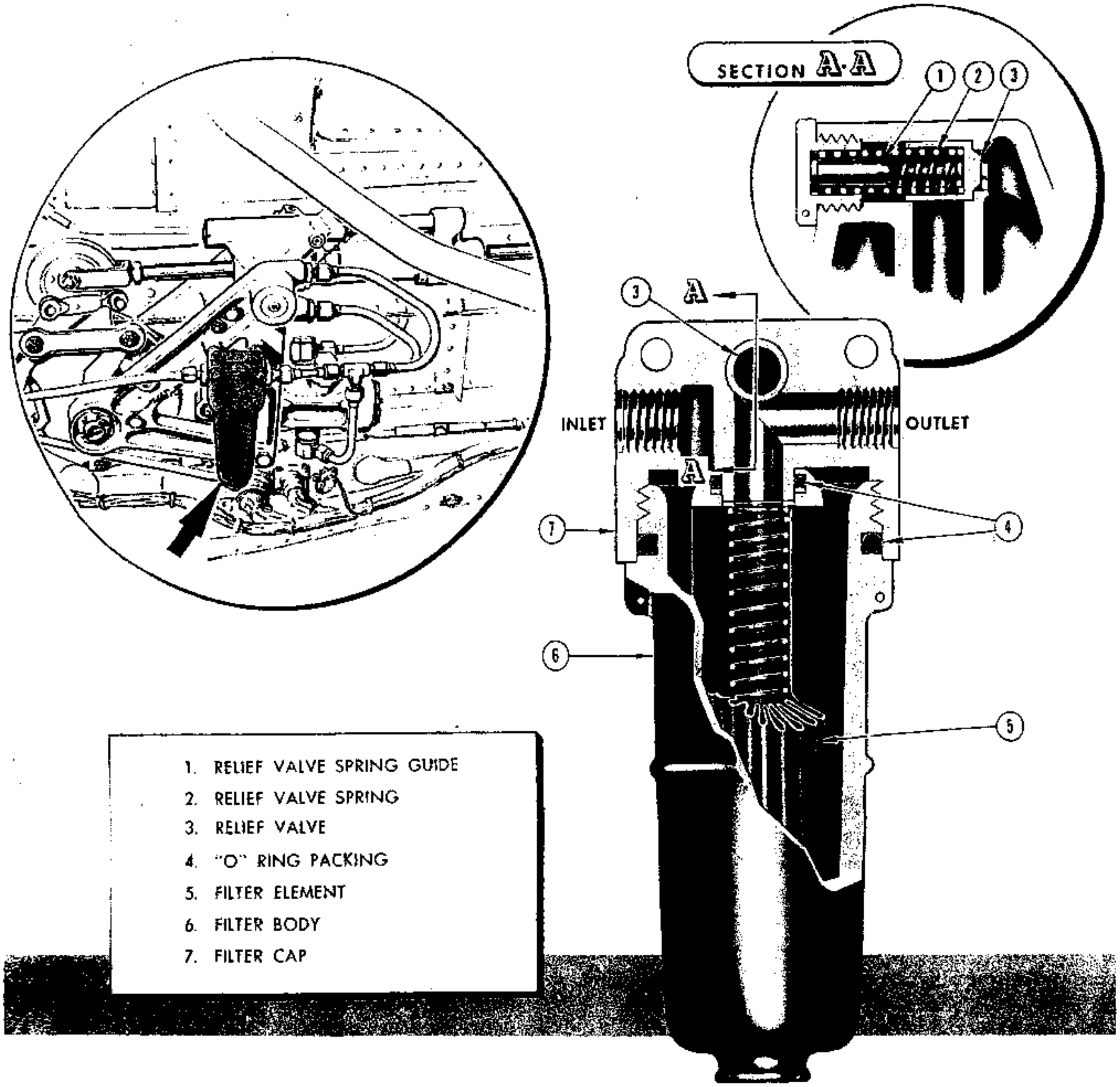



*Figure 171 — Aileron Booster Filter*

3. END BLOCKS AND CAPS. *(See 9 and 1, figure 170.)*

a. Carefully check end block bore for scratches or scoring.

b. Replace "O" rings at valve overhaul; however, if visual inspection shows that packing is not scratched or broken, rings may be used again.

**CAUTION**

Do not remove packing "O" rings unless a replacement ring is available. Use of scribe or other tool to remove ring will damage the packing.

c. Restrictor fitting and check valve in end blocks will operate normally if thoroughly clean. Do not attempt to remove them unless they fail to operate. If it is necessary to remove either of these, use correct size Allen wrench and apply a small amount of heat. These are set-locked in place and must be handled carefully.

4. GENERAL.

a. Inspect portions of plunger stems which extend through end blocks and "O" rings for scratches, nicks, or other damage which might cause binding or failure of packing. Remove light marks with crocus cloth.

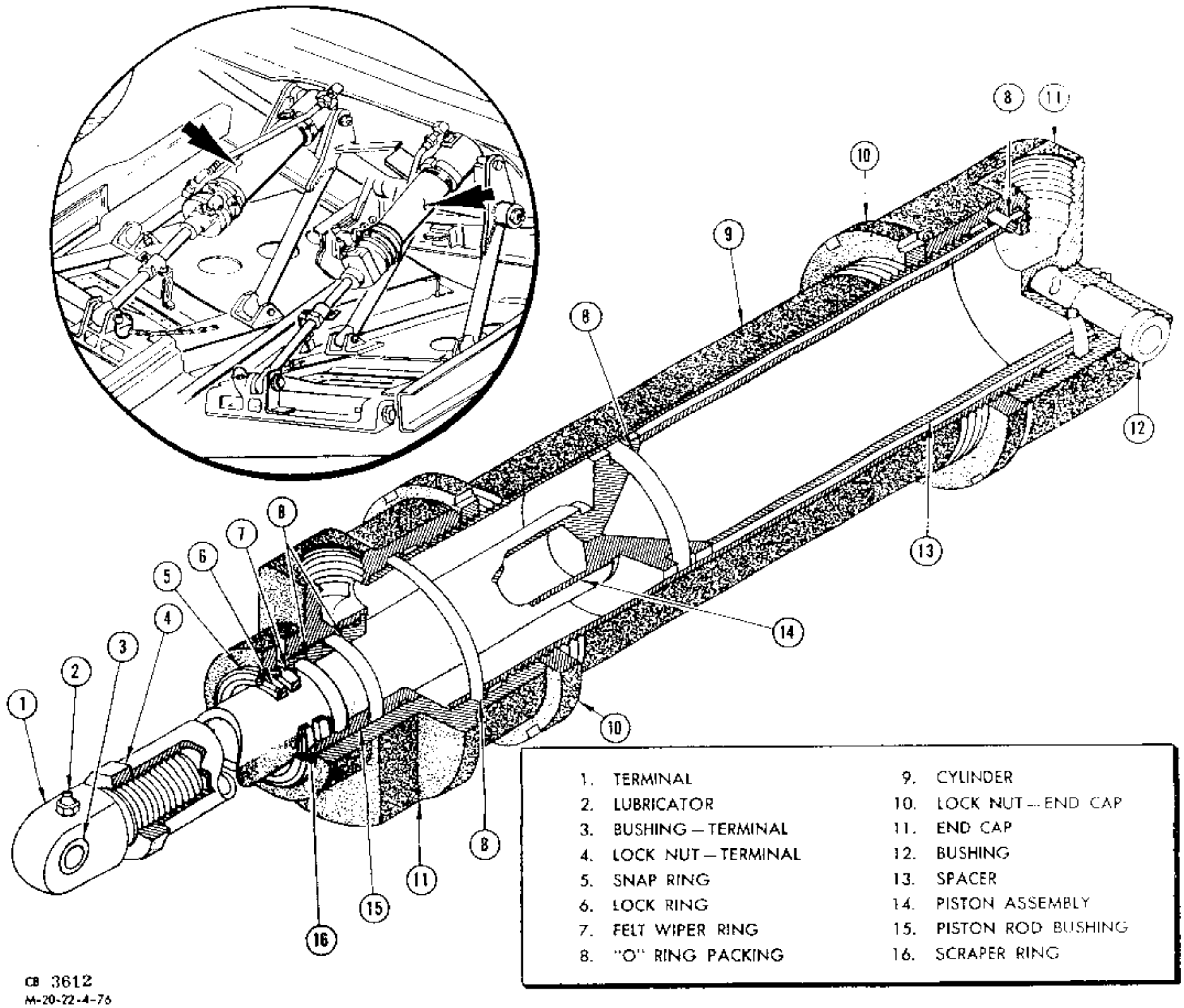



*Figure 172 — Dive Flaps Actuating Cylinder*

b. Inspect drive rod for fit in end cap. There must be no binding. Check surface of drive rod and bore of cap bearing sleeve for scratches or other damage. Remove light marks with crocus cloth.

*(dA)* ASSEMBLY. *(See figure 170.)*

*1.* Insert piston into body.

*2.* Install end block (9) and bolt (10). Be sure there is a washer under each nut at this end.

*3.* Install block at other end of piston, and replace cap over end.

*(e)* TESTS AFTER ASSEMBLY. — Thoroughly bench test the control valve.

*1.* Center valve piston with centering pin.

*2.* Apply 1500 psi pressure to port "P." Leakage at port "S" shall not exceed 0.10 gallon per minute with ports "C1" and "C2" interconnected.

*3.* With 1500 psi pressure applied to port "P," pressure at the gage in the line connecting ports "C1" and "C2" shall be 750 psi (± 90 psi).

*4.* Valve should work freely through the full stroke with no trace of binding in any portion of the stroke.

*5.* Apply 200 psi at port "S." Leakage from valve shall not exceed one drop in five minutes.

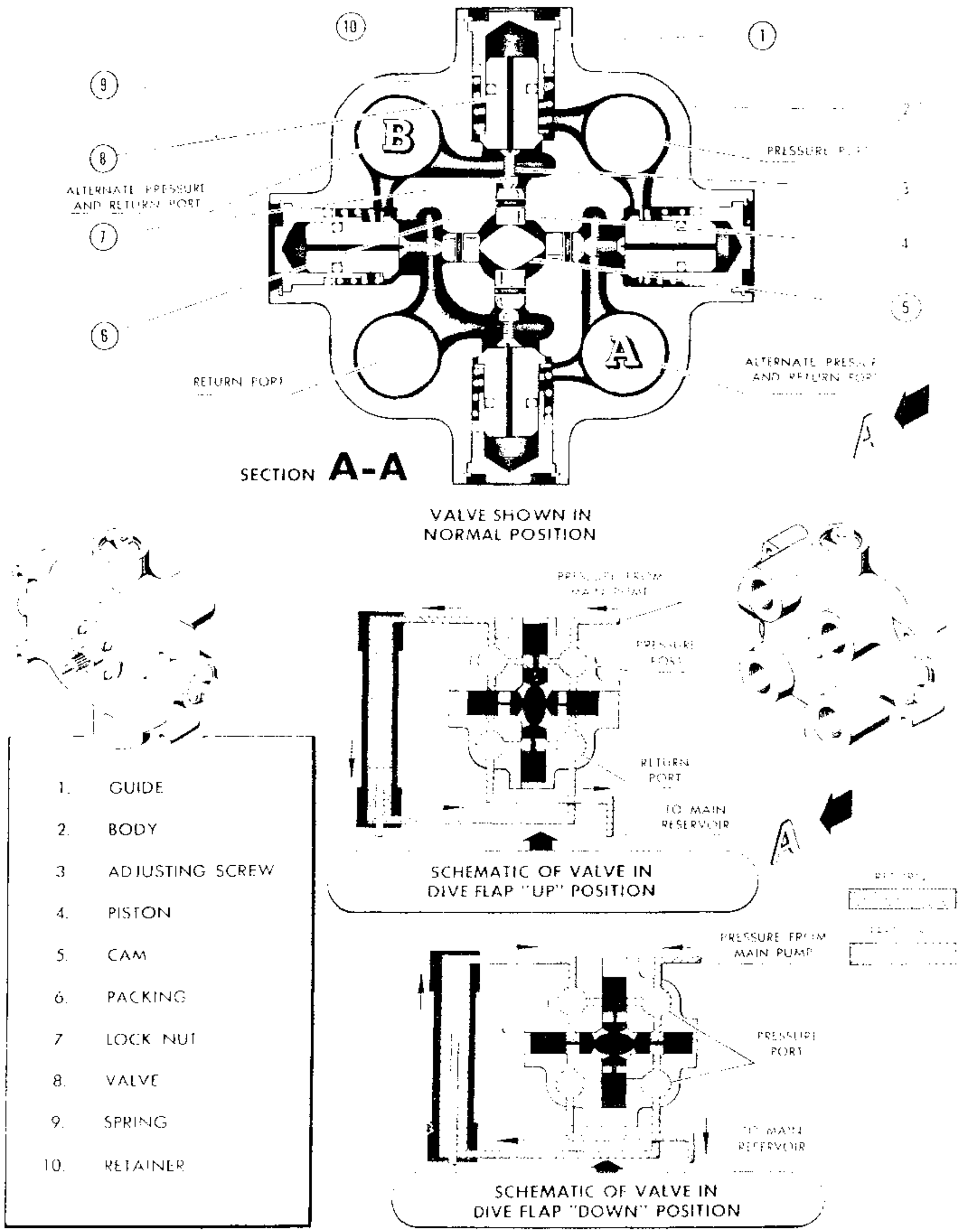



*Figure 172A — Dive Flap Selector Valve*

(5) AILERON BOOSTER FILTER. *(See figure 171.)*—The aileron booster filter is in the pressure line and insures a supply of clean fluid to the booster hydraulic unit. The filter has a capacity of 3 gallons per minute.

(6) AILERON BOOSTER SHUT-OFF VALVE. The aileron booster shut-off valve is an Adel, Part No. 16892-7, valve. Manually operated, it is controlled by a lever at the left-hand cockpit control panel. When the valve lever is moved to the "OFF" position, hydraulic pressure to the aileron booster is cut off.

*g.* DIVE RECOVERY FLAPS SYSTEM.

(1) DESCRIPTION.—The two dive recovery flaps are actuated by individual hydraulic cylinders which are controlled by one selector valve. The selector valve in turn is operated by an electrical actuator controlled by a switch in the cockpit.

The selector valve and the dive flaps actuating cylinder are both located in the fuel compartment and are accessible through the dive flaps. A restrictor check valve with a No. 48 (.076) hole in the poppet is installed in the dive flap "up" line to restrict the flow of hydraulic fluid during the flap-up cycle.

(2) OPERATION.—The dive flaps are operated by means of the dive flaps switch in the cockpit. The switch is a two-position switch, and does not have an off position. Thus the flaps can be operated only to the flaps up or flaps down position, with no intermediate positions. Operating the control switch to "FLAPS DOWN" position connects port "A" of the selector valve to pressure, resulting in lowering of the dive flaps by the actuating cylinder. With the switch in the "FLAPS UP" position, pressure is connected to port "B" of the selector valve, resulting in raising of the dive flaps.

(3) GROUND CHECK SHUT-OFF VALVE. *(See figure 155.)*—A manually operated shut-off valve is installed in the pressure line to the selector valve for use when making ground checks. The valve should be shut off when work is being done through the dive flap opening, to prevent inadvertent operation of the flaps.

**CAUTION**

The shut-off valve must be safetied in the open position before flight.

(4) SELECTOR VALVE.—The dive flap selector valve is identical to the unit used in the alighting gear system. For information on this part, see figure 172A and paragraph *c*(2) preceding.

(5) ACTUATING CYLINDER. *(See figure 172.)*

*(a)* DESCRIPTION.—The dive flap actuating cylinder consists principally of a piston, cylinder barrel, and two end caps. The piston rod end is fitted with an adjustable clevis terminal. "O" rings are employed for all packings. A spacer within the cylinder limits dive flap travel to 60 degrees.

The clevis terminal is fitted with a lubricator to provide lubrication for the clevis bushing. A scraper ring on the piston rod bearing area excludes foreign matter from the cylinder.

*(b)* REMOVAL.

*1.* Extend the dive flaps.

*2.* Remove the quick disconnect pin attaching actuator clevis to dive flap.

*3.* Remove bolt, nut, and cotter attaching actuating cylinder to link assembly, and remove actuating cylinder.

*(c)* DISASSEMBLY.

*1.* With piston bottomed, measure accurately and record the distance between the clevis attaching hole and the mounting hole on the end cap opposite the clevis.

*2.* Measure and record the full stroke of the piston.

*3.* Loosen the end-cap lock nuts. Use tool No. S-20618-20 (figure 29).

*4.* With a strap wrench, remove both end caps from the cylinder barrel.

*5.* Loosen clevis lock nut and remove clevis from piston rod.

*6.* Slide end cap off piston rod.

*7.* Remove lock ring and scraper from end caps.

*8.* Remove all "O" ring packings and gaskets.

*9.* Thoroughly clean all parts.

*(d)* INSPECTION AND REPLACEMENTS.

*1.* Inspect cylinder bore for scoring, worn spots, or roughness. Inspect piston rod for continuity of plating and for pitted condition.

*2.* Replace all "O" ring packings and gaskets.

*(e)* ASSEMBLY, TEST, AND INSTALLATION.

*1.* Lubricate all "O" ring packings, cylinder bore, and piston rod with hydraulic fluid, Specification AN-VV-O-366.

*2.* Assemble two end caps on piston rod and cylinder barrel.

*3.* Tighten end cap opposite the clevis so that cylinder barrel bottoms in end cap. Adjust piston stroke with other end cap to length recorded in paragraph *(c)2* preceding.

*4.* Tighten two end-cap lock nuts.

*5.* Assemble clevis and lock nut on piston rod.

*6.* With piston bottomed, adjust clevis for an over-all length as recorded in paragraph *(c)1* preceding.

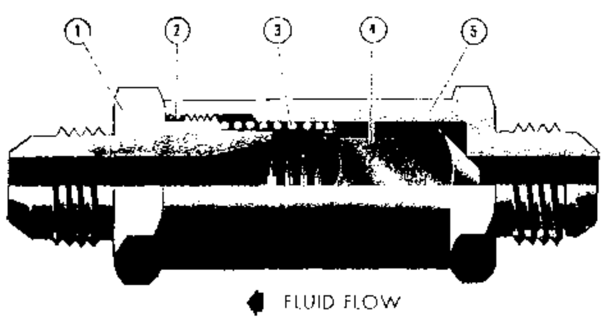
*7.* Tighten clevis lock nut.

*8.* If bench testing equipment is available, operate cylinder under 1500 psi pressure through several cycles and check for leaks. If such equipment is not available, install cylinder and test for leaks by operating dive flaps.

*h.* HYDRAULIC CHECK VALVES. *(See figure 173.)* —Check valves are installed at various points in the hydraulic system to prevent reverse flow of fluid. An arrow stamped on the body of each valve indicates direction of flow.

*i.* GENERAL MAINTENANCE REPAIRS.

(1) Relieve the hydraulic pressure by operating the aileron booster before disconnecting any hydraulic line.




| | | | |
|---|---|---|---|
| 1. | END FITTING | 4 | POPPET |
| 2 | PACKING | 5 | BODY |
| 3 | SPRING | | |

*Figure 173 — Check Valve*

(2) Cap all hydraulic tubes after disconnecting to prevent entrance of dust or other foreign matter.

(3) Clean disassembled units with kerosene or unleaded gasoline, and coat with hydraulic fluid, Specification AN-VV-O-366.

(4) Before installing any tube, clean it thoroughly by flushing with solvent and blowing with air pressure. Check for obstruction by rolling a steel ball through the tube.

(5) Tighten tubing connections and aluminum fittings in accordance with recommended tightening torques listed in section VIII, paragraph 8*e*.

*j.* HYDRAULIC SYSTEM CHECKOUT.

(1) GENERAL PRECAUTIONS.

**Note**

The hydraulic gig shall have a micronic filter. Relief valve on gig shall be set to bypass at 1000 (±50) psi.

*(a)* Inflate accumulators on hydraulic gig and on the airplane with air to between 425 and 450 psi.

*(b)* Fill main and emergency reservoirs to the proper level with hydraulic fluid, Specification AN-VV-O-366.

*(c)* Jack the airplane. (See section III, paragraph 2*d*.)

*(d)* Connect the hydraulic gig to the pressure and return lines at the ground test connections. Connect electrical power to the airplane through the external power connection.

*(e)* Be sure the alighting gear emergency selector valve handle is in the "NORMAL" position.

(2) HYDRAULIC FUSE CHECKOUT.

*(a)* Using the switch on the cockpit left shelf, shut off the aileron booster.

*(b)* Operate the dive flaps at least five times. Allow 30 seconds between each operation.

*(c)* Operate the alighting gear up and down at least five times. Allow 30 seconds between each operation.

*(d)* If steps *(b)* and *(c)* are accomplished with no hydraulic fuse lock-out, the hydraulic fuse checkout is satisfactory.

**Note**

If the hydraulic fuse locks, check for air in the system, or for internal leakage at valves.

(3) ALIGHTING GEAR MAIN SYSTEM CHECKOUT.

*(a)* Check the shock struts for proper inflation. (See paragraphs 4*c*(3) and 4*g*(2), this section.)

*(b)* Make sure the doors and gear are free of obstructions such as ladders, tape, bumpers, and stiff-knees.

*(c)* Close the alighting gear manual shut-off valves. Turn on hydraulic pressure and check for leakage through the manual shut-off valves. When the alighting gear valve handle is moved to "UP" or "DOWN," non-movement of the gear indicates no leakage or valves.

*(d)* Open only one alighting gear manual shut-off valve at a time and observe for proper operation of gear and door mechanism through at least six cycles.

*(e)* After individual operations have proven satisfactory, open all alighting gear manual shutoff valves and run all gear simultaneously. Check operating time with a stop watch. All gear should retract and doors close and lock in a maximum of five seconds. With gear in retracted position, turn off hydraulic gig and deplete aircraft hydraulic pressure by operating aileron boost. Place selector handle in "DOWN" position. Turn on gig and permit pressure to build up to BUT NOT TO EXCEED 600 PSI. Assure that gear comes down and locks.

**Note**

Failure of gear to operate satisfactorily using the above procedure, indicates marginally rigged units, worn parts, improper lubrication, or defective hydraulic units.

*(f)* Check gear down lock latch assembly to see that the lock is fully seated in notch on the side strut cam.

*(g)* Check main alighting gear inboard door for premature operation. With stiff-knees in place, operate alighting gear selector valve to "UP" and "DOWN" positions. Inboard door should remain open. The door should not close when subjected to vibration or manual force.

*(h)* With hydraulic pressure off, check break-over adjustment on main alighting gear inboard door brace. Push on the brace at the knee joint separating the surfaces of the upper and lower brace. Insert a .020 thickness gage and push the door back to open position. The brace shall hold the door rigidly open. File off the surfaces of the upper brace if necessary to obtain proper adjustment.

(4) ALIGHTING GEAR MAIN SYSTEM LEAKAGE TEST.

*(a)* Be sure the alighting gear selector valve handle is in the "DOWN" position, and the aileron booster manual or electrical shut-off valves and the dive flap manual shut-off valve are closed.

*(b)* Wipe clean all fittings and units in the alighting gear system.

*(c)* Apply hydraulic pressure at 1000 ($\pm$50) psi for five minutes.

*(d)* Shut off pressure and check for visible leaks in the alighting gear system.

*(e)* Put the alighting gear selector valve handle in the "UP" position. Apply hydraulic pressure to retract the gear. Maintain 1000 ($\pm$50) psi on the system for five minutes.

*(f)* Put the alighting gear selector valve handle in the "DOWN" position. Shut off pressure and check the system for visible leaks.

*(g)* Allowable leakage for each actuating cylinder is one drop in 25 cycles of operation.

(5) ALIGHTING GEAR EMERGENCY SYSTEM CHECKOUT.

*(a)* With alighting gear in the "UP" position, shut off hydraulic pressure, open aileron booster shut-off valve, and operate the aileron booster to relieve the hydraulic pressure.

*(b)* Place the alighting gear selector valve in "DOWN" position; the emergency selector valve in "EMERGENCY" position; and the ground test selector valve in normal flight position.

*(c)* Operate the hand pump approximately 75 full strokes. Gear should extend and lock down. If the number of strokes exceeds 80, check for leaks at the shuttle valves or emergency selector valve.

*(d)* Continue pumping until the emergency relief valve bypasses. This can be determined by placing the ear near the valve and listening for the vibration of the spring when the valve unseats.

*(e)* Allow system to stand for five minutes. Clean off all fittings in the emergency system.

*(f)* After five minutes, check pressure at the hand pump. The pump handle shall feel solid, indicating that pressure is still up. Leakage in the system will be evidenced by having to rebuild pressure before

the emergency relief valve bypasses. Visually check for any external leakage in the emergency system. Allowable leakage from each actuating cylinder is one drop in 25 cycles of operation.

*(g)* Relieve pressure by placing the emergency selector valve handle in "NORMAL" position. Leave the alighting gear selector valve handle in "DOWN" position and turn on hydraulic pressure to move the shuttle valves to their normal positions. Move the alighting gear selector valve handle to "UP" position, and retract the alighting gear. Operate the gear through two or three cycles. Place a container under the main hydraulic tank to catch the overflow.

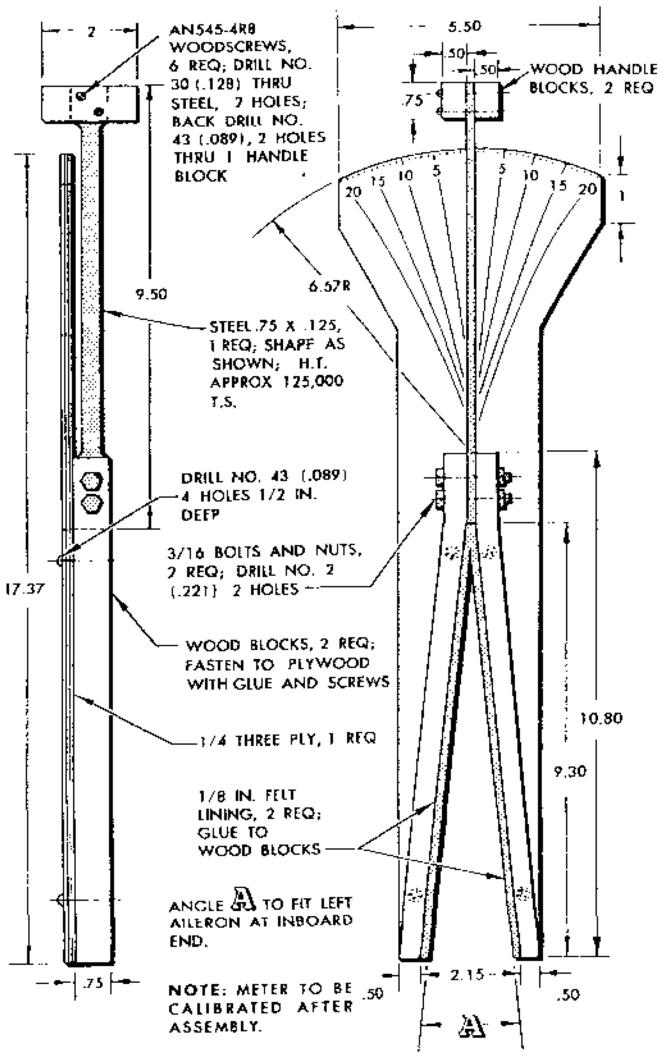



*Figure 173A — Creep Meter*

(6) AILERON BOOSTER OPERATIONAL CHECKOUT.

*(a)* Close the dive flap and alighting gear manual shut-off valves.

*(b)* With hydraulic pressure on, move the control stick from side to side several times to bleed air from the aileron booster system.

*(c)* After bleeding operation is complete, continue to move the stick through its entire range. Operation shall be smooth and free from rough spots.

**Note**

Slightly higher pressure on the control stick may be required at reversal of direction due to presence of dash pot in the booster control valve.

*(d)* After placing the control stick in neutral, it shall remain in that position. Slight creeping is allowable at any other control stick position. To check degree of creeping, use a creep meter as shown in figure 173A to measure pressure on the trailing edge at the inboard rib of the aileron. Restraining force on the handle of the creep meter must not be more than 10 pounds. If a force of more than 10 pounds is necessary to restrain the aileron creep, readjust the linkage in the booster assembly to reduce creep.

(7) DIVE RECOVERY FLAP OPERATIONAL CHECKOUT.

**WARNING**

The dive flaps move rapidly, and every precaution should be taken to avoid injury to personnel.

*(a)* Close the aileron booster electrical shut-off valve and the alighting gear manual shut off valves.

*(b)* Open the dive flaps, and close the manual shut-off valve. Make sure that the dive flaps are free of obstructions such as loose screws, nuts, and bolts in the flap tracks. Check the cylinder shaft pin for proper installation, and proper safetying.

*(c)* Check the hydraulic reservoir to make sure it is full to the proper level.

*(d)* Shut off hydraulic pressure and electrical power. Open the dive flap manual shut-off valve.

*(e)* Turn on hydraulic pressure and electrical power. Operate the flaps through several cycles.

(8) DIVE RECOVERY FLAP SYSTEM LEAKAGE TEST.

*(a)* Clean all fittings and units in the dive flap system.

*(b)* Retract the flaps and hold a pressure of 1000 (±50) psi for five minutes.

*(c)* Extend the flaps and check for leaks.

*(d)* Maintain 1000 (±50) psi pressure for five minutes with the flaps extended. Check for leaks.

*(e)* Each actuating cylinder is permitted one drop leakage in 25 cycles.

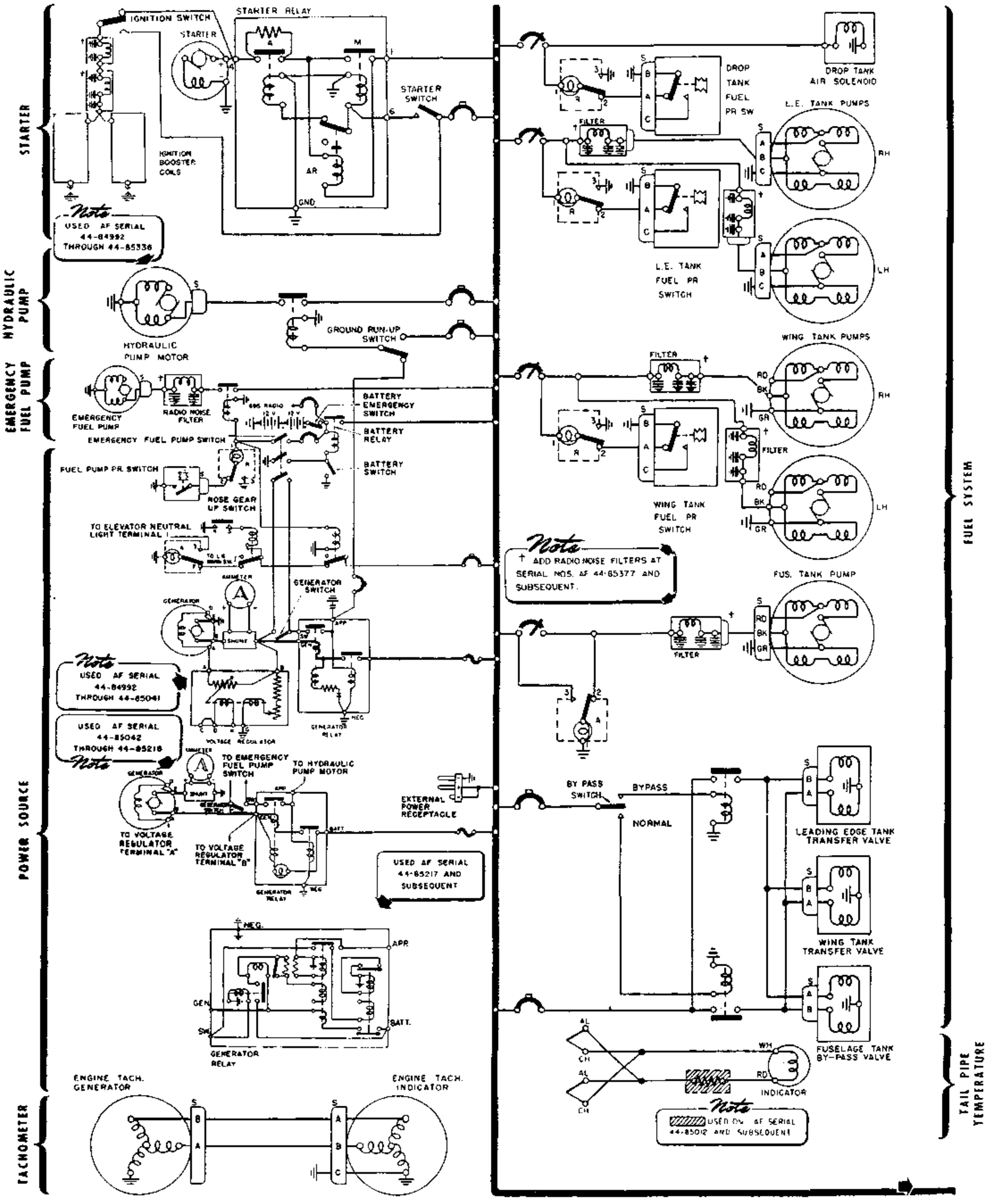



*Figure 174 (Sheet 1 of 3 Sheets) — Simplified Electrical Diagram, P-80A-1 and P-80A-5 Airplanes, Serial Nos. AF44-84992 through AF44-85406*

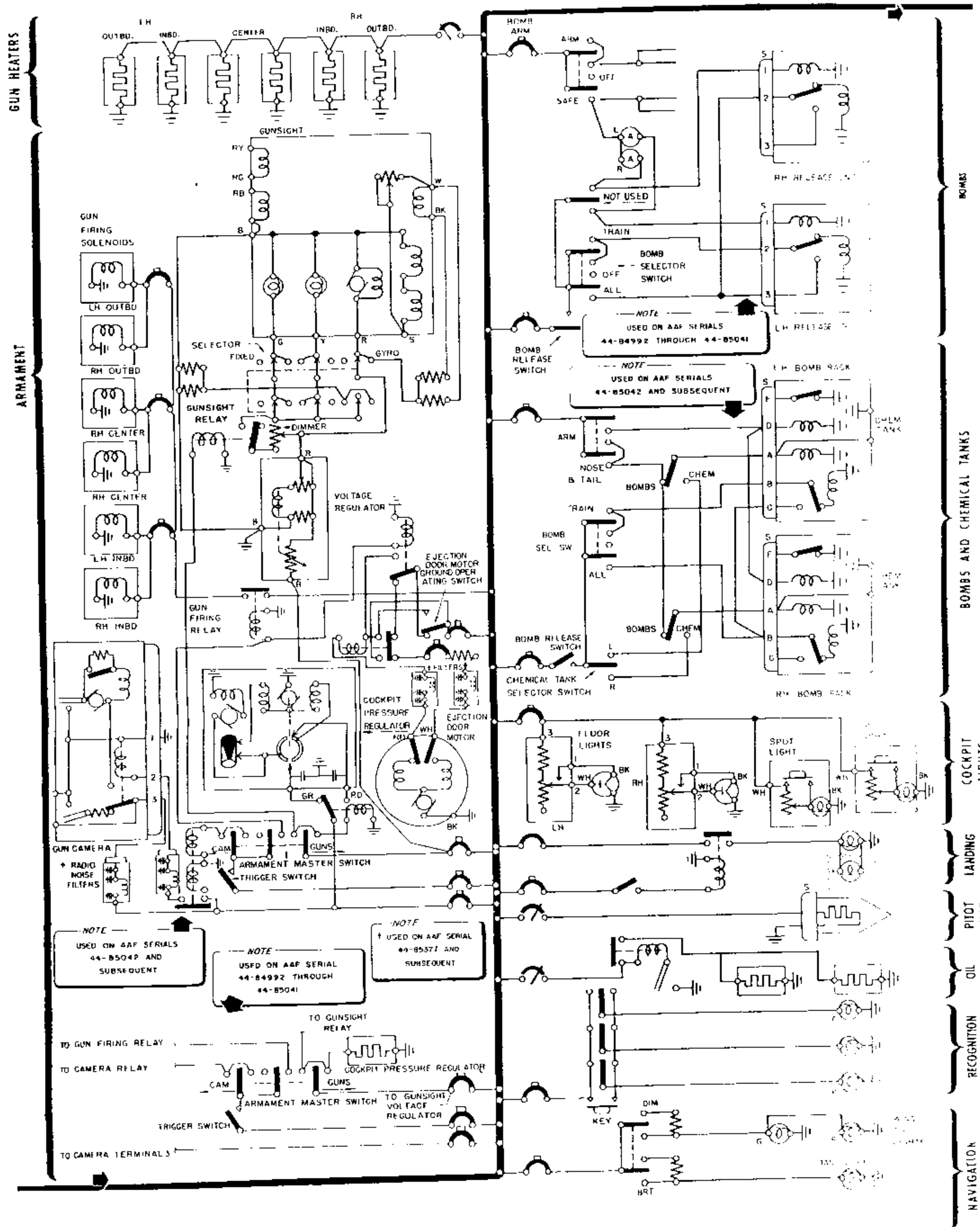



Figure 174 (Sheet 2 of 3 Sheets)—Simplified Electrical Diagram, P-80A-1 and P-80A-5 Airplanes, Serial Nos. AF44-84992 through AF44-85406

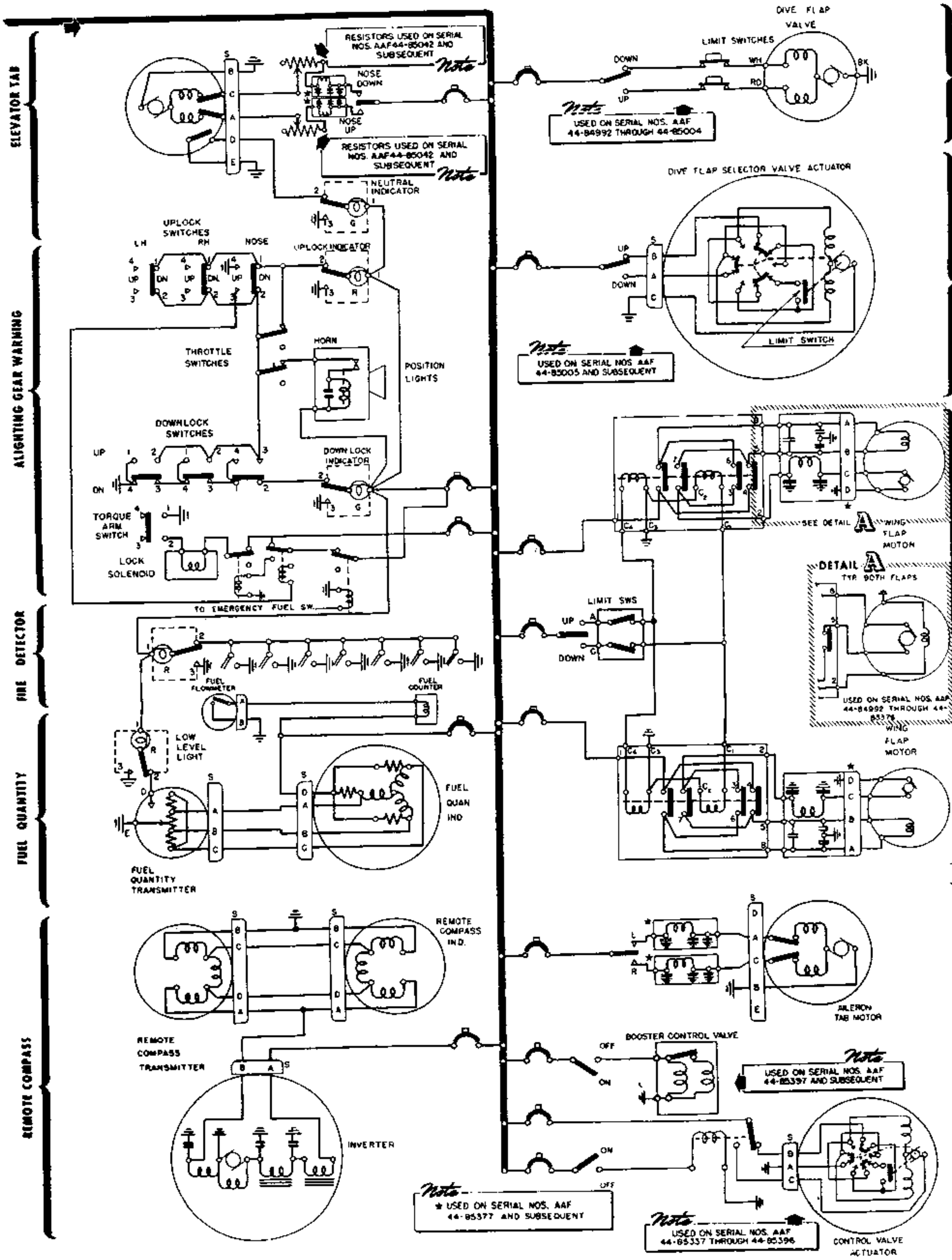



*Figure 174 (Sheet 3 of 3 Sheets)—Simplified Electrical Diagram, P-80A-1 and P-80A-5 Airplanes, Serial Nos. AF44-84992 through AF44-85406*

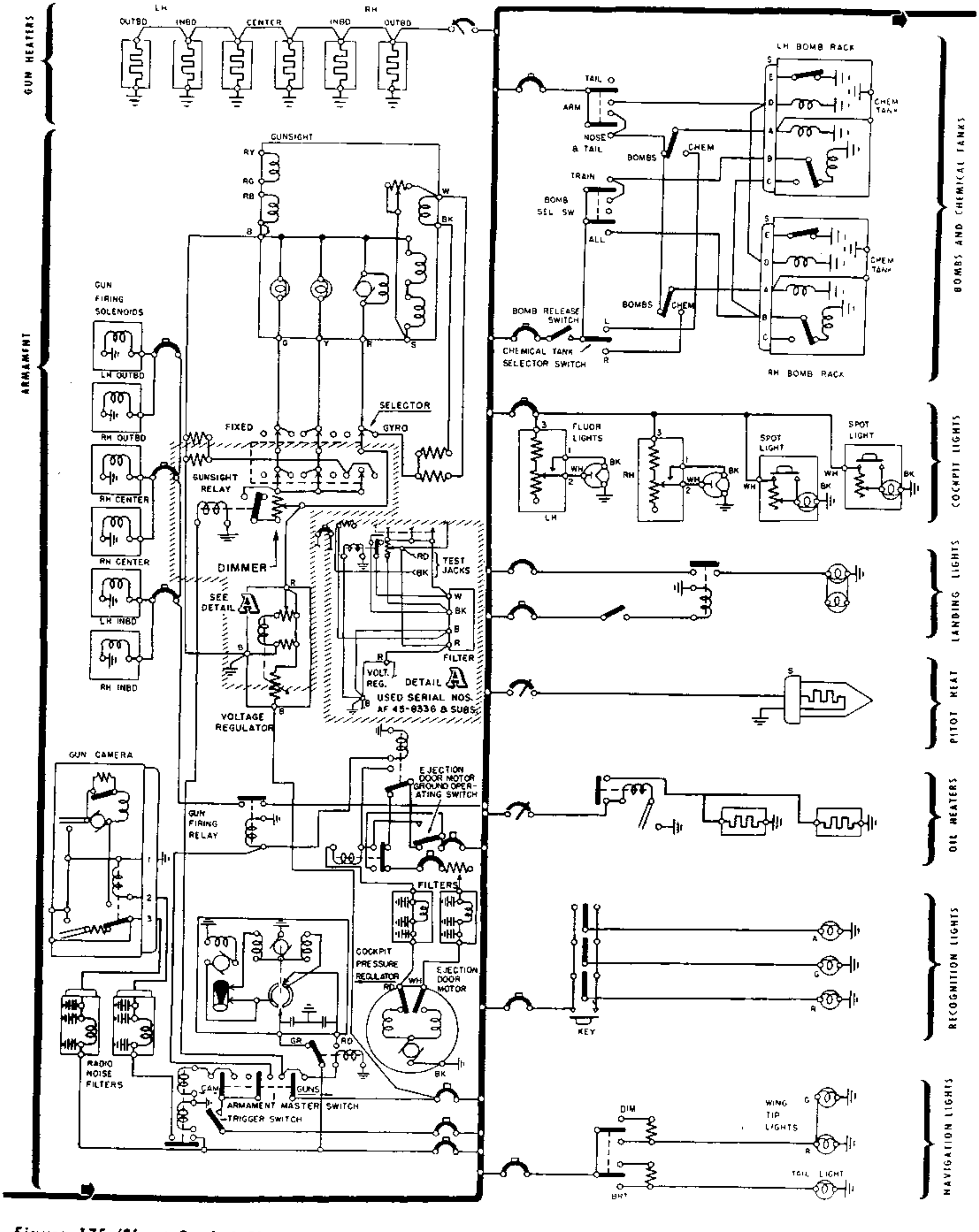



*Figure 175 (Sheet 2 of 4 Sheets) — Simplified Electrical Diagram, P-80A-5 and FP-80A-5 Airplanes, Serial Nos. AF44-85407 and Subsequent*

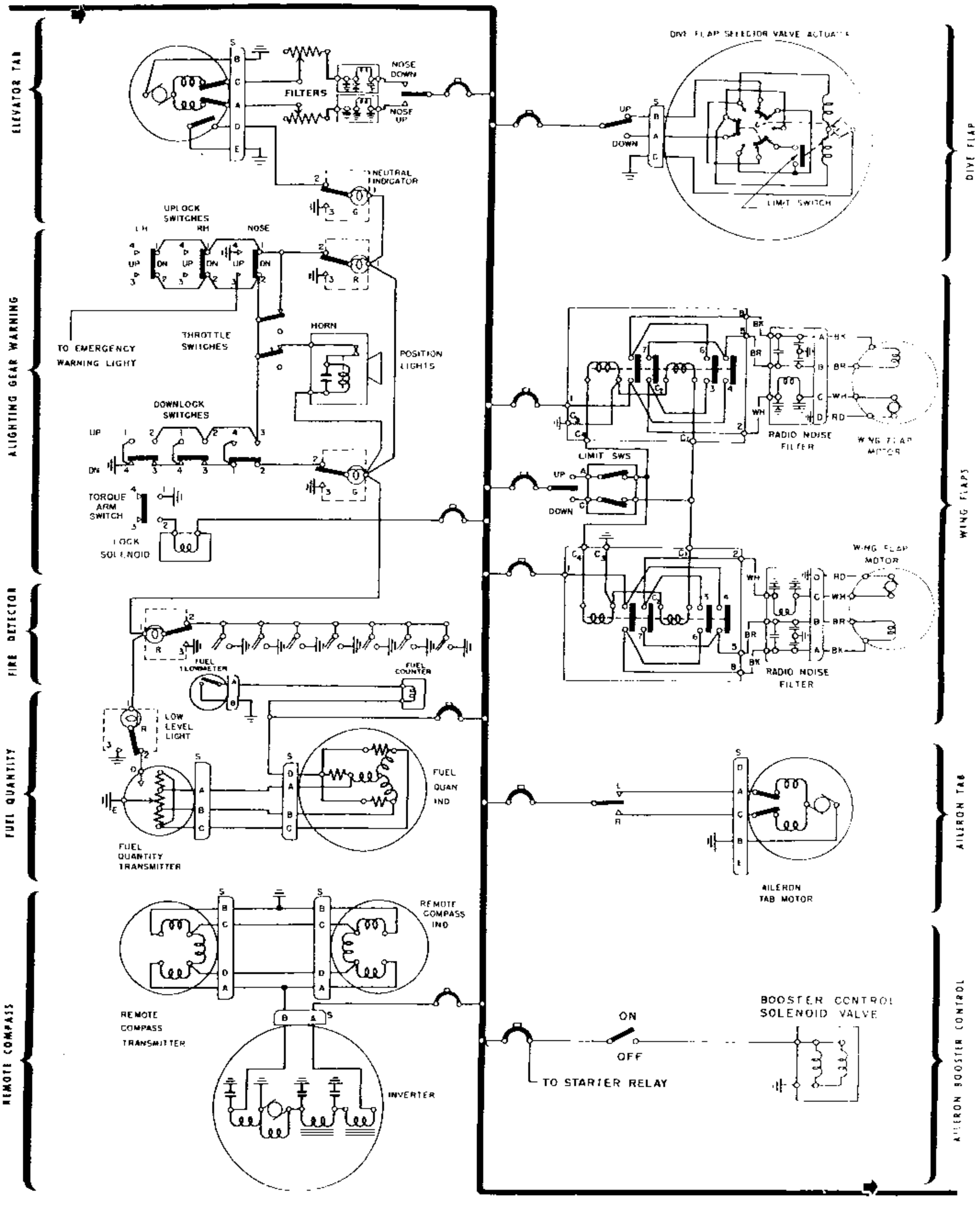
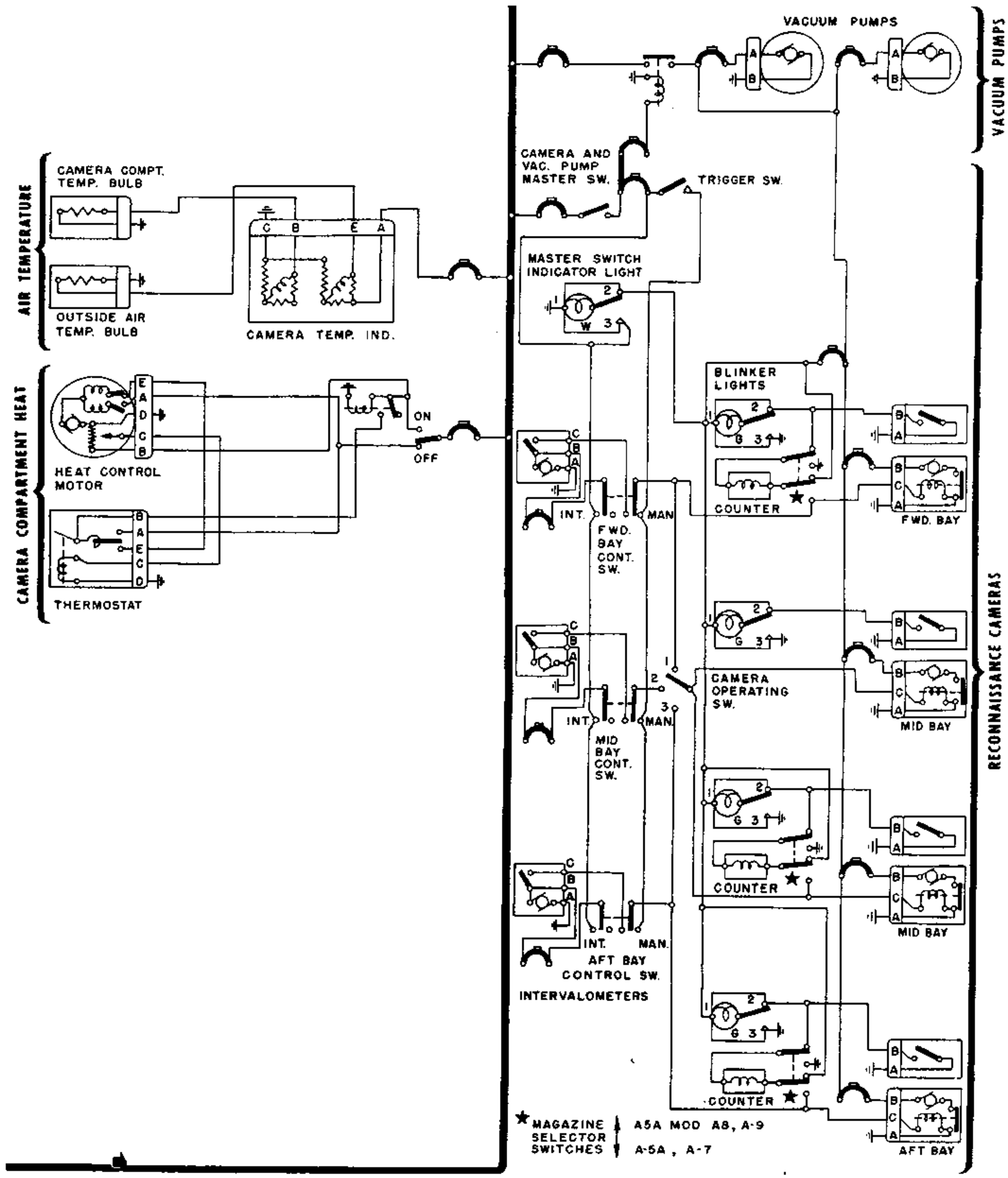



Figure 175 (Sheet 3 of 4 Sheets) — Simplified Electrical Diagram, P-80A-5 and FP-80A-5 Airplanes, Serial Nos. AF44-85407 and Subsequent




FP-80A-5 AIRPLANES ONLY

*Figure 175 (Sheet 4 of 4 Sheets) — Simplified Electrical Diagram, P-80A-5 and FP-80A-5 Airplanes, Serial Nos. AF44-85407 and Subsequent*

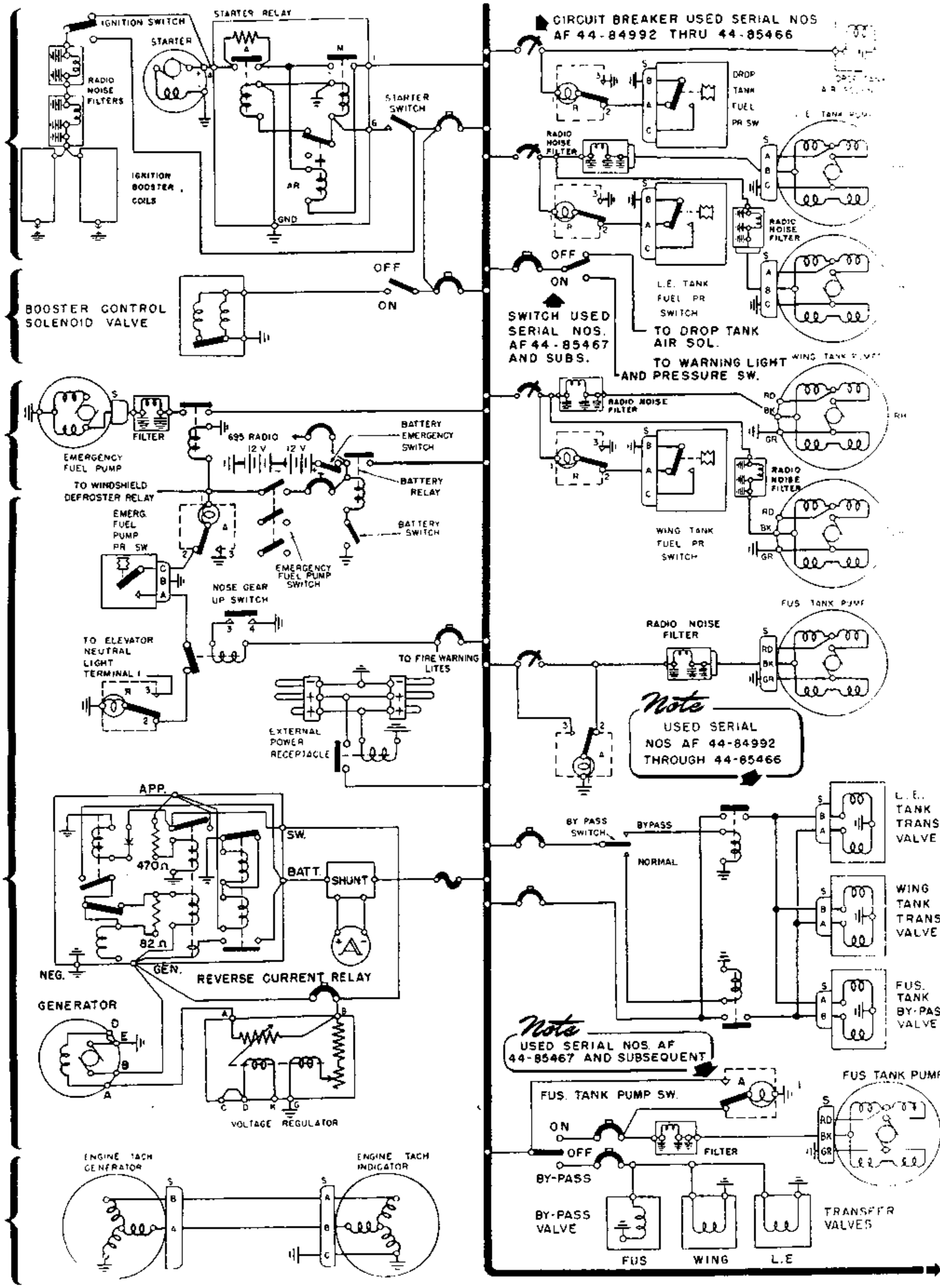



*Figure 175A (Sheet 1 of 4 Sheets) — Simplified Electrical Diagram, P-80A-10 and FP-80A-10 Airplanes*

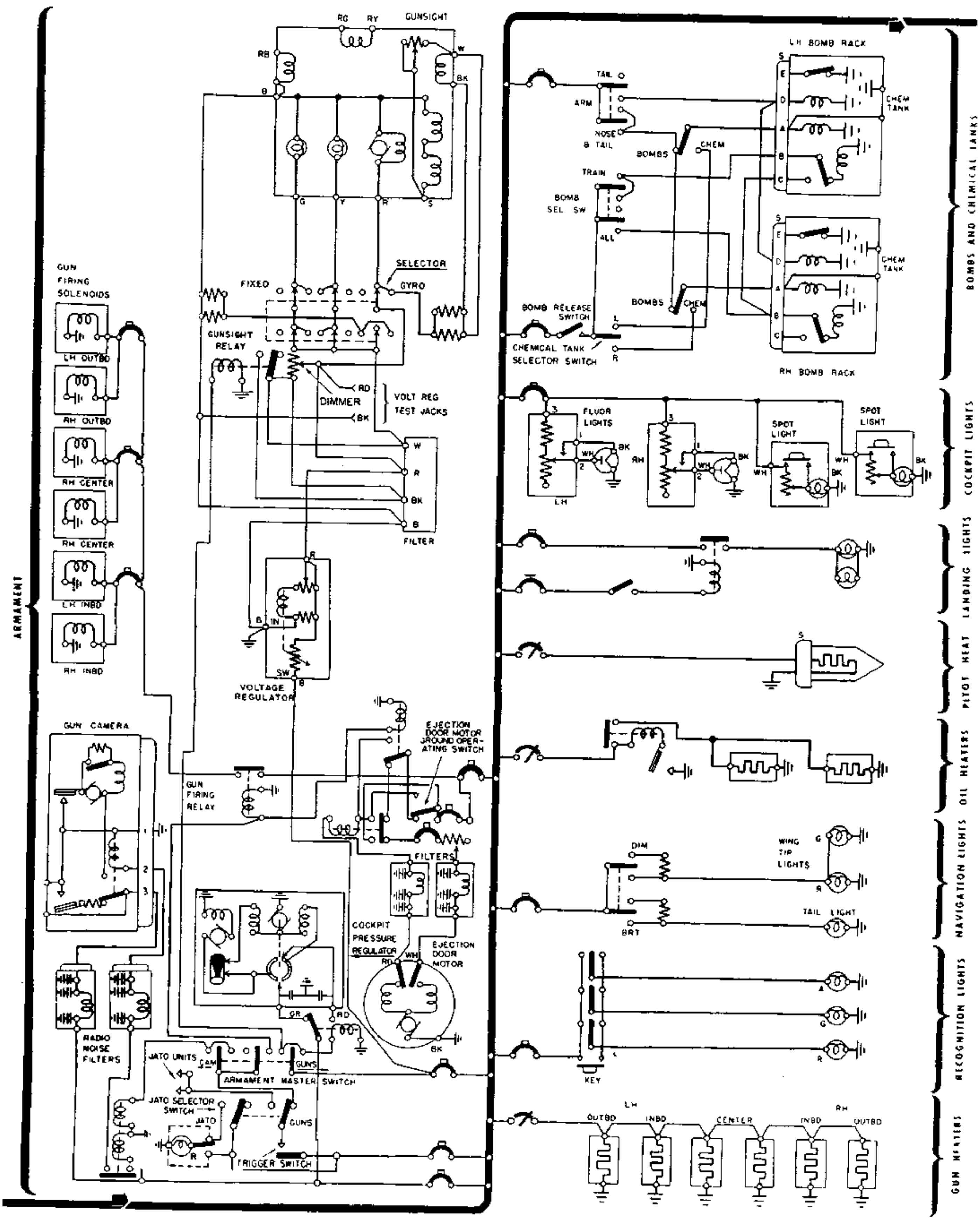



*Figure 175A (Sheet 2 of 4 Sheets)—Simplified Electrical Diagram, P-80A-10 and FP-80A-10 Airplanes*

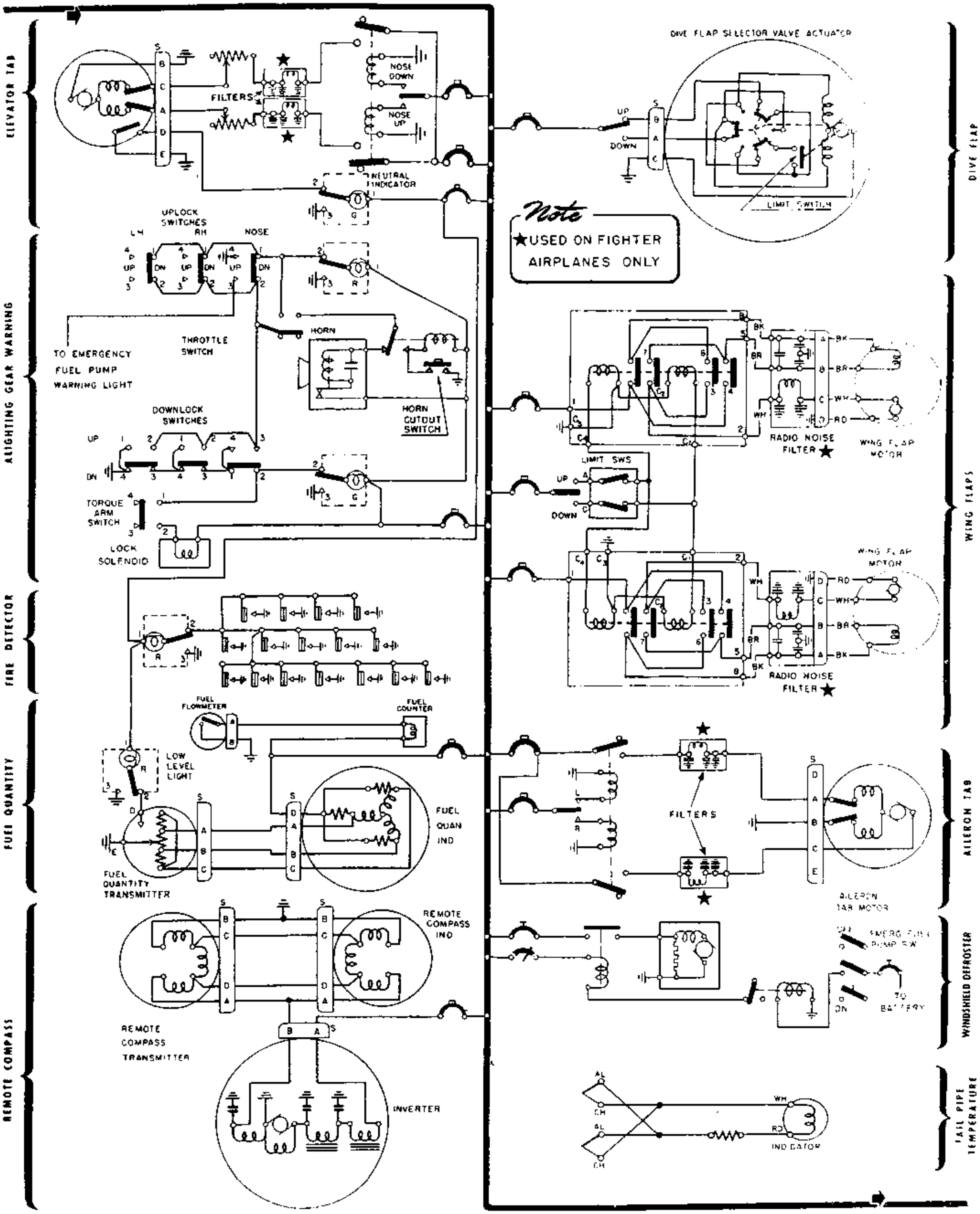



*Figure 175A (Sheet 3 of 4 Sheets) — Simplified Electrical Diagram, P-80A-10 and FP-80A-10 Airplanes*

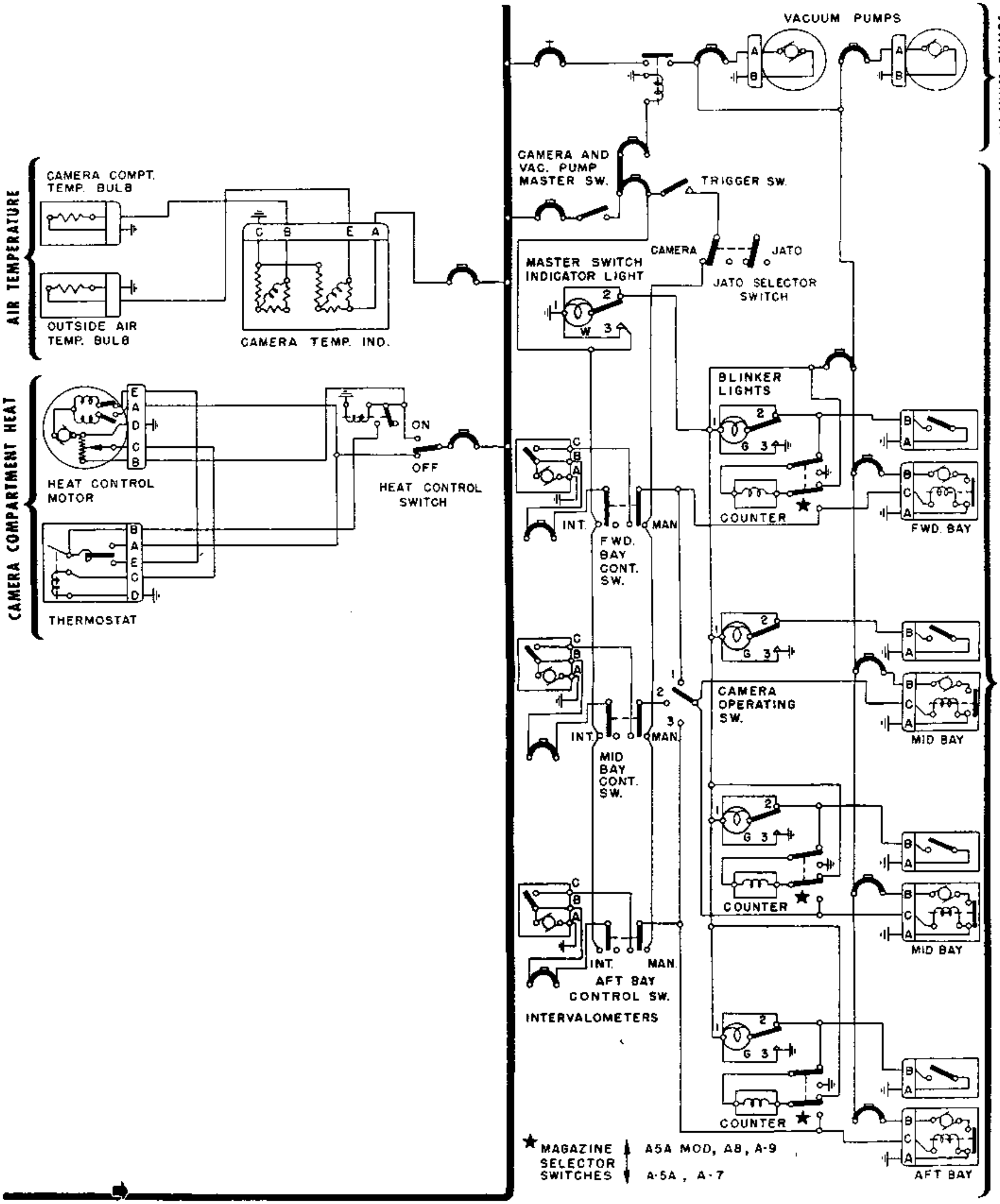



*Figure 175A (Sheet 4 of 4 Sheets) — Simplified Electrical Diagram, P-80A-10 and FP-80A-10 Airplanes*

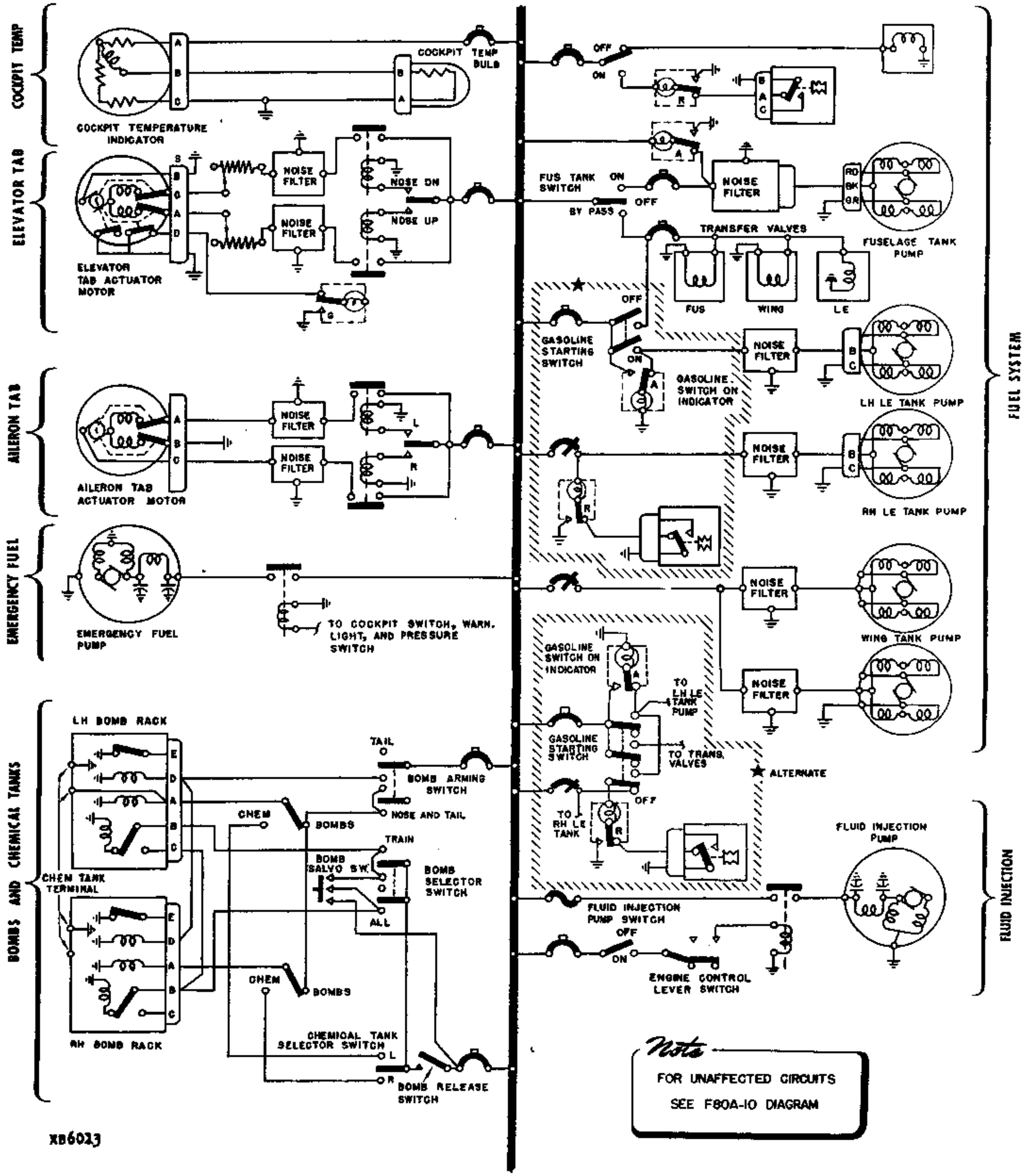



*Figure 175B — Simplified Electrical Diagram, F-80A-10 Winterized Airplanes*

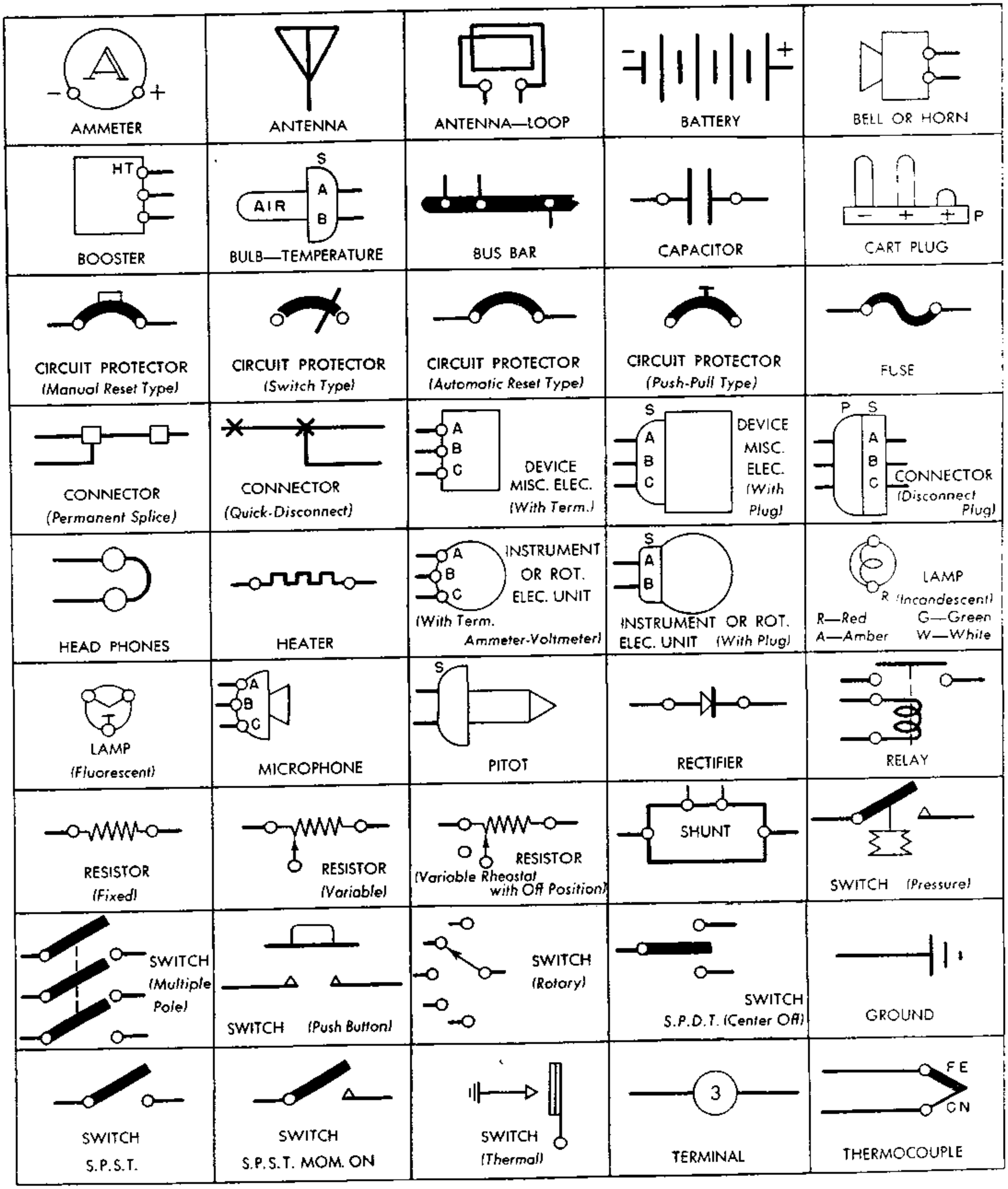
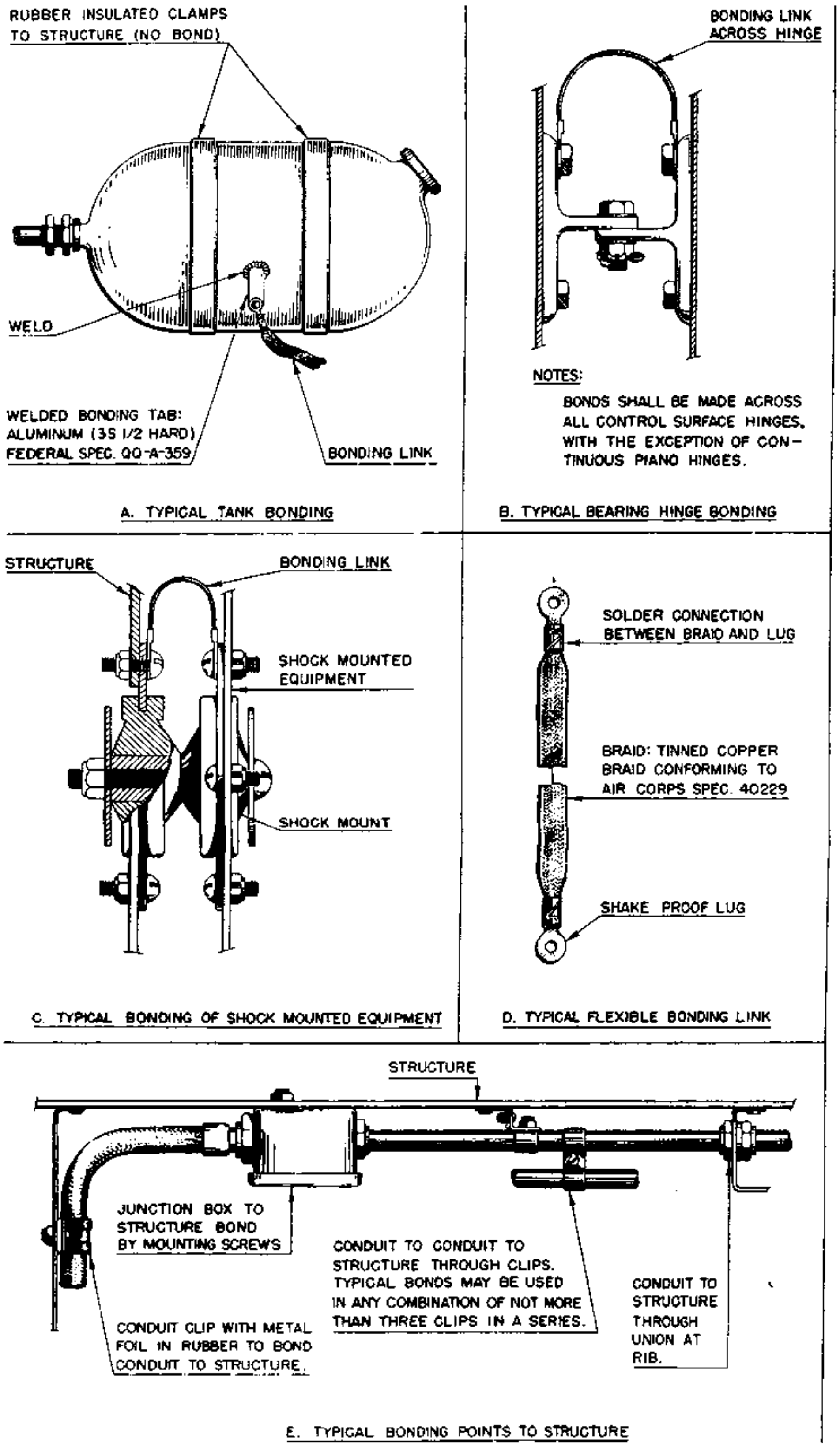



*Figure 176 — Electrical Symbols*




## TYPICAL BONDING PROCEDURE

1. METAL PARTS OF THE AIRPLANE WHICH DO NOT MAKE GOOD ELECTRICAL CONTACT WITH THE AIRPLANE STRUCTURE, SHALL BE BONDED TO STRUCTURE.

SEE EXAMPLES A, B, C, AND E.

2. OTHER BONDING REQUIREMENTS:

a. ENGINE TO ENGINE MOUNT VALUE MUST NOT EXCEED THAT STATED IN 5. b BELOW.

b. LONG, METAL MEMBERS, SUCH AS FUEL, OIL, VACUUM AND PRESSURE LINES SHALL BE BONDED ONLY AT POINTS OF SUPPORT, EXCEPT THAT BONDS SHALL BE MADE AT NOT OVER 36 INCH INTERVALS.

c. GOOD METAL TO METAL CONTACT SHALL BE MADE ON ALL BONDS. ON RIVETED ATTACHED PARTS, SUCH AS JUNCTION AND SWITCH BOXES, AT LEAST TWO PLACES SHALL BE SPOT CLEANED THROUGH PAINT AND ANODIZING IN THE CASE OF ALUMINUM AND THROUGH PAINT IN CASE OF STEEL. THESE SPOT CLEANED SURFACES SHALL AT LEAST BE EQUAL TO THE DIAMETER OF THE RIVET HEADS. SIMILAR SPOT CLEANING SHALL BE DONE FOR ALL PARTS ATTACHED BY BOLTS OR SCREWS.

WHENEVER BONDING IS OBTAINED BY A CLAMP AROUND A TUBULAR MEMBER, THE PAINT AND ANODIZING SHALL BE REMOVED ON BOTH SURFACES AT POINT OF CONTACT.

IN NO CASE SHALL A METAL SURFACE BE CLEANED BY REMOVING SOME OF THE METAL. CADMIUM PLATING IS A GOOD BOND AND SHOULD NEVER BE REMOVED.

3. IN THE STRUCTURAL COMPONENTS OF THE AIRPLANE, THE FOLLOWING TYPE JOINTS ARE CONSIDERED GOOD ELECTRICAL CONNECTIONS AND REQUIRE NO FURTHER BONDING:

a. WELDING, SOLDERING (USING NON-CORROSIVE FLUX), SWEATING, RIVETING (WHEN JOINTS ARE CLEAN), BRAZING, SELF TAPPING SCREWS, MACHINE SCREWS WITH LOCK WASHERS.

b. SLIDING COCKPIT ENCLOSURES, SLIDING PANELS, COWLING WHERE JOINT RESISTANCE DOES NOT EXCEED .0025 OHMS.

c. DRAG STRUT ENDS SUCH AS THREADED ROD ENDS AND SOCKET FITTINGS.

d. PINNED FITTINGS WHEREVER DRIVEN TIGHT OR UNDER TENSION (EXCEPT CONTROL CABLE FITTINGS).

e. CLAMP FITTINGS, NORMALLY PERMANENT AFTER INSTALLATION.

4. PARTS NOT TO BE BONDED:

a. MEMBERS WHICH ARE MOVABLE TO AN UNLIMITED EXTENT, SUCH AS STABILIZER ADJUSTMENT MECHANISM, LANDING WHEELS, HAND WHEELS, PROPELLER, ETC.

b. CONTROL CABLES.

c. HOSE CONNECTIONS, STRUCTURAL CLAMPS, PINNED FITTINGS.

d. SURFACES OF LESS THAN 1.5 SQUARE FEET.

e. MOVABLE METAL MEMBERS NOT EXCEEDING 36 INCHES IN LENGTH.

5. RESISTANCE BETWEEN THE FOLLOWING ITEMS AND THE AIRPLANE STRUCTURE, AS TESTED BY A MILLI-OHMMETER, SHALL NOT EXCEED:

a. .001 OHM. -- CONDUIT, CONNECTOR PANEL SHIELDS, ELECTRICAL AND RADIO EQUIPMENT.

b. .002 OHM. -- ENGINE AND MOUNT, FIREWALL AND FLOORING, TUBING AND VALVES, CONTROL SURFACES, INSTRUMENT BOARD, BOMB RACKS.

c. .004 OHM. -- NACELLE COWLING, DOORS (CLOSED), TANKS, CONTROL RODS, SEATS, CHAINS, TABLES, CONTROL COLUMN, IGNITION MANIFOLD ASSEMBLY, GUN MOUNTS, RUDDER BARS.

6. ON ALL CONDUIT:

BONDS SHALL BE MADE AT EACH END AND AT INTERVALS NOT EXCEEDING 18 INCHES, EXCEPT THAT IN OUTER WING, INTERVALS MAY BE 26 INCHES.

*Figure 177 — Electrical Bonding*

## 17. ELECTRICAL SYSTEM.

*(See figures 174 and 175.)*

*a.* GENERAL.—The electrical system is a 28-volt, single-wire system, with the negative return for all circuits grounded to the airplane structure. Alternating current at 26 volts, 400 cycles for the autosyn system (remote magnetic compass) is supplied by an inverter, which in turn receives power from the 28-volt direct-current system. Protection against electrical overloads is effected by circuit protectors.

The following parts and equipment are electrically operated:

Engine starter
Ignition coils
Fuel booster pumps
Fuel transfer valves
Fuel quantity gage
Emergency fuel pump
Cockpit pressure regulator
Fluid injection pump
Air solenoid valve
Tachometer indicator
*Hydraulic pump (P-80A-1 airplanes)
Wing flaps
Elevator trim tabs
Aileron tab
Aileron booster control
Pitot head heater
Remote compass
Alighting gear warning system
Tail pipe temperature indicator
Navigation lights
Landing light
*Gun heater
*Case ejection door
*Guns
*Gun sight camera
*Gun sight
Bomb shackles
Dive flap selector valve
Fire warning thermal switches
**Reconnaissance cameras
**Blinker lights
**Intervalometers
**Counters
**Vacuum pumps
**Camera heat thermostat and control motor
**Air temperature circuit
Windshield auxiliary defroster unit
Jato
Cockpit Temperature Indicator (P-80A-10 Winterized)

*Equipment used on fighter airplanes only.
**Equipment used on photographic airplanes only.

In removing the aft section of the fuselage, the electrical wiring is disconnected at the disconnect plugs contained within the wing-fuselage fillet. The plugs are accessible through the access door for the external power-receptacle, and through the wing flap opening.

All wiring is routed in harnesses suspended by clips and straps attached to the airplane structure. The electrical switches and most of the circuit protectors are located on the cockpit side panels. (See figure 246.)

Electrical disconnection is effected by disconnect plugs and terminal panels. Disconnect plugs mounted on the cockpit pressurized panels are sealed to prevent loss of cockpit pressure, and treated to prevent corrosion. (See paragraph *b*(5) following.)

Radio noise filters are installed in all electric motor circuits of airplanes which have the AN/ARN-6 radio.

*b.* ELECTRICAL SERVICE PROCEDURES.

(1) ELECTRICAL BONDING. *(See figure 177.)*—All electrical circuits must be securely bonded to the airplane structure to reduce radio interference. Be certain that grounded equipment makes good electrical contact.

(2) SOLDERING ELECTRICAL CONNECTIONS.—When making a soldered connection, the parts must be thoroughly clean and the soldering iron hot enough to cause the solder to flow into the joint. Solder which has been applied with insufficient heat will not make a good electrical connection, nor will the joint have the proper strength. Use solder U.S. Army Specification 71-332. Use a non-corrosive flux, such as resin. Do not use an acid flux or an acid-core solder.

(3) CLEANING ELECTRICAL EQUIPMENT. *(See figure 178.)*—Clean parts such as antenna insulators with a clean dry cloth. Clean generator armatures with a solvent as noted in the cleaning chart. If a solvent is used, it must be completely removed from the electrical part before the part is put in service. To dry, warm the part in a well ventilated oven, or blow dry compressed air over it at low pressure.

**WARNING**

Great care must be taken to prevent fire when using benzine, gasoline, or other petroleum distillates as cleaning agents. Cleaning with any type of solvent must be done in a location where there is good ventilation.

(4) WIRING.—Individual circuit diagrams of all electrical circuits are shown in this paragraph. Included with each diagram is a wire gage table, an item list, and a sketch of the airplane showing location of applicable

| EQUIPMENT TO BE CLEANED | DISASSEMBLED PARTS | CLEANING AGENT TO BE USED | ARMY or COMMERCIAL DESIGNATION OF CLEANING AGENT | PROCEDURE FOR CLEANING PARTS | SPECIAL CONSIDERATIONS |
|---|---|---|---|---|---|
| 1. Motors<br>Generators<br>Starters<br>Dynamotors<br>Inverters<br>Etc. | A. Armature | Benzine<br>Naphtha<br>Solvent | Spec 4-1016<br>AN-VV-N-96<br>P-S-661 | With air gun, spray agent on armature winding and scrub thoroughly with stiff non-wire brush. If spray gun is not available, armature may be dipped into agent, BUT NOT SOAKED. After all dirt has been removed, bake armature two to four hours at 93° C (200° F) in an open or circulating air oven, or if oven is not available, compressed air under low pressure (25 lb) may be blown into winding until thoroughly dry. | CAUTION<br>Extreme care must be taken while spraying on inflammable solvent. Spraying must be done under open air conditions.<br>The use of solvents such as carbon tetrachloride or trichlorethylene should be avoided for cleaning the armature as they are somewhat corrosive to the commutator. |
| | B. Commutator | See above | | After drying armature, check commutator. | |
| | C. Brushes | Benzine | Spec 4-1016 | Wipe brushes with cleaning fluid. | Do not soak brushes in cleaning agent. |
| | D. Ball Bearing | See Cleaning Agent specified under 1, E below | | Spray bearings with cleaning agent. Dry in open air. Do not use compressed air to dry as dust particles may enter bearings. For lubrication see maintenance instructions for the unit. | CAUTION<br>Never hold bearings between thumb and forefinger and revolve outer race by compressed air. |
| | E. Field Windings and Housing | Naphtha | AN-VV-N-96 | Spray the parts with the cleaning agent and if necessary scrub carefully with a stiff non-wire brush. If a spray gun is not available dip, but do not soak, the parts in the cleaning agent. After all dirt has been removed, bake the field windings for two hours at 93° C (200° F) in open, or circulating air oven, or if oven is not available, blow low pressure compressed air (25 psi) onto windings until they are thoroughly dry. | CAUTION<br>Extreme care must be taken while spraying an inflammable solvent.<br>Spraying must be done under open air conditions. |
| | F. Clutch (Starter) | See 1, E above | | If not disassembled, wipe surfaces with cleaning agent. If disassembled, wipe each part. | Do not dip clutch assembly in cleaning agent. |
| 2. Condensers<br>Dielectrics Surfaces<br>Electrode-Surfaces<br>Insulators | | Acetone | Spec 0-A-51 | Acetone is the best cleaning agent for dielectric parts in removing nitric acid precipitate caused by corona and arcing. It will attack rubber insulation, however, therefore all high tension wires should be removed from the part before cleaning. Wipe—DO NOT IMMERSE—surfaces of part with clean rag dampened with acetone. When the red color characteristic of the nitric acid precipitate no longer comes off on the cleaning rag, the part is clean. | Acetone is extremely explosive and toxic, and requires utmost care in handling. It should always be used in the open air or in a well ventilated room to prevent the fumes from becoming dangerously concentrated. |
| 3. Induction Coils | | Benzine | Spec 4-1016 | Wipe coil with clean rag dampened with cleaning agent. DO NOT SOAK. Blow out with dry compressed air. | Do not use non-petroleum agents on coils insulated with varnish as these solvents cause insulation failure. |
| 4. Antenna Insulators | | See 1, E above | | | |
| 5. Magnetos | A. Breaker Points | See 1, E above | | | |
| | B. Pole Shoes, Housing Gears, etc. | See 1, E above | | | |
| 6. Switches | Contacts | See 1, E above | | | |
| 7. Miscellaneous Electrical Metal Parts (External) | Housing, Nuts and Bolts, Painted Exteriors | See 1, A or 1, E above | | | |
| 8. Batteries—Wet Cell | Outside Case and Terminals | A Creamy Solution of Baking Soda ($NaHCO_3$) and Hot Water<br>Dilute Solution of Ammonia | | Remove corrosion with a wire brush after which solution should be applied. When bubbling has stopped, wash off with plain water. | Do not let any solution get into the battery cells. |

*Figure 178 — Electrical Cleaning Chart*

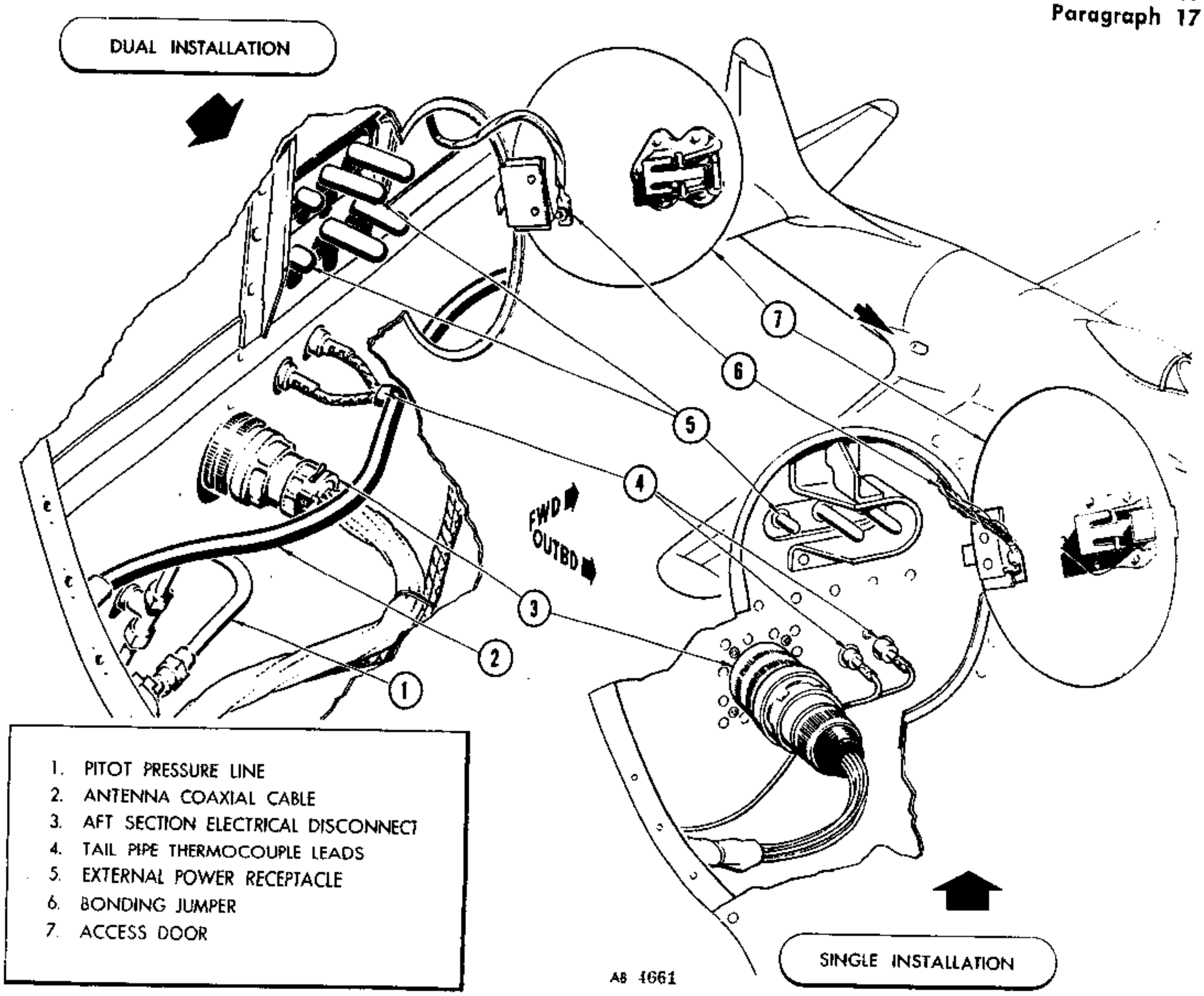



*Figure 179 — External Power Receptacle*

units and the wire routing. Items are cross-referenced between the wiring diagram, the perspective inset, and the item list.

The wire numbers used in the individual circuit diagrams agree with those used in the master electrical wiring diagrams included with each airplane. Each wire is identified with numbers printed at intervals along its entire length, which correspond with the wire numbers assigned on the wiring diagram. All wire numbers are in accordance with electrical Specification AN-W-14. Wire identification consists of a letter followed by a number. The letters identify the groups of wires as follows:

A. ARMAMENT (All armament and jato circuits other than those associated with bombing).

B. BOMB (Includes bomb release, arming, and chemical tank circuits).

C. FLIGHT CONTROLS (All flight control circuits including tabs, wing flaps, and dive flaps).

D. DE-ICING or ANTI-ICING (Pitot heater and windshield defroster).

E. ENGINE INSTRUMENTS (Engine tachometer and fuel quantity circuits).

F. FLIGHT INSTRUMENTS.

G. ALIGHTING GEAR.

H. HEAT, VENTILATION, and PRESSURIZATION (Gun heaters, oil heaters, and cockpit pressure regulator).

I. NOT USED.

J. IGNITION (Includes booster coil circuit).

K. ENGINE CONTROLS (Starter).

L. LIGHTS (Cockpit lights, landing light, navigation lights, and recognition lights).

M. MISCELLANEOUS (Photographic equipment).

N. GROUND (Wires grounded to the airplane structure).

O. NOT USED.

P. POWER (Battery, generator, and similar power circuits).

Q. FUEL and OIL (Fuel pump circuits).

R. RADIO (Command and range radios).

S. RADIO OPERATED DEVICES. (Identification radio and radar).

W. WARNING DEVICES (Fire, fuel low pressure, and alighting gear circuits).

(5) INSTALLATION OF DISCONNECT PLUGS.—Lock-wire all AN connectors attached to engine and engine mounted equipment with 0.020 or 0.032-inch steel wire. Lock-wire all others with the exception of those connectors attached to shock-mounted equipment and panels. Lock-wire the drilled screw-heads of the adjustable square flange type, the split-shell type, and the cable clamp type connectors. All AN connectors not having provisions in the coupling ring for lock-wiring shall be secured by wrapping two turns of wire around the connector shell in back of the coupling nut and securing the wire to a drilled screw-head or safety lug.

*c.* BATTERY AND GENERATOR CIRCUIT. *(See figures 179, 180, 181, 182, and 182A.)*

(1) GENERAL.—Power for the airplane direct-current electrical system is supplied on early F-80A-1 airplanes by a 200-ampere, 30-volt generator; on all other airplanes (and on F-80A-1 airplanes modified by T.O. No. 1F-80A-20) by a 300-ampere, 30-volt generator. In addition to the generator, two 12-volt batteries in series supply power when the generator is not operating, or when generator voltage drops below 26 volts. Accessory equipment in the battery and generator circuit includes a voltage regulator, reverse current relay, generator fuse-type circuit protector, battery relay, ammeter, and ammeter shunt. An external power receptacle on F-80A-1 airplanes, and two external power receptacles on F-80-5, RF-80A-5, F-80A-10, and RF-80A-10 airplanes are provided at the right wing-fuselage junction for the connection of a battery cart for engine starting or for ground checking of the electrical apparatus. (See figure 179.)

The battery is connected to the 24-volt bus through a type B-14 relay located in the sub-cockpit compartment to the right of the batteries. The relay is controlled by the battery switch on the main switch box. The recognition-radio destructor circuit and the emergency fuel system are wired around the battery switch. These two circuits may be operated whether the normal battery switch is "OFF" or "ON." The battery emergency switch disconnects the battery from all of the electrical system.

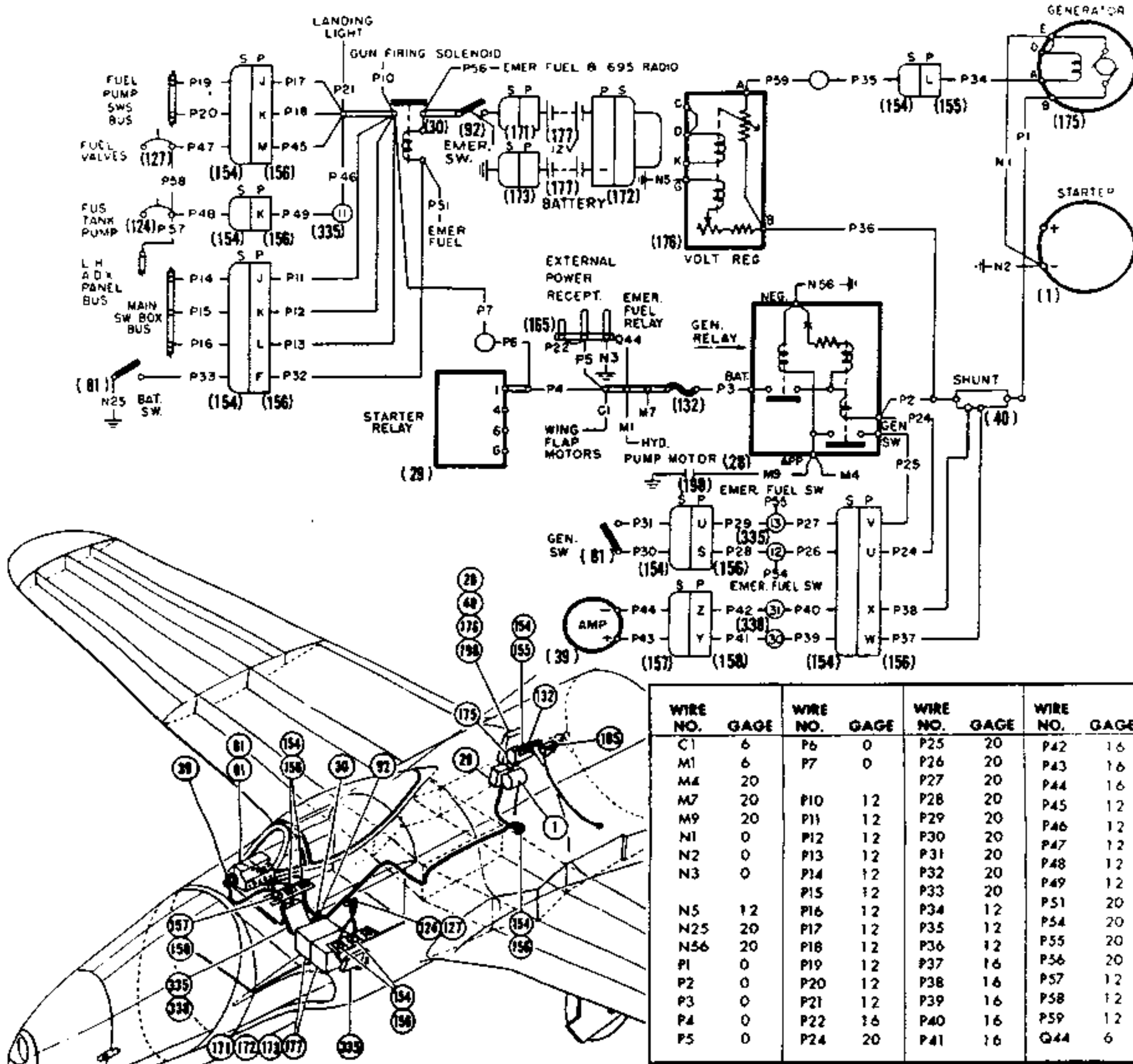
The generator is controlled through the reverse current relay by the generator switch on the main switch box. The reverse current relay serves also to disconnect the generator from the bus in the event of a reverse current.

Constant generator voltage is maintained by the voltage regulator. A 275-ampere fuse-type circuit protector gives protection to the generator against overloads.

An ammeter, used in conjunction with an ammeter shunt gives continuous indication of generator current. The ammeter shunt is located in the engine junction box. (figures 183, 184, and 184A) or on the airplane structure above it.

(2) GENERATOR .*(See figure 88.)*

*(a)* DESCRIPTION.—The generator, mounted on the accessory case of the engine, is a type R-1 generator which is rated at 9 kilowatts, 300 amperes, and 30 volts. The generator rotates in a counterclockwise direction, viewed from the drive shaft end.

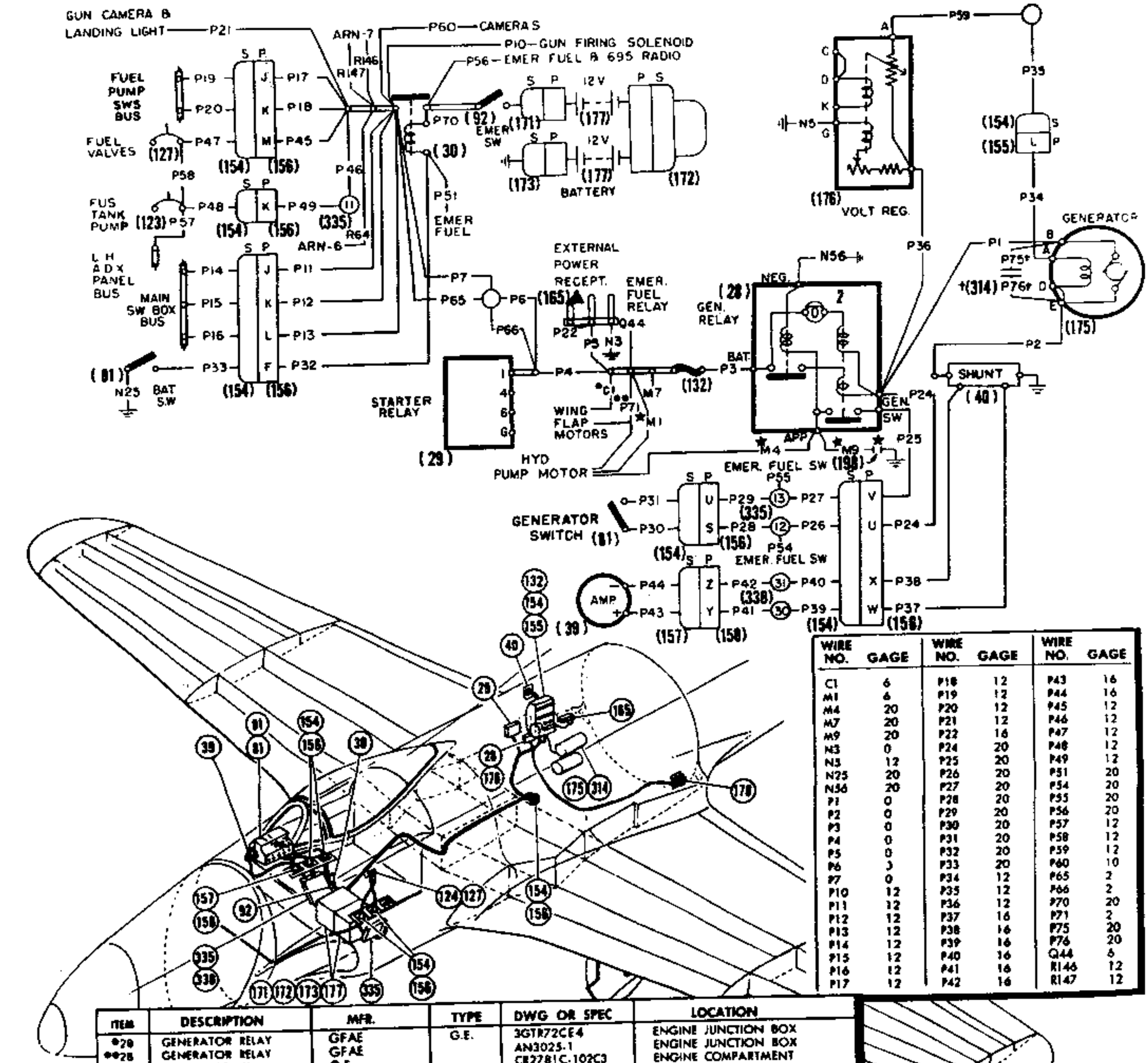



| WIRE NO. | GAGE | WIRE NO. | GAGE | WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|---|---|---|---|
| C1 | 6 | P6 | 0 | P25 | 20 | P42 | 16 |
| M1 | 6 | P7 | 0 | P26 | 20 | P43 | 16 |
| M4 | 20 | | | P27 | 20 | P44 | 16 |
| M7 | 20 | P10 | 12 | P28 | 20 | P45 | 12 |
| M9 | 20 | P11 | 12 | P29 | 20 | P46 | 12 |
| N1 | 0 | P12 | 12 | P30 | 20 | P47 | 12 |
| N2 | 0 | P13 | 12 | P31 | 20 | P48 | 12 |
| N3 | 0 | P14 | 12 | P32 | 20 | P49 | 12 |
| | | P15 | 12 | P33 | 20 | P51 | 20 |
| N5 | 12 | P16 | 12 | P34 | 12 | P54 | 20 |
| N25 | 20 | P17 | 12 | P35 | 12 | P55 | 20 |
| N56 | 20 | P18 | 12 | P36 | 12 | P56 | 20 |
| P1 | 0 | P19 | 12 | P37 | 16 | P57 | 12 |
| P2 | 0 | P20 | 12 | P38 | 16 | P58 | 12 |
| P3 | 0 | P21 | 12 | P39 | 16 | P59 | 12 |
| P4 | 0 | P22 | 16 | P40 | 16 | Q44 | 6 |
| P5 | 0 | P24 | 20 | P41 | 16 | | |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 1 | STARTER MOTOR | GFAE | G.E. | 2CM95B10 | ENGINE |
| 28 | GENERATOR RELAY | GFAE | G.E. | 3GTR72C1A | ENGINE JUNCTION BOX |
| 29 | STARTER RELAY | G.E. | | CR2781C-102A3 | ENGINE COMPARTMENT |
| 30 | BATTERY RELAY | GFAE | B-4 | 94-32324 | RH SUB-COCKPIT |
| 39 | AMMETER | GFAE | E-1 | 94-32173 | MAIN INSTRUMENT PANEL |
| 40 | SHUNT | GFAE | | AN3200-2 | ENGINE JUNCTION BOX |
| 81 | SWITCH | C.H. | | AN3021-2 | MAIN SWITCH BOX |
| 92 | SWITCH | SQUARE D | 1056 | CLASS 9320 | RH SUB-COCKPIT |
| 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | LH SHELF |
| 127 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | LH SHELF |
| 132 | CIRCUIT PROTECTOR | BURNDY | | FLLH | ENGINE COMPARTMENT |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 156 | CONNECTOR | CANNON | | 7312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 7312-23 | RH SUB-COCKPIT |
| 165 | CONNECTOR | KERWOOD | | 121-0 | ENGINE COMPARTMENT |
| 171 | CONNECTOR | KERWOOD | | 123-0 (9,70) | BATTERY |
| 172 | CONNECTOR | KERWOOD | | 131-0 (5/16) | BATTERY |
| 173 | CONNECTOR | KERWOOD | | 129-0 | BATTERY |
| 175 | GENERATOR | GFAE | G.E. | 2CM7386 | ENGINE |
| 176 | VOLTAGE REGULATOR | GFAE | 1 | 17R21 | ENGINE JUNCTION BOX |
| 177 | BATTERY | EXIDE | | 6-GT-13 | SUB-COCKPIT |
| 198 | CAPACITOR | MALLORY | 4MFD | AC43D9224-8-40 | ENGINE JUNCTION BOX |
| 335 | TERMINAL PANEL | LOCKHEED | | LS1926-12 | SUB COCKPIT JUNCTION BOXES |
| 338 | TERMINAL PANEL | LOCKHEED | | LS1929-26 | RH SUB-COCKPIT JUNCTION BOX |

FB 679
1M-39-18-4-180

*Figure 180 — Battery and Generator Circuit, F-80A-1 Airplanes, Serial No. AF44-84992 through AF44-85061*




| WIRE NO. | GAGE | WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|---|---|
| C1 | 6 | P18 | 12 | P43 | 16 |
| M1 | 6 | P19 | 12 | P44 | 16 |
| M4 | 20 | P20 | 12 | P45 | 12 |
| M7 | 20 | P21 | 12 | P46 | 12 |
| M9 | 20 | P22 | 16 | P47 | 12 |
| N3 | 0 | P24 | 20 | P48 | 12 |
| N5 | 12 | P25 | 20 | P49 | 12 |
| N25 | 20 | P26 | 20 | P51 | 20 |
| N56 | 20 | P27 | 20 | P54 | 20 |
| P1 | 0 | P28 | 20 | P55 | 20 |
| P2 | 0 | P29 | 20 | P56 | 20 |
| P3 | 0 | P30 | 20 | P57 | 12 |
| P4 | 0 | P31 | 20 | P58 | 12 |
| P5 | 0 | P32 | 20 | P59 | 12 |
| P6 | 3 | P33 | 20 | P60 | 10 |
| P7 | 0 | P34 | 12 | P65 | 2 |
| P10 | 12 | P35 | 12 | P66 | 2 |
| P11 | 12 | P36 | 12 | P70 | 20 |
| P12 | 12 | P37 | 16 | P71 | 2 |
| P13 | 12 | P38 | 16 | P75 | 20 |
| P14 | 12 | P39 | 16 | P76 | 20 |
| P15 | 12 | P40 | 16 | Q44 | 6 |
| P16 | 12 | P41 | 16 | R146 | 12 |
| P17 | 12 | P42 | 16 | R147 | 12 |

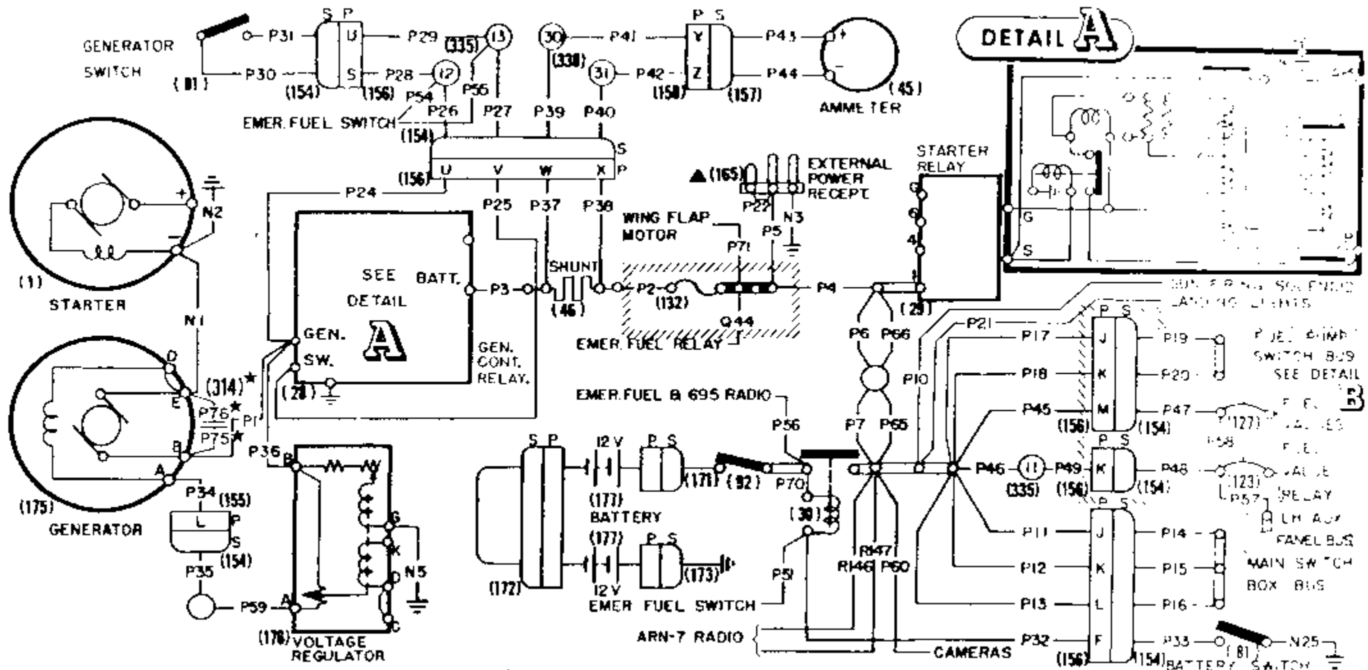
| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| •28 | GENERATOR RELAY | GFAE | G.E. | 3GTR72CE4 | ENGINE JUNCTION BOX |
| ••28 | GENERATOR RELAY | GFAE | | AN3025-1 | ENGINE JUNCTION BOX |
| 29 | STARTER RELAY | G.E. | | CR2781C-102C3 | ENGINE COMPARTMENT |
| 30 | BATTERY RELAY | GFAE | B-14 | 32490 | RH SUB-COCKPIT |
| ††39 | AMMETER | GFAE | G-1 | 32463 | MAIN INSTRUMENT PANEL |
| ††40 | SHUNT | AL NORRIS | 503A | 4489004-3 | ENGINE JUNCTION BOX |
| 81 | SWITCH | C.H. | | AN3021-2 | MAIN SWITCH BOX |
| 92 | SWITCH | SQUARE D | 3056 | CLASS 9320 | RH SUB-COCKPIT |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH SHELF |
| 127 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | LH SHELF |
| 132 | CIRCUIT PROTECTOR | BURNDY | | FLLH | ENGINE COMPARTMENT |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| ▲165 | CONNECTOR | KERWOOD | | 121-0 | ENGINE COMPARTMENT |
| 171 | CONNECTOR | KERWOOD | | 123-0 (9.70) | BATTERY |
| 172 | CONNECTOR | KERWOOD | | 131-0 (5 16) | BATTERY |
| 173 | CONNECTOR | KERWOOD | | 129-0 | BATTERY |
| 175 | GENERATOR | GFAE | R-1 | 2CM73B6 | ENGINE |
| 176 | VOLTAGE REGULATOR | GFAE | 1 | 17R21 | ENGINE JUNCTION BOX |
| 177 | BATTERY | EXIDE | | 6-GT.13 | SUB-COCKPIT |
| ★198 | CAPACITOR | MALLORY | 4 MFD | AC43D9224-B-40 | ENGINE JUNCTION BOX |
| ✝314 | CAPACITOR | GFAE | 4 MFD | CA-275 | GENERATOR |
| 335 | TERMINAL PANEL | LOCKHEED | | 151926-12 | SUB-COCKPIT JUNCTION BOXES |
| 338 | TERMINAL PANEL | LOCKHEED | | 151929-26 | RH SUB-COCKPIT JUNCTION BOX |

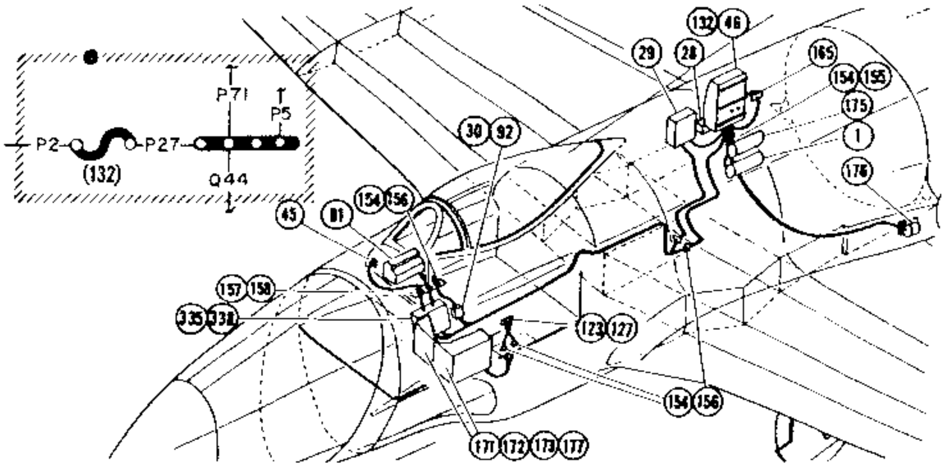
- • AAF SERIAL 44-85062 THRU 44-85216
- •• AAF SERIAL 44-85217 THRU 44-85406
- ★ AAF SERIAL 44-85062 THRU 44-85336
- ✝ AAF SERIAL 44-85377 AND SUBSEQUENT — FIGHTER AIRPLANES ONLY
- ▲ ALL P-80A-5 AIRPLANES ARE EQUIPPED WITH TWO EXTERNAL POWER RECEPTACLES (T O 01-75FJ-24)

FB 682

EM-39-18-4-181

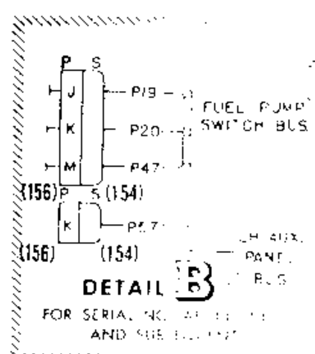
*Figure 181 — Battery and Generator Circuit, F-80A-1 and F-80A-5 Airplanes, Serial No. AF44-85062 through AF44-85406*



| WIRE NO. | GAUGE | WIRE NO. | GAUGE | WIRE NO. | GAUGE |
|---|---|---|---|---|---|
| N1 | 0 | P22 | 16 | P45 | 12 |
| N2 | 0 | P24 | 20 | P46 | 12 |
| N3 | 0 | P25 | 20 | P47 | 12 |
| N5 | 12 | P26 | 20 | P48 | 12 |
| N25 | 20 | P27 | 20 | P49 | 12 |
| P1 | 0 | P28 | 20 | P51 | 20 |
| P2 | 0 | P29 | 20 | P54 | 20 |
| P3 | 0 | P30 | 20 | P55 | 20 |
| P4 | 0 | P31 | 20 | P56 | 20 |
| P5 | 0 | P32 | 20 | P57 | 12 |
| P6 | 0 | P33 | 20 | P58 | 12 |
| P7 | 0 | P34 | 12 | P59 | 12 |
| P11 | 12 | P35 | 12 | P60 | 10 |
| P12 | 12 | P36 | 12 | P65 | 2 |
| P13 | 12 | P37 | 16 | P66 | 2 |
| P14 | 12 | P38 | 16 | P70 | 20 |
| P15 | 12 | P39 | 16 | P71 | 2 |
| P16 | 12 | P40 | 16 | *P75 | 20 |
| P17 | 12 | P41 | 16 | *P76 | 20 |
| P18 | 12 | P42 | 16 | Q44 | [illegible] |
| P19 | 12 | P43 | 16 | R147 | 12 |
| P20 | 12 | P44 | 16 | R146 | 12 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 1 | STARTER | GFAE | G.E. | 8437749 | ENGINE |
| 28 | GENERATOR RELAY | GFAE | G.E. | AERNO42-1504 | RH FILLET |
| 29 | STARTER RELAY | G.E. | | CR2781C-102C3 | ENGINE COMPARTMENT |
| 30 | BATTERY RELAY | GFAE | B-14 | 32490 | RH SUB-COCKPIT |
| 45 | AMMETER | GFAE | J-1 | 32529 | MAIN INSTRUMENT PANEL |
| 46 | SHUNT | | | AN3200-300 | ENGINE JUNCTION BOX |
| 81 | SWITCH | C.H. | | AN3021-2 | MAIN SWITCH BOX |
| 92 | SWITCH | SQUARE D | 1056 | CLASS 9320 | RH SUB-COCKPIT |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH SHELF |
| 127 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | LH SHELF |
| 132 | CIRCUIT PROTECTOR | BURNDY | | FLLH | ENGINE COMPARTMENT |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| ▲165 | CONNECTOR | KERWOOD | | 121.0 | ENGINE COMPARTMENT |
| 171 | CONNECTOR | KERWOOD | | 123.0 (9.70) | BATTERY |
| 172 | CONNECTOR | KERWOOD | | 131.0 (5/16) | BATTERY |
| 173 | CONNECTOR | KERWOOD | | 129.0 | BATTERY |
| 175 | GENERATOR | GFAE | G.E. | 2CM73B6 | ENGINE |
| 176 | VOLTAGE REGULATOR | GFAE | 1 | 17R21 | LH FILLET |
| 177 | BATTERY | GFAE | EXIDE | 6 GT-13A | SUB-COCKPIT |
| ★314 | CAPACITOR | GFAE | 4 MFD | CA-275 | GENERATOR |
| 335 | TERMINAL PANEL | LOCKHEED | | LS1926-12 | SUB COCKPIT JUNCTION BOXES |
| 338 | TERMINAL PANEL | LOCKHEED | | LS1929-26 | RH SUB-COCKPIT JUNCTION BOX |




*Note*

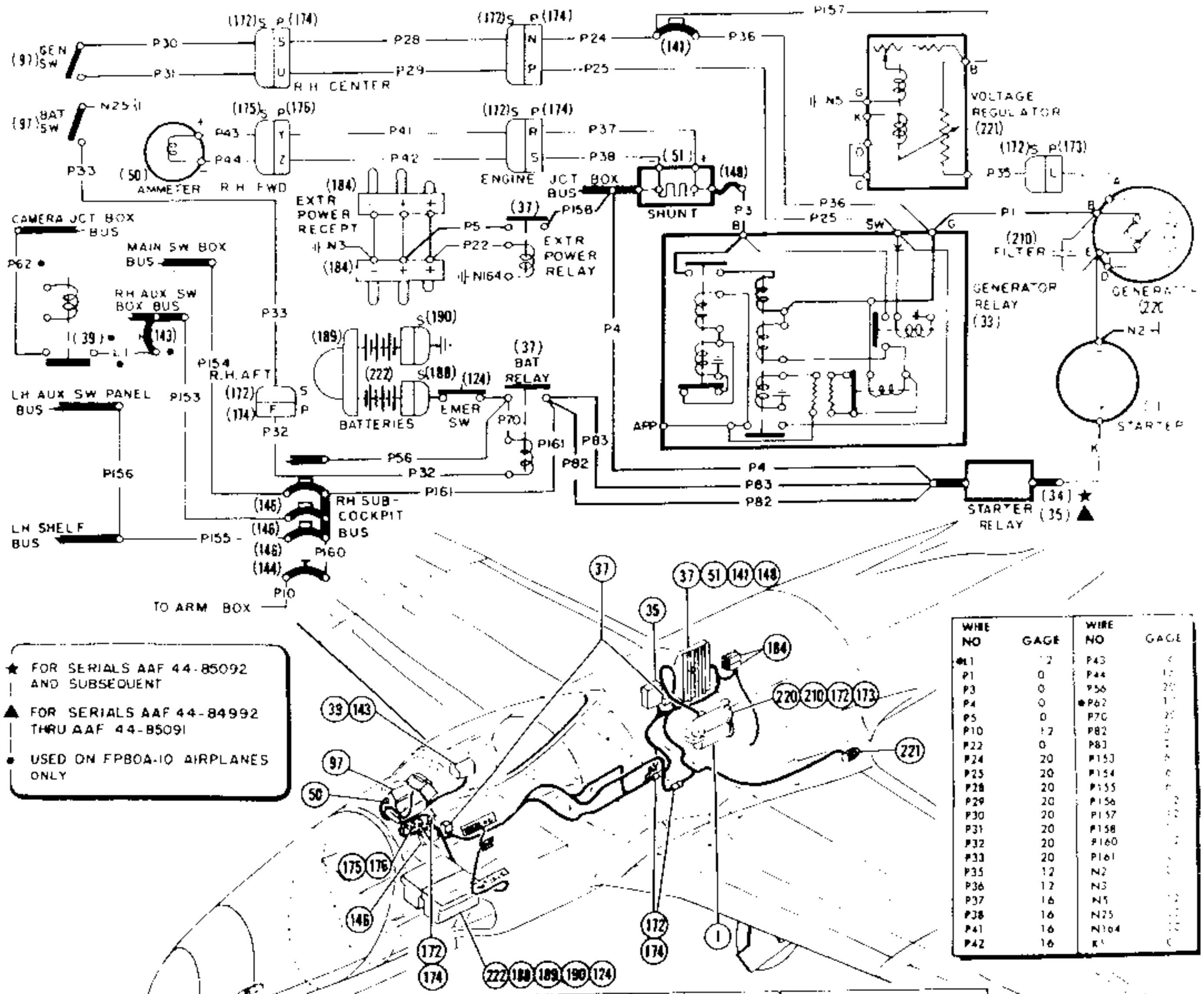
▲ ALL AIRPLANES ARE EQUIPPED WITH TWO EXTERNAL POWER RECEPTACLES

★ USED ON FIGHTER AIRPLANES ONLY

● ALL AIRPLANES T.O. 01-75FJB-28

EM-39-18-4-182
FB 683

*Figure 182 — Battery and Generator Circuit, F-80A-5 and RF-80A-5 Airplanes, Serial No. AF44-85407 and Subsequent*




| WIRE NO | GAGE | WIRE NO | GAGE |
|---|---|---|---|
| ● L1 | 12 | P43 | [illegible] |
| P1 | 0 | P44 | [illegible] |
| P3 | 0 | P56 | [illegible] |
| P4 | 0 | ● P62 | [illegible] |
| P5 | 0 | P70 | [illegible] |
| P10 | 12 | P82 | [illegible] |
| P22 | 0 | P83 | [illegible] |
| P24 | 20 | P153 | [illegible] |
| P25 | 20 | P154 | [illegible] |
| P28 | 20 | P155 | [illegible] |
| P29 | 20 | P156 | [illegible] |
| P30 | 20 | P157 | [illegible] |
| P31 | 20 | P158 | [illegible] |
| P32 | 20 | P160 | [illegible] |
| P33 | 20 | P161 | [illegible] |
| P35 | 12 | N2 | [illegible] |
| P36 | 12 | N3 | [illegible] |
| P37 | 16 | N5 | [illegible] |
| P38 | 16 | N25 | [illegible] |
| P41 | 16 | N164 | [illegible] |
| P42 | 16 | K1 | [illegible] |

★ FOR SERIALS AAF 44-85092 AND SUBSEQUENT

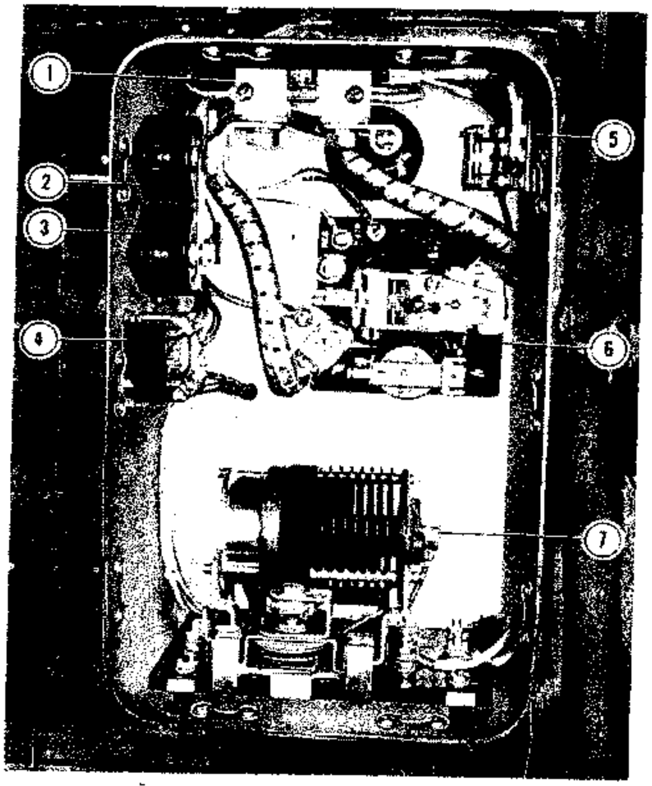
▲ FOR SERIALS AAF 44-84992 THRU AAF 44-85091

● USED ON FP80A-10 AIRPLANES ONLY

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 1 | STARTER | GFAE | | B437749 | ENGINE COMPARTMENT |
| 33 | RELAY | GFAE | | AN3025-1 | ENGINE COMPARTMENT |
| ★ 34 | RELAY | GF | | CR27B1C 102A3 | ENGINE COMPARTMENT |
| ▲ 35 | RELAY | GE | | CR27B1C 102C3 | ENGINE COMPARTMENT |
| 37 | RELAY | GFAE | 6-14 | 32490 | SUB COCKPIT |
| ● 39 | RELAY | | 6-5 | AN3350-1 | RH AUX SWITCH PANEL |
| 50 | AMMETER | GFAE | J-1 | 32579 | INSTRUMENT PANEL |
| 51 | SHUNT | GFAE | | AN3200-300 | ENGINE PANEL |
| 97 | SWITCH | | | AN3021-2 | MAIN SWITCH BOX |
| 124 | SWITCH | SQUARE D | 1056 | CLASS 9320 | SUB COCKPIT |
| 141 | CIRCUIT PROTECTOR | | | AN3161-P15 | ENGINE PANEL |
| ● 143 | CIRCUIT PROTECTOR | | | AN3161-P35 | RH AUX SWITCH PANEL |
| 144 | CIRCUIT PROTECTOR | | | AN3161-P50 | RH SUB-COCKPIT JUNC BOX |
| 146 | CIRCUIT PROTECTOR | SPENCER | | PLM 105 | RH SUB COCKPIT JUNC BOX |
| 148 | CIRCUIT PROTECTOR | BURNDY | | FLIH (275A) | ENGINE PANEL |
| 172 | CONNECTOR | | | AN3106 28 15 | ENGINE |
| 173 | CONNECTOR | | | AN3107 28 11P | |
| 174 | CONNECTOR | | | AN3102P 28 11P | COCKPIT RH FLOOR |
| 175 | CONNECTOR | | | AN3106 28 12S | COCKPIT RH FLOOR |
| 176 | CONNECTOR | | | AN3102P 28 12P | ENGINE COMPARTMENT |
| 184 | CONNECTOR | KERWOOD | | 121 0 | BATTERY |
| 188 | CONNECTOR | KERWOOD | | 123 0 (9.70) | BATTERY |
| 189 | CONNECTOR | KERWOOD | | 131 0 (5/16) | |
| 190 | CONNECTOR | KERWOOD | | 129 0 | GENERATOR |
| 210 | FILTER | GFAE | 4MFD | CA-275 | ENGINE |
| 220 | GENERATOR | GFAE | R-1 | 2CM7386 | LH WING FILLET |
| 221 | VOLTAGE REGULATOR | GFAE | 1 | 17R21 | SUB COCKPIT |
| 222 | BATTERY | GFAE | | 6 GT-13A | |

FB 775
EM-39-18-4-182A

*Figure 182A — Battery and Generator Circuit, F-80A-10 and RF-80A-10 Airplanes*




| | | |
|---|---|---|
| 1. | AMMETER SHUNT | |
| 2. | CIRCUIT PROTECTOR, LEFT WING FLAP | |
| 3. | CIRCUIT PROTECTOR, RIGHT WING FLAP | |
| 4. | CIRCUIT PROTECTOR, HYDRAULIC PUMP RELAY | |
| 5. | OIL HEATER RELAY | |
| 6. | REVERSE CURRENT RELAY | |
| 7. | VOLTAGE REGULATOR | |

*Figure 183 — Engine Junction Box, F-80A-1 Airplanes*

The connections to the generator are made at a terminal block on the side of the generator housing. The terminal are identified as follows:

| *Terminal* | *Circuit* |
|---|---|
| A | Field Positive |
| B | Generator Positive |
| D | Equalizer (Not Used) |
| E | Generator Negative |

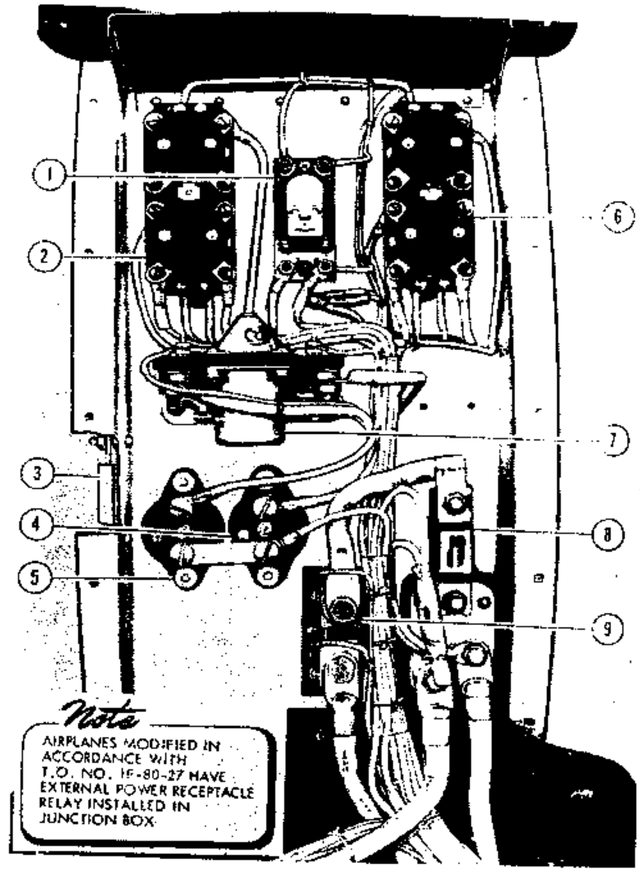
(*b*) REMOVAL.

*1.* Disconnect air blast tube at generator.

*2.* Remove electrical connections at generator.

*3.* Remove nuts from studs at mounting flange.

*4.* Remove generator.




| | |
|---|---|
| 1. | OIL HEATER RELAY |
| 2. | RH WING FLAP RELAY |
| 3. | SPARE GENERATOR CIRCUIT PROTECTOR (FUSE TYPE) |
| 4. | LH WING FLAP CIRCUIT PROTECTOR |
| 5. | RH WING FLAP CIRCUIT PROTECTOR |
| 6. | LH WING FLAP RELAY |
| 7. | EMERGENCY FUEL PUMP RELAY |
| 8. | GENERATOR CIRCUIT PROTECTOR (FUSE TYPE) |
| 9. | SHUNT |

CB 5186 M-39-7-4-184

*Figure 184 — Engine Junction Box, F-80A-5 and RF-80A-5 Airplanes*

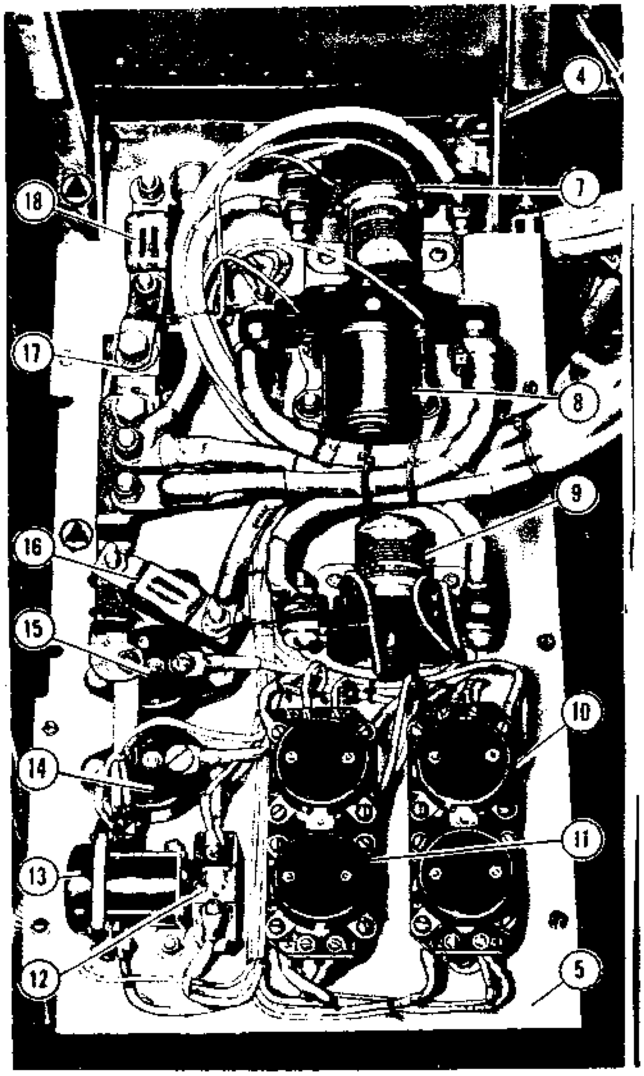
(*c*) MAINTENANCE.

*1.* Remove generator from aircraft, place it on a work bench, preferably on wooden V-blocks.

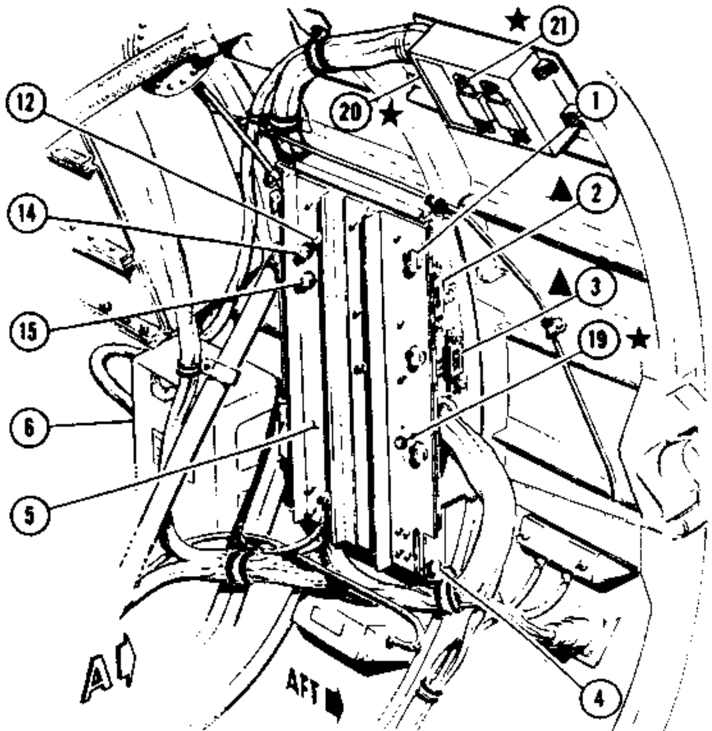
*2.* Use spring scale QB80004-3 and measure tension of brush springs.

**Note**

Place the hook under spring where it rests on brush. Pull on scale should be in line with point where finger rests on brush and parallel to sides of brush. Scale should be jiggled up




VIEW A
Junction
Box Open




*Note*

▲ DELETED } (LOCKHEED SERVICE
★ ALL AIRPLANES } BULLETIN NO. 48)

| | |
|---|---|
| 1. | JUNCTION BOX FASTENERS |
| ▲2. | SPARE GENERATOR CURRENT LIMITER |
| ▲3. | SPARE FLUID INJECTION CIRCUIT CURRENT LIMITER |
| 4. | JUNCTION BOX HINGE |
| 5. | ENGINE COMPARTMENT JUNCTION BOX COVER |
| 6. | STARTER RELAY PANEL |
| 7. | EMERGENCY FUEL PUMP RELAY |
| 8. | EXTERNAL POWER RECEPTACLE RELAY |
| 9. | FLUID INJECTION RELAY |
| 10. | RH FLAP RELAY |
| 11. | LH FLAP RELAY |
| 12. | GENERATOR FIELD COIL CIRCUIT PROTECTOR |
| 13. | OIL HEAT RELAY |
| 14. | LH FLAP CIRCUIT PROTECTOR |
| 15. | RH FLAP CIRCUIT PROTECTOR |
| ▲16. | FLUID INJECTION CIRCUIT CURRENT LIMITER |
| 17. | AMMETER SHUNT |
| ▲18. | GENERATOR CIRCUIT CURRENT LIMITER |
| ★19. | CURRENT LIMITER JUNCTION BOX |
| ★20. | SPARE FLUID INJECTION CIRCUIT CURRENT LIMITER |
| ★21. | SPARE GENERATOR CURRENT LIMITER |

*Figure 184A — Engine Junction Box, F-80A-10 and RF-80A-10 Airplanes* and down as pull is exerted to minimize effects of friction. When spring is raised to position where it would normally be when resting on a new brush, scale should register a spring tension within tolerance specified in table 184B. The above procedure may be followed for all generators except Jack & Heintz part No. G300-4B. For this particular generator, check brush spring tension by using a new brush with a narrow groove cut vertically around it. With a wire located in the groove and a scale attached, raise brush until it is flush with bottom of brush holder assembly. The new brush with the groove cut on its side will not be considered serviceable. If spring tension in any generator is not as specified in table 184B replace generator.

*3.* Remove defective brushes and clean brush boxes and commutator as necessary. Slide a strip of No. 0000 or finer sandpaper (not emery cloth) around commutator, abrasive outward, lap it for direction of of rotation of generator, and secure temporarily with string. Do not use adhesive (glue or varnish) to secure sandpaper. To do so may cause irreparable damage to brushes, commutator, or both. If commutator is so worn that sandpaper will not lie smoothly, generator shall be replaced.

*4.* Obtain a new set of brush assemblies. Place brushes in brush holders. Do not snap them down on sandpaper. Secure brush terminals to brush holders. Make certain that sandpaper is wrapped smoothly around commutator and that all brushes are in place. Rotate armature assembly turning it slowly counterclockwise (looking at drive end) so as not to dislodge sandpaper. From time to time lift brushes for inspection. Wearing face of each brush should be hollowed out from edge to edge. Do not sand any more than necessary to obtain this fit on all brushes. When sanding-in is completed, remove all brushes. Remove sandpaper. Blow out commutator end of generator. Return brushes to their holders. To settle brushes, again rotate armature assembly counterclockwise (looking at drive end). Once more blow out commutator end of generator.

*5.* Brushes which have been sanded must be "run-in," that is, they must be seated to the contour of commutator. Brushes may be "run-in" by operating generator at 3000 to 5000 rpm and with 90 to 120 amperes load current until each brush is seated to the degree specified in table 184B. At intervals during "run-in" commutation should be observed. If excessive arcing takes place and inspection reveals that brushes are properly contour-sanded, replace generator.

*6.* A varidrive or other variable speed unit of 20 horsepower or more is required to drive generator. Cooling air must be supplied at rate of 115 cubic feet per minute (mimimum) at a pressure equal to six inches of water in a three inch diameter blast tube. Provide a transparent cover band for observing commutation during test, and provide a means of loading generator from 0 to 300 amperes at 30 volts direct current. Unless facilities are available as described above, brush replacement shall not be accomplished.

*(d)* FLASHING GENERATOR FIELD.

*1.* Occasionally it is found that a generator that operated satisfactorily during a previous flight will not develop any output during engine run-up in preparation for next mission. Such a condition should not be readily accepted as an indication that residual magnetism of generator is weak or nonexistant. In most of these instances, other defects are responsible for the apparent inability of generator to function properly for lack of residual magnetism. A peculiar characteristic that often serves to strengthen the theory of lost residual magnetism is the fact that flashing the field of a generator will restore its output in a majority of cases in which the gererator was inoperative due to other causes. For this reason it is essential that a thorough inspection be made prior to flashing the field of a generator that appears in normal condition but is not capable of self-excitation. Laxity in this respect will invariably result in the need to flash the generator field at every engine run-up. This is undesirable as continuous flashing of the generator field can cause permanent damage to generator. Furthermore, conditions will undoubtedly be overlooked that can only become progressively worse and may eventually lead to failure of generator in flight. To ascertain that flashing the field is accomplished only when failure of generator is due to loss of residual magnetism, inspect affected generator and associated voltage regulator for the following conditions:

Brushes excessively worn.

Brush spring tension too low.

Brushes binding in brush holders.

Commutator, dirty, rough, pitted, or eccentric.

Regulator base contacts are corroded.

Connections in circuit between generator and voltage regulator dirty or corroded.

*2.* In the absence of all possibilities listed above, it is reasonable to assume that generator inability to develop voltage is due to a loss of residual magnetism. This discrepancy may be corrected by flashing the field of the affected generator in the following manner:

Turn battery switch "ON" and leave generator switch "OFF."

Remove voltage regulator from mounting base.

Place a jumper from a convenient battery voltage source to "A" terminal on voltage regulator base, for approximately one second.

If necessary, repeat above operation two or three times. Should generator fail to develop output after third application of voltage to its field, replace generator.

## WARNING

Do not flash field by closing reverse circuit relay contacts. Such action may result in serious damage to relay, electrical system, or to personnel by heavy current drawn from batteries.

**Note**

A jumper assembly, consisting of a switch and No. 16 gage wire, should be used to apply battery voltage. This switch is necessary in order to prevent sparking and damage to terminals.

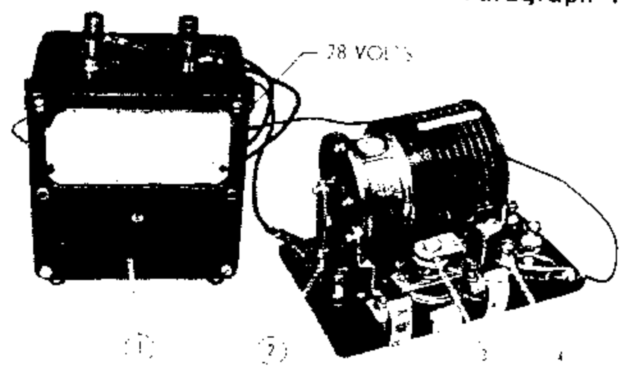
(*e*) TROUBLE SHOOTING OF GENERATOR.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Low voltage output. | Voltage regulator out of adjustment. | Adjust voltage regulator. |
| | Worn or damaged brushes. | Replace brushes. |
| | Loss of residual magnetism. | Flash generator field. Refer to paragraph 17,*c*,(2),(*d*). |
| High voltage output. | Regulator out of adjustment. | Adjust or replace voltage regulator. |
| | Defective generator. | Replace generator. |
| Generator housing overheated, broken, cracked, or other structural defects. | Generator overloaded. Construction flaw. | Replace generator. |
| Air blast tube broken or cracked. Stripped threads in holes that accommodate cap retaining screws. | Air blast tube misaligned or too rigid. | Replace generator if threads in blast cap retaining screws are stripped. If above defect is not found to exist and all damage is confined to blast cap only replace blast cap. |
| Mounting flange cracked, broken, or other structural defects. Elongated holes in nonbutton type hole mounting flange. Worn or elongated recess in narrow part of mounting holes in button type hole mounting flange. | | Replace generator. |
| Radio noise filter condenser. Loose connections. Broken mounting brackets. Loose condenser. Loose mounting bracket. Dents in outer case of condenser. | Lead not properly tightened. Bracket not securely attached to generator. | Repair filter condenser mounting attachments as necessary. Any component with damaged threads must be replaced including screws. Loose filter condensers may be reused except when dents or other physical damage is evident or in cases where filter is found to have become separated from generator and is recovered after having been lodged in some part of the engine. |

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Terminal block connections loose. Post bent, loose, cracked, broken, overheated, or burned damaged threads on terminal block mounting screws or in matching holes in field frames. Burned external leads. | Leads not properly tightened at time of generator installation. Insufficient slack in leads. Generator overloaded. | Tighten all loose connections, terminal blocks and terminal block mounting screws. Replace generator if evidence of overheating is apparent. If any of terminal block components or connections indicate having been subjected to heat or if threads in field frame are damaged and if burned insulation is found on cables connecting "B" and "E" posts, replace generator. |
| Brush coverband cracked, holes, dents, or dirty. | Improper handling. Arcing to brush leads. | Tap out small dents and clean as required. If other defects worse than minor dents are present, install a new brush coverband. |
| Armature, oil soaked, burned commutator. | Defective engine drive seal. Weak brush springs. Poor commutation. | Replace generator. |
| Brushes worn, burned, cracked, chipped, binding loose rivets, corroded, burned or broken leads, loose terminals on brush leads. | Weak brush springs, improper handling, corrosion in brush boxes. | Brushes that are not burned or binding may be replaced. Measure brush length and refer to table 184B for minimum permissible length. Replace brushes that are not worn to the maximum wear limit but which are likely to wear below minimum permissible length prior to next anticipated inspection. Replacing brushes necessitates removal of generator. Replacement of brushes will be accomplished in accordance with paragraph 17,*c*,(2),(*c*). |

### *Figure 184B — Generator Component Maintenance Limits*

| *Generators* | | | *Brush Spring Tension (Ounces)* | *Minimum Brush Length (Inches)* | *Minimum Contact Area Between Commutator and Brushes When Seating New Brushes* |
|---|---|---|---|---|---|
| *Mfgr* | *Type* | *Part No.* | | | |
| G. E. | R-1 | 2CM73B3 | 15 to 23 | ¼ inch from brush lead rivet. | Properly seated brushes must show contact 100 percent across brush thickness in direction of rotation and for at least 70 percent of brush width in direction parallel to shaft. This insures proper commutation without arcing, which is desirable since arcing is one of the primary causes of rapid wear of brushes. |
| G. E. | R-1 | 2CM73B6 | 15 to 23 | ¼ inch from brush lead rivet. | |
| J & H | R-1 | 2000-3 | 22 to 28 | 9/16 inch from top of brush. | |
| WH | DF-30 | A24A9315-2A | 24 to 32 | ⅝ inch from top of brush. | |
| G. E. | DF-30 | 2CM75C10 | 24 to 36 | ¼ inch from brush lead rivet. | |
| G. E. | DF-30 | 2CM75D2 | 24 to 36 | ¼ inch from brush lead rivet. | |
| WH | E-30 | A28A8584(1) | 28 to 36 | ¾ inch from top of brush. | |
| G. E. | E-30 | 2CM75D6 | 30 to 47 | Maximum wear slot is cut in side of brush. | |
| J & H | E-30 | G330-4B | 45 to 57 | 11/16 inch from top of brush. | |




1. PORTABLE PRECISION VOLTMETER
2. "G" TERMINAL (VOLTMETER NEGATIVE)
3. THUMB SCREW ADJUSTMENT
4. "B" TERMINAL (VOLTMETER POSITIVE)

*ECLIPSE VOLTAGE REGULATOR SHOWN. OTHER CARBON PILE TYPES SIMILAR*

***Figure 185 — Voltage Regulator Adjustment***

(3) VOLTAGE REGULATOR.

(a) DESCRIPTION. — Constant generator output voltage is maintained by the voltage regulator mounted in the engine junction box on P-80A-1 and early P-80A-5 airplanes (figure 183), and in the left-hand fillet on all other airplanes (figure 50). The regulating resistance is wired in series with the shunt field of the generator and maintains a constant generator output voltage by automatically controlling the generator field current.

The equalizing coil of the voltage regulator is not used in this installation, since only a single generator is used.

*(b)* ADJUSTMENT. *(See figure 185.)*—Connect a 30-volt precision portable voltmeter to terminals "B" and "G" of the voltage regulator base. Drive the generator at rated speed at no load. Adjust regulator by means of the rheostat adjusting screw so that voltmeter reads 28.0 volts.

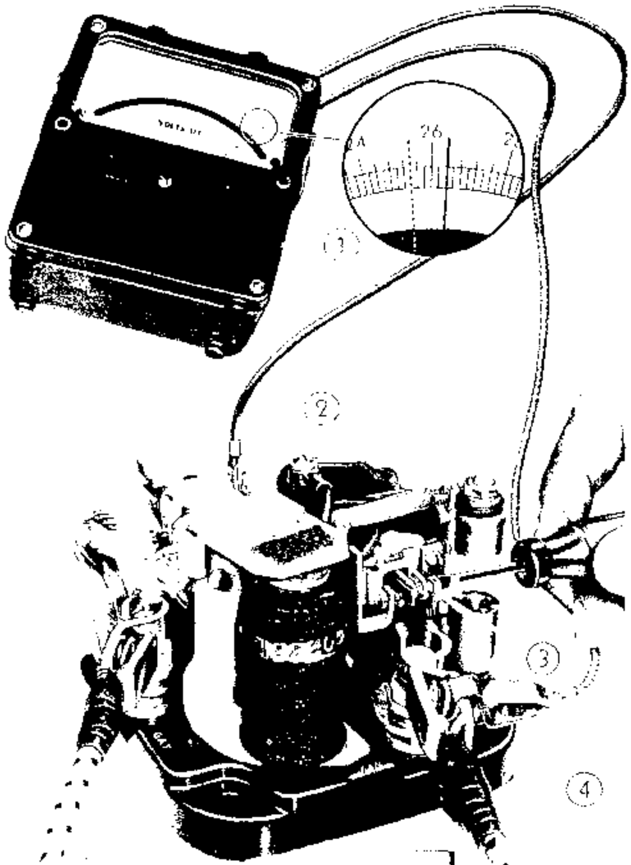
(4) REVERSE CURRENT RELAY. *(See figure 186.)*

*(a)* DESCRIPTION.—The reverse current relay is used to connect the generator to the line, and to protect the battery against discharging through the generator when the generator voltage becomes less than battery voltage. The unit is mounted in the engine junction box on early P-80A-1 and P-80A-5 airplanes (figure 183), and in the right-hand fillet on all other airplanes.

Early P-80A-1 airplanes used a fixed-voltage type reverse current relay. The relay is composed of a contactor controlled by a pilot relay. The pilot-relay contacts are controlled by a spring-loaded balanced armature which is acted upon by two coils, a potential coil and a current coil. At a generator voltage of 26.0 to 26.5 volts ("pick-up" voltage) the potential coil acts to close the contacts of the pilot relay. (The potential coil is connected across the generator potential.)

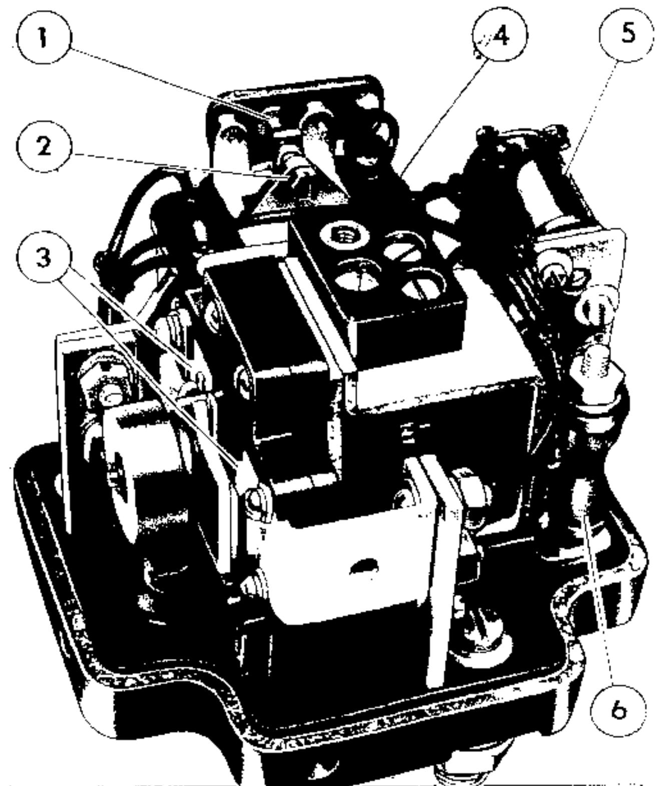
Normal load current through the current coil of the pilot relay aids the potential coil in holding the contacts closed. Reverse current of from 8 to 20 amperes through the current coil will open the contacts.

Later P-80A-1 and early P-80A-5 airplanes have a differential type reverse current relay in which the main contactor unit is controlled by the differential voltage pilot relay. The pilot relay is controlled by two coils, a series coil and a differential voltage coil. The differential voltage coil, in series with a ballast




1. PORTABLE PRECISION VOLTMETER
2. GROUND TERMINAL (VOLTMETER NEGATIVE)
3. ADJUSTING SCREW
4. [illegible]

*Figure 186 — Reverse Current Relay Adjustment, Early P-80A-1 Airplanes*




1. CONTACT SCREW
2. STOP SCREW
3. MAIN CONTACTS
4. POLARIZED RELAY
5. AUXILIARY RELAY ASSEMBLY
6. 82 OHM RESISTOR

*Figure 187 — AN3025-1 Reverse Current Relay*

lamp, is connected across the battery and generator terminals of the reverse current relay. A generator voltage of 0.35 to 0.65 volt above the battery voltage provides sufficient excitation to close the pilot relay contacts. This completes the circuit through the main contactor coil. A reverse current of from 15 to 25 amperes through the pilot relay series coil will open the circuit and remove the generator from the bus. No adjustment of the differential type relay is required.

All other airplanes are equipped with the AN-3025-1 differential voltage type relay which prevents the battery voltage from discharging into the generator at low engin speeds. (See figure 187.) The relay accomplishes .nis by connecting the generator to the bus when the generator voltage is sufficient to supply the load, and disconnecting the generator from the bus when reverse current tends to drive it as a motor.

The differential relay will not connect the generator to an open bus. A fraction of an ampere load however, will cause the differential relay to connect the generator to a bus on which there is no voltage when the generator voltage is 22 volts or more. A load is required to complete this circuit on the differential coil.

The relay connects the generator to the bus when the generator voltage is 0.35 to 0.65 volt above bus voltage. The bus must be at any voltage above 22 volts. A reverse current of 15 to 25 amperes will cause the differential relay switch to disconnect the generator from the system. If the generator switch is not closed until the generator potential is 4.5 to 11 volts above bus potential, the main contacts may fail to close and the generator will remain off the bus until its voltage drops to approximately 0.5 volt above the bus voltage, or increases to more than 11 volts above bus voltage.

Three main assemblies comprise the relay. These are the auxiliary relay assembly, the contactor assembly, and the polarized relay assembly. The ground connection is made through the mounting bolts.

*(b)* ADJUSTMENT. (Early P-80A-1 Airplanes). Connect a precision voltmeter across terminals "GEN" and "NEG" of the reverse current relay. Adjust pilot relay adjusting screw so that pilot relay closes on pick-up voltage of 26.0 and 25.5 volts.

**Note**

Do not attempt an adjustment of the AN3025-1 relay. Return defective relays to the repair depots for overhaul and adjustment.

(5) BATTERY. *(See figure 188.)*

*(a)* DESCRIPTION. — Two 12-volt batteries, connected in series, which are capable of starting the engine several times without recharging are mounted in the sub-cockpit compartment. Battery cases are transparent plastic and must he handled with care. At no time while they are in the airplane are they to be rested on the bottom of the cases, but must always be suspended from their mounting angles. Power from the battery is put on the bus through the battery relay in the right side of the sub-cockpit compartment. The battery switch disconnects the battery from all circuits except the identification-radio destructor circuit and the emergency fuel pump circuit. A normally closed battery emergency switch is on the upper aft end of the battery supports. This switch may be opened by pulling a handle which is on the cockpit floor to the right of the pilot.

On early P-80A-1 airplanes, the battery gases pass through tubes at the aft end of the batteries to a sump at the right side of the sub-cockpit compartment behind the batteries. All other airplanes have two battery sumps, one on each side of the sub-cockpit compartment forward of the batteries. The acid sumps contain pads saturated with a solution of sodium bicarbonate and water, and are vented overboard. Access to the batteries is through the nose wheel well.

*(b)* ARCTIC OPERATION.—Storage batteries are of little value at sub-zero temperatures, since chemical action stops. At −29° C (—20° F) storage batteries will deliver about one-sixth of their rated power. Similarly, at −29° C (—20° F) the charging rate is less than one-sixth that of normal temperatures.

If an airplane is to be grounded for any length of time in sub-zero weather, and there is no external power available, remove the batteries and store them in a warm room, so maximum energy will be available for starting.

*(c)* REMOVAL.—Special tools required, S-40752 battery lift, and S-40750 battery puller.

*1.* Turn battery switch "OFF." Remove fabric cover between wheel well and sub-cockpit compartment.

*2.* Disconnect battery drain tubes from acid vents.

*3.* Pull knob on battery disconnect crank forward to clear flanges on forward quick-disconnect plate. Turn disconnect crank counterclockwise until forward quick-disconnect plate can be removed.

*4.* Position battery lift S-40752 (figure 27) in nose wheel well. With battery puller S-40750 pull batteries off tracks onto battery lift. Batteries weigh approximately 74 pounds each.

**CAUTION**

Handle batteries carefully.

*(d)* MAINTENANCE.—Do not use the batteries for starting the engine except in emergency. Batteries are subject to severe load drains; therefore perform a daily inspection, with the batteries removed from the airplane. If reconditioned units are available they may be substituted for the uninspected units, and the inspection performed later.

Check electrolyte level and the specific gravity. Check open- and closed-circuit voltage with a momentary load of 200 amperes applied. Inspect the battery cases for checking and cracks. See that cell caps are tight. Check the acid traps and remove any acid. Refill the pads in the acid traps with a saturate solution of sodium bicarbonate and water.

*(e)* SERVICE.

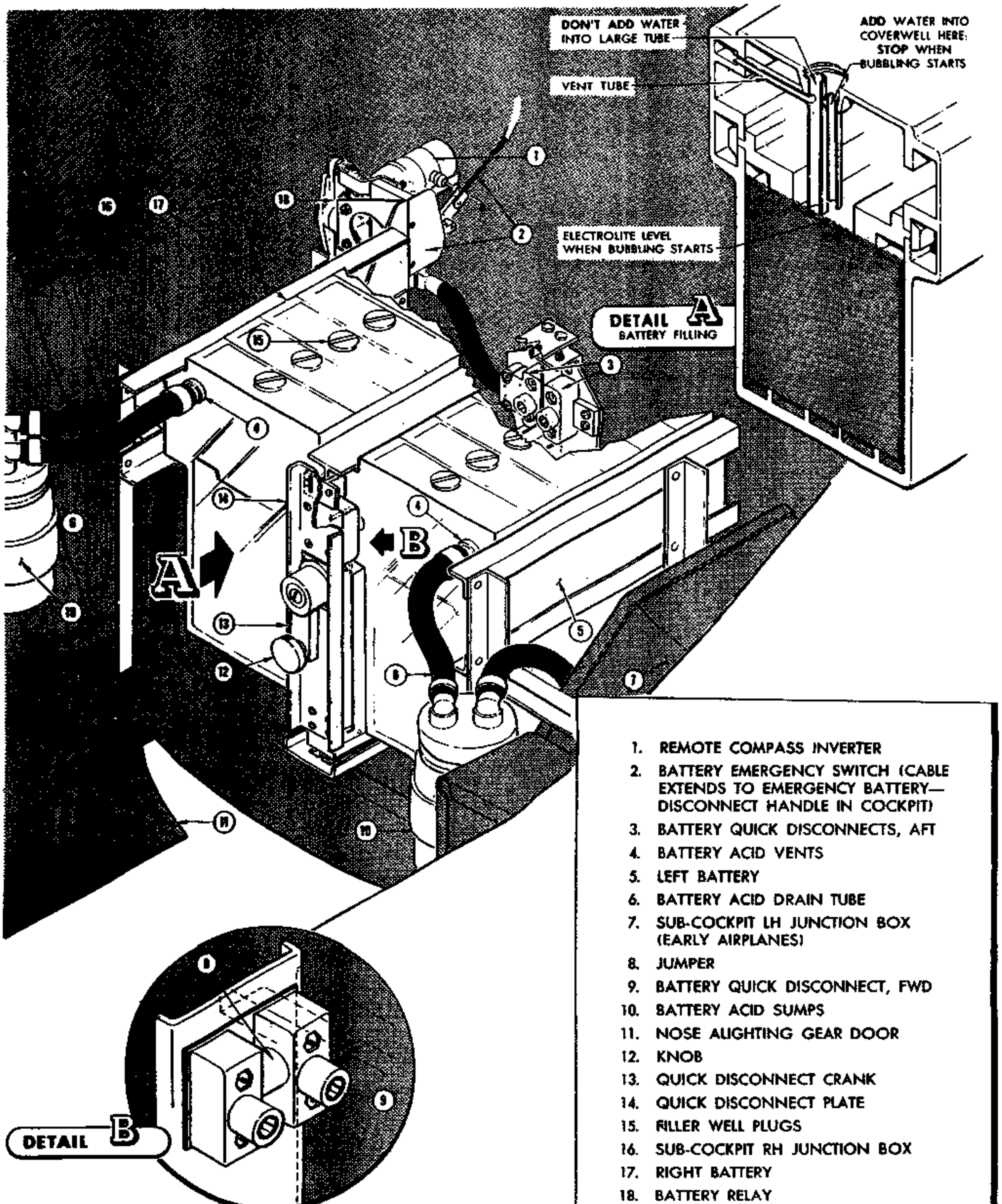
*1.* To prepare a new battery for service, fill the cells with electrolyte and charge as follows:

a. Remove filler well plugs from holes in cover.

**CAUTION**

Do not place filler well plugs on top of the battery while filling. Keep battery cases free from acid, as acid will cause the cases to crack.

b. Fill each cell with dilute sulphuric acid having a specific gravity of 1.275, sufficiently pure and suitable for storage battery use. When filling, pour electrolyte or water into the filler well in such a way that the small tube is kept covered, and stop filling when bubbling is noted in the small tube. The bubbling indicates that the maximum filling height has been




1. REMOTE COMPASS INVERTER
2. BATTERY EMERGENCY SWITCH (CABLE EXTENDS TO EMERGENCY BATTERY—DISCONNECT HANDLE IN COCKPIT)
3. BATTERY QUICK DISCONNECTS, AFT
4. BATTERY ACID VENTS
5. LEFT BATTERY
6. BATTERY ACID DRAIN TUBE
7. SUB-COCKPIT LH JUNCTION BOX (EARLY AIRPLANES)
8. JUMPER
9. BATTERY QUICK DISCONNECT, FWD
10. BATTERY ACID SUMPS
11. NOSE ALIGHTING GEAR DOOR
12. KNOB
13. QUICK DISCONNECT CRANK
14. QUICK DISCONNECT PLATE
15. FILLER WELL PLUGS
16. SUB-COCKPIT RH JUNCTION BOX
17. RIGHT BATTERY
18. BATTERY RELAY

*Figure 188 — Battery Filling and Installation*

reached. Excess electrolyte added will flood into the vent tubes. The temperature of the filling electrolyte should not exceed 32° C (90° F).

c. Allow the battery to stand for at least one hour after filling. The electrolyte level generally lowers during the first hour after filling.

d. Fill cells again, until bubbling is noted.

e. Install and tighten filler well plugs.

f. Charge battery at an initial rate of 5.5 amperes until four consecutive hourly readings show no rise in specific gravity and voltage. The time required to charge the battery initially will be at least 18 hours at normal temperature. If temperatures exceed 43° C (110° F), reduce the charging rate and lenghten the time. For cold-weather charging, see paragraph *(b)* preceding.

g. After completion of charge, the specific gravity should be between 1.275 and 1.285. If it is above this value, remove some electrolyte with a syringe and replace it with distilled or clean drinking water. If the specific gravity is below 1.275, add electrolyte having a specific gravity of from 1.30 to 1.345 to bring the gravity up to 1.275.

*2.* Do not use batteries having specific gravity below 1.240 or above 1.310.

*3.* When necessary to add water, proceed as indicated in paragraph *1* preceding.

*4.* Remove terminal corrosion by brushing with a stiff, non-metallic brush. Wash terminals with solution of sodium bicarbonate and water, and rinse with water.

*5.* When airplane is to be idle for more than one week, remove battery and return it to storage room.

*(f)* INSTALLATION. — Reverse removal procedure.

**CAUTION**

Move batteries into place slowly. Be sure fitting on aft end of battery enters battery quick disconnect in correct alignment.

(6) BATTERY EMERGENCY SWITCH. *(See figure 188.)*—The battery emergency switch is mounted on the battery support at the upper aft end. This switch is operated through a flexible cable by a handle on the floor to the right of the pilot's seat, and when operated, it disconnects the battery from all circuits. (See figure 246, sheets 3 and 4.) The handle is safety wired and is not to be operated by the pilot except in emergency, since it is a one-way switch and cannot be reset during flight. If a pilot wishes to prevent destruction of the identification radio in a crash landing, he can break the safety wire and pull the switch after lowering the alighting gear and the wing flaps.

*d.* STARTER CIRCUIT. *(See figures 189 and 190.)*—The engine is started by a 15-horsepower electric starter. (See figure 88.) The starter receives energy from the battery or from an external power source, through a relay assembly consisting of five relays. The starter circuit is controlled by the starter switch.

Operating the starter switch closes the contacts of the control relay in the relay panel, and completes the circuit to the starter motor through an 0.042-ohm resistor. This shorts out the time delay relay coil to complete the circuit to the resistor-shorting relay coil after a delay of 0.75 second. When the resistor-shorting relay closes, it shorts out the 0.042-ohm resistor, and full battery voltage is impressed on the starter.

The relay panel and the resistor serve to limit the initial current delivered to the starter, and to apply full battery voltage on the starter after the starter motor has begun to rotate.

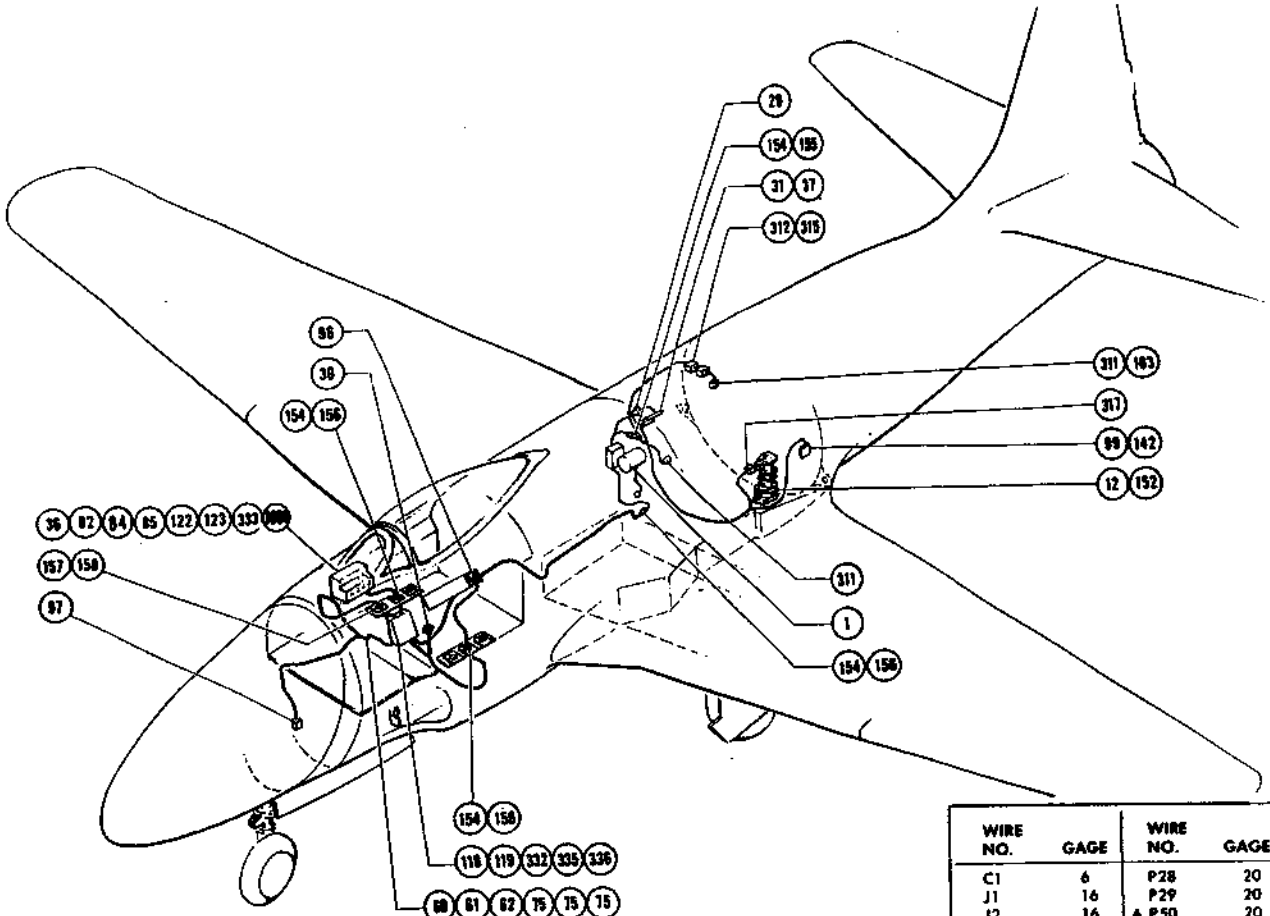
Circuit protection is given by a 10-ampere circuit protector in the starter relay circuit.

For engine starting instructions, see paragraph 11, this section.

*e.* IGNITION CIRCUIT. *(See figures 189 and 189A.)*

(1) GENERAL.—Two ignition booster coils are mounted on the engine and wired in parallel. (See figure 88.) The coils receive power from the engine-starter relay through the ignition booster switch in the cockpit. On winterized airplanes, this switch has a center "OFF" position to permit motoring the engine with the ignition off. Operating the starter switch automatically energizes the booster coils.

On early P-80A-1 airplanes the ignition booster should not be energized for longer than 45 seconds. A cooling period of approximately five minutes should be allowed after 40 seconds of booster coil operation. On all other airplanes, the coil may be left on for not longer than 15 minutes at one time.




| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| C1 | 6 | P28 | 20 |
| J1 | 16 | P29 | 20 |
| J2 | 16 | ▲ P50 | 20 |
| J3 | 16 | ▲ P51 | 20 |
| J4 | 16 | ▲ P52 | 20 |
| J5 | 16 | ▲ P53 | 20 |
| J6 | 16 | P54 | 20 |
| J7 | 16 | P55 | 20 |
| J8 | 16 | P56 | 20 |
| J9 | 16 | P66††† | 0 |
| J10 | 16 | P70 | 20 |
| J11 | 16 | P71 | 2 |
| J12 | 16 | Q37 | 20 |
| J13 | 16 | Q38 | 20 |
| J14 | 16 | Q39 | 20 |
| K1 | 0 | Q40 | 20 |
| K3 | 16 | Q41 | 20 |
| K4 | 20 | Q42 | 20 |
| K5 | 20 | Q43 | 20 |
| K6 | 20 | Q44 | 6 |
| K7 | 20 | Q45 | 6 |
| ▲▲ K123 | 20 | | |
| ▲▲ K124 | 20 | | |
| ▲▲ K125 | 20 | | |
| M1●●● | 6 | Q67 | 6 |
| M7●●● | 20 | W1 | 20 |
| N1● | 0 | W11 | 20 |
| N2●● | 0 | W12 | 20 |
| ▲ N31 | 20 | W101 | 20 |
| N47 | 6 | W102 | 20 |
| N58 | 20 | W103 | 20 |
| N64 | 20 | W104 | 20 |
| N65 | 20 | W110 | 20 |
| N110 | 20 | W111 | 20 |
| N111 | 20 | W112 | 20 |
| N112 | 20 | W113 | 20 |
| N113 | 20 | W114 | 20 |
| P3 | 0 | W115 | 20 |
| P4 | 0 | W116 | 20 |
| P5 | 0 | W117 | 20 |
| P6 | 0 | W118 | 20 |
| P26 | 20 | W119 | 20 |
| P27 | 20 | W120 | 20 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 1 | STARTER MOTOR | GFAE | G.E. | 2CM95810 | ENGINE |
| 12 | MOTOR - EMERG FUEL | E.E.M.C. | 7420 | C-338-C | ENGINE COMPARTMENT |
| ▲▲▲29 | STARTER RELAY | G.E. | | CR-2781-C102C-3 | ENGINE COMPARTMENT |
| ▲▲29 | STARTER RELAY | G.E. | | CR-2781-C106C-3 | ENGINE COMPARTMENT |
| 30 | BATTERY RELAY | GFAE | B-14 | 32490 | SUB-COCKPIT |
| 31†† | RELAY | | B-4 | 94-32324 | ENGINE COMPARTMENT |
| 36 | RELAY | E.P.S. | | NB-57-C | MAIN SWITCH BOX |
| 37† | RELAY | LEACH | | 7220-4-24 | ENGINE COMPARTMENT |
| 60 | LIGHT | SEARLE | RED | VM400-2 | SUB-INSTRUMENT PANEL |
| 62 | LIGHT | SEARLE | AMBER | VM400-4 | INSTRUMENT PANEL |
| 75 | LAMP | | CLEAR | AN3121-313 | SUB-INSTRUMENT PANEL |
| 82 | SWITCH | C.H. | | AN3021-3 | MAIN SWITCH BOX |
| ▲▲84 | SWITCH | C.H. | | AN3021-7 | MAIN SWITCH BOX |
| ▲▲▲85 | SWITCH | C.H. | | AN3021-8 | MAIN SWITCH BOX |
| 96 | SWITCH | C.H. | | 8905K728 | L.H. AUXILIARY SWITCH PANEL |
| 97 | SWITCH | G.E. | | CR1070D110C3 | NOSE GEAR |
| 99 | SWITCH - FUEL PRESS. | COOK | | 556-585 | ENGINE COMPARTMENT |
| 118 | CIRCUIT PROTECTOR | SPENCER | | PA-10 | R.H. SUB-COCKPIT JUNCTION BOX |
| 119 | CIRCUIT PROTECTOR | SPENCER | | PA-20 | R.H. SUB-COCKPIT JUNCTION BOX |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| 132 | CIRCUIT PROTECTOR | BURNDY | | FLLH | ENGINE COMPARTMENT |
| 142 | CONNECTOR | | | AN3106-14S-7S | ENGINE COMPARTMENT |
| 152 | CONNECTOR | | | AN3108-18-6S | ENGINE COMPARTMENT |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | R.H. SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | R.H. SUB-COCKPIT |
| 183★ | IGNITION COIL | GFAE | G.E. | 57G710-G1 | ENGINE |
| 311★★ | IGNITION COIL | GFAE | DELCO | 5072360 | ENGINE |
| 312■ | FILTER | GFAE | | B-120 | ENGINE |
| 315■ | FILTER | GFAE | | JX51 | ENGINE |
| 317■ | FILTER | G.E. | | 1C202G2 | ENGINE COMPARTMENT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | R.H. SUB-COCKPIT JUNCTION BOX |
| 333 | TERMINAL PANEL | LOCKHEED | | LS1929-12 | MAIN SWITCH BOX |
| 335 | TERMINAL PANEL | LOCKHEED | | LS1926-19 | R.H. SUB-COCKPIT JUNCTION BOX |
| 336 | TERMINAL PANEL | LOCKHEED | | LS1926-12 | R.H. SUB-COCKPIT JUNCTION BOX |
| 1001♦ | SWITCH | C.H. | | AN3021-1 | MAIN SWITCH BOX |

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*Figure 189 (Sheet 1 of 2 Sheets)—Starter, Ignition, and Emergency Fuel Pump Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*

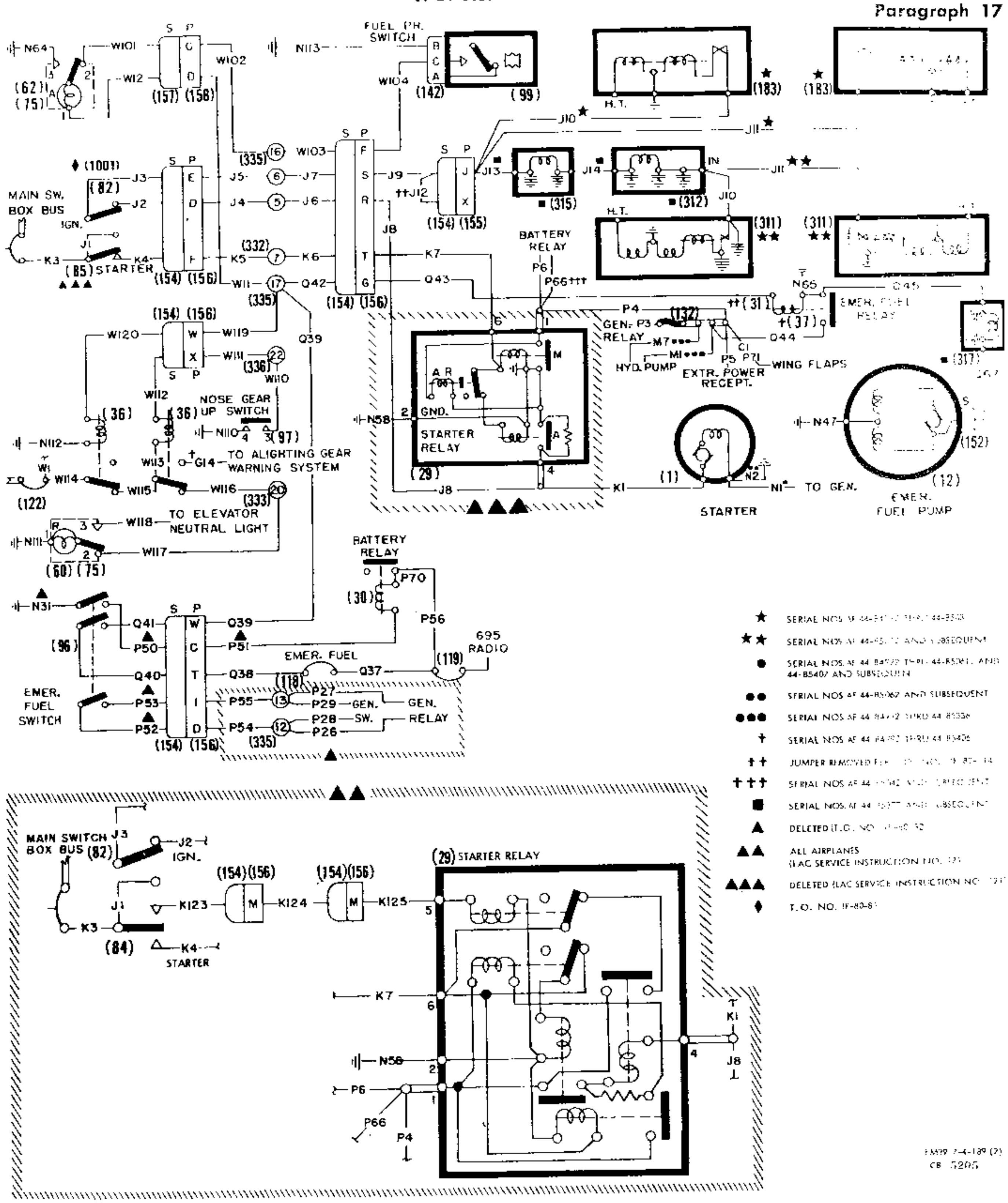
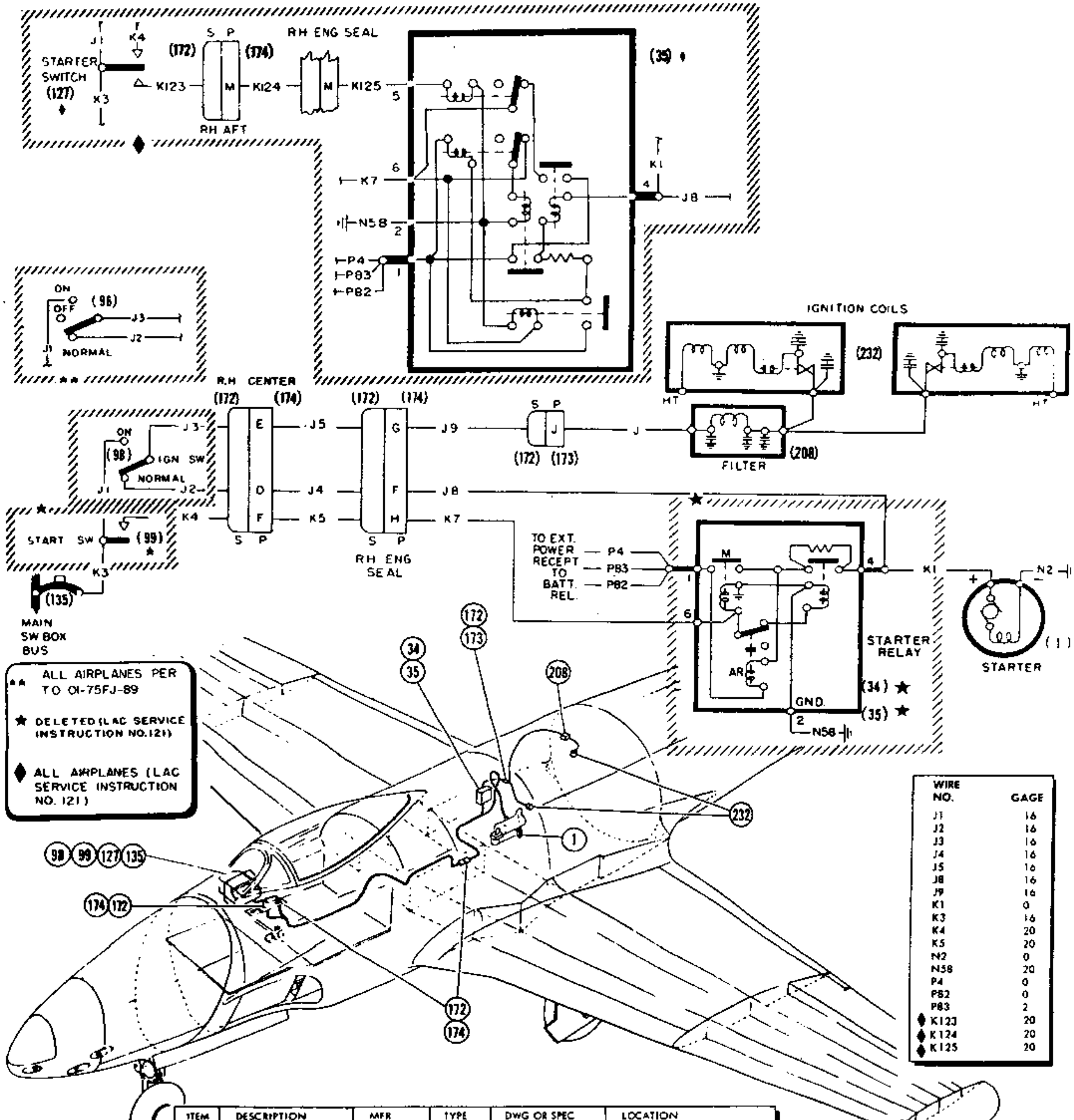



*Figure 189 (Sheet 2 of 2 Sheets) — Starter, Ignition, and Emergency Fuel Pump Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*

(2) SPARK PLUGS.—Spark plugs are used to ignite the fuel in the combustion chambers when starting the engine. Two spark plugs are used, and are mounted on bosses in the air adapters of combustion chambers Nos. 7 and 14. They are porcelain core plugs, and have electrodes long enough to extend into the combustion chambers. The gap between the electrodes should be maintained at from 0.070 to 0.080 inch.




| WIRE NO. | GAGE |
|---|---|
| J1 | 16 |
| J2 | 16 |
| J3 | 16 |
| J4 | 16 |
| J5 | 16 |
| J8 | 16 |
| J9 | 16 |
| K1 | 0 |
| K3 | 16 |
| K4 | 20 |
| K5 | 20 |
| N2 | 0 |
| N58 | 20 |
| P4 | 0 |
| P82 | 0 |
| P83 | 2 |
| ♦ K123 | 20 |
| ♦ K124 | 20 |
| ♦ K125 | 20 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 1 | MOTOR | G F E | | 2CM95B10 | ENGINE |
| ★34 | RELAY | G.E. | | CR27B1C102A3 | ENGINE COMPARTMENT |
| ★35 | RELAY | G.E. | | CR27B1C102C3 | ENGINE COMPARTMENT |
| ♦35 | RELAY | | | CR27B1C106C3 | ENGINE COMPARTMENT |
| ★★96 | SWITCH | | | AN3021-1 | |
| 98 | SWITCH | | | AN3021-3 | MAIN SWITCH BOX |
| ★99 | SWITCH | | | AN3021-8 | MAIN SWITCH BOX |
| ♦127 | SWITCH | | | AN3021-7 | MAIN SWITCH BOX |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 173 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 174 | CONNECTOR | | | AN3102P-28-11P | RH FLOOR COCKPIT |
| 208 | FILTER | POTTER | | B-120 | ENGINE |
| 232 | IGNITION COIL | G F E | | 5072360 | ENGINE |

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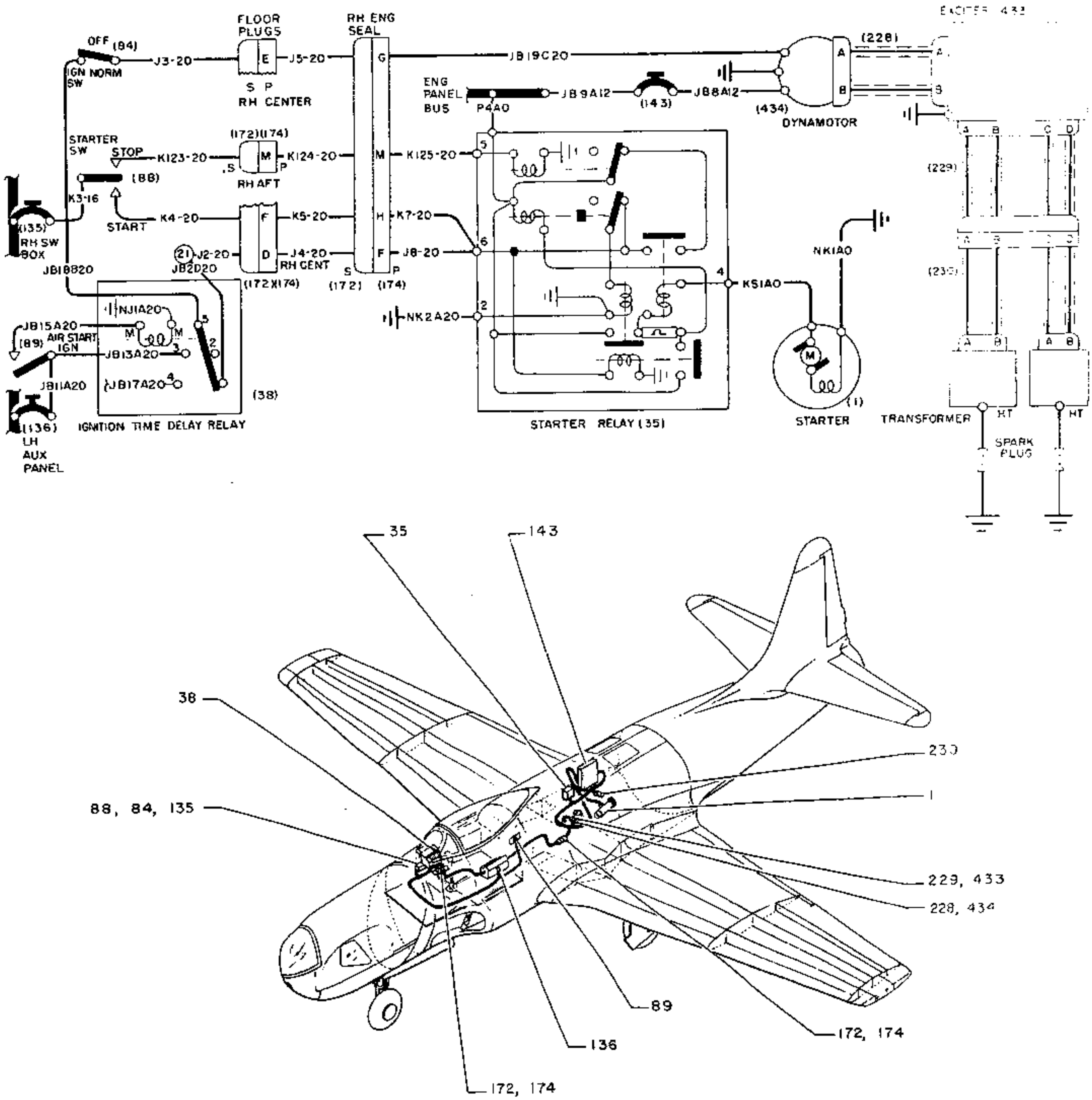
*Figure 189A — Starter and Ignition Circuit, F-80A-10, RF-80A-10 and RF-80A-15 Airplanes*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 1 | STARTER | G.E. | | 2CM95B13 |
| 35 | RELAY | G.E. | | CR2781C106C3 |
| 38 | RELAY | SCINTILLA | | 10-34637-1 |
| 84 | SWITCH | | | AN3021-2 |
| 88 | SWITCH | | | AN3021-7 |
| 89 | SWITCH | | | AN3021-8 |
| 135 | CIRCUIT PROTECTOR | | | AN3161-P10 |
| 136 | CIRCUIT PROTECTOR | | | AN3161-P15 |
| 143 | CIRCUIT PROTECTOR | | | AN3161-P35 |
| 172 | CONNECTOR | | | AN3106-28-11S |
| 174 | CONNECTOR | | | AN3102P-28-11P |
| 228 | HARNESS | SCINTILLA | | 10-54427-1 |
| 229 | HARNESS | SCINTILLA | | 10-54426-1 |
| 230 | HARNESS | SCINTILLA | | 10-53302-1 |
| 433 | EXCITER | SCINTILLA | | 10-55440-1 |
| 434 | DYNAMOTOR | SCINTILLA | | 10-55460-1 |

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*Figure 189B — Starter and Ignition Circuit, RF-80A-20 and RF-80A-25 Airplanes*

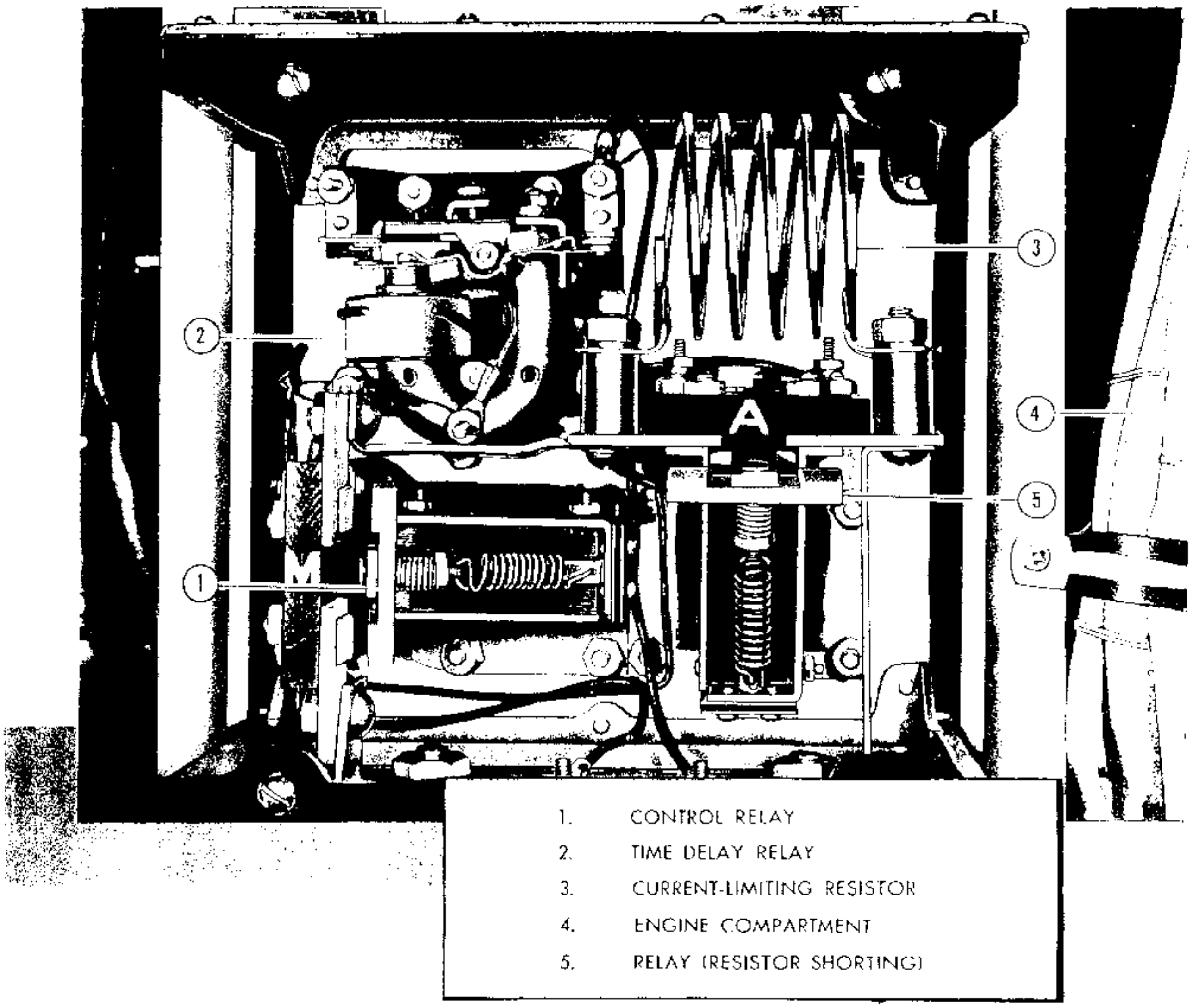



*Figure 190 — Starter Relay Panel*

(3) ADJUSTMENT.—Adjust ignition coil so that primary coil takes 1.8 amperes at 24 volts.

*f.* FUEL SYSTEM CIRCUIT.

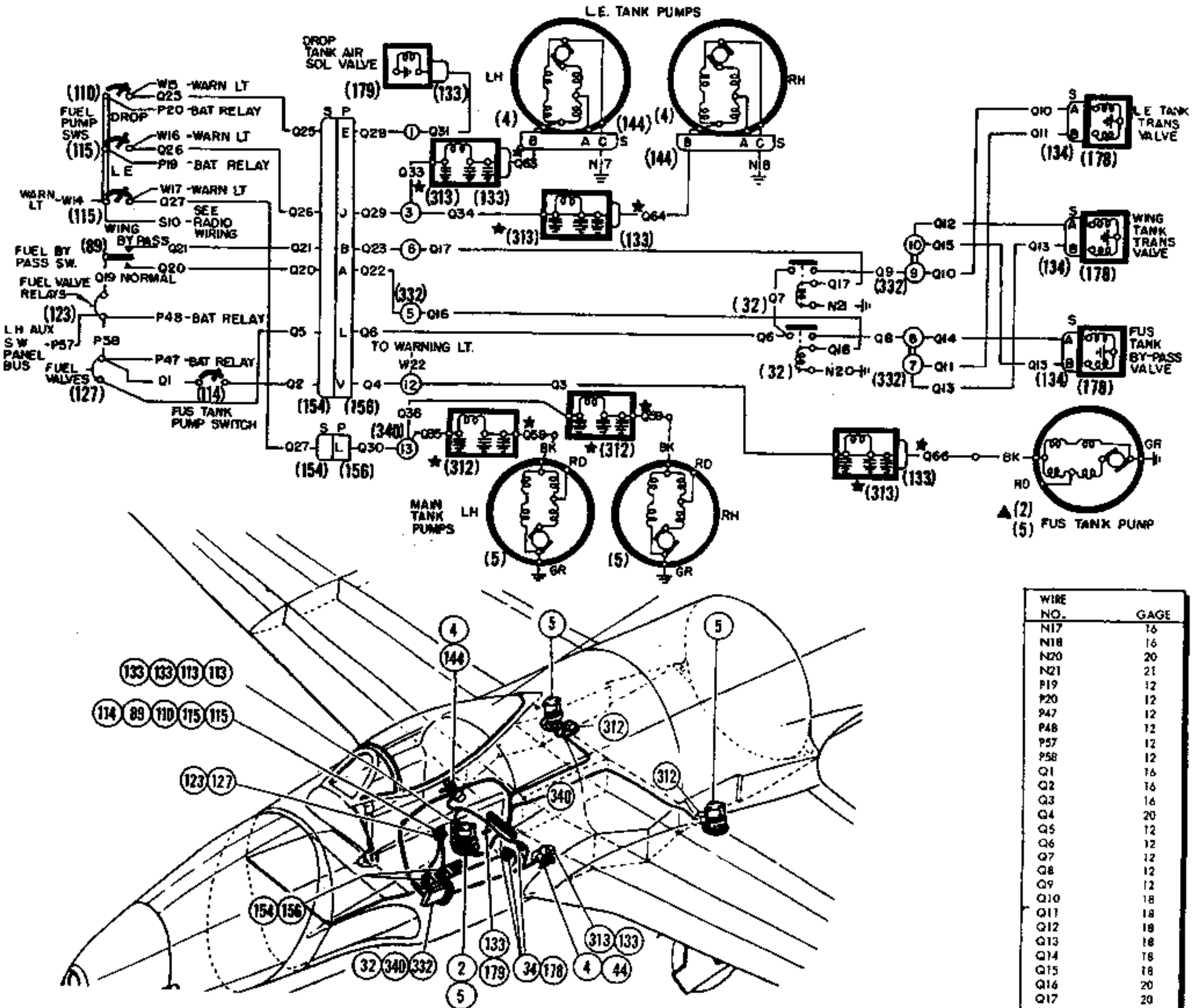
*(See figures 191, 192, 192A, 192B, 192C, and 192D.)*

(1) GENERAL.—The flow of fuel from the droppable tanks, wing leading edge tanks, and wing inboard tanks to the fuselage tank is controlled electrically from the fuel system switch panel on the left side of the cockpit. (See figure 101 for fuel system units location diagram. See figure 100 for fuel system schematic diagram.)

A solenoid shut-off valve controls the air pressure to the droppable tanks, which in turn controls the flow of fuel to the fuselage tank. On early airplanes the valve is operated by a 5-ampere switch-type circuit breaker. On later airplanes the air valve is controlled by a two-position toggle switch, and the circuit is protected by a 5-ampere push-to-reset circuit protector. The shut-off valve is inserted in the air pressure line upstream of the tank pressure regulators, and controls the pressure to both tanks.

The wing leading edge tanks employ electrically driven fuel booster pumps to transfer fuel into the fuselage tank. Both pumps, on all except winterized P-80A-10 airplanes, are operated simultaneously by a 35-ampere switch type circuit breaker. The pumps are mounted outside the tank at the wing-fuselage junction. (See fig. 103.)

On winterized P-80A-10 airplanes the left leading-edge tank may be filled with gasoline for cold weather starting. A special switch marked "LH LE TANK" is mounted on the cockpit left switch panel adjacent to the engine control lever. When placed in "GASOLINE" position, this switch energizes the transfer valves to bypass the fuselage tank, turns on the left leading-edge tank pump, and lights an amber warning light. The trans-




| WIRE NO. | GAGE |
|---|---|
| N17 | 16 |
| N18 | 16 |
| N20 | 20 |
| N21 | 21 |
| P19 | 12 |
| P20 | 12 |
| P47 | 12 |
| P48 | 12 |
| P57 | 12 |
| P58 | 12 |
| Q1 | 16 |
| Q2 | 16 |
| Q3 | 16 |
| Q4 | 20 |
| Q5 | 12 |
| Q6 | 12 |
| Q7 | 12 |
| Q8 | 12 |
| Q9 | 12 |
| Q10 | 18 |
| Q11 | 18 |
| Q12 | 18 |
| Q13 | 18 |
| Q14 | 18 |
| Q15 | 18 |
| Q16 | 20 |
| Q17 | 20 |
| Q19 | 20 |
| Q20 | 20 |
| Q21 | 20 |
| Q22 | 20 |
| Q23 | 20 |
| Q25 | 18 |
| Q26 | 12 |
| Q27 | 12 |
| Q28 | 18 |
| Q29 | 12 |
| Q30 | 12 |
| Q31 | 18 |
| Q33 | 16 |
| Q34 | 16 |
| Q35 | 16 |
| Q36 | 16 |
| ★Q58 | 16 |
| ★Q59 | 16 |
| ★Q63 | 16 |
| ★Q64 | 16 |
| ★Q66 | 16 |
| S10 | 16 |
| W14 | 20 |
| W15 | 20 |
| W16 | 20 |
| W17 | 20 |
| W22 | 20 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| ▲ 2 | FUEL PUMP MOTOR | PESCO | B-18A | 121071-010-01 | SUB-COCKPIT |
| 4 | FUEL PUMP MOTOR | NASH | B7B | B-7007<br>B-7166-16A | HYDRAULIC COMPARTMENT |
| 5 | FUEL PUMP MOTOR | NASH | B19 | B-7166-16E | WING |
| 32 | RELAY | | B-5 | 94-32351 | LH SUB-COCKPIT |
| 89 | SWITCH | C. H. | | AN3022-7 | LH SHELF |
| 110 | CIRCUIT BREAKER | | | AN3160-5 | LH SHELF |
| 114 | CIRCUIT BREAKER | | | AN3161P25 | LH SHELF |
| 115 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH SHELF |
| 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | LH SHELF |
| 127 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | LH SHELF |
| 133 | CONNECTOR | | | AN3106-10S-2S | HYDRAULIC COMPARTMENT |
| 134 | CONNECTOR | | | AN3106-12S-3S | HYDRAULIC COMPARTMENT |
| 144 | CONNECTOR | | | AN3106-16S-5S | HYDRAULIC COMPARTMENT |
| 154 | CONNECTOR | | | AN3106-28-11S | SUB-COCKPIT |
| 156 | CONNECTOR | CANNON | | 2312-41 | SUB-COCKPIT |
| 178 | SOLENOID VALVE | GEN. CONT. | | 40R239A | HYDRAULIC COMPARTMENT |
| 179 | SOLENOID VALVE | GEN. CONT. | | 40R686 | HYDRAULIC COMPARTMENT |
| ★312 | FILTER | POTTER | | B-120 | WING |
| ★313 | FILTER | PESCO | | 22-2013 | HYDRAULIC COMPARTMENT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | LH SUB-COCKPIT JUNCTION BOX |
| 340 | TERMINAL PANEL | LOCKHEED | | LS1909-12 | LH SUB-COCKPIT JUNCTION BOX |

★ SERIAL NOS. AF 44-85377 AND SUBSEQUENT - FIGHTER AIRPLANES ONLY

▲ T.O. NO. 1F-80-64

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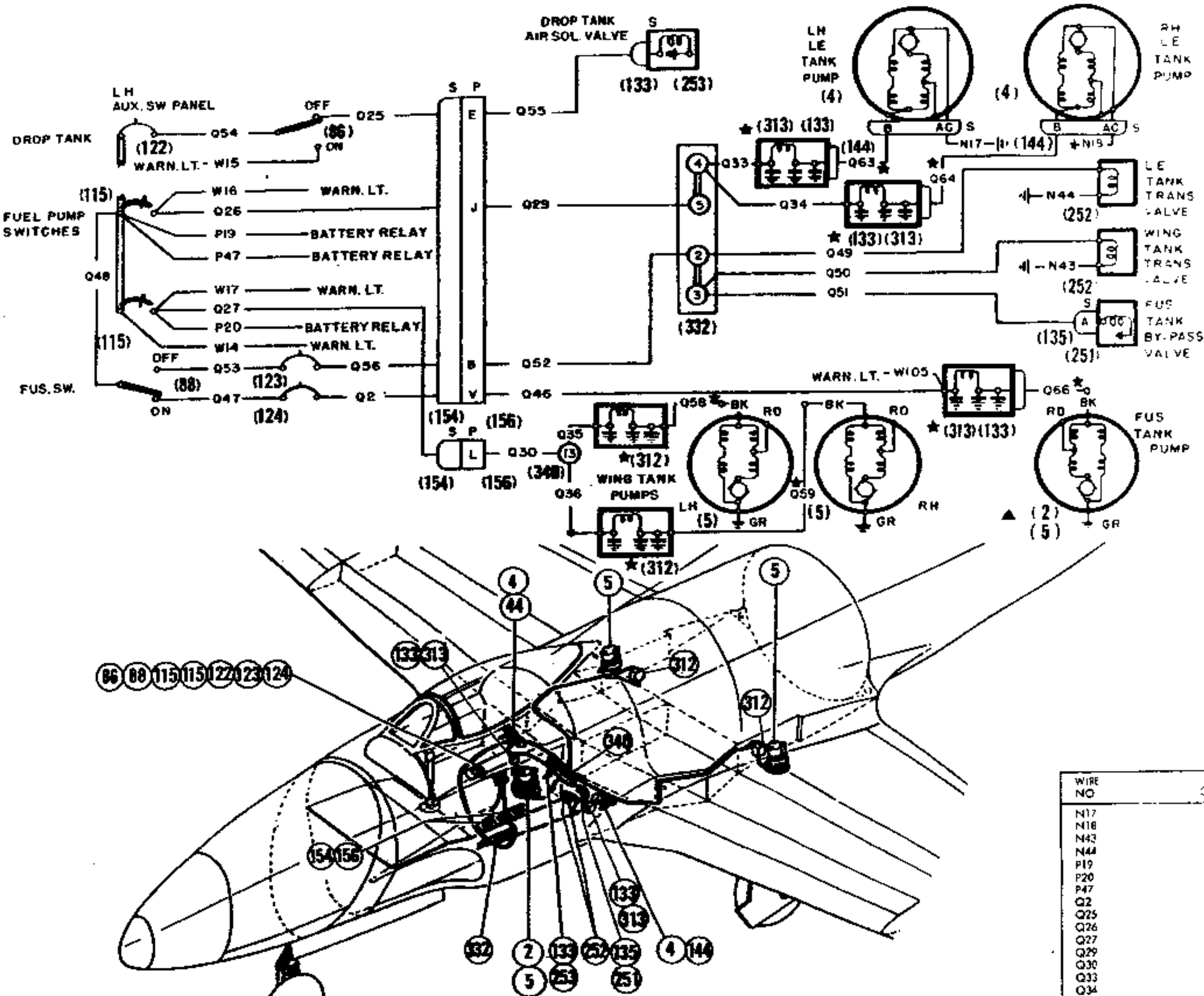
*Figure 191 — Fuel Pumps Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes, Serial Nos. AF44-84992 through AF44-85466*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| ▲ 2 | FUEL PUMP | PESCO | B-18A | 121071-010-01 | SUB-COCKPIT |
| 4 | FUEL PUMP MOTOR | NASH | B78 | B-7007<br>B-7166-16A | HYDRAULIC COMPARTMENT |
| 5 | FUEL PUMP MOTOR | NASH | B19 | B-7166-16E | WING |
| 32 | RELAY | | B-5 | 94-32351 | LH SUB-COCKPIT |
| 89 | SWITCH | C.H. | | AN3022-7 | LH SHELF |
| 110 | CIRCUIT BREAKER | | | AN3160-5 | LH SHELF |
| 115 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH SHELF |
| 124 | CIRCUIT BREAKER | | | AN3161P25 | LH SHELF |
| 127 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | LH SHELF |
| 133 | CONNECTOR | | | AN3106-10S-2S | HYDRAULIC COMPARTMENT |
| 134 | CONNECTOR | | | AN3106-12S-3S | HYDRAULIC COMPARTMENT |
| 144 | CONNECTOR | | | AN3106-16S-5S | HYDRAULIC COMPARTMENT |
| 154 | CONNECTOR | | | AN3106-28-11S | SUB-COCKPIT |
| 156 | CONNECTOR | CANNON | | 2312-41 | SUB-COCKPIT |
| 178 | SOLENOID VALVE | GEN CONT | | 40E239A | HYDRAULIC COMPARTMENT |
| 179 | SOLENOID VALVE | GEN CONT | | 40E686 | HYDRAULIC COMPARTMENT |
| ★ 312 | FILTER | POTTER | | B-120 | WING |
| ★ 313 | FILTER | PESCO | | 22-2013 | HYDRAULIC COMPARTMENT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | LH SUB-COCKPIT JUNCTION BOX |
| 340 | TERMINAL PANEL | LOCKHEED | | LS1909-12 | LH SUB-COCKPIT JUNCTION BOX |

| WIRE NO | GAGE |
|---|---|
| N17 | 16 |
| N18 | 16 |
| N43 | 18 |
| N44 | 18 |
| P19 | 12 |
| P20 | 12 |
| P47 | 12 |
| Q2 | 16 |
| Q25 | 18 |
| Q26 | 12 |
| Q27 | 12 |
| Q29 | 12 |
| Q30 | 12 |
| Q33 | 16 |
| Q34 | 16 |
| Q35 | 16 |
| Q36 | 16 |
| Q46 | 16 |
| Q47 | 16 |
| Q48 | |
| Q49 | 18 |
| Q50 | 18 |
| Q51 | 18 |
| Q52 | 18 |
| Q53 | 18 |
| Q54 | 18 |
| Q55 | 18 |
| Q56 | 18 |
| Q58 ★ | 16 |
| Q59 ★ | 16 |
| Q63 ★ | 16 |
| Q64 ★ | 16 |
| Q66 ★ | 16 |
| W14 | 20 |
| W15 | 20 |
| W16 | 20 |
| W17 | 20 |
| W105 | 20 |

★ USED ON FIGHTER AIRPLANES ONLY

▲ T.O. NO. IF-80-64

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EM39-7-4-192

*Figure 192 — Fuel Pumps Circuit, F-80A-5 and RF-80A-5 Airplanes, Serial Nos. AF44-85467 and Subsequent*

fer valves are still protected by the transfer-valve circuit protector, and by a 15-ampere push-to-reset circuit protector between the gasoline starting switch and the bus. The left leading-edge-tank pump circuit is protected by the 15-ampere push-to-reset circuit protector between the gasoline starting switch and the bus. Before stopping the engine when ambient temperature is expected to reach —17.8° C (0° F) or lower, turn the left leading-edge-tank switch to "GASOLINE" and turn all other fuel switches off. Idle the engine for two minutes, switching emergency fuel pump on for the last 15 seconds to fill the lines with gasoline for the next start.

**Note**

When starting the engine with gasoline, all fuel switches, other than the left leading-edge-tank switch should be "OFF."

The wing inboard tanks are provided with electrically driven fuel booster pumps mounted inside the aft inboard tanks. (See figure 104.) These pumps transfer fuel from the inboard tanks to fuselage tank. Both pumps are operated simultaneously by a single 35-ampere switch type circuit breaker.

The fuselage fuel tank booster pump is controlled by a 25-ampere circuit breaker and the bypass and transfer valves circuit is controlled by a three-position switch with a 15-ampere push-to-reset circuit protector. During normal operation, fuel is supplied to the fuselage tank by the wing tanks through the transfer valves and fuselage tank float valves. The fuselage tank booster pump delivers fuel to the engine fuel system.

The fuel flow from the leading edge tanks and the wing outboard tanks is controlled further by solenoid shut-off transfer valves. Two valves are used, one for the two leading edge tanks, and another for the four inboard tanks. The valves are installed in the fuel system upstream of their respective fuselage tank float valves. The solenoid valves are wired in parallel, and are controlled by the bypass switch, located on the cockpit left shelf. (See figure 246, sheets 1 and 2.) An additional solenoid bypass valve is installed to allow fuel from the leading edge and inboard tanks to be bypassed around the fuselage tank. This valve is wired in parallel with the transfer valves, but in such a way that the bypass valve is open when the transfer valves are closed and closed when the transfer valves are open.

On early airplanes the bypass and transfer valves are operated by a separate bypass switch which has three positions, "BYPASS," "NORMAL," and "OFF." The "BYPASS" and "NORMAL" positions are momentary contacts. When it becomes necessary to bypass fuel, the fuselage tank booster pump switch is turned off, and the bypass switch is held in the "BYPASS" position for two seconds. This opens the bypass valve in the fuselage tank bypass line, and closes the transfer valves to the fuselage tank. To return the valves to their normal position, the switch is held in "NORMAL" for two seconds. The fuel from the droppable tanks cannot be bypassed around the fuselage tank.

On later airplanes there is no separate bypass switch. The fuselage tank bypass and transfer valves are operated by the three-position fuselage tank pump switch. (See figure 193.) With the switch on, the fuselage tank pump is on, the transfer valves are open, and the bypass valve is closed. With the fuselage tank switch in "BYPASS" position, the bypass and transfer valve circuit is energized, closing the transfer valves and opening the bypass valve. In the "OFF" position, the transfer valves are open and the bypass valve is closed. The fuselage tank pump and its warning light are off.

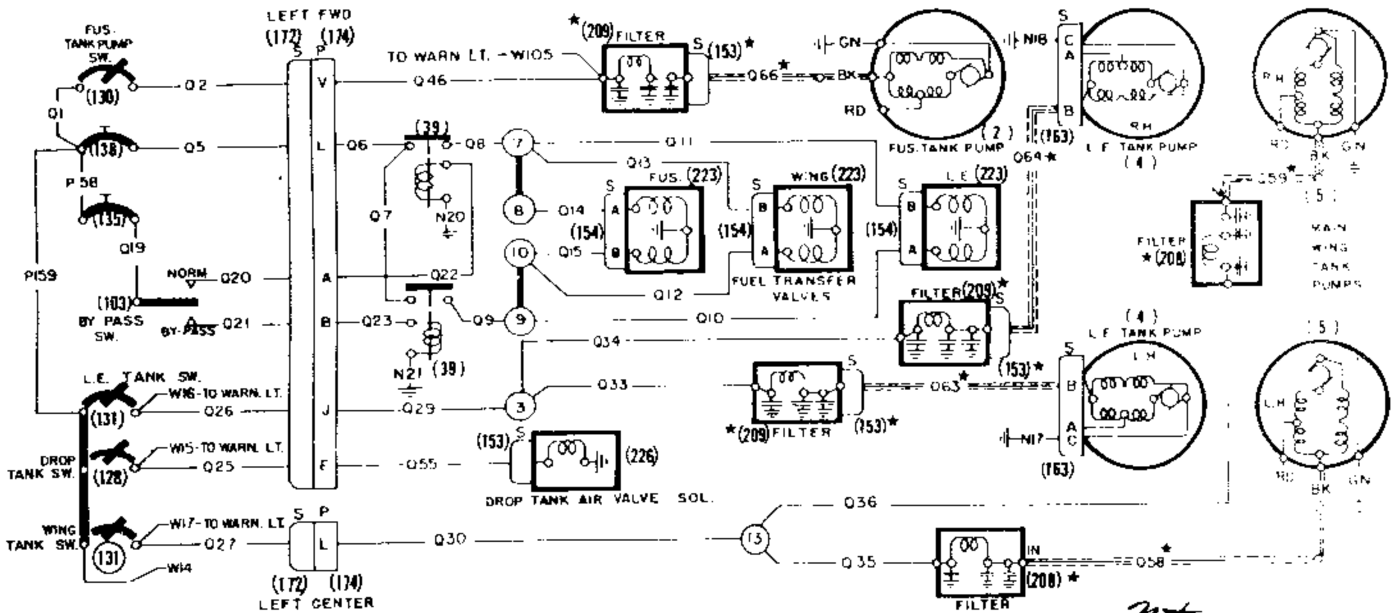
An amber indicator light directly above the fuselarge tank booster pump switch glows during normal operation of the booster pump.

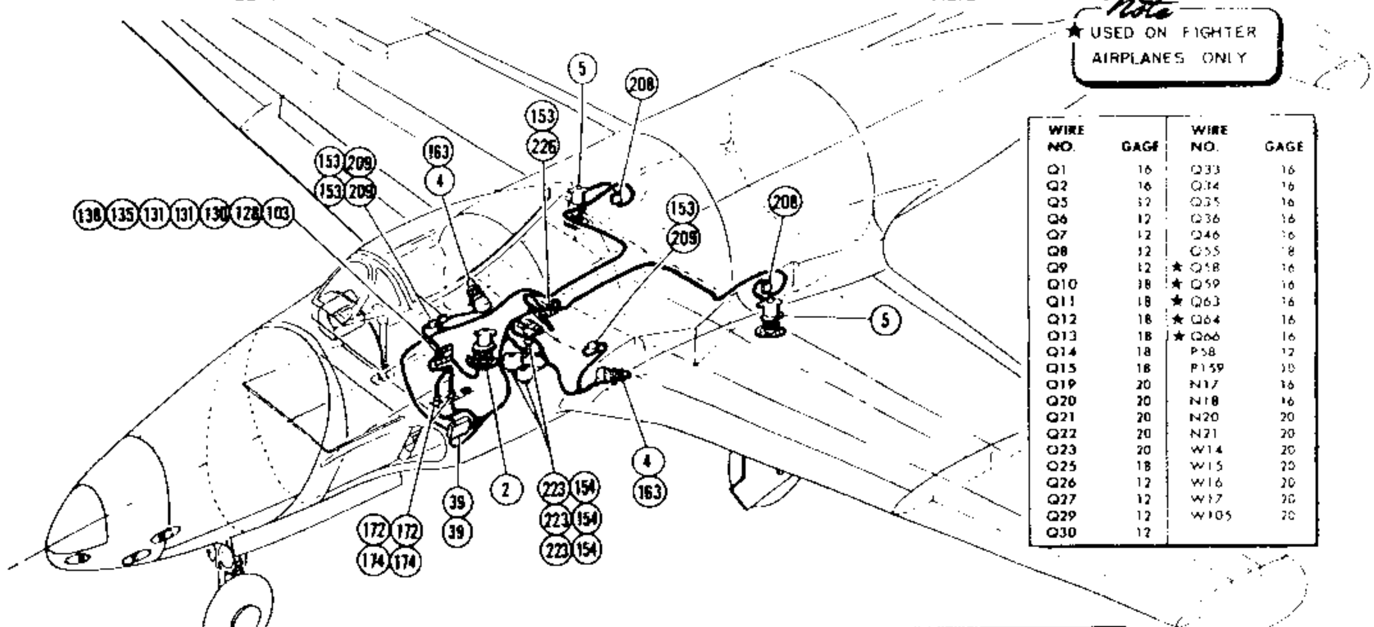
(2) FUEL PUMPS.—The fuel pumps are driven by 24-volt, direct-current, series wound motors. For further information on the pumps, see paragraph 13*b*(8), this section.

(3) TRANSFER AND BYPASS VALVES. *(See figures 114, 115, and 116.)*—The three solenoid valves are located in the fuselage mid-section hydraulic compartment. On early airplanes the transfer valves are operated to the open position, and the bypass valve is operated to the closed position by solenoid action, and are latched in place until solenoid action trips the latch. Continued application of electric power is not required to hold the valve in either position. On later airplanes the transfer valves are normally open, and the bypass valve is normally closed. Continued application of electric power is necessary to hold the transfer valves closed and the bypass valve open. For further information on the operation of the valves, see paragraphs 13*b*(12) and (13), this section.

(4) DROPPABLE TANK AIR VALVE. *(See figure 257.)*

*(a)* DESCRIPTION. — The droppable tank air shut-off valve is in the hydraulic compartment. The valve is solenoid operated through a switch type circuit breaker, and remains open when system voltage is maintained across the terminals. The valve closes when the switch is turned off. On later airplanes the valve is normally open, and closes when system voltage is maintained across the terminals.

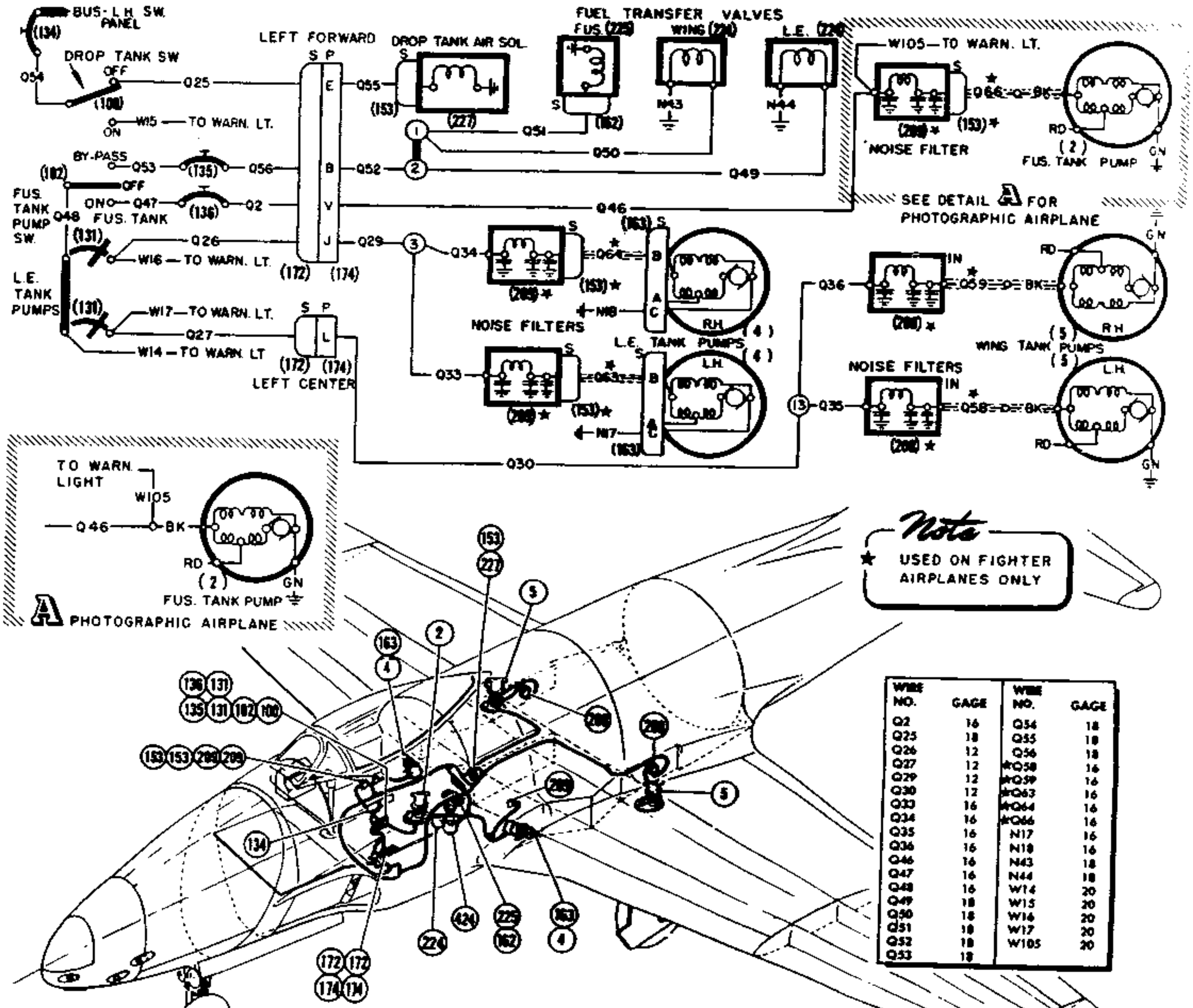



| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| Q1 | 16 | Q33 | 16 |
| Q2 | 16 | Q34 | 16 |
| Q5 | 12 | Q35 | 16 |
| Q6 | 12 | Q36 | 16 |
| Q7 | 12 | Q46 | 16 |
| Q8 | 12 | Q55 | 18 |
| Q9 | 12 | ★ Q58 | 16 |
| Q10 | 18 | ★ Q59 | 16 |
| Q11 | 18 | ★ Q63 | 16 |
| Q12 | 18 | ★ Q64 | 16 |
| Q13 | 18 | ★ Q66 | 16 |
| Q14 | 18 | P58 | 12 |
| Q15 | 18 | P159 | 10 |
| Q19 | 20 | N17 | 16 |
| Q20 | 20 | N18 | 16 |
| Q21 | 20 | N20 | 20 |
| Q22 | 20 | N21 | 20 |
| Q23 | 20 | W14 | 20 |
| Q25 | 18 | W15 | 20 |
| Q26 | 12 | W16 | 20 |
| Q27 | 12 | W17 | 20 |
| Q29 | 12 | W105 | 20 |
| Q30 | 12 | | |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 2 | FUEL PUMP | PESCO | B-18A | 2E-781-8 | SUB-COCKPIT |
| 4 | FUEL PUMP | NASH | 878 | 87007 | SUB-COCKPIT |
| 5 | FUEL PUMP | PESCO | B-19 | 2E-781-A | WING |
| 39 | RELAY | | B-5 | AN3370-1 | LH SUB-COCKPIT JUNC BOX |
| 103 | SWITCH | | | AN3022 7 | LH SHELF |
| 128 | CIRCUIT BREAKER | | | AN3160 5 | LH SHELF |
| 130 | CIRCUIT BREAKER | | | AN3161P25 | LH SHELF |
| 131 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM 10 | LH SHELF |
| 138 | CIRCUIT PROTECTOR | SPENCER | | PSM 35 | LH SHELF |
| 153 | CONNECTOR | | | AN3106-10S 2S | SUB-COCKPIT |
| 154 | CONNECTOR | | | AN3106-12S-3S | SUB-COCKPIT |
| 163 | CONNECTOR | | | AN3106-16S-5S | SUB-COCKPIT |
| 172 | CONNECTOR | | | AN3106-28-11S | LH FLOOR |
| 174 | CONNECTOR | | | AN3102P-28-11P | LH FLOOR |
| ★208 | FILTER | POTTER | | B 120 | WING |
| ★209 | FILTER | POTTER | | B-135 | SUB-COCKPIT |
| 223 | SOLENOID VALVE | GEN. CONT | | 40R239A | SUB COCKPIT |
| 226 | SOLENOID VALVE | GEN. CONT. | | 40R686 | SUB-COCKPIT |

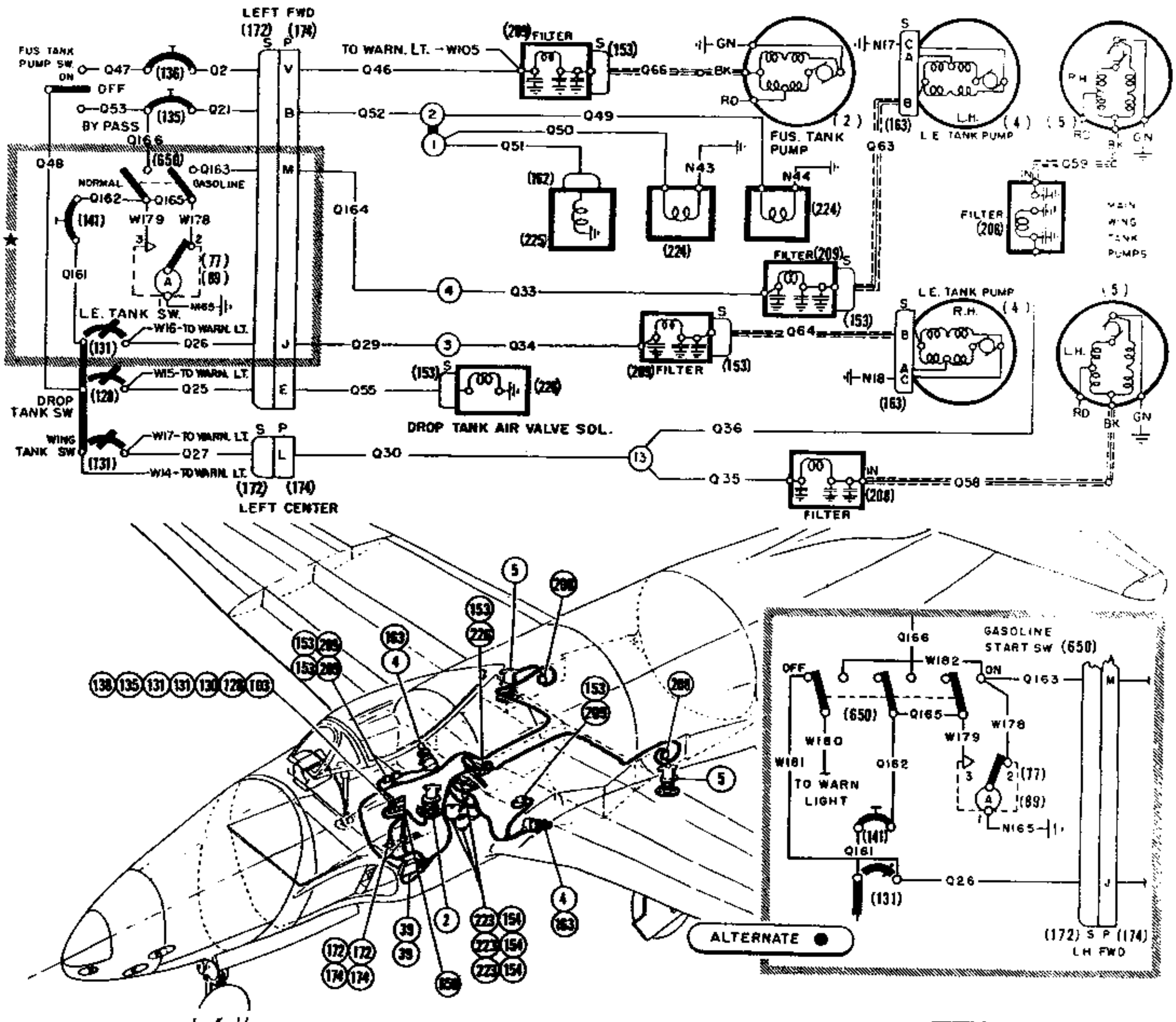
*Figure 192A — Fuel Pumps Circuit, P-80A-10 and FP-80A-10 Airplanes, Serial Nos. AF44-84992 through 44-85466*




| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| Q2 | 16 | Q54 | 18 |
| Q25 | 18 | Q55 | 18 |
| Q26 | 12 | Q56 | 18 |
| Q27 | 12 | ★Q58 | 16 |
| Q29 | 12 | ★Q59 | 16 |
| Q30 | 12 | ★Q63 | 16 |
| Q33 | 16 | ★Q64 | 16 |
| Q34 | 16 | ★Q66 | 16 |
| Q35 | 16 | N17 | 16 |
| Q36 | 16 | N18 | 16 |
| Q46 | 16 | N43 | 18 |
| Q47 | 16 | N44 | 18 |
| Q48 | 16 | W14 | 20 |
| Q49 | 18 | W15 | 20 |
| Q50 | 18 | W16 | 20 |
| Q51 | 18 | W17 | 20 |
| Q52 | 18 | W105 | 20 |
| Q53 | 18 | | |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 2 | FUEL PUMP | PESCO | B-12A | 2E781-B | SUB-COCKPIT |
| 4 | FUEL PUMP | NASH | 878 | 8-7007 | SUB-COCKPIT |
| 5 | FUEL PUMP | PESCO | B-19 | 2E781-A | WING |
| 100 | SWITCH | | | AN3022-3 | LH SHELF |
| 102 | SWITCH | | | AN3022-1 | LH SHELF |
| 131 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | LH AUX SWITCH PANEL |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH SHELF |
| 136 | CIRCUIT PROTECTOR | | | AN3161P25 | LH SHELF |
| 153 | CONNECTOR | | | AN3106-10S-2S | SUB-COCKPIT |
| 162 | CONNECTOR | | | AN3106-16S-3S | SUB-COCKPIT |
| 163 | CONNECTOR | | | AN3106-16S-5S | SUB-COCKPIT |
| 172 | CONNECTOR | | | AN3106-28-11S | LH FLOOR |
| 174 | CONNECTOR | | | AN3102P-28-11P | LH FLOOR |
| ★208 | FILTER | POTTER | | B-120 | WING |
| ★209 | FILTER | PESCO | | 22-2013 | HYDRAULIC COMP'T. |
| 224 | SOLENOID VALVE | SAVAL | | 5120 | SUB-COCKPIT |
| 225 | SOLENOID VALVE | GEN. CONT. | | 408733 | SUB-COCKPIT |
| 227 | SOLENOID VALVE | GEN. CONT. | | 408721 | SUB-COCKPIT |

*Figure 192B — Fuel Pumps Circuit, P-80A-10 and FP-80A-10 Airplanes, Serial Nos. AF44-85467 and Subsequent*




| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 2 | FUEL PUMP | PESCO | B-19 | 2E-781-B | SUB-COCKPIT |
| 4 | FUEL PUMP | NASH | B7B | B7007 | SUB-COCKPIT |
| 5 | FUEL PUMP | PESCO | B-19 | 2E-781-A | WING |
| 39 | RELAY | | B-5 | AN3370-1 | LH SUB-COCKPIT JUNC BOX |
| 77 | LIGHT | | AMBER | AN3157-A | LH SHELF |
| 89 | LAMP | | | AN3121-313 | LH SHELF |
| 103 | SWITCH | | | AN3022-7 | LH SHELF |
| 128 | CIRCUIT BREAKER | | | AN3160-5 | LH SHELF |
| 130 | CIRCUIT BREAKER | | | AN3160-25 | LH SHELF |
| 131 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH SHELF |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM15 | |
| 138 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | LH SHELF |
| 153 | CONNECTOR | | | AN3106-10S-2S | SUB-COCKPIT |
| 154 | CONNECTOR | | | AN3106-12S-3S | SUB-COCKPIT |
| 162 | CONNECTOR | | | AN3106-16S-6S | SUB-COCKPIT |
| 172 | CONNECTOR | | | AN3106-28-11S | LH FLOOR |
| 174 | CONNECTOR | | | AN3102P-28-11P | LH FLOOR |
| 208 | FILTER | POTTER | | B-120 | WING |
| 209 | FILTER | POTTER | | B-135 | SUB-COCKPIT |
| 224 | SOLENOID VALVE | SAVAL | | 5120 | SUB-COCKPIT |
| 225 | SOLENOID VALVE | GEN. CONT. | | 40R733 | SUB-COCKPIT |
| 226 | SOLENOID VALVE | GEN. CONT. | | 40R686 | SUB-COCKPIT |
| ★ 650 | SWITCH | | | AN3226 | LH SHELF |
| ● 650 | SWITCH | | | AN3226 | LH SHELF |

| WIRE NO. | GAGE | WIRE NO | GAGE |
|---|---|---|---|
| N43 | 18 | Q58 | 16 |
| N44 | 16 | Q59 | 16 |
| Q2 | 16 | Q63 | 16 |
| Q14 | 18 | Q64 | 16 |
| Q15 | 18 | Q66 | 16 |
| Q21 | 20 | Q161 | 16 |
| Q25 | 18 | Q162 | 16 |
| Q26 | 12 | Q163 | 16 |
| Q27 | 12 | Q164 | 16 |
| Q29 | 12 | Q166 | 18 |
| Q30 | 12 | N17 | 16 |
| Q33 | 16 | N18 | 16 |
| Q34 | 16 | N20 | 20 |
| Q35 | 16 | N21 | 20 |
| Q36 | 16 | W14 | 20 |
| Q46 | 16 | W15 | 20 |
| Q47 | 16 | W16 | 20 |
| Q48 | 16 | W17 | 20 |
| Q49 | 18 | W105 | 20 |
| Q50 | 18 | W178 | 20 |
| Q51 | 18 | W179 | 20 |
| Q52 | 18 | W180 | 20 |
| Q53 | 18 | W181 | 20 |
| Q55 | 18 | W182 | 20 |

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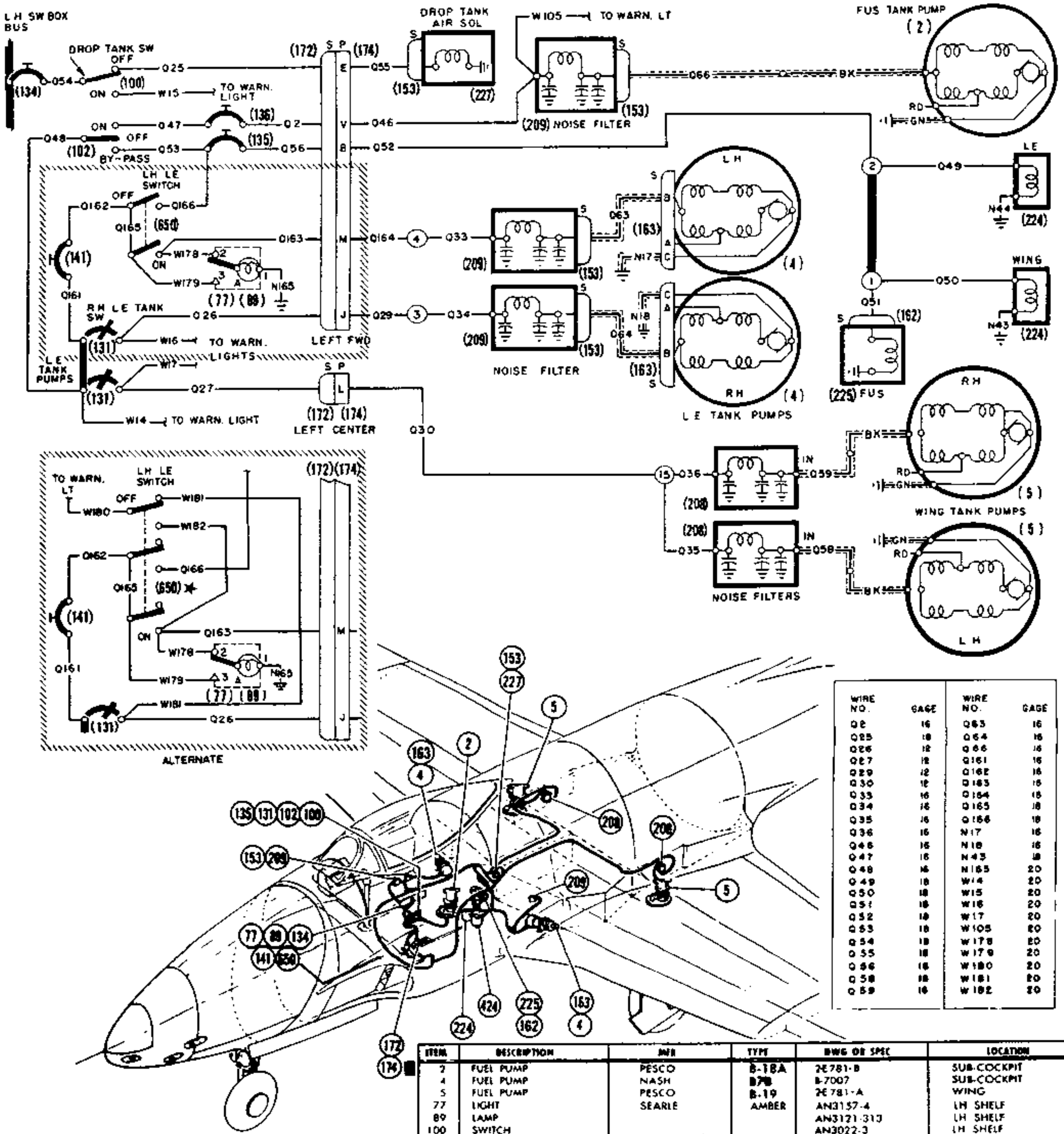
*Figure 192C — Fuel Pumps Circuit, Winterized F-80A-10 Airplanes*




| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| Q2 | 16 | Q63 | 16 |
| Q25 | 18 | Q64 | 16 |
| Q26 | 12 | Q66 | 16 |
| Q27 | 12 | Q161 | 16 |
| Q29 | 12 | Q162 | 16 |
| Q30 | 12 | Q163 | 16 |
| Q33 | 16 | Q164 | 16 |
| Q34 | 16 | Q165 | 18 |
| Q35 | 16 | Q166 | 18 |
| Q36 | 16 | N17 | 16 |
| Q46 | 16 | N18 | 16 |
| Q47 | 16 | N43 | 18 |
| Q48 | 16 | N165 | 20 |
| Q49 | 18 | W14 | 20 |
| Q50 | 18 | W15 | 20 |
| Q51 | 18 | W16 | 20 |
| Q52 | 18 | W17 | 20 |
| Q53 | 18 | W105 | 20 |
| Q54 | 18 | W178 | 20 |
| Q55 | 18 | W179 | 20 |
| Q56 | 16 | W180 | 20 |
| Q58 | 18 | W181 | 20 |
| Q59 | 16 | W182 | 20 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 2 | FUEL PUMP | PESCO | B-18A | 2E781-B | SUB-COCKPIT |
| 4 | FUEL PUMP | NASH | B78 | B-7007 | SUB-COCKPIT |
| 5 | FUEL PUMP | PESCO | B-19 | 2E781-A | WING |
| 77 | LIGHT | SEARLE | AMBER | AN3157-4 | LH SHELF |
| 89 | LAMP | | | AN3121-313 | LH SHELF |
| 100 | SWITCH | | | AN3022-3 | LH SHELF |
| 102 | SWITCH | | | AN3022-1 | LH SHELF |
| 131 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM 5 | LH AUX SWITCH PANEL |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH SHELF |
| 136 | CIRCUIT BREAKER | SPENCER | | AN3161P25 | LH SHELF |
| 141 | CIRCUIT PROTECTOR | | | AN3161-P15 | LH SHELF |
| 153 | CONNECTOR | | | AN3106-10S-2S | SUB COCKPIT |
| 162 | CONNECTOR | | | AN3106-16S-3S | SUB-COCKPIT |
| 163 | CONNECTOR | | | AN3106-16S-5S | SUB-COCKPIT |
| 172 | CONNECTOR | | | AN3106-28-11S | LH FLOOR |
| 174 | CONNECTOR | | | AN3102P-28-11P | LH FLOOR |
| 208 | FILTER | POTTER | | B-120 | WING |
| 209 | FILTER | PESCO | | 22-2013 | HYDRAULIC COMP'T. |
| 224 | SOLENOID VALVE | SAVAL | | 5120 | SUB-COCKPIT |
| 225 | SOLENOID VALVE | GEN CONT. | | 40R733 | SUB-COCKPIT |
| 227 | SOLENOID VALVE | GEN CONT. | | 40R721 | SUB-COCKPIT |
| 650 | SWITCH | | | AN3027-2 | LH SHELF |
| ★650 | SWITCH | | | AN3226-3 | LH SHELF |

*Figure 192D — Fuel Pumps Circuit, P-80A-10 Airplanes, Serial Nos. AF44-85467 and Subsequent*



Revised 14 July 1950

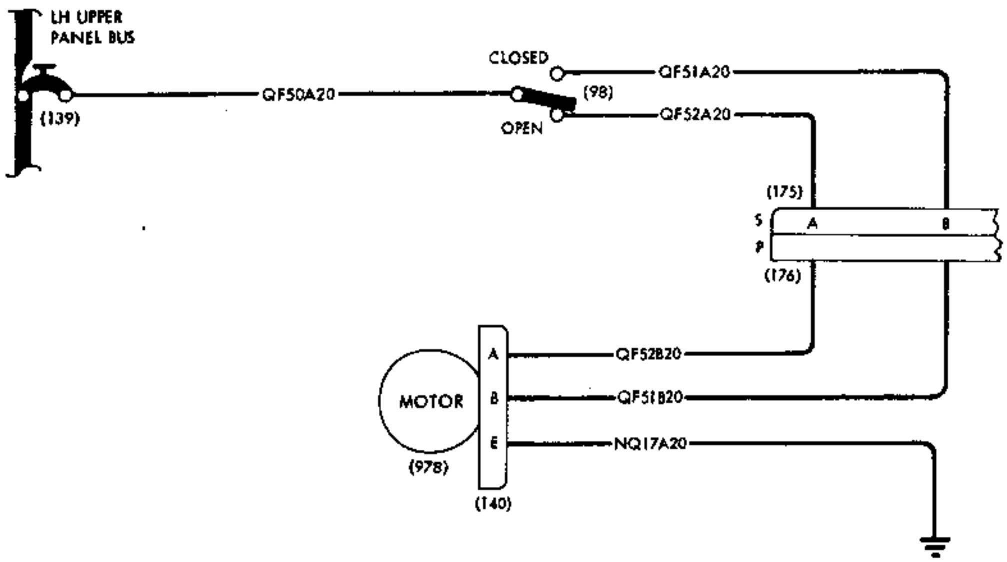
*(b)* REMOVAL.

*1.* Remove electrical disconnect plug.

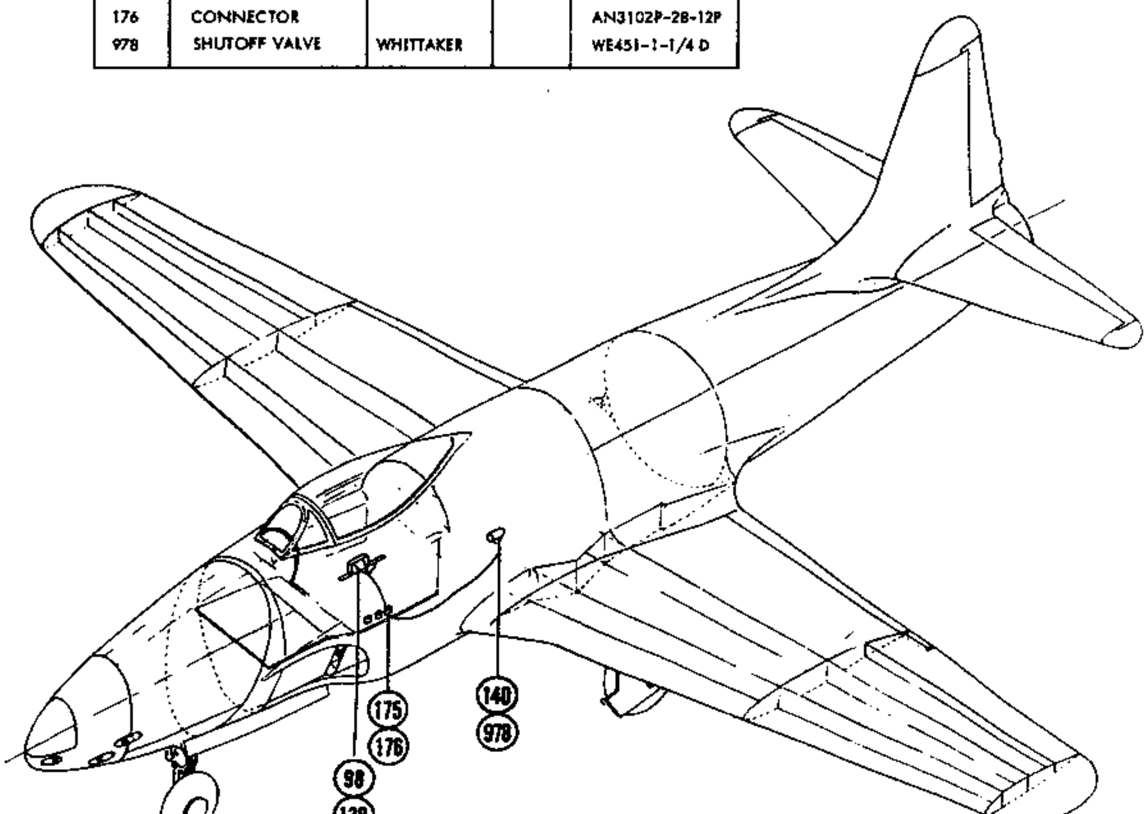
*2.* Disconnect and immediately cap two air lines.

*3.* Remove four screws mounting valve to bracket, and remove valve.

(4A) MOTOR-OPERATED MAIN FUEL SHUT-OFF VALVE CIRCUIT (AIRPLANES INCORPORATING T.O. 1F-80A-506). *(See figure 192F.)* The motor-operated main fuel shut-off valve circuit consists of control switch located on the left cockpit shelf, marked MAIN FUEL SHUT-OFF with control positions marked "OPEN" and "CLOSE." The switch is controlled by a circuit protector located on the left upper circuit protector panel. With the circuit protector in the closed position, the switch controls the motor-operated main fuel shut-off valve located in the right speed brake area.

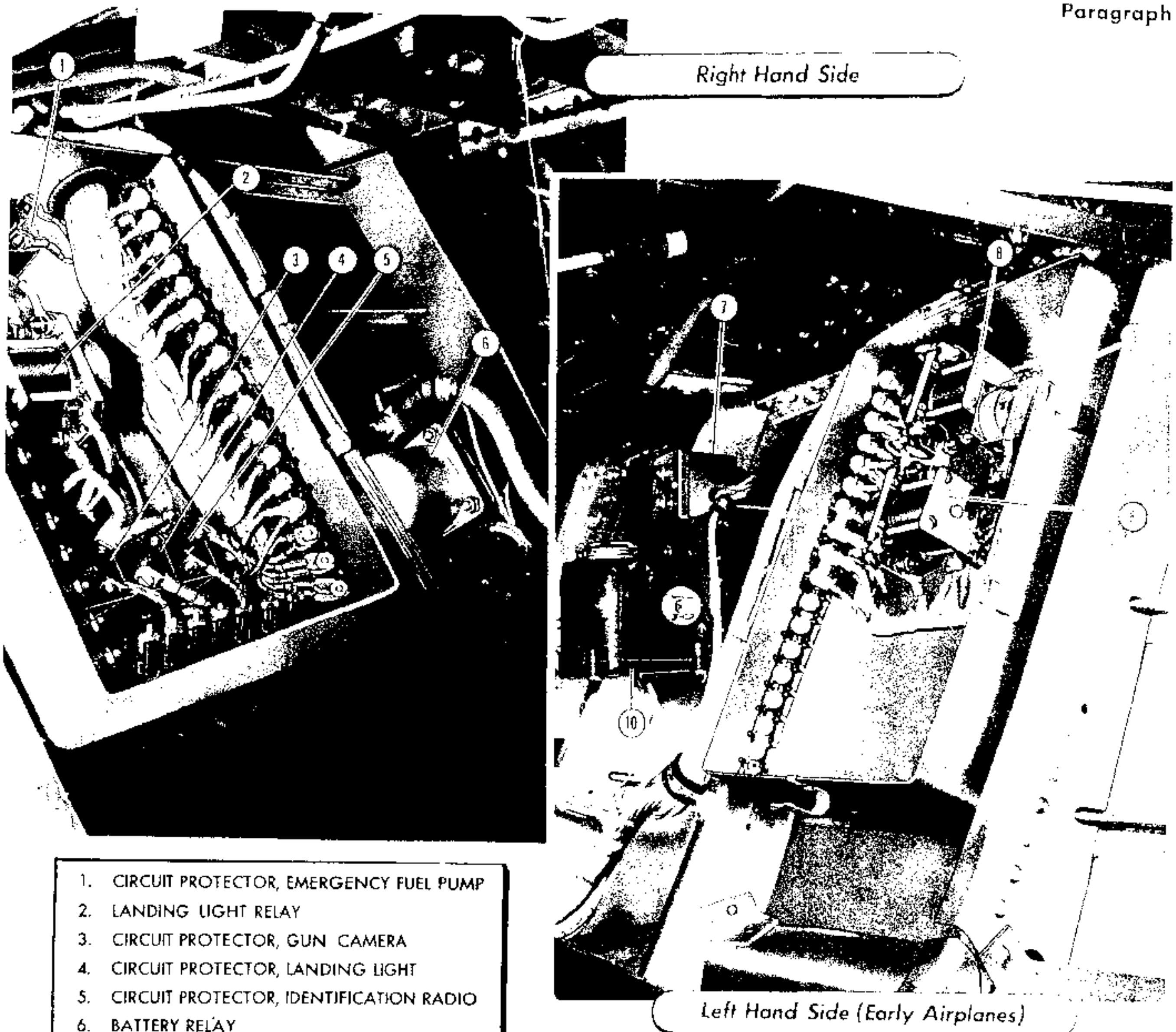



| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 98 | SWITCH | | | AN3021-3 |
| 139 | CIRCUIT PROTECTOR | | | AN3161-P5 |
| 140 | CONNECTOR | | | AN3106-14S-5S |
| 175 | CONNECTOR | | | AN3106-28-12S |
| 176 | CONNECTOR | | | AN3102P-28-12P |
| 978 | SHUTOFF VALVE | WHITTAKER | | WE451-1-1/4 D |




FB 4589
EM39-20-4-192F

*Figure 192F — Motor-Operated Main Fuel Shut-off Valve Circuit, Airplanes Incorporating T. O. 1F-80A-506*

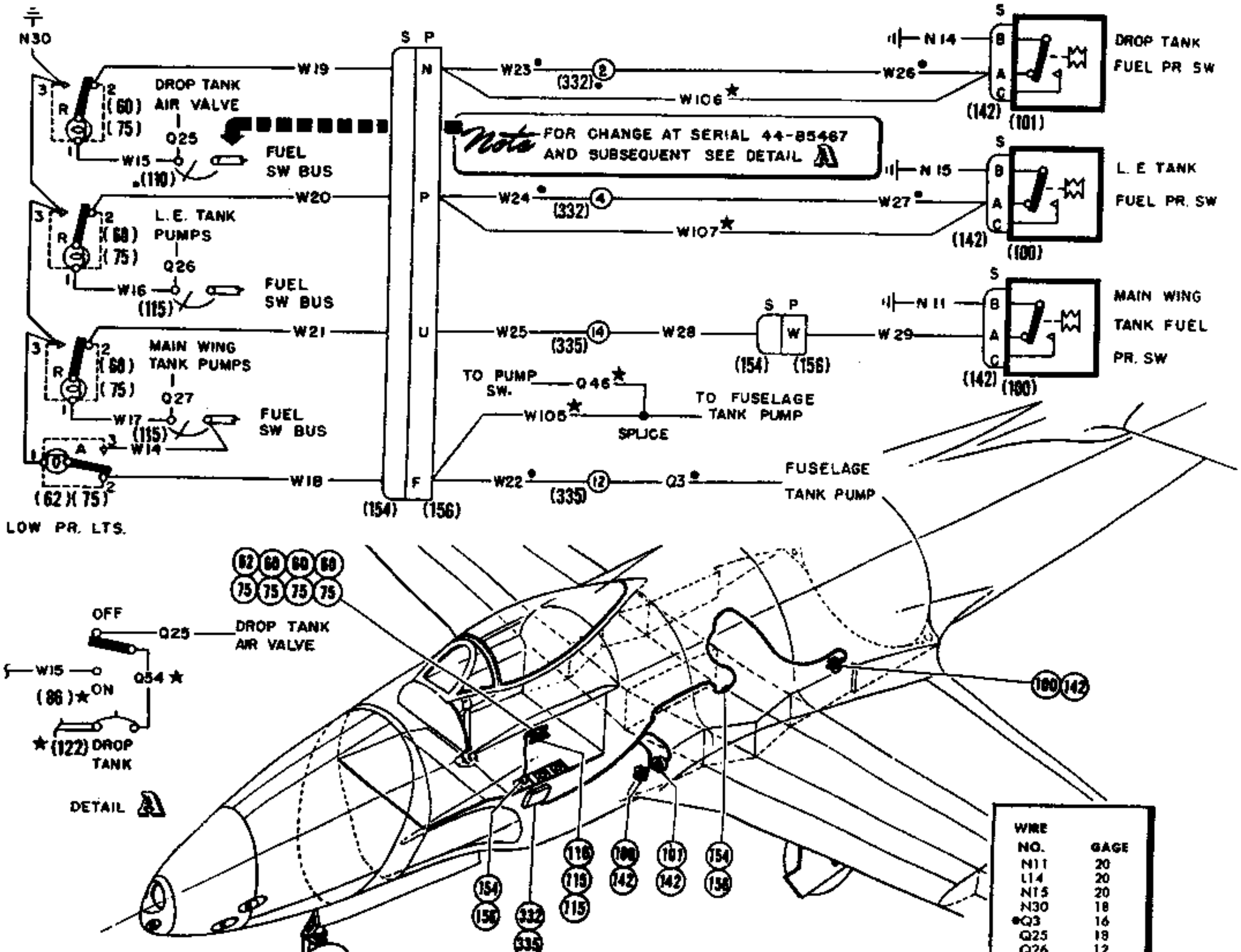



1. CIRCUIT PROTECTOR, EMERGENCY FUEL PUMP
2. LANDING LIGHT RELAY
3. CIRCUIT PROTECTOR, GUN CAMERA
4. CIRCUIT PROTECTOR, LANDING LIGHT
5. CIRCUIT PROTECTOR, IDENTIFICATION RADIO
6. BATTERY RELAY
7. INDICATOR BOX, IDENTIFICATION RADIO
8. FUEL TRANSFER VALVES RELAY
9. RELAY (NOT USED)
10. CRASH SWITCH, IDENTIFICATION RADIO

***Figure 193 — Sub-cockpit Junction Boxes***

(5) FUEL PRESSURE WARNING CIRCUIT.—*(See figures 194 and 194A.)*—The fuel pressure warning system consists of three pressure switches, two located in the hydraulic compartment in the droppable-tank line and in the wing leading-edge tank line, and one in the engine compartment in the inboard-tank line. The pressure switch in the droppable-tank line turns on a red light on the fuel-system switch panel when the pressure in the line drops to approximately 2 psi. The pressure switches in the other two lines turn on red lights when the pressure in their respective lines drops to approximately 5 psi. These lights indicate that all fuel has been delivered from the respective tanks. The switches adjacent to the lights control the warning light, the fuel pumps, and the air-pressure shut-off valve. Access to droppable tank and leading edge tank pressure warning switches is through the dive flap opening. The wing tank fuel pressure switch is in the engine compartment. (See figure 50.) For further information on the pressure switches, see paragraph 13*b*(16), this section.

(6) EMERGENCY FUEL PUMP CIRCUIT. *(See figures 49, 189, and 194B.)*—The emergency fuel pump circuit operates the emergency fuel pump warning lights, and through the emergency fuel relay, the emergency fuel pump motor. The emergency fuel pump is located in the engine compartment aft of the hydraulic reservoir. The relay which connects the motor to the bus is located



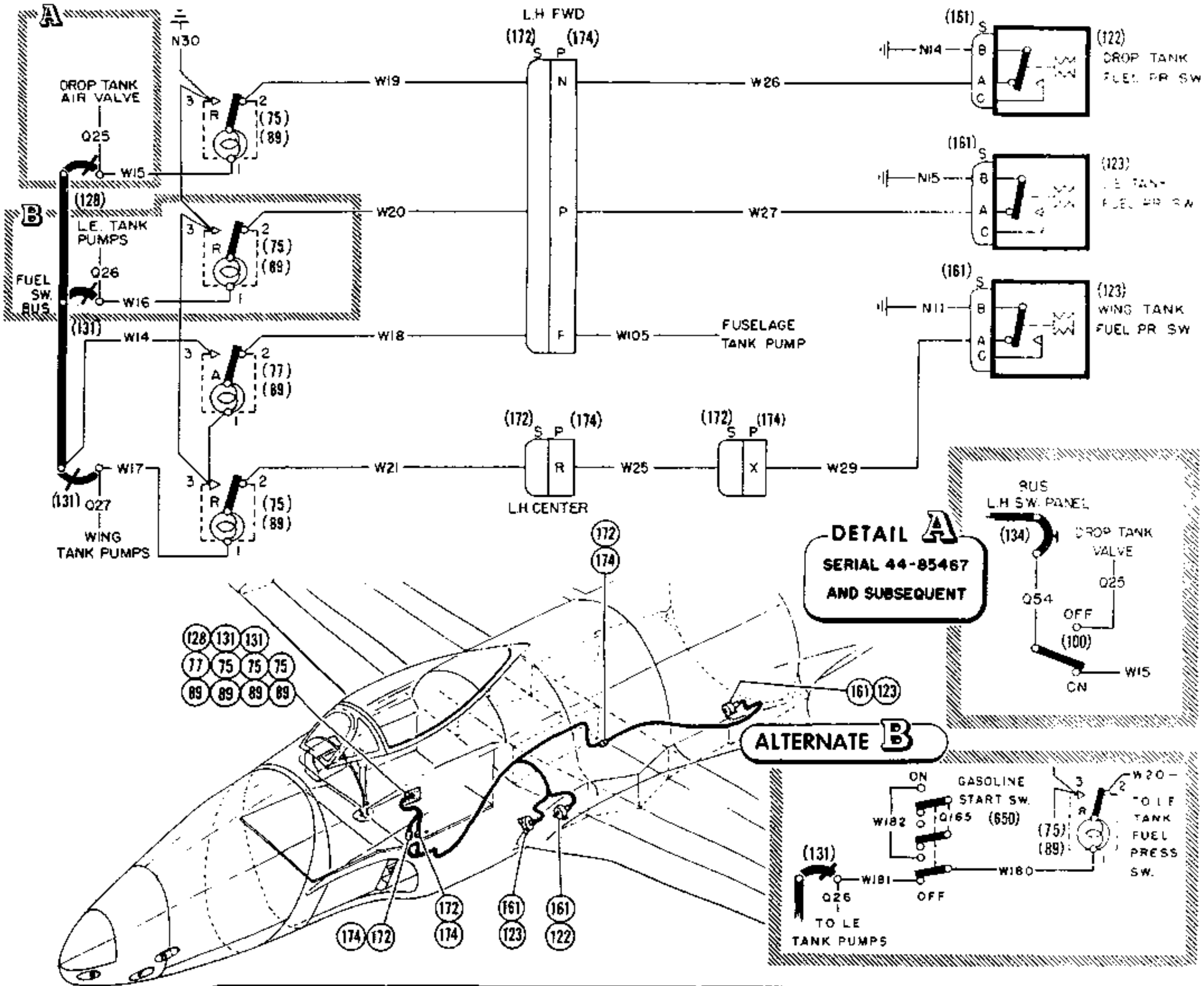

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 60 | LIGHT | SEARLE | RED | VM400-2 | LH SHELF |
| 75 | LAMP | | CLEAR | AN3121-313 | LH SHELF |
| 100 | SWITCH | COOK | | 555-117 | HYDRAULIC AND ENGINE COMPARTMENTS |
| 101 | FUEL PRESSURE SWITCH | COOK | | 555-113 | HYDRAULIC COMPARTMENT |
| •110 | CIRCUIT BREAKER | | | AN3160-5 | LH SHELF |
| 115 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 142 | CONNECTOR | | | AN3106-14S-7S | HYDRAULIC AND ENGINE COMPARTMENTS |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| •332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | LH SUB-COCKPIT JUNCTION BOX |
| 335 | TERMINAL PANEL | LOCKHEED | | LS1926-12 | LH SUB-COCKPIT JUNCTION BOX |
| 62 | LIGHT | SEARLE | AMBER | VM400-4 | LH SHELF |
| ★86 | SWITCH | C.H. | | AN3022-3 | LH SHELF |
| ★122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | LH SHELF |

| WIRE NO. | GAGE |
|---|---|
| N11 | 20 |
| L14 | 20 |
| N15 | 20 |
| N30 | 18 |
| •Q3 | 16 |
| Q25 | 18 |
| Q26 | 12 |
| Q27 | 12 |
| ★Q46 | 16 |
| ★Q54 | 18 |
| W14 | 20 |
| W15 | 20 |
| W16 | 20 |
| W17 | 20 |
| W18 | 20 |
| W19 | 20 |
| W20 | 20 |
| W21 | 20 |
| •W22 | 20 |
| •W23 | 20 |
| •W24 | 20 |
| W25 | 20 |
| •W26 | 20 |
| •W27 | 20 |
| W28 | 20 |
| W29 | 20 |
| ★W105 | 20 |
| ★W106 | 20 |
| ★W107 | 20 |

★USED SERIAL NOS. AF 44-85467 AND SUBSEQUENT

•USED SERIAL NOS. AF 44-84992 THRU 44-85466

*Figure 194 — Fuel Pressure Warning Lights Circuit, P-80A-1, P-80A-5, and FP-80A-5 Airplanes*



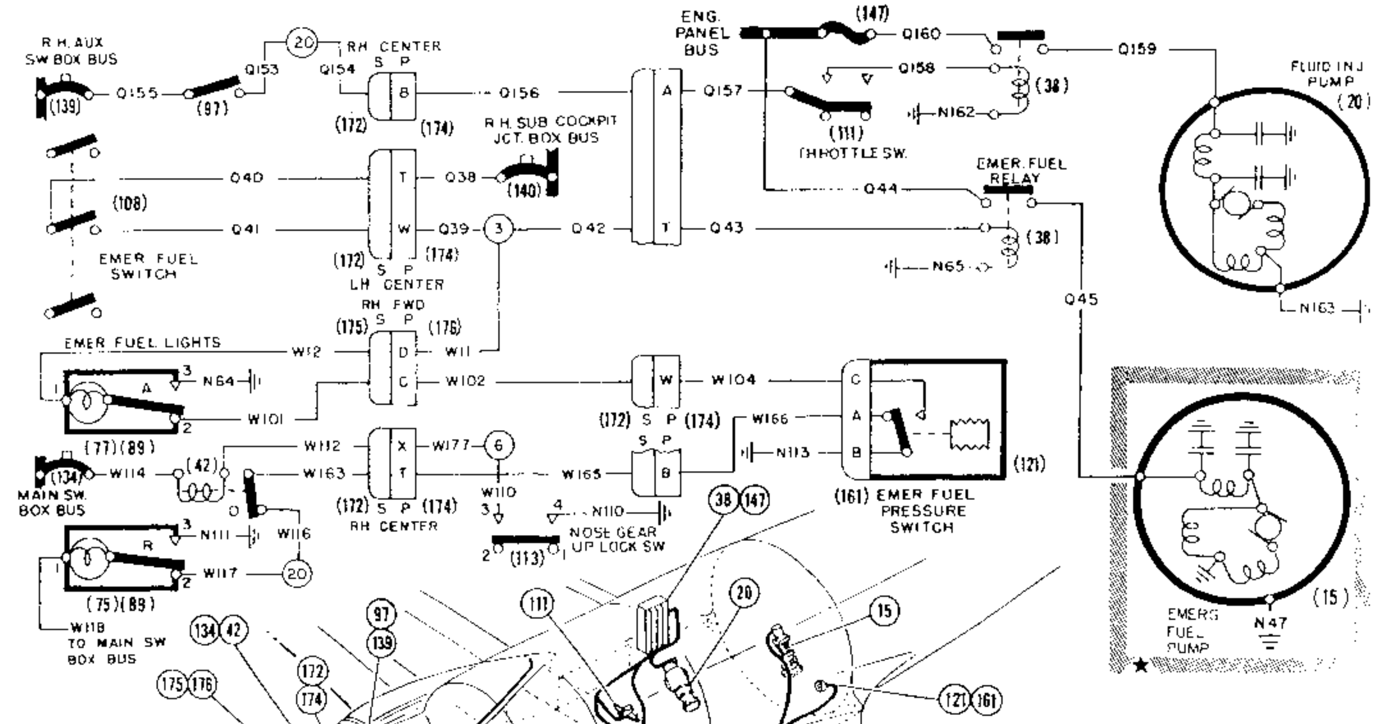

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 75 | LIGHT | | RED | AN3157-2 | LH SHELF |
| 77 | LIGHT | | AMBER | AN3157-4 | LH SHELF |
| 89 | LAMP | | | AN3121-313 | LH SHELF |
| 100 | SWITCH | | | AN3022-3 | LH SHELF |
| 122 | SWITCH | COOK | | 555-113 | SUB-COCKPIT |
| 123 | SWITCH | COOK | | 555-117 | |
| 131 | CIRCUIT BREAKER | | | AN3160-35 | LH SHELF |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | LH SHELF |
| 161 | CONNECTOR | | | AN3106-14S-7S | |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 650 | SWITCH | | | AN3226 | LH SHELF |

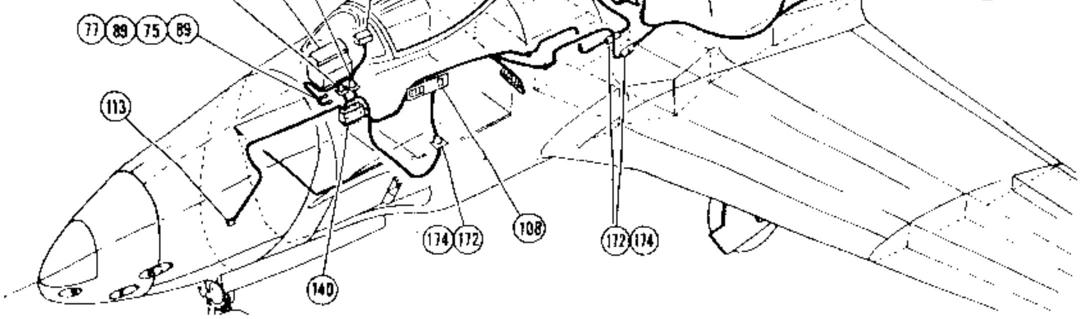
X86110

ALL WIRES No. 20 GAGE EXCEPT

| WIRE NO. | GAGE |
|---|---|
| N30 | 18 |
| Q25 | 18 |
| Q26 | 12 |
| Q27 | 12 |

Figure 194A — Fuel Pressure Warning Circuit, F-80A-10 and RF-80A-10 Airplanes





| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| N47 | 6 | Q156 | 20 |
| N64 | 20 | Q157 | 20 |
| N65 | 20 | Q158 | 20 |
| N110 | 20 | Q159 | 2 |
| N111 | 20 | Q160 | 2 |
| N113 | 20 | W11 | 20 |
| N162 | 20 | W12 | 20 |
| N163 | 2 | W101 | 20 |
| Q38 | 20 | W102 | 20 |
| Q39 | 20 | W104 | 20 |
| Q40 | 20 | W110 | 20 |
| Q41 | 20 | W112 | 20 |
| Q42 | 20 | W114 | 20 |
| Q43 | 20 | W116 | 20 |
| Q44 | 6 | W117 | 20 |
| Q45 | 6 | W118 | 20 |
| | | W163 | 20 |
| Q153 | 20 | W165 | 20 |
| Q154 | 20 | W166 | 20 |
| Q155 | 20 | W177 | 20 |

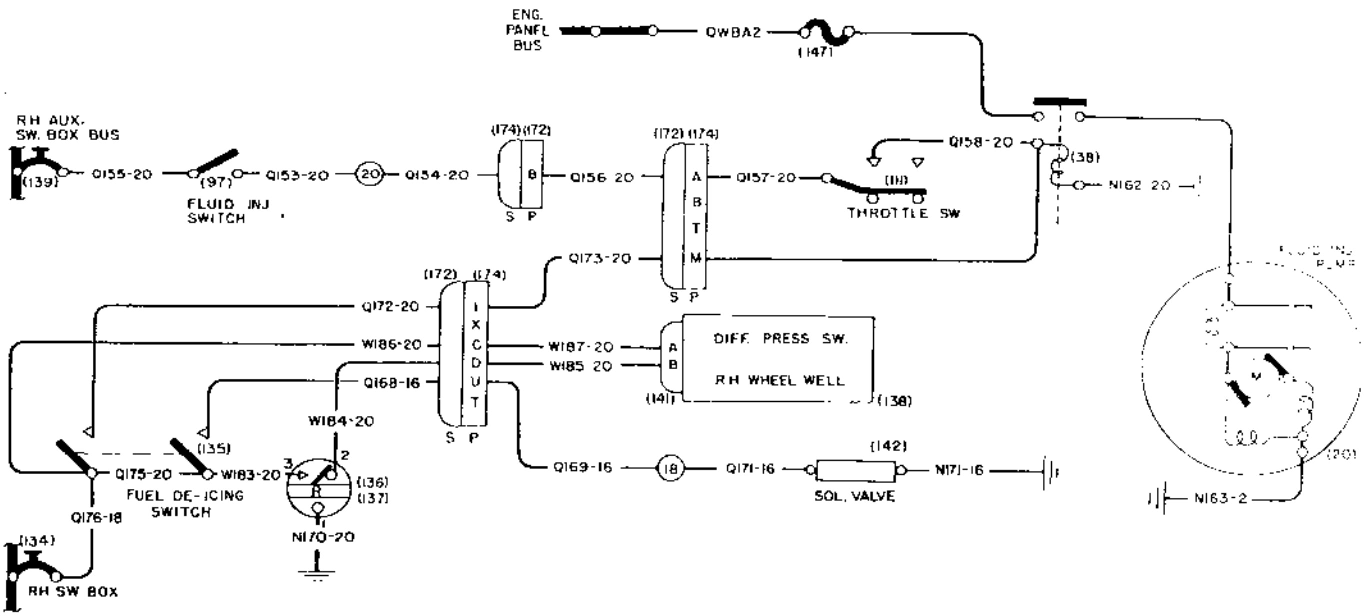
| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| ★ 15 | EMERGENCY FUEL PUMP | PESCO | | 121064-012-02 |
| 20 | FLUID INJECTION PUMP | EEMCO | | D-209 |
| 38 | RELAY | | B-4 | AN3370-1 |
| 42 | RELAY | EL. PROD. SUP. | | N8-57-C |
| 75 | LIGHT | | RED | AN3157-2 |
| 77 | LIGHT | | AMBER | AN3157-4 |
| 89 | LAMP | | | AN3121-313 |
| 97 | SWITCH | | | AN3021-2 |
| 108 | SWITCH | CUT. HAM. | | 8905K728 |
| 111 | SWITCH | | | AN3216-1 |
| 113 | SWITCH | G.E. | | CR-1070D-110C3 |
| 121 | SWITCH | COOK | | 555-585 |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 |
| 139 | CIRCUIT PROTECTOR | | | AN3161-P5 |
| 140 | CIRCUIT PROTECTOR | | | AN3161-P10 |
| 147 | CIRCUIT PROTECTOR | BURNDY | | FLLF 200A |
| 161 | CONNECTOR | | | AN3106-14S-7S |
| 172 | CONNECTOR | | | AN3106-28-11S |
| 174 | CONNECTOR | | | AN3102P-28-11P |
| 175 | CONNECTOR | | | AN3106-28-12S |
| 176 | CONNECTOR | | | AN3102P-28-12P |

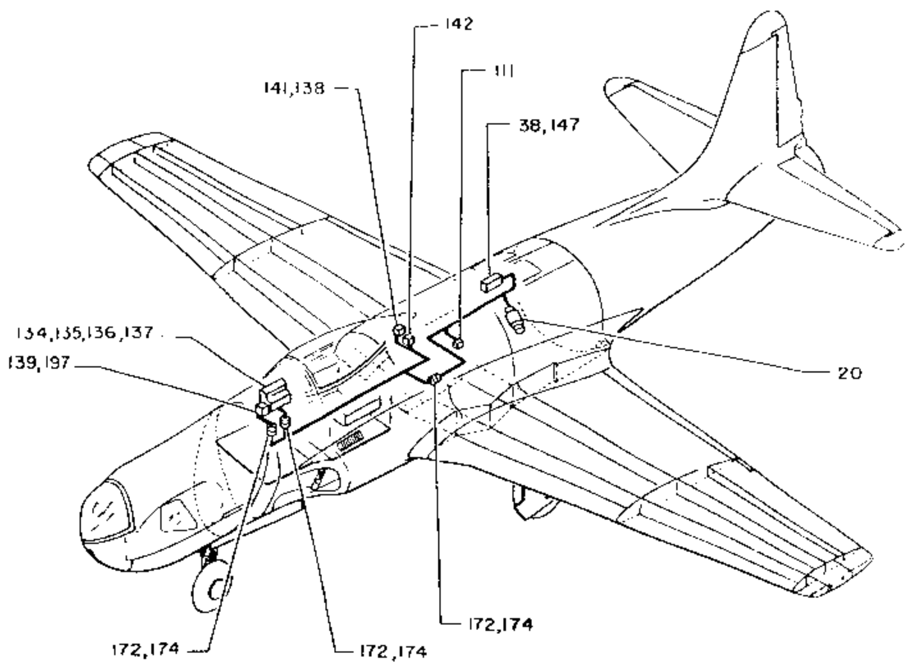
*Note*

★ J-16 PUMP REPLACED BY PESCO PUMP (T.O. 01-75FJ-2S)

AB 5059

*Figure 194B — Emergency Fuel and Fluid Injection Circuits, F-80A-1, F-80A-5, F-80A-10, RF-80A-5 RF-80A-10 and RF-80A-15 Airplanes*

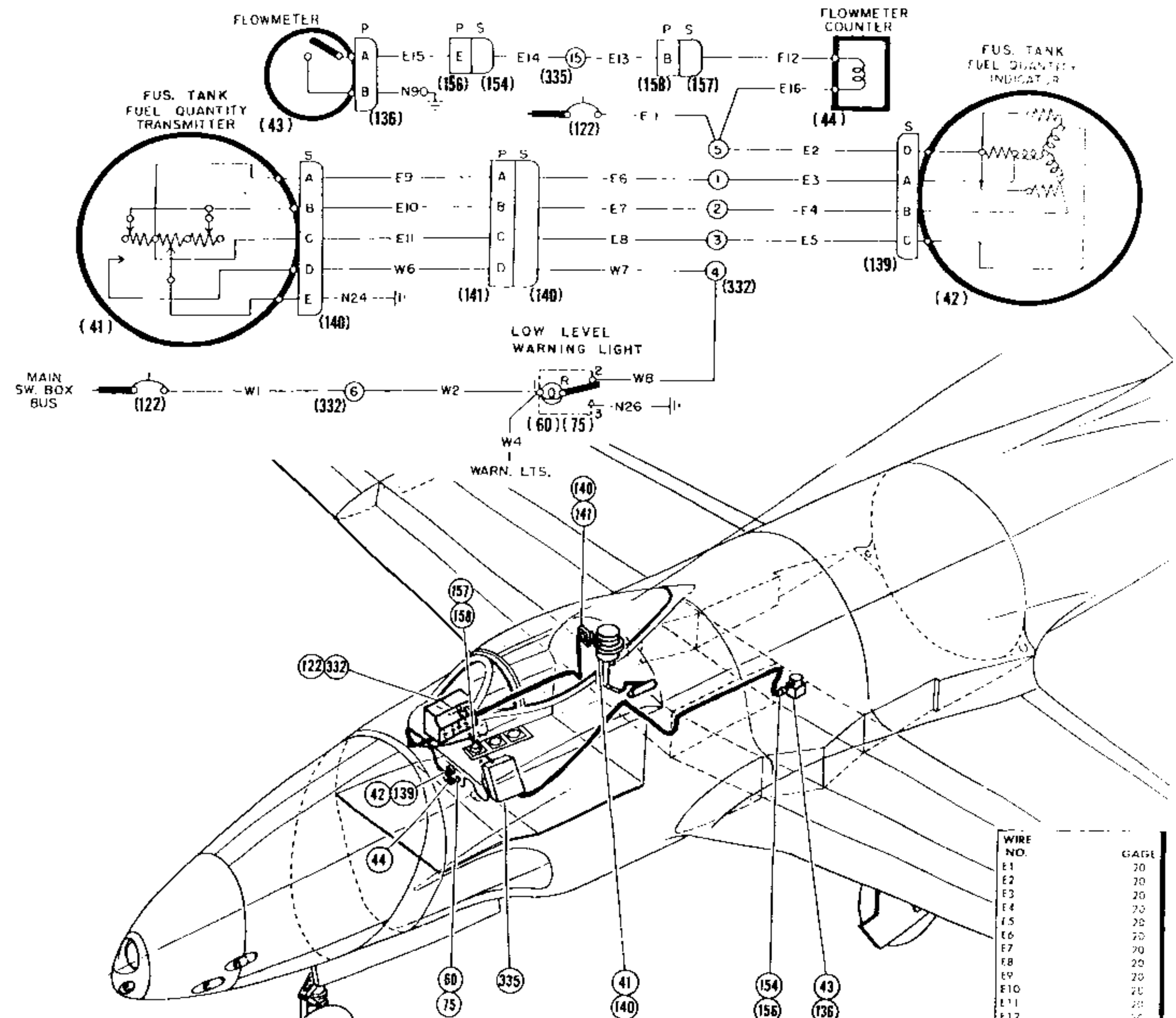



| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 20 | FLUID INJECTION PUMP | ZEMCO | | D-289 |
| 38 | RELAY | | B-4 | AN3370 |
| 97 | SWITCH | | | AN3021-2 |
| 111 | SWITCH | | | AN3216-1 |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 |
| 135 | SWITCH | | | AN3027-5 |
| 136 | LIGHT | | | AN3157-2 |
| 137 | LAMP | | RED | AN3121-313 |
| 138 | DIFFERENTIAL PRESS SW | MINN-HONEYWELL | | 12257-25 |
| 139 | CIRCUIT PROTECTOR | | | AN3161-P5 |
| 141 | CONNECTOR | | | AN3108-14S-9S |
| 142 | SOLENOID VALVE | ADEL | | 620A10 |
| 147 | CIRCUIT PROTECTOR | BURNDY | | FLLF 200A |
| 172 | CONNECTOR | | | AN3106-28-11S |
| 174 | CONNECTOR | | | AN3102P-28-11P |

EM-39-58-4-9
CB 247

*Figure 194C — Fluid Injection and Fuel De-icing Circuits, RF-80A-20 and RF-80A-25 Airplanes*




| WIRE NO. | GAGE |
|---|---|
| E1 | 20 |
| E2 | 20 |
| E3 | 20 |
| E4 | 20 |
| E5 | 20 |
| E6 | 20 |
| E7 | 20 |
| E8 | 20 |
| E9 | 20 |
| E10 | 20 |
| E11 | 20 |
| E12 | 20 |
| E13 | 20 |
| E14 | 20 |
| E15 | 20 |
| E16 | 20 |
| N24 | 20 |
| N90 | 20 |
| N26 | 20 |
| W1 | 20 |
| W2 | 20 |
| W4 | 20 |
| W6 | 20 |
| W7 | 20 |
| W8 | 20 |

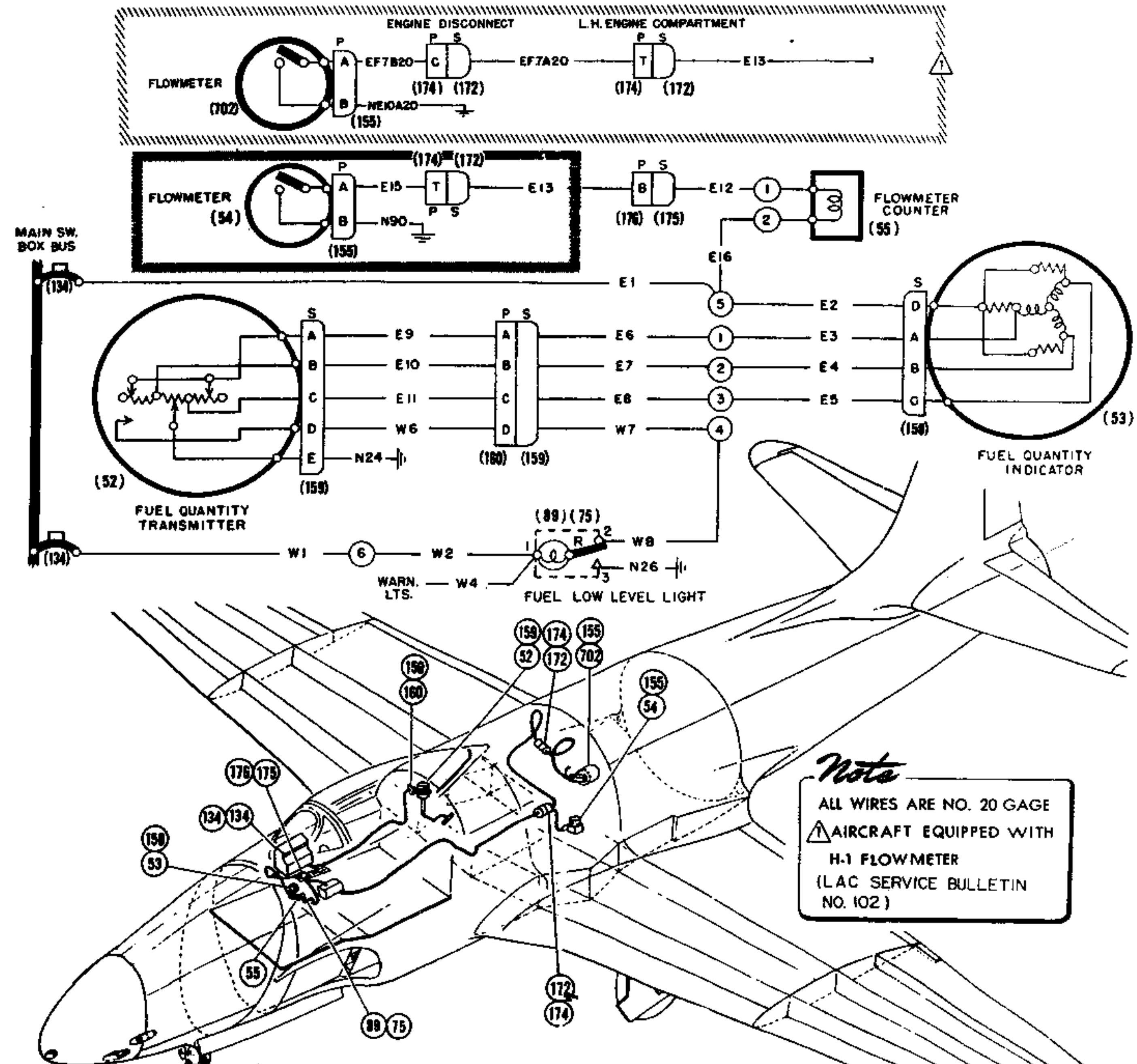
| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| *41 | FUEL QUANTITY TRANSMITTER | LIQUIDOMETER | | EA-65W-207 | FUSELAGE TANK |
| **41 | FUEL QUANTITY TRANSMITTER | LIQUIDOMETER | | EA 565W 269 | FUSELAGE TANK |
| 42 | FUEL QUANTITY INDICATOR | LIQUIDOMETER | | EA-100-17 | INSTRUMENT PANEL |
| 43 | FLOWMETER | NEPTUNE | | 45091-40 | ENGINE COMPARTMENT |
| 44 | FLOWMETER COUNTER | VEEDER ROOT | | AY-62801-3 | INSTRUMENT PANEL |
| 60 | LIGHT | SEARLE | RED | VM400-2 | SUB-INSTRUMENT PANEL |
| 75 | LAMP | | CLEAR | AN3121 313 | SUB-INSTRUMENT PANEL |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 136 | CONNECTOR | | | AN3106-12 3P | ENGINE COMPARTMENT |
| 139 | CONNECTOR | | | AN3106-14S-2S | FUSELAGE TANK |
| 140 | CONNECTOR | | | AN3106 14S 5S | COCKPIT |
| 141 | CONNECTOR | CANNON | | 2304-7 | COCKPIT |
| 154 | CONNECTOR | | | AN3106 28 11S | REAR BEARING |
| 156 | CONNECTOR | CANNON | | 2312 41 | REAR BEARING |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929 2 | MAIN SWITCH BOX |
| 335 | TERMINAL PANEL | LOCKHEED | | LS1929-12 | RH SUB-COCKPIT JUNCTION BOX |

*AF SERIAL 44 84992 THRU 44 85244 **AF SERIAL 44 85245 AND SUBSEQUENT

*Figure 195 — Fuel Quantity Circuit, P-80A-1, P-80A-5, and FP-80A-5 Airplanes*

on the engine junction box. The relay circuit is controlled by a three-pole switch on the cockpit left shelf. The switch closes the relay, and in addition, on the F-80A-1, F-80A-5, and RF-80A-5 airplanes, bypasses the generator and battery switches. This will put the battery and generator on the bus if either or both of the switches were accidentally left off. On all other airplanes the switch closes the emergency fuel pump relay only. The amber pressure warning light on the instrument sub-panel receives its power from the relay circuit and is grounded through a pressure warning switch. The pressure switch is located aft of the emergency fuel pump, and causes the pressure warning light to glow when the fuel pressure from the emergency pump reaches 240 psi on some airplanes, or 30 ($\pm$10) psi on airplanes that have the emergency fuel system unloading valve installed. (See figure 110.) The circuit protector in the relay circuit is a 10-ampere automatic reset type, located in the sub-cockpit right junction box. (See figure 193.)

The red warning light, operated by two relays, glows when the emergency fuel pump is not "ON" when it should be "ON." Power for this light comes from the bus in the main switch box through a five-ampere push-to-reset circuit protector. The current flows through two relays which are normally "ON." The first relay is connected to the emergency fuel pump switch in such a way that operation of the switch to the "ON" position opens the circuit and turns off the light. The second relay is connected to the nose gear up lock switch so that when the nose gear is up and the up lock switch is closed, the relay operates. This opens the red warning




*Note*

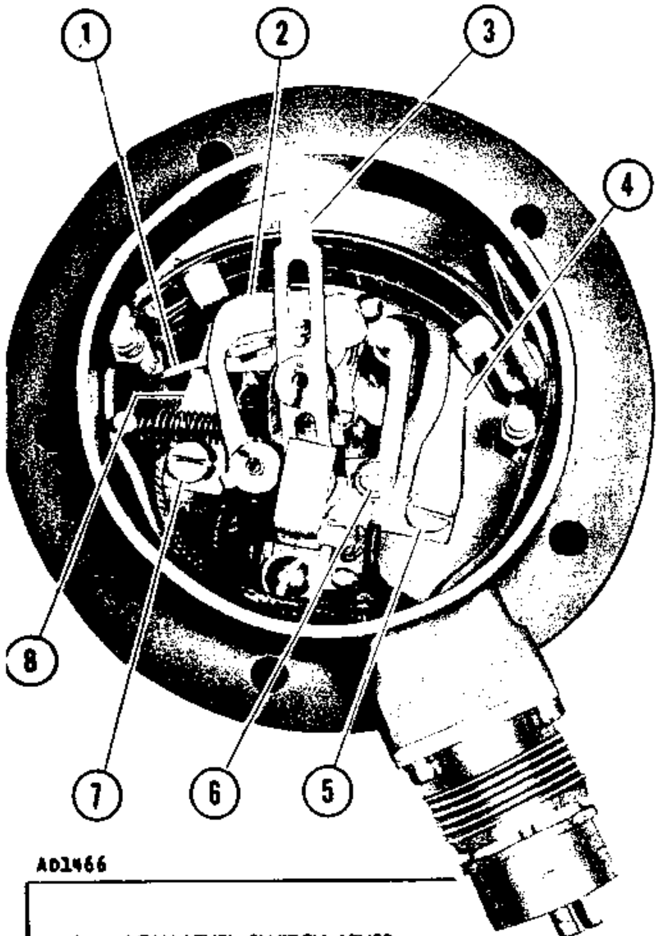
ALL WIRES ARE NO. 20 GAGE

⚠ AIRCRAFT EQUIPPED WITH H-1 FLOWMETER (LAC SERVICE BULLETIN NO. 102)

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 52 | FUEL QTY TRANSMITTER | LIQUIDOMETER | | EA-565W-269 |
| 53 | FUEL QTY INDICATOR | LIQUIDOMETER | | EA-100-17 |
| 54 | FLOWMETER | NEPTUNE | | 45091-40 |
| 55 | FLOW COUNTER | VEEDER-ROOT | | AY-62801-3 |
| 75 | LIGHT | | RED | AN3157-2 |
| 89 | LAMP | | | AN3121-313 |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 |
| 155 | CONNECTOR | | | AN3106-12S-3P |
| 158 | CONNECTOR | | | AN3106-14S-2S |
| 159 | CONNECTOR | | | AN3106-14S-5S |
| 160 | CONNECTOR | | | AN3102P-14S-5P |
| 172 | CONNECTOR | | | AN3106-28-.1S |
| 174 | CONNECTOR | | | AN3102P-28-11P |
| 175 | CONNECTOR | | | AN3106-28-12S |
| 176 | CONNECTOR | | | AN3102P-28-12P |
| ⚠702 | FLOW METER | REVERE | H-1 | R-86204 |

AS 5055

*Figure 195A — Fuel Quantity Circuit, F-80A-10 and RF-80A-10 Airplanes*




1. LOW-LEVEL SWITCH LEVER
2. LOW-LEVEL SWITCH ADJUSTING ARM
3. SHOE
4. CONTACT ARM ("FULL")
5. ADJUSTMENT SCREW ("FULL")
6. SCREW (LINKAGE ADJUSTMENT)
7. ADJUSTMENT SCREW ("EMPTY")
8. CONTACT ARM ("EMPTY")

***Figure 196 — Fuel Quantity Transmitter Adjustment***

light circuit and turns off the emergency fuel pump red warning light, if it is on.

Current drain from operation of the emergency fuel pump motor should not be more than 90 amperes. For information regarding a current test, see paragraph 13*b*(8)*(d)*7, this section.

*g.* FUEL QUANTITY CIRCUITS. *(See figures 195 and 195A.)*

(1) GENERAL.—The fuel quantity circuits consist of the fuselage-tank quantity indicator, and a flowmeter circuit. The quantity indicator indicates the fuel in the fuselage tank only, and the flowmeter indicates the amount of fuel remaining in the entire fuel system at any given time. Both circuits receive their power from the main switch box bus through the same circuit protector.

(2) FUSELAGE TANK FUEL QUANTITY INDICATOR.

*(a)* DESCRIPTION.—The fuel quantity system indicates only the quantity of fuel contained in the fuselage tank. A remote indicating system is used, employing a Liquidometer-type gage on the instrument panel and a transmitter mounted on top of the fuselage fuel tank. The transmitter incorporates a switch to indicate a fuel low-level condition. The system operates from the 28-volt direct-current system.

The low-level switch is adjusted to light the warning light when approximately 100 gallons of fuel remain in the fuselage tank.

**CAUTION**

Be careful when installing fuselage tank quantity transmitters to locate mounting screws in proper holes. Improper location of these screws will allow longer ones to bottom before tank unit is securely mounted, resulting in leaks around the mounting flange.

*(b)* ADJUSTMENT. *(See figure 196.)*

*1.* Adjustments must be made with the transmitter and indicator in place and wired as shown in figure 195.

**CAUTION**

Do not damage transmitter resistor when making adjustments.

*2.* Align slots in adjustment screws (full and empty).

*3.* With voltage applied to the system, raise float through its range of travel and note travel of indicator pointer. If movement of pointer is not symmetrical about "FULL" and "EMPTY" marks of indicator, it may be centralized by moving shoe about its point of attachment. The shoe is attached to the bakelite with a friction fit.

*4.* If after the above adjustment the indicator pointer does not indicate "EMPTY" and "FULL" within 0.06 inch, a further adjustment is necessary. If pointer moves past "EMPTY" and "FULL" marks, adjust within 0.06 inch of each mark by moving linkage adjustment screw away from central moulded part. To make this adjustment, back off linkage screw just enough to permit movement in the slotted arm. Insert and turn a screw driver between screw and molded part.

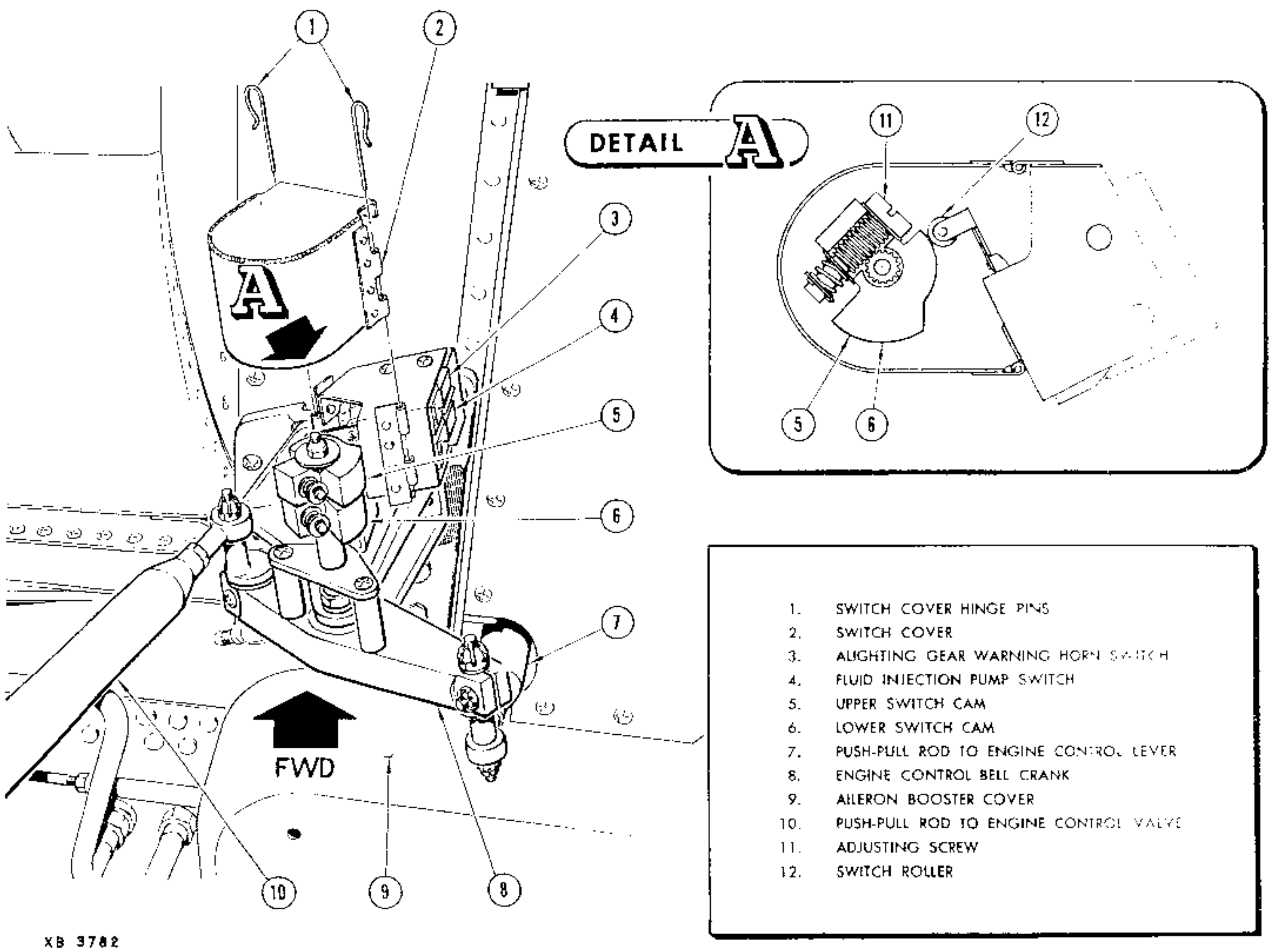



*Figure 196A — Engine Control Lever Switch Adjustment, F-80A-10 and RF-80A-10 Airplanes*

5. For final adjustment necessary to bring the pointer to each mark, rest the float on the bottom stop and turn adjustment screw ("EMPTY") until indicator pointer is directly over the "EMPTY" mark. With the float held lightly at its top position, turn adjustment screw ("FULL") until indicator pointer is directly over the "FULL" mark.

6. To adjust the low-level warning switch, place 100 gallons of fuel in the tank. Move the low-level switch arm until the warning light turns on. The switch arm presses down on the switch lever, closing the contacts of the enclosed limit switch.

(c) INSTALLATION OF FUEL QUANTITY TRANSMITTER.

1. Place transmitter in tank.

2. Install mounting bolts finger-tight.

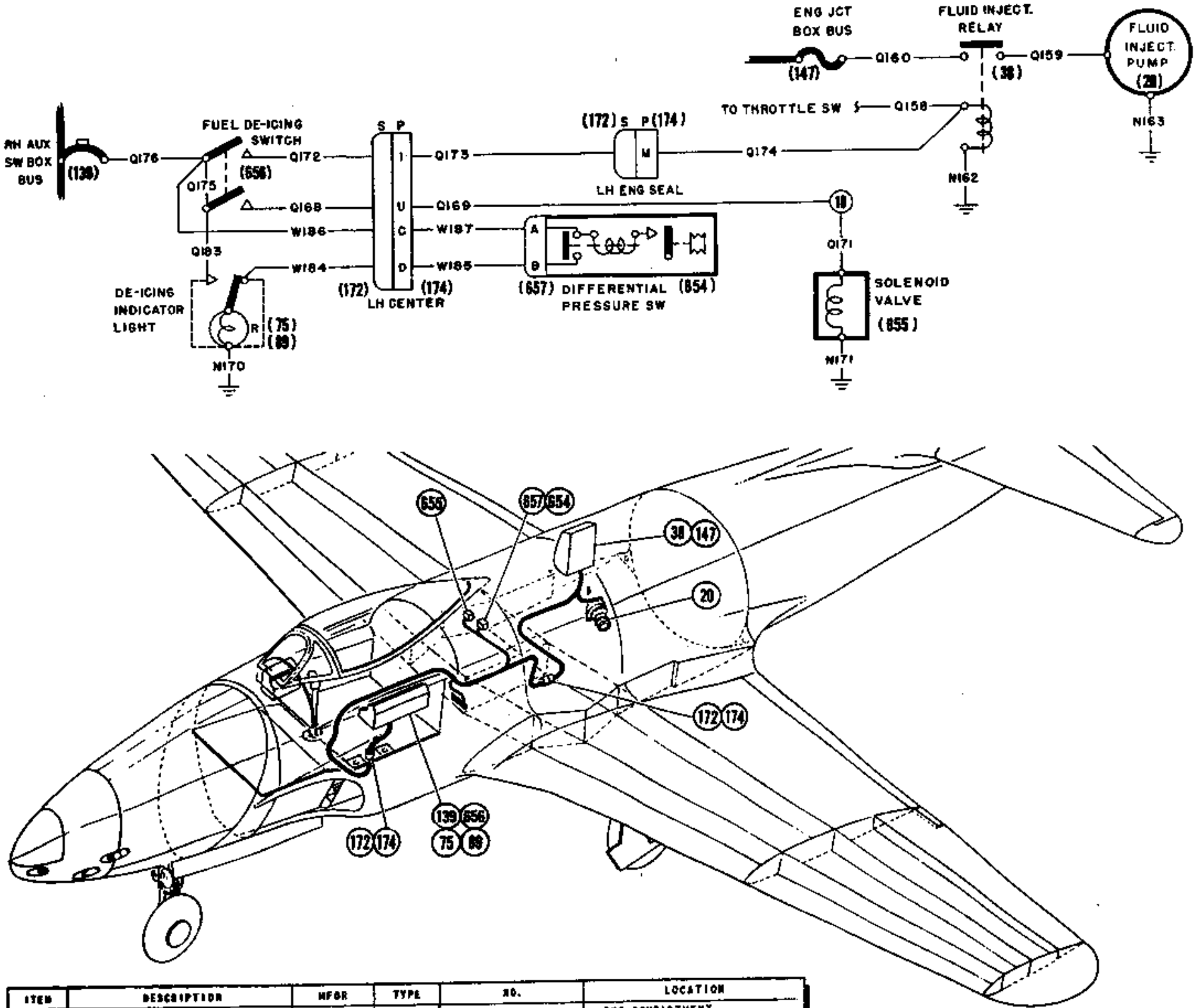
3. Position transmitter with float in "tank full" position so that float is centered between tip tank float valve standpipe and tank well.

4. Tighten mounting bolts to a torque of 30 to 40 inch-pounds. Safety bolts together.

(3) FUEL FLOWMETER CIRCUIT. — A remote subtracting type fuel counter on the instrument panel registers the number of gallons of fuel remaining in the system. The counter is connected electrically to a cam-operated micro switch in the flowmeter. The flowmeter circuit is protected by the five-ampere push-to-reset circuit protector in the fuel quantity circuit.

gA. FLUID INJECTION CIRCUIT, F-80A-10 AND RF-80A-10 AIRPLANES. *(See figure 194B.)*

(1) DESCRIPTION.—The units in the fluid injection circuit consist of the fluid injection pump, a relay, an engine control lever switch, a toggle switch, and circuit protectors. The fluid injection relay, located in the engine compartment junction box (figure 184A), is operated by the control circuit through the two-position toggle switch on the cockpit left shelf. The control circuit is protected by a five-ampere push-to-reset




| ITEM | DESCRIPTION | MFGR | TYPE | NO. | LOCATION |
|---|---|---|---|---|---|
| 20 | FLUID INJECT PUMP | TENCO | 7420 | C395C | ENG COMPARTMENT |
| 38 | RELAY | | B-4 | AN3370-1 | ENG JUNC BOX |
| 75 | LIGHT | | RED | AN3157-2 | LH SHELF |
| 89 | LAMP | | | AN3121-313 | LH SHELF |
| 139 | CIRCUIT PROTECTOR | | | AN3161-75 | RH AUX SW BOX |
| 147 | CIRCUIT PROTECTOR | BURNDY | | FLLF 200A | ENG JUNC BOX |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 654 | DIFFERENTIAL PRESS SWITCH | M-H | | 820A19 | RH MAIN WHEEL WELL |
| 855 | SOLENOID VALVE | ADEL | | 12267-27 | ENGINE COMPARTMENT |
| 656 | SWITCH | | | AN3027-5 | COCKPIT LH SHELF |
| 657 | CONNECTOR | | | AN3106-14S-9S | DIFFERENTIAL PRESS SWITCH |

| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| N162 | 20 | Q173 | 20 |
| N170 | 20 | Q174 | 20 |
| N171 | 16 | Q175 | 20 |
| Q158 | 20 | Q176 | 16 |
| Q159 | 2 | W183 | 20 |
| Q160 | 2 | W184 | 20 |
| Q168 | 16 | W185 | 20 |
| Q169 | 16 | W186 | 20 |
| Q171 | 16 | W187 | 20 |
| Q172 | 20 | | |

*Figure 196B — Fuel De-icing Circuit*

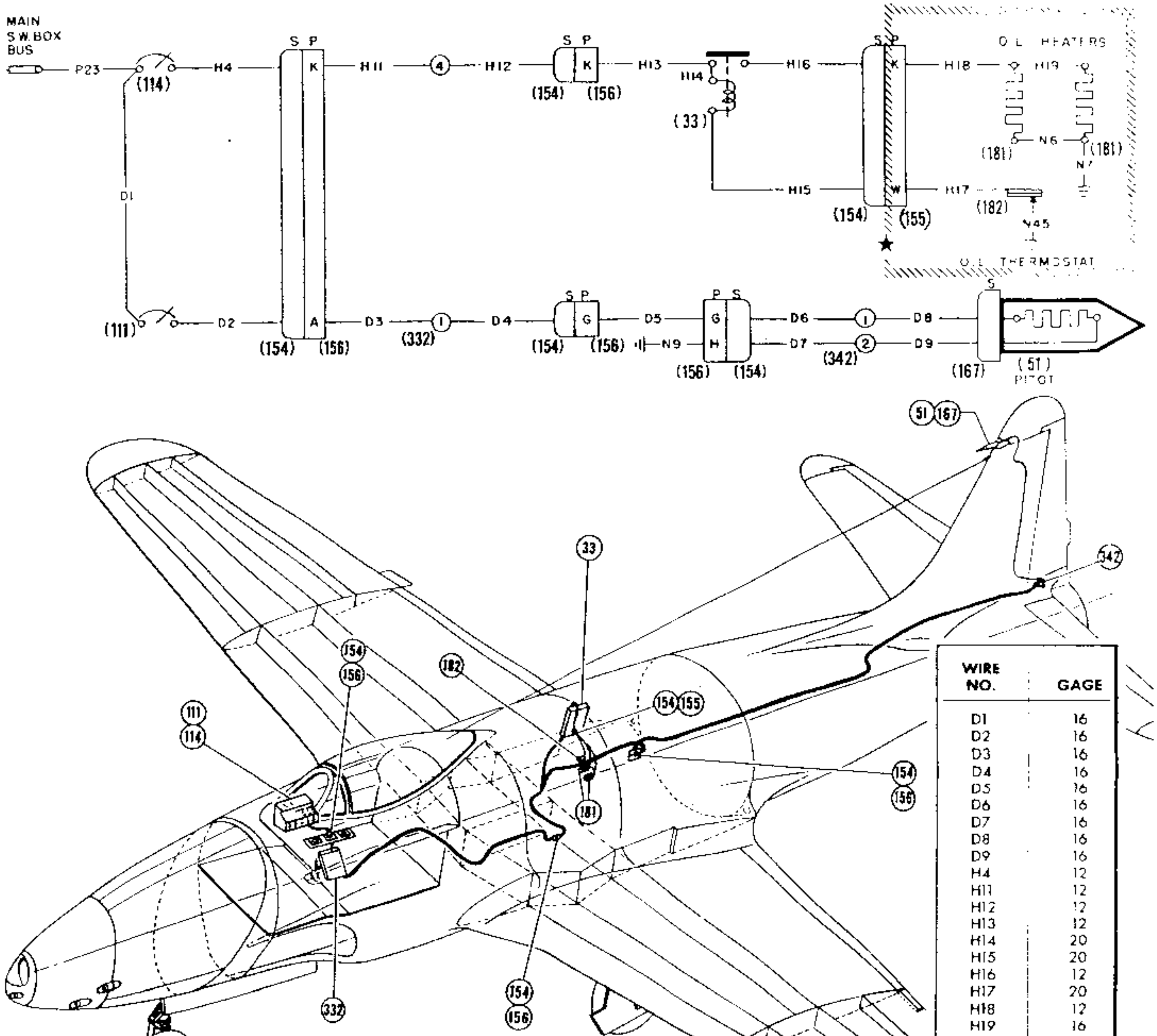
circuit protector on the same shelf. The engine control lever switch in the control circuit is mounted on the forward bulkhead of the engine compartment, and permits control circuit operation of the fluid injection relay when the engine control lever is fully advanced. The power circuit to the pump through the relay is protected by the FLLF 200-ampere fuse-type current limiter located in the engine compartment junction box. A spare fuse is mounted on the junction box cover.

(2) ADJUSTMENT OF ENGINE CONTROL LEVER FLUID INJECTION SWITCH. *(See figure 196A.)*

*(a)* Remove cover from engine control lever switches.

*(b)* Move engine control lever to full forward position.

*(c)* By means of large adjusting screw on fluid injection limit-switch cam, move cam to point where limit switch will just "click" on.




| WIRE NO. | GAGE |
|---|---|
| D1 | 16 |
| D2 | 16 |
| D3 | 16 |
| D4 | 16 |
| D5 | 16 |
| D6 | 16 |
| D7 | 16 |
| D8 | 16 |
| D9 | 16 |
| H4 | 12 |
| H11 | 12 |
| H12 | 12 |
| H13 | 12 |
| H14 | 20 |
| H15 | 20 |
| H16 | 12 |
| H17 | 20 |
| H18 | 12 |
| H19 | 16 |
| N6 | 16 |
| N7 | 12 |
| N9 | 16 |
| N45 | 20 |
| P23 | 12 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 33 | OIL HEAT RELAY | G.E. | B-2 | CR2791A-100A3 | ENGINE JUNCTION BOX |
| 51 | PITOT HEATER | G.F.E. | G-1 | 27378 | VERTICAL STABILIZER |
| 111 | CIRCUIT BREAKER | | | AN3160-10 | MAIN SWITCH BOX |
| 114 | CIRCUIT BREAKER | | | AN3160-25 | MAIN SWITCH BOX |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 167 | CONNECTOR | G.F.E. | | AN3115 | PITOT |
| 181 | OIL HEATER | G.F.E. | G.E. | 9A76 | ENGINE |
| 182 | THERMOSTAT | G.F.E. | G.E. | CR2992B103B1 | ENGINE |
| 342 | TERMINAL PANEL | LOCKHEED | | LS1902-2 | TAIL |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | RH SUB-COCKPIT JUNCTION BOX |

★ NOT FURNISHED WITH AIRPLANE

XB6771

*Figure 197 — Oil and Pitot Heaters Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*

**Note**

Fluid injection limit switch is the one to which "Q" wires are attached.

(3) FLUID INJECTION PUMP MOTOR.—The fluid injection pump series-wound intermittent-duty motor must not be run for any period longer than three minutes, and will draw approximately 135 amperes under normal operating conditions. A radio noise filter is mounted on the side of the motor. The motor is on the floor of the engine compartment, and is accessible through the engine compartment lower access doors.

*gB.* FUEL DE-ICING CIRCUIT. *(See figure 196B.)*—A solenoid valve is located in the fuel injection line downstream of the pump. A double-pole double-throw momentary-contact switch on the cockpit left shelf controls both this valve and the fluid injection pump. A pressure differential switch plumbed into both sides of the fuel filter operates the indicator light adjacent to the cockpit de-icing switch.

*h.* ENGINE OIL HEATER. *(See figures 197 and 197A.)*—Provisions are made on the engine accessory case for two integral oil heaters to be controlled by a switch-type circuit breaker and a thermostat switch. The relay is mounted in the engine junction box. (See figures 183, 184, and 184A.) The circuit breaker is mounted on the main switch box and provisions are made for the thermostat on the engine, adjacent to the heater provisions.

*i.* TACHOMETER CIRCUIT. *(See figure 198.)*

(1) GENERAL.—The tachometer circuit employs a tachometer generator in the engine accessory case and an indicator on the instrument panel. The system operates independently of the airplane's electrical system. The tachometer generator is geared to the engine and rotates at a speed proportional to rotor speed, and generates a-c voltage. The indicator is basically an electric motor, and it rotates at a speed proportional to the frequency of the tachometer-generator output. For information on the tachometer indicator see paragraph 14*b*(24), this section.

(2) TACHOMETER GENERATOR. *(See figure 88.)*—The tachometer generator, General Electric model 2CM5-ADC, is a two-pole, three-phase, alternating-current generator which is used with an indicator to record rotor speed. It is mounted on the accessory gear casing at the front of the engine between the starter and the generator. Facing the front of the engine, its rotation is counterclockwise. The gear ratio of its gear drive to the rotor shaft is 1.000:2.404.

The tachometer generator consists of a two-pole permanent-magnet rotor and a three-phase wound stator. The rotor, which is made of alnico, is cast directly on the generator shaft. The shaft runs on two ball bearings set in stainless steel inserts which are cast into the generator end shields. The stator consists of a steel ring into which a laminated core of ferromagnetic material is placed. A three-phase winding is inserted around this coil, and is insulated from it. Connections are made to the three-phase stator through the receptacle which is attached to the junction box of the generator. When the shaft of the generator is rotated, three-phase electric power is transmitted to the synchronous motor of the indicator. The frequency of the voltage generated is proportional to the speed of the engine, and the generator develops one cycle for each revolution of its rotor.

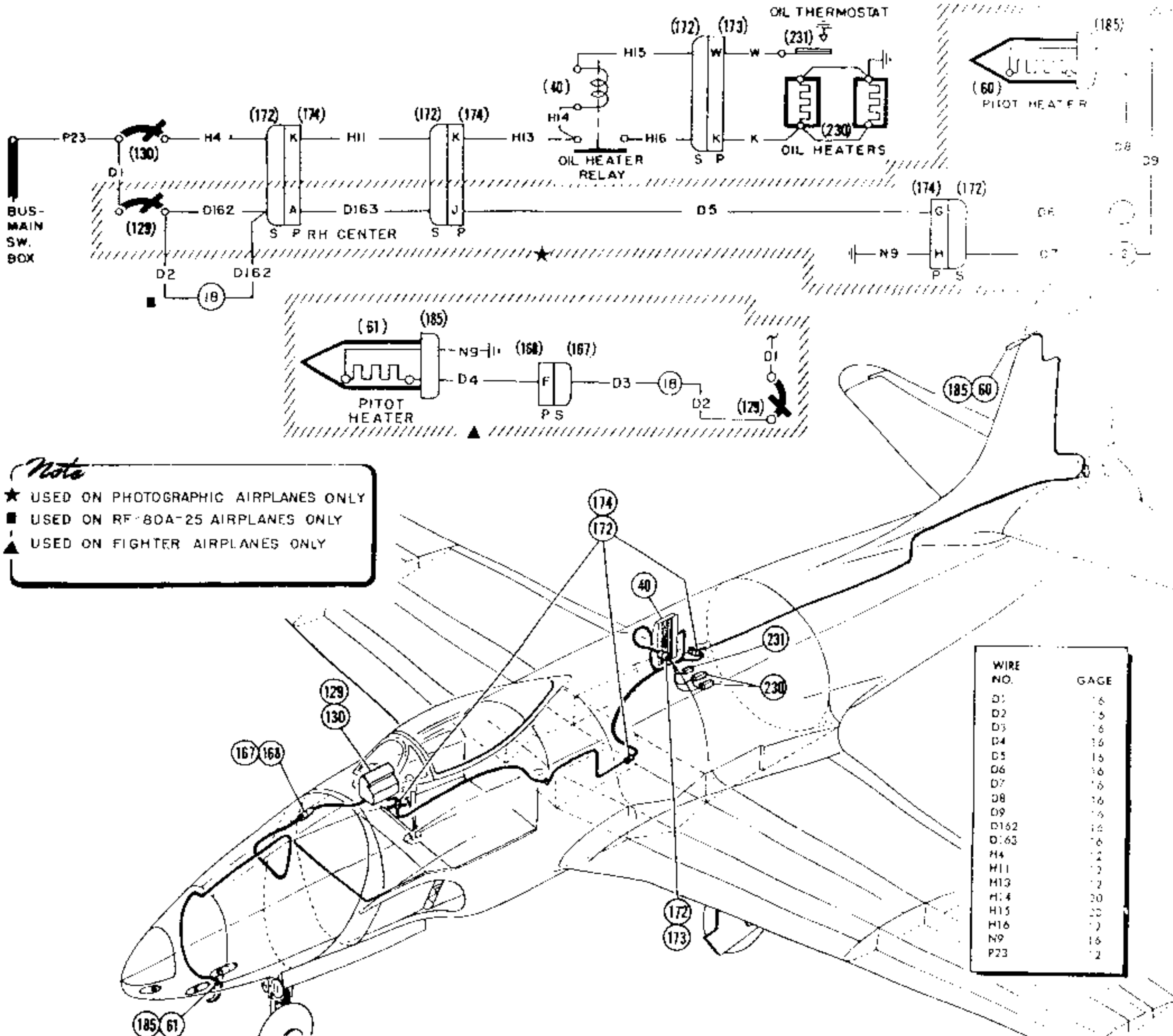
*j.* HYDRAULIC PUMP CIRCUIT.
*(See figures 49 and 199.)*

(1) GENERAL.—On F-80A-1 airplanes, the hydraulic pump is motor-driven and is located on the lower right side of the engine compartment. On all other airplanes, the hydraulic pump is engine driven. (T.O. 01-75FJA-2H-1.) Current to the motor of the electrically driven pump is controlled by a relay, the coil of which operates from generator voltage or from the external power bus. The hydraulic pump-motor-relay circuit contains a single-pole double-throw ground run-up switch to permit operation from an external power source. When the switch is on, the relay is connected to the external power bus. When the switch is in the normal "OFF" position, the hydraulic pump relay is connected to the generator reverse current relay. The line from the ground run-up switch to the external power bus has a 5-ampere push-to-reset circuit protector located on the engine accessory panel. The line from the ground run-up switch to the generator reverse current relay has a 5-ampere push-to-reset circuit protector in the engine junction box.

There is no separate control switch in the cockpit for the motor. With the generator switch in its normally "ON" position, the hydraulic pump motor will automatically start when the generator voltage reaches a preset point, and will stop when the voltage drops below this point.

(2) MOTOR.

(*a*) DESCRIPTION.—The motor used to drive the hydraulic pump is a 24-volt, direct-current, continuous duty, internally grounded series motor. It is mounted with the hydraulic pump on rubber shock mounts in the engine compartment.




*Note*

★ USED ON PHOTOGRAPHIC AIRPLANES ONLY

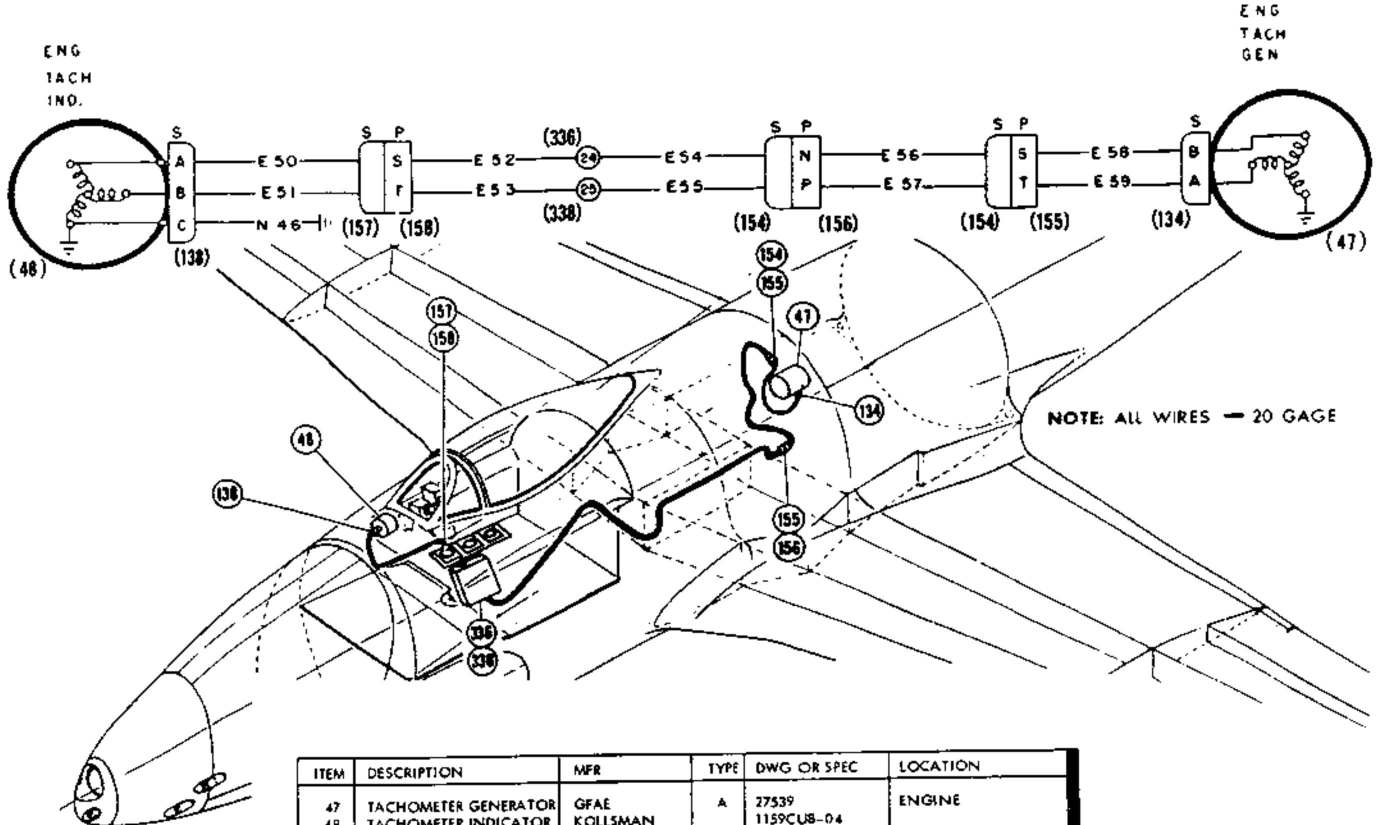
■ USED ON RF-80A-25 AIRPLANES ONLY

▲ USED ON FIGHTER AIRPLANES ONLY

| WIRE NO. | GAGE |
|---|---|
| D1 | 16 |
| D2 | 16 |
| D3 | 16 |
| D4 | 16 |
| D5 | 16 |
| D6 | 16 |
| D7 | 16 |
| D8 | 16 |
| D9 | 16 |
| D162 | 16 |
| D163 | 16 |
| H4 | 12 |
| H11 | 12 |
| H13 | 12 |
| H14 | 20 |
| H15 | 20 |
| H16 | 12 |
| N9 | 16 |
| P23 | 12 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 40 | RELAY | | B 2 | AN3350-1 | ENGINE PANEL |
| ★ 60 | PITOT HEATER | G.F.E. | G-1 | 27378 | VERTICAL STABILIZER |
| ▲ 61 | PITOT HEATER | G.F.E. | | AN5812-1 | NOSE |
| 129 | CIRCUIT PROTECTOR | | | AN3160-10 | MAIN SWITCH BOX |
| 130 | CIRCUIT PROTECTOR | | | AN3160-25 | MAIN SWITCH BOX |
| 167 | CONNECTOR | | | AN3106-18-9S | FWD PRESSURE BLKHD |
| 168 | CONNECTOR | | | AN3102P-18-9P | FWD PRESSURE BLKHD |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 173 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 185 | CONNECTOR | | | AN3115 | VERTICAL STABILIZER |
| 230 | HEATER | G.F.E. | | 9A76 | ENGINE |
| 231 | THERMOSTAT | G.F.E. | | CR2992B103B1 | ENGINE |

*Figure 197A — Oil and Pitot Heaters Circuit, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 Airplanes*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 47 | TACHOMETER GENERATOR | GFAE | A | 27539 | ENGINE |
| 48 | TACHOMETER INDICATOR | KOLLSMAN G.E. CH. FLEX SHAFT | | 1159CU8-04 OR 8DJ13AFN OR X70BP | INSTRUMENT PANEL |
| 134 | CONNECTOR | | | AN3106-12S-3S | ENGINE |
| 138 | CONNECTOR | | | AN3106-14S-1S | INSTRUMENT PANEL |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 156 | CONNECTOR | CANNON | | 2312-41 | REAR BEAM |
| 157 | CONNECTOR | | | AN3106-28-12S | R.H. SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | R.H. SUB-COCKPIT |
| 336 | TERMINAL PANEL | LOCKHEED | | LS1926-19 | R.H. SUB-COCKPIT JUNCTION BOX |
| 338 | TERMINAL PANEL | LOCKHEED | | LS1929-26 | R.H. SUB-COCKPIT JUNCTION BOX |

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CB 32103

*Figure 198 — Tachometer Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*

(*b*) REMOVAL.

*1.* Disconnect the electrical disconnect plug.

*2.* Remove four bolts attaching the motor base to the pump support members.

*3.* Remove the four bolts holding the motor to the adapter housing.

*4.* Pull motor away from the pump.

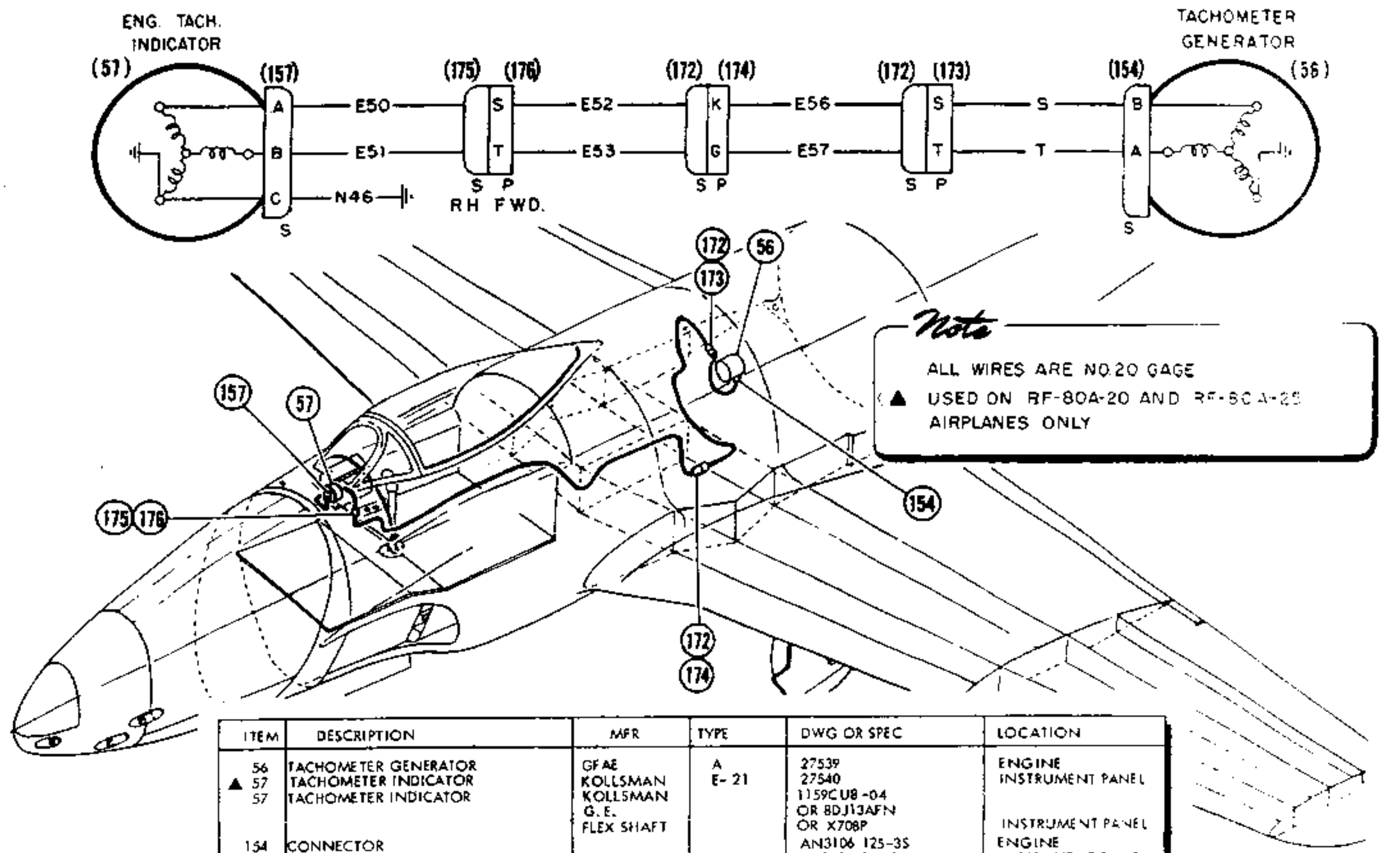
*5.* To remove motor-shaft to pump-shaft adapter from the motor shaft, remove the bolt and slide the adapter off the shaft.

*k.* WING FLAP ACTUATOR CIRCUIT.
*(See figures 200 and 200A.)*

(1) GENERAL.—The wing flaps are operated by two electrically operated linear actuators, one at each wing-fuselage junction. (See figure 39.) Both actuators are controlled through relays by a switch on the cockpit left shelf.

The relay for each motor controls the current to the motor field and armature. The relay also reverses the current flow through the armature to reverse the motor rotation. On F-80A-1 and early F-80A-5 airplanes, the left flap relay is located in the flap relay junction box on a bulkhead in the engine compartment directly over the left flap motor; the right flap relay is mounted on a bulkhead below the engine junction box in the engine compartment. On all other airplanes, both flap relays are in the engine junction box. (See figures 184 and 184A.)

The two actuators are linked mechanically by a flexible shaft and a gear box. This ensures operation of both flaps in the event of failure of one of the actuators.



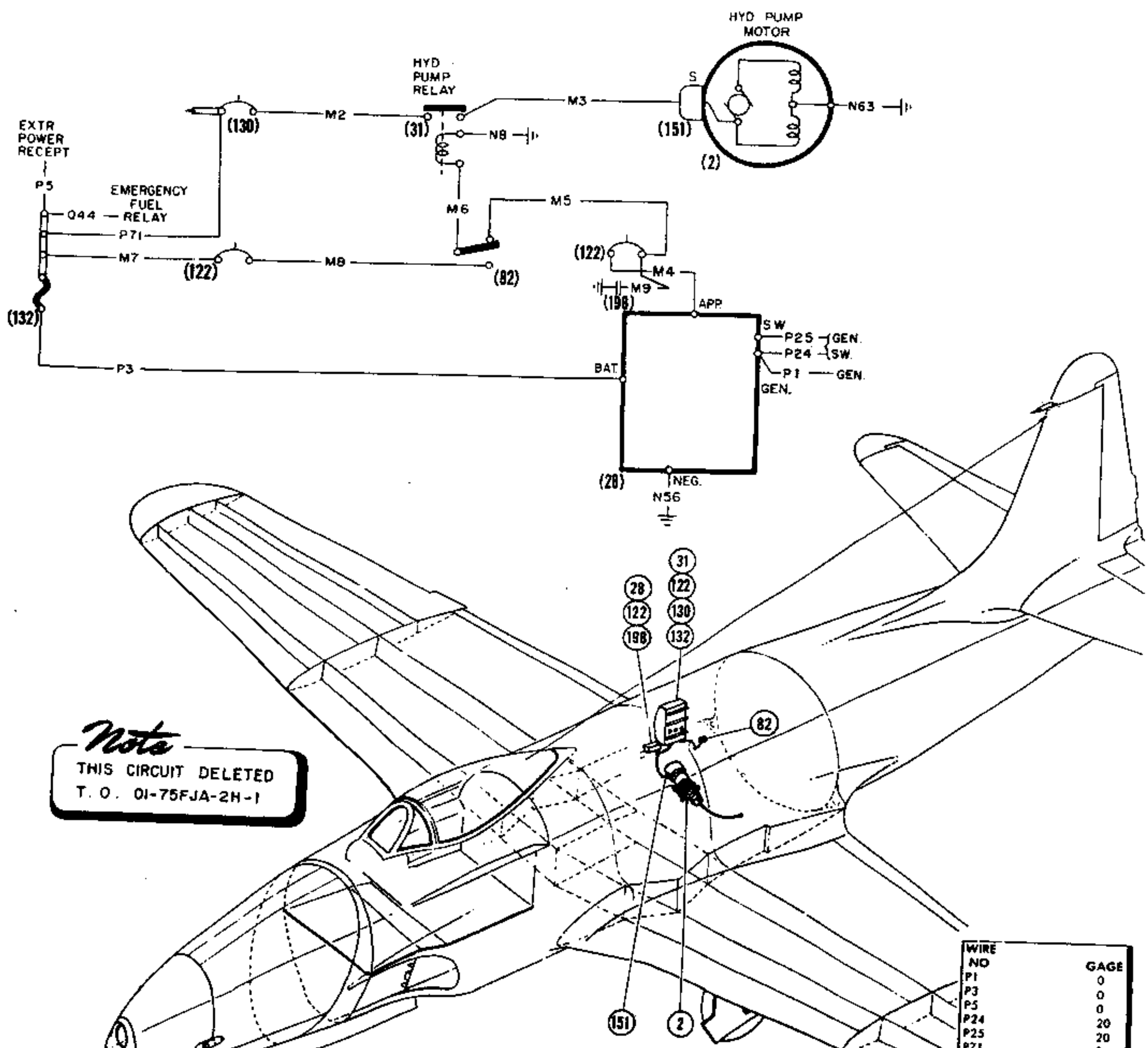

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 56 | TACHOMETER GENERATOR | GFAE | A | 27539 | ENGINE |
| ▲ 57 | TACHOMETER INDICATOR | KOLLSMAN | E-21 | 27540 | INSTRUMENT PANEL |
| 57 | TACHOMETER INDICATOR | KOLLSMAN | | 1159CU8-04 | |
| | | G.E. | | OR 8DJ13AFN | |
| | | FLEX SHAFT | | OR X708P | INSTRUMENT PANEL |
| 154 | CONNECTOR | | | AN3106 12S-3S | ENGINE |
| 157 | CONNECTOR | | | AN3106-14S-1S | INSTRUMENT PANEL |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 173 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 174 | CONNECTOR | | | AN3102P-28-11P | REAR BEAM |
| 175 | CONNECTOR | | | AN3106-28-12S | R.H. FLOOR |
| 176 | CONNECTOR | | | AN3102P-28-12P | R.H. FLOOR |

EM-39-7-4-198A
CB 5204

*Figure 198A — Tachometer Circuit, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 Airplanes*

A switch box containing the limit switches is mounted on the gear box at the center of the flexible shaft directly forward of the engine lower mount.

An indicator on the cockpit left shelf is connected with a Bowden wire to the left flap, and indicates flap position at all times. (See figure 40.)



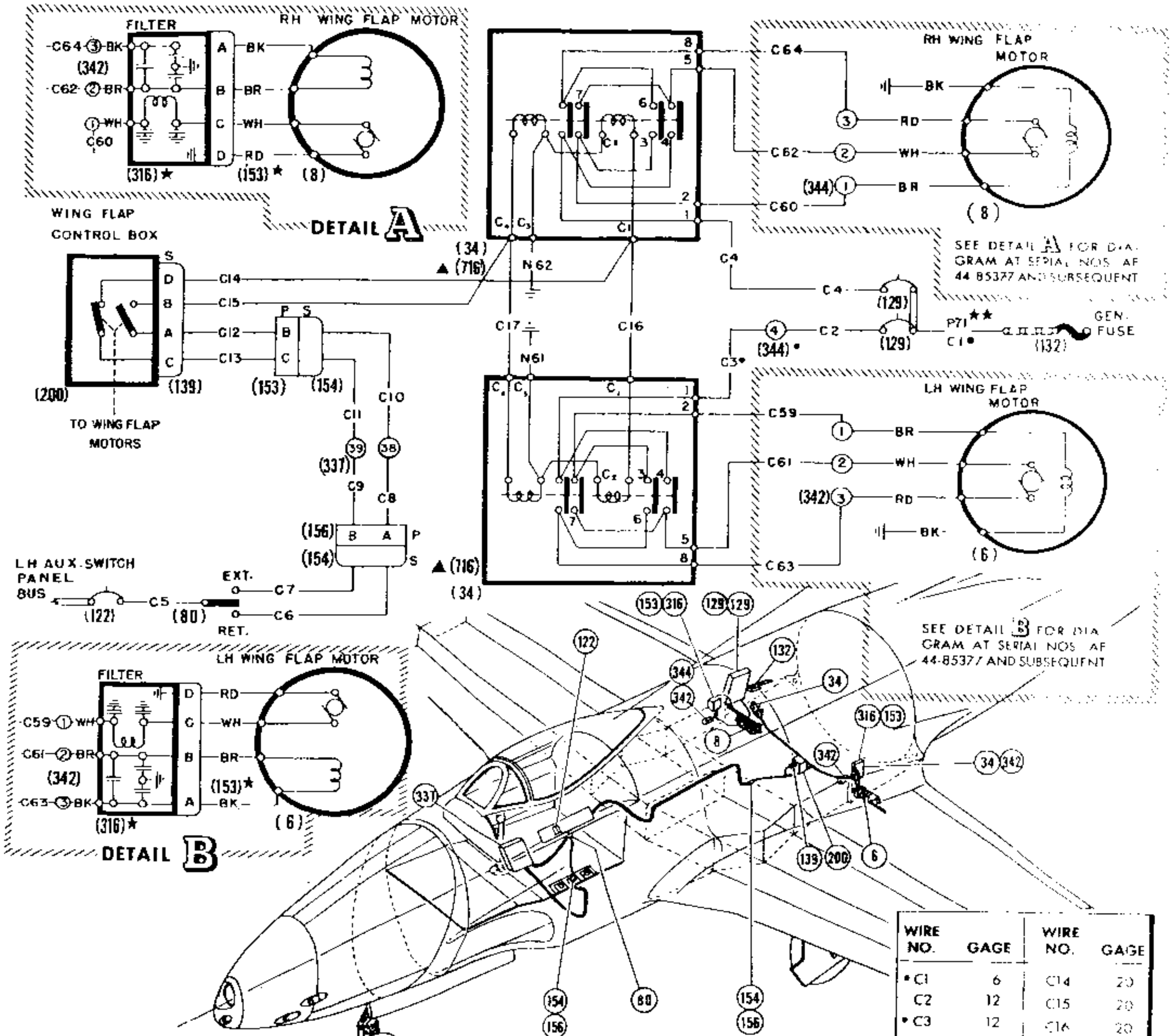

Note
THIS CIRCUIT DELETED
T. O. 01-75FJA-2H-1

| WIRE NO | GAGE |
|---|---|
| P1 | 0 |
| P3 | 0 |
| P5 | 0 |
| P24 | 20 |
| P25 | 20 |
| P71 | 2 |
| M2 | 6 |
| M3 | 6 |
| M4 | 20 |
| M5 | 20 |
| M6 | 20 |
| M7 | 20 |
| M8 | 20 |
| M9 | 20 |
| N8 | 20 |
| N56 | 20 |
| N63 | 6 |
| Q44 | 6 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 2 | HYDRAULIC PUMP MOTOR | EMERSON | GROUNDED | 99667-G | ENGINE COMPT |
| 28 | GENERATOR RELAY | G.F.E. | G.E. | AERN042-1504 | ENGINE JUNC BOX |
| 31 | HYDRAULIC PUMP RELAY | | B-4 | 94-32324 | ENGINE COMPT |
| 82 | SWITCH (GROUND RUN-UP) | C.H. | | AN3021-3 | RH FILLET |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | ENGINE COMPT |
| 130 | CIRCUIT PROTECTOR | SPENCER | | PLM-120 | ENGINE COMPT |
| 132 | CIRCUIT PROTECTOR | BURNDY | | FLLH | ENGINE COMPT |
| 151 | CONNECTOR | | | AN3106-20-2S | ENGINE COMPT |
| 198 | CAPACITOR | MALLORY | 4MFD | AC43D9224-B-40 | ENGINE JUNC BOX |

AB 5034

*Figure 199 — Hydraulic Pump Motor Circuit, F-80A-1 Airplanes*




| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| • C1 | 6 | C14 | 20 |
| C2 | 12 | C15 | 20 |
| • C3 | 12 | C16 | 20 |
| C4 | 12 | C17 | 20 |
| C5 | 20 | C59 | 12 |
| C6 | 20 | C60 | 12 |
| C7 | 20 | C61 | 12 |
| C8 | 20 | C62 | 12 |
| C9 | 20 | C63 | 12 |
| C10 | 20 | C64 | 12 |
| C11 | 20 | N61 | 20 |
| C12 | 20 | N62 | 20 |
| C13 | 20 | ** P71 | 2 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 6 | WING FLAP LEFT MOTOR | LEAR | | 423DL | ENGINE COMPARTMENT |
| 8 | WING FLAP RIGHT MOTOR | LEAR | | 423DR | ENGINE COMPARTMENT |
| 34 | WING FLAP RELAY | | C-1 | 94-32347 | ENGINE COMPARTMENT |
| 80 | SWITCH | C.H. | | AN3021-1 | LH SHELF |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | LH AUXILIARY SWITCH PANEL |
| 129 | CIRCUIT PROTECTOR | SPENCER | | PLM-50 | ENGINE JUNCTION BOX |
| 132 | CIRCUIT PROTECTOR | BURNDY | | FLLH | ENGINE COMPARTMENT |
| 139 | CONNECTOR | | | AN3106-14S-2S | ENGINE COMPARTMENT |
| * 153 | CONNECTOR | | | AN3106-18-10P | ENGINE COMPARTMENT |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 156 | CONNECTOR | | | 2312-41 | |
| 200 | CONTROL BOX | LEAR | | 790A | ENGINE COMPARTMENT |
| * 316 | FILTER | SPRAGUE | | S-13-122 | ENGINE COMPARTMENT |
| 342 | TERMINAL PANEL | LOCKHEED | | LS1902-2 | ENGINE COMPARTMENT |
| 344 | TERMINAL PANEL | LOCKHEED | | LS1903-2 | ENGINE COMPARTMENT |
| 337 | TERMINAL PANEL | LOCKHEED | | LS1927-36 | RH SUB-COCKPIT JUNCTION BOX |
| ▲ 716 | RELAY | LEACH | | 7058-24 | ENGINE COMPARTMENT |

★ USED AF SERIAL NOS [illegible] AND SUBSEQUENT FIGHTER PLANES ONLY

★★ USED AF SERIAL NOS 44-85[illegible] AND SUBSEQUENT.

• USED AF SERIAL NOS 44-8499[illegible] THRU 44-85406

▲ ALL AIRPLANES ACCORDING TO T.O. 01-75FJ-[illegible]

AB 5032

Figure 200 — Wing Flap Actuator Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes

flap relay is mounted on a bulkhead below the engine junction box in the engine compartment. On all other airplanes, both flap relays are in the engine junction box. (See figures 184 and 184A.) A switch box containing the limit switches is mounted on the gear box at the center of the flexible shaft directly forward of the engine lower mount.

(2) OPERATION.—For flap operation, see paragraph 1*g*(2), this section.

(3) ACTUATOR. *(See figure 39.)*

*(a)* DESCRIPTION.—The wing flap actuator employs a 24-volt, direct-current, series wound, single-field, reversible, intermittent duty motor, with an electromagnetic clutch and brake. The flap actuators are mounted on brackets on each side of the engine compartment and extend through cut-outs in the fuselage skin into the wing. The actuator shaft bolts to the flap push-pull rod in the wing. The cut-outs in the fuselage are closed against the air pressure in the engine compartment by canvas boots. A switch box mounted on the "H" drive gear box in the middle of the flexible synchronizing shaft contains the motor limit switches and the switch actuating arms. Reversal of the motor is effected by reversing the current through the armature winding.

**CAUTION**

The wing flap actuators are designed for intermittent duty and should not be operated through more than one cycle without a definite cooling period.

*(b)* REMOVAL.—See paragraph 1*g*(4)*(b)*, this section.

*(c)* ADJUSTMENT.—See paragraph 1*g*(4)*(e)*, this section.

*l.* ELEVATOR TAB ACTUATOR CIRCUIT. *(See figures 136, 201, and 201A.)*

(1) GENERAL.—The two elevator trim tabs are controlled through a flexible drive shaft by a single electrical actuator. The actuator is controlled by a switch in the control stick grip. On airplanes with the old type control stick (figure 212), the switch on the grip energizes the elevator trim tab motor. On airplanes equipped with the type B-7 control-stick grip, the grip switch operates the elevator trim tabs through relays in the cockpit aft junction box. Forward movement of the switch raises the tab (nose down); aft movement of the switch lowers the tab (nose up). A green indicator light on the instrument sub-panel glows when the elevator tabs are in neutral. The light will remain on for all positions of the control stick until such time as the elevator tabs are trimmed away from neutral. The light is a push-to-test type. Rheostats in both the tab-up and tab-down circuits decrease overtravel of the actuator. The rheostats are in the aft section of the airplane, near the actuator. A single flexible drive shaft is splined to the actuator shaft and is routed to the empennage rear beam where a "T" drive actuates the elevator-tab jack screws through two more flexible shafts. Circuit protection is provided by a push-to-reset circuit protector on the cockpit left switch panel above the flap position indicator. (See figure 246.)

(1a) On airplanes incorporating T.O. 1F-80-151. (See figures 201B and 201C) an elevator trim tab override switch is installed in the cockpit under the canopy left sill. The override switch is a single pole triple throw switch with a center off position. With the override switch in the "OFF" position all power is removed from the trim tab switch on the control stick, thereby making both the aileron and elevator trim tabs inoperative. The elevator tabs are then operated by the override switch which bypasses the tab relays and supplies power directly to the tab actuator. With the override switch in the "NORMAL" position, power is supplied to the trim tab switch, and then both the aileron and elevator tabs may be operated by the tab switch on the control stick.

(2) ACTUATOR.

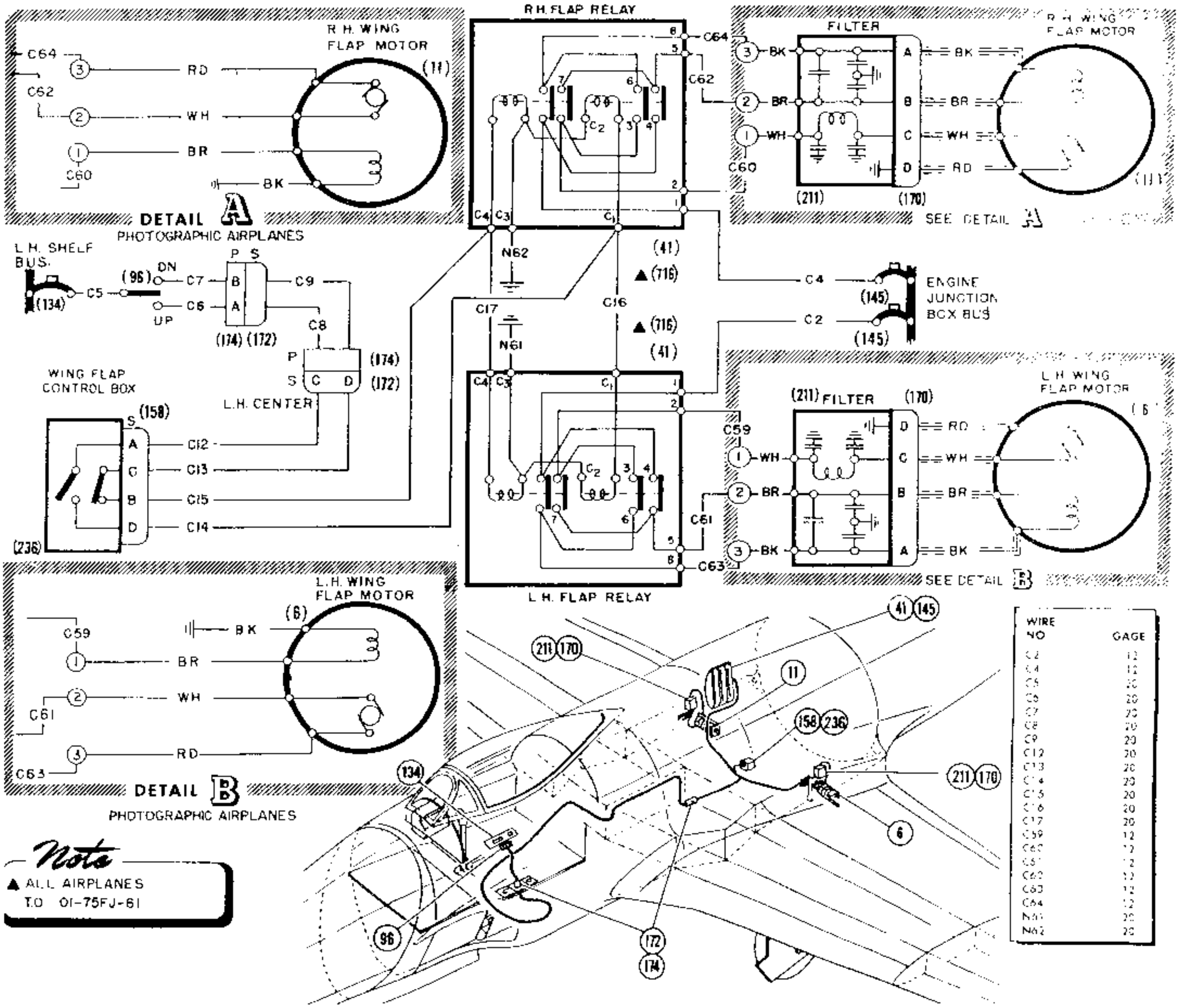
*(a)* DESCRIPTION.—The elevator tab actuator employs a reversible, intermittent-duty motor, with an electromagnetic clutch and brake. The motor is series wound, with split field, and is rated 24 volts. A thermal switch, mounted on the end of the motor housing and wired in series with the motor armature and clutch coil, protects the motor against overheating. A switch box on the actuator contains the motor limit switches, the tab neutral switch, and the electrical disconnect plug.

*(b)* ADJUSTMENTS. *(See figure 202.)*

*1.* TAB NEUTRAL SWITCH.—To adjust the elevator tab neutral switch, run the tab to the neutral position (tab and elevator faired with the stabilizer). Disconnect the flexible drive from the actuator and operate the elevator tab until the tab neutral switch is in the neutral position between the inner limit switches. Check to see that the tab neutral light is glowing. The tab neutral switch is the inner arm with the knob.

**Note**

Although the elevator has servo action, the tab neutral light will remain on for all positions of the control stick. The light will go off when the tab is trimmed to any position other than neutral.

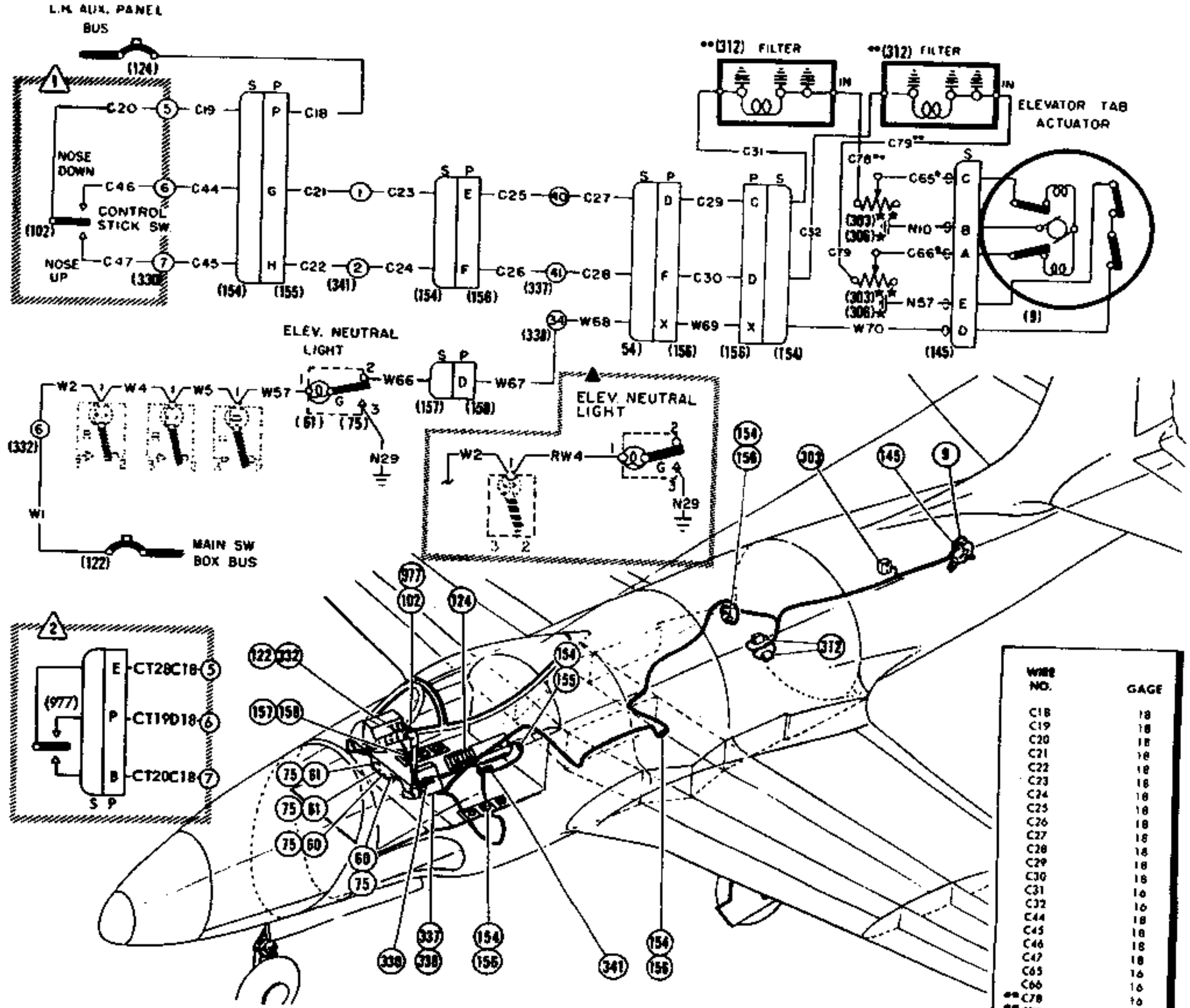



| WIRE NO | GAGE |
|---|---|
| C2 | 12 |
| C4 | 12 |
| C5 | 20 |
| C6 | 20 |
| C7 | 20 |
| C8 | 20 |
| C9 | 20 |
| C12 | 20 |
| C13 | 20 |
| C14 | 20 |
| C15 | 20 |
| C16 | 20 |
| C17 | 20 |
| C59 | 12 |
| C60 | 12 |
| C61 | 12 |
| C62 | 12 |
| C63 | 12 |
| C64 | 12 |
| N61 | 20 |
| N62 | 20 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 6 | WING FLAP MOTOR LH | LEAR | | 423DL | WING FILLET |
| 11 | WING FLAP MOTOR RH | LEAR | | 423DR | WING FILLET |
| 41 | RELAY | CUT. HAM. | C-1 | 6046-H1 | ENGINE COMPARTMENT |
| 96 | SWITCH | | | AN3021-1 | LH SHELF |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | LH AUX SWITCH PANEL |
| 145 | CIRCUIT PROTECTOR | SPENCER | | PDLM-50 | ENGINE PANEL |
| 158 | CONNECTOR | | | AN3106-14S-2S | CONTROL BOX |
| 170 | CONNECTOR | | | AN3106-18-10P | |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P 28 11P | |
| 211 | FILTER | SPRAGUE | | 513-122 | ENGINE COMPARTMENT |
| 236 | CONTROL BOX | LEAR | | 790A | ENGINE COMPARTMENT |
| ▲716 | RELAY | LEACH | | 7058-2 4 | ENGINE COMPARTMENT |

AB 4850

*Figure 200A — Wing Flaps Circuit, F-80A-10 and RF-80A-10 Airplanes*




| WIRE NO. | GAGE |
|---|---|
| C18 | 18 |
| C19 | 18 |
| C20 | 18 |
| C21 | 18 |
| C22 | 18 |
| C23 | 18 |
| C24 | 18 |
| C25 | 18 |
| C26 | 18 |
| C27 | 18 |
| C28 | 18 |
| C29 | 18 |
| C30 | 18 |
| C31 | 16 |
| C32 | 16 |
| C44 | 18 |
| C45 | 18 |
| C46 | 18 |
| C47 | 18 |
| C65 | 16 |
| C66 | 16 |
| **C78 | 16 |
| **C79 | 16 |
| N10 | 18 |
| N29 | 20 |
| N57 | 18 |
| W1 | 20 |
| W2 | 20 |
| W4 | 20 |
| W5 | 20 |
| W57 | 20 |
| W66 | 20 |
| W67 | 20 |
| W68 | 20 |
| W69 | 20 |
| W70 | 18 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 9 | ELEVATOR TAB MOTOR | LEAR | RED | 157P | TAIL CONE |
| 61 | LIGHT | SEARLE | CLEAR | VM400-3 | SUB-INSTRUMENT PANEL |
| 75 | LAMP | | | AN3121-313 | SUB-INSTRUMENT PANEL |
| △1 102 | CONTROL STICK SWITCH | MASON | | 212 | CONTROL STICK |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | LH AUXILIARY SWITCH PANEL |
| 145 | CONNECTOR | | | AN3106-16S-8S | TAIL |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | LH SHELF |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| ★★303 | RHEOSTAT | OHMITE | | 2Ω100W | TAIL CONE |
| ★306 | RESISTOR | OHMITE | | 2Ω100W | TAIL CONE |
| 312 | FILTER | POTTER | | B-120 | TAIL CONE |
| 330 | TERMINAL PANEL | LOCKHEED | | LS1906-2 | COCKPIT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | MAIN SWITCH BOX |
| 337 | TERMINAL PANEL | LOCKHEED | | LS1927-36 | RH SUB-CKPT JUNC BOX |
| 338 | TERMINAL PANEL | LOCKHEED | | LS1929-26 | RH SUB-CKPT JUNC BOX |
| 341 | TERMINAL PANEL | LOCKHEED | | LS1905-2 | LH SHELF |
| △2 997 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

M-39-20-4-201
FB 4620

## NOTE

● AF SERIAL NO. 44-850-42 AND SUBSEQUENT

●● AF SERIAL NO. 44-85377 AND SUBSEQUENT - FIGHTER AIRPLANES ONLY

★ AF SERIAL NO. 44-85042 THRU 44-85111

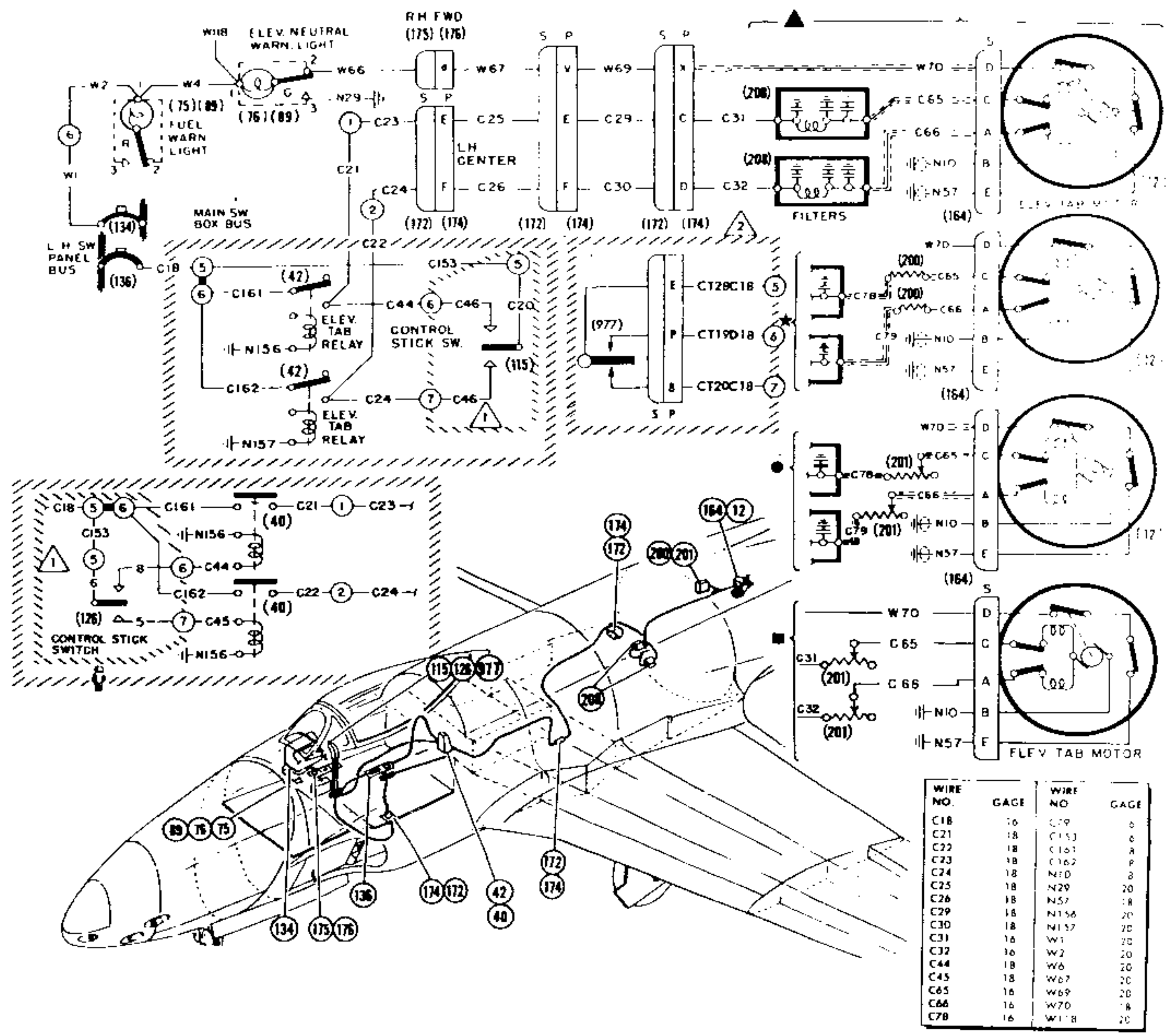
★★ AF SERIAL NO. 44-85112 AND SUBSEQUENT

▲ T.O. IF 80A-36

△1 USED ON AIRPLANES NOT INCORPORATING T.O. IF-1-225

△2 USED ON AIRPLANES INCORPORATING T.O. IF-1-225

*Figure 201 — Elevator Tab Actuator Circuit, F-80A-1, F-80A-5 and RF-80A-5 Airplanes Not Incorporating T. O. 1F-80-151*




| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| C18 | 16 | C79 | 16 |
| C21 | 18 | C153 | 16 |
| C22 | 18 | C161 | 18 |
| C23 | 18 | C162 | 18 |
| C24 | 18 | N10 | 18 |
| C25 | 18 | N29 | 20 |
| C26 | 18 | N57 | 18 |
| C29 | 18 | N156 | 20 |
| C30 | 18 | N157 | 20 |
| C31 | 16 | W1 | 20 |
| C32 | 16 | W2 | 20 |
| C44 | 18 | W6 | 20 |
| C45 | 18 | W67 | 20 |
| C65 | 16 | W69 | 20 |
| C66 | 16 | W70 | 18 |
| C78 | 16 | W118 | 20 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 12 | MOTOR | LEAR | | 157P | TAIL CONE |
| 40 | RELAY | | | AN3350-1 | COCKPIT AFT JUNC BOX |
| 42 | RELAY | EL. PROD. SUP. | | NB-57-C | COCKPIT AFT JUNC BOX |
| 75 | LIGHT | | RED | AN3157-2 | INSTRUMENT PANEL |
| 76 | LIGHT | | GREEN | AN3157-3 | INSTRUMENT PANEL |
| 89 | LAMP | | | AN3121-313 | INSTRUMENT PANEL |
| 115 | SWITCH | MASON | | 212C-1 | CONTROL STICK |
| 126 | CONTROL STICK SWITCH | | B-7 | | CONTROL STICK |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | LH AUX SWITCH PANEL |
| 164 | CONNECTOR | | | AN3106-16S-8S | |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 175 | CONNECTOR | | | AN3106-28-12S | RH FLOOR |
| 176 | CONNECTOR | | | AN3102P-28-12P | RH FLOOR |
| ★ 200 | RESISTOR | OHMITE | | 2Ω100W 0956B | TAIL CONE |
| 201 | RESISTOR | OHMITE | | 2Ω100W | TAIL CONE |
| 208 | FILTER | POTTER | | B-120 | AFT FUSELAGE |
| 977 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

M39-20-201A FB 4585

***Note***

▲ FOR AF SERIALS 44-84992 THRU 44-85041

★ FOR AF SERIALS 44-85042 THRU 44-85111

● FOR SERIALS AF 44-85112 AND SUBSEQUENT

■ USED ON RF-80A-10 AIRPLANE ONLY

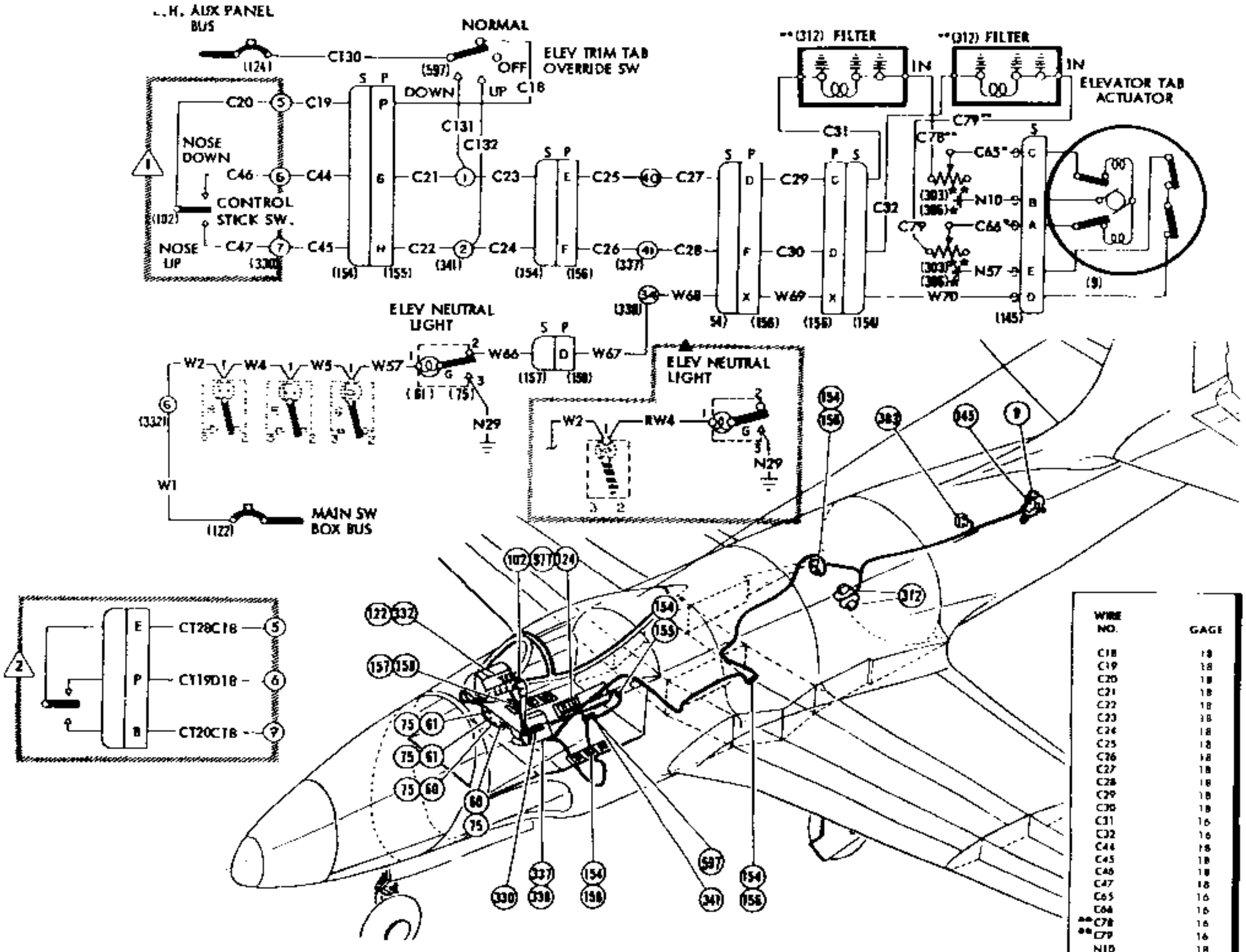
F80A-10 WINTERIZED AIRPLANES AND OTHERS INCORPORATING B-7 GRIP

AIRPLANES NOT INCORPORATING B-7 GRIP ARE WIRED AROUND RELAYS PER T.O. 1F-80-34

1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

*Figure 201A — Elevator Tab Actuator Circuit, F-80A-10 and RF-80A-10 Airplanes Not Incorporating T. O. 1F-80-151*




| WIRE NO. | GAGE |
|---|---|
| C18 | 18 |
| C19 | 18 |
| C20 | 18 |
| C21 | 18 |
| C22 | 18 |
| C23 | 18 |
| C24 | 18 |
| C25 | 18 |
| C26 | 18 |
| C27 | 18 |
| C28 | 18 |
| C29 | 18 |
| C30 | 18 |
| C31 | 16 |
| C32 | 16 |
| C44 | 18 |
| C45 | 18 |
| C46 | 18 |
| C47 | 18 |
| C65 | 16 |
| C66 | 16 |
| **C78 | 16 |
| **C79 | 16 |
| N10 | 18 |
| N29 | 20 |
| N57 | 18 |
| W1 | 20 |
| W2 | 20 |
| W4 | 20 |
| W5 | 20 |
| W57 | 20 |
| W66 | 20 |
| W67 | 20 |
| W68 | 20 |
| W69 | 20 |
| W70 | 18 |

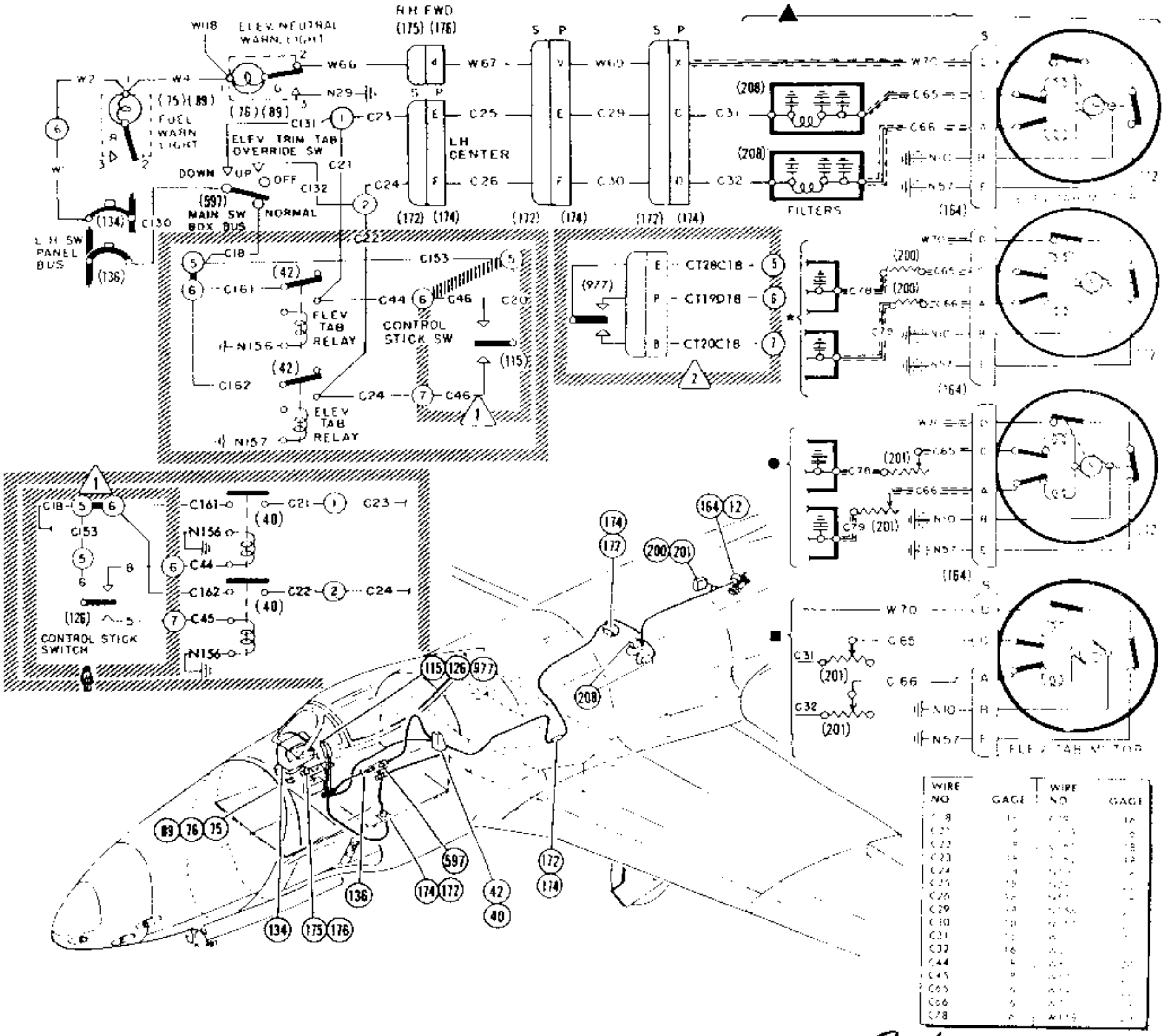
| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 9 | ELEVATOR TAB MOTOR | LEAR | RED | 157P | TAIL CONE |
| 61 | LIGHT | SEARLE | CLEAR | VM400-3 | SUB-INSTRUMENT PANEL |
| 75 | LAMP | | | AN3121-313 | SUB-INSTRUMENT PANEL |
| △1 102 | CONTROL STICK SWITCH | MASON | | 212 | CONTROL STICK |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | LH AUXILIARY SWITCH PANEL |
| 145 | CONNECTOR | | | AN3106-16S-8S | TAIL |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 155 | CONNECTOR | | | AN3102-28-11P | LH SHELF |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| ▲*303 | RHEOSTAT | OHMITE | | 2R100W | TAIL CONE |
| *306 | RESISTOR | OHMITE | | 2R100W | TAIL CONE |
| 312 | FILTER | POTTER | | B-120 | TAIL CONE |
| 330 | TERMINAL PANEL | LOCKHEED | | LS1906-2 | COCKPIT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | MAIN SWITCH BOX |
| 337 | TERMINAL PANEL | LOCKHEED | | LS1927-36 | RH SUB-CKPT JUNC BOX |
| 338 | TERMINAL PANEL | LOCKHEED | | LS1929-26 | RH SUB-CKPT JUNC BOX |
| 341 | TERMINAL PANEL | LOCKHEED | | LS1905-2 | LH SHELF |
| 597 | SWITCH | C-H | SP3T | 8749 | UNDER LH SILL |
| △2 977 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

# NOTE

- ▪ AF SERIAL NO. 44-85042 AND SUBSEQUENT
- ** AF SERIAL NO. 44-85377 AND SUBSEQUENT - FIGHTER AIRPLANES ONLY
- * AF SERIAL NO. 44-85042 THRU 44-85111
- ** AF SERIAL NO. 44-85112 AND SUBSEQUENT
- ▲ T.O. NO. 1F-80A-36
- △1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225
- △2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

FB 4587
EM39-20-4-201B

*Figure 201B — Elevator Tab Actuator Circuit, F-80A-1, F-80A-5 and RF-80A-5 Airplanes Incorporating T. O. 1F-80-151*




FB 4617
EM39-20-4-201C

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 12 | MOTOR | LEAR | | 157P | TAIL CONE |
| 40 | RELAY | | | AN3350-1 | COCKPIT AFT JUNC BOX |
| 42 | RELAY | EL PROD. SUP. | | N8-57-C | COCKPIT AFT JUNC BOX |
| 75 | LIGHT | | RED | AN3157-2 | INSTRUMENT PANEL |
| 76 | LIGHT | | GREEN | AN3157-3 | INSTRUMENT PANEL |
| 89 | LAMP | | | AN3121-313 | INSTRUMENT PANEL |
| 115 | SWITCH | MASON | | 212C-1 | CONTROL STICK |
| 126 | CONTROL STICK SWITCH | | B-7 | | CONTROL STICK |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | LH AUX SWITCH PANEL |
| 164 | CONNECTOR | | | AN3106-16S-8S | |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 175 | CONNECTOR | | | AN3106-28-12S | RH FLOOR |
| 176 | CONNECTOR | | | AN3102P-28-12P | RH FLOOR |
| ★ 200 | RESISTOR | OHMITE | | 2 Ω 100W 0956B | TAIL CONE |
| 201 | RESISTOR | OHMITE | | 2 Ω 100W | TAIL CONE |
| 208 | FILTER | POTTER | | B-120 | AFT FUSELAGE |
| 597 | SWITCH | C-H | SP3T | 8749 | UNDER LH SILL |
| 977 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

*Note*

▲ FOR AF SERIALS 44-84992 THRU 44-85041

★ FOR AF SERIALS 44-85042 THRU 44-85111

● FOR AF SERIALS 44-85047 AND SUBSEQUENT

■ USED ON RF-80A-10 AIRPLANE ONLY

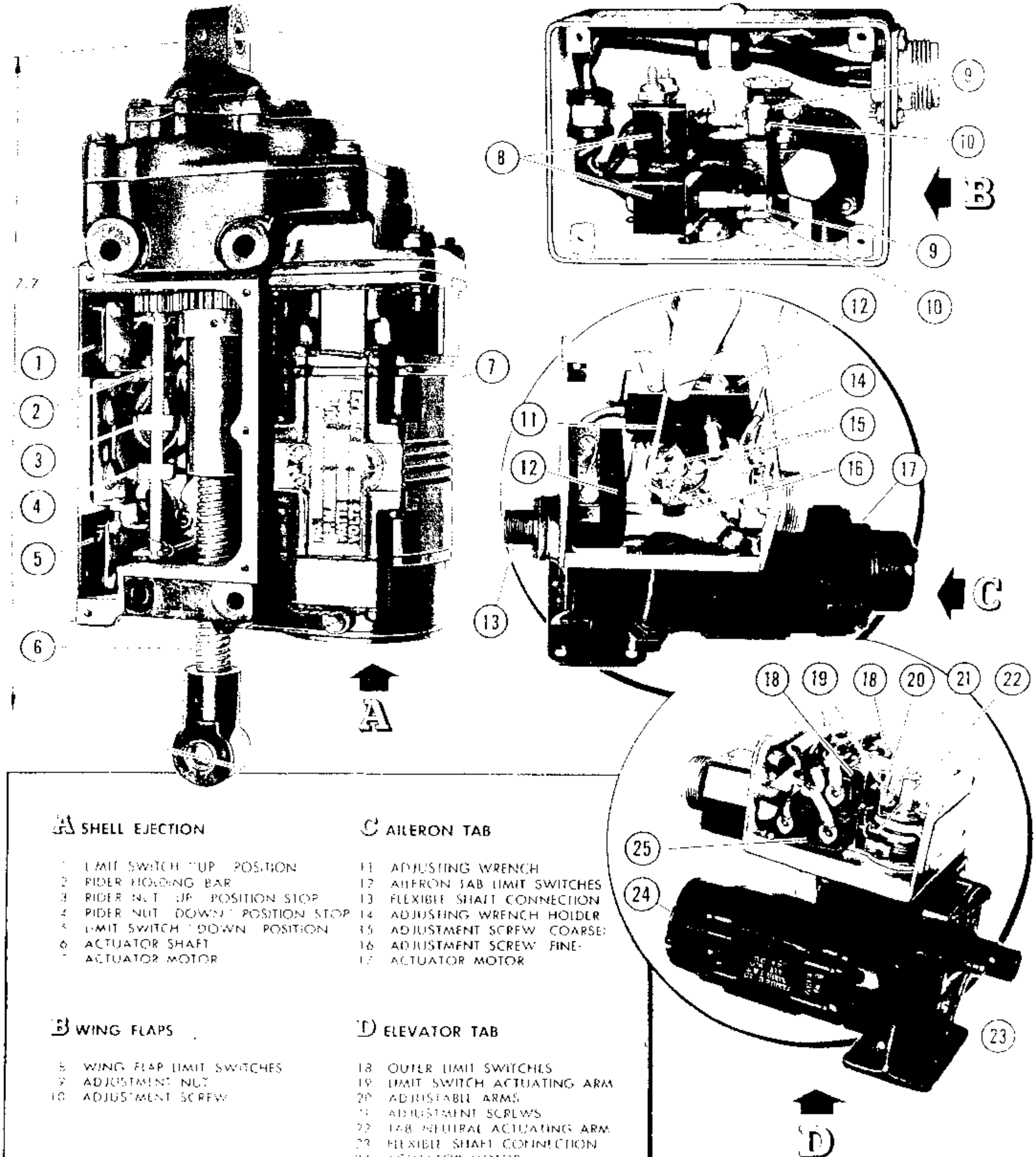
F80A-10 WINTERIZED AIRPLANES AND OTHERS INCORPORATING B-7 GRIP

AIRPLANES NOT INCORPORATING B-7 GRIP ARE WIRED AROUND RELAYS PER T.O. NO. 1F-80-34

1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

*Figure 201C — Elevator Tab Actuator Circuit, F-80A-10 and RF-80A-10 Airplanes Incorporating T. O. 1F-80-151*




A SHELL EJECTION

1 LIMIT SWITCH "UP" POSITION
2 RIDER HOLDING BAR
3 RIDER NUT "UP" POSITION STOP
4 RIDER NUT "DOWN" POSITION STOP
5 LIMIT SWITCH "DOWN" POSITION
6 ACTUATOR SHAFT
7 ACTUATOR MOTOR

B WING FLAPS

8 WING FLAP LIMIT SWITCHES
9 ADJUSTMENT NUT
10 ADJUSTMENT SCREW

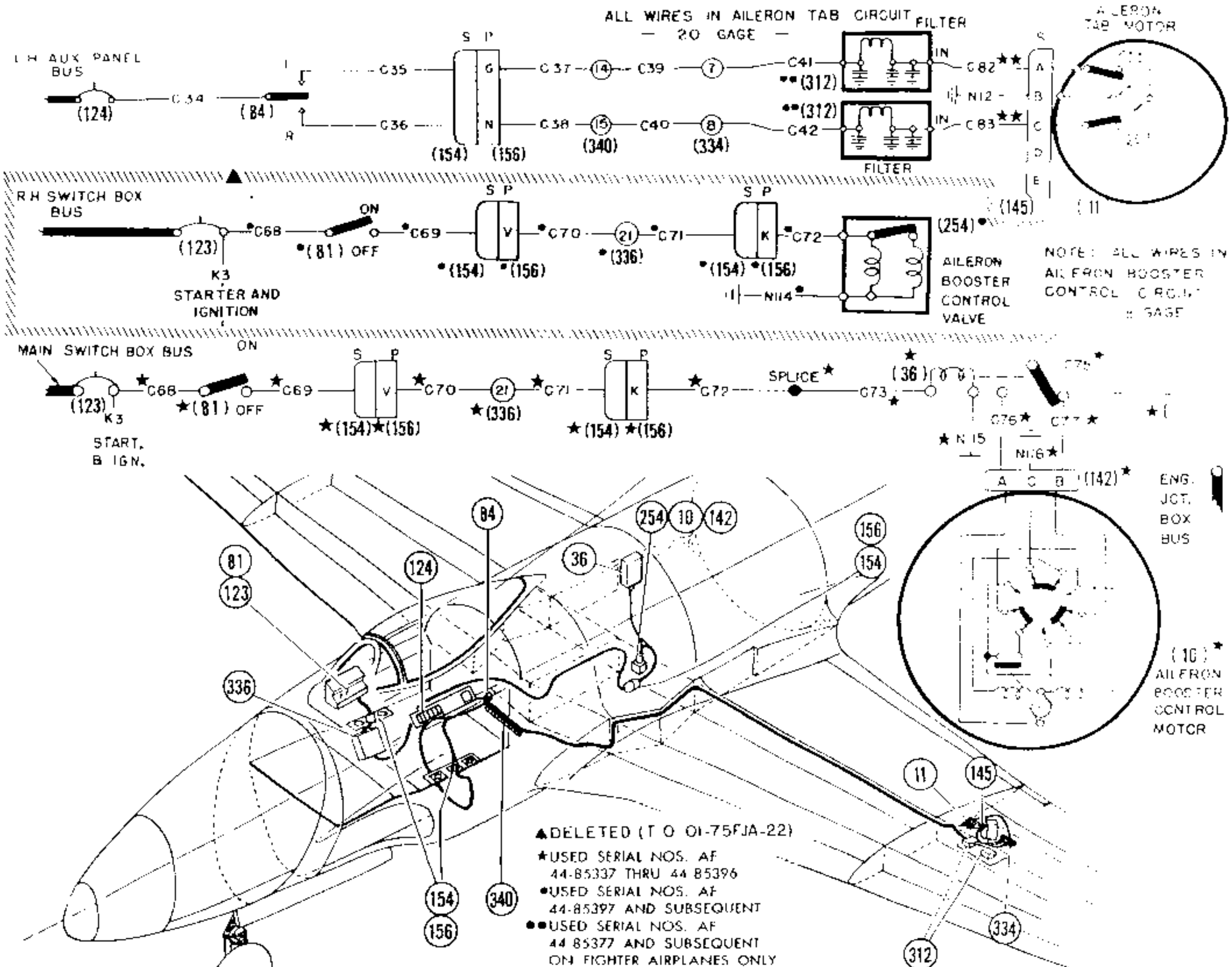
C AILERON TAB

11 ADJUSTING WRENCH
12 AILERON TAB LIMIT SWITCHES
13 FLEXIBLE SHAFT CONNECTION
14 ADJUSTING WRENCH HOLDER
15 ADJUSTMENT SCREW (COARSE)
16 ADJUSTMENT SCREW (FINE)
17 ACTUATOR MOTOR

D ELEVATOR TAB

18 OUTER LIMIT SWITCHES
19 LIMIT SWITCH ACTUATING ARM
20 ADJUSTABLE ARMS
21 ADJUSTMENT SCREWS
22 TAB NEUTRAL ACTUATING ARM
23 FLEXIBLE SHAFT CONNECTION
24 ACTUATOR MOTOR
25 INNER LIMIT SWITCHES (ON BOTH SIDES)

*Figure 202 — Actuator Limit Switch Adjustment*




| ITEM | DESCRIPTION | MFR. | DWG OR SPEC | LOCATION |
|---|---|---|---|---|
| ★10 | BOOSTER CONTROL MOTOR | BENDIX | 405381 | ENGINE COMPARTMENT |
| 11 | AILERON TAB MOTOR | LEAR | 157V | LH WING |
| ★36 | RELAY | EL. PROD. | NB-57-C | ENGINE JUNCTION BOX |
| 81 | SWITCH | C.H. | AN3021-2 | LH SHELF |
| 84 | SWITCH | C.H. | AN3021-7 | LH SHELF |
| 123 | CIRCUIT PROTECTOR | SPENCER | PSM-10 | RH SWITCH BOX |
| 124 | CIRCUIT PROTECTOR | SPENCER | PSM-15 | LH AUXILIARY SWITCH PANEL |
| ★142 | CONNECTOR | | AN3106-14S-7S | BOOSTER CONTROL MOTOR |
| 145 | CONNECTOR | | AN3106-16S-8S | TAB MOTOR |
| 154 | CONNECTOR | | AN3106-28-11S | |
| 156 | CONNECTOR | CANNON | 2312-41 | |
| •▲254 | SOLENOID VALVE | ADEL | 13701-8 | ENGINE COMPARTMENT |
| ••312 | FILTER | POTTER | B-120 | MIDWING |
| 334 | TERMINAL PANEL | LOCKHEED | LS1907-2 | MIDWING |
| 336 | TERMINAL PANEL | LOCKHEED | LS1926-19 | RH SUB-COCKPIT |
| 340 | TERMINAL PANEL | LOCKHEED | LS1909-12 | FUSELAGE WING |

AB 5036

*Figure 203 — Aileron Tab Actuator and Booster Control Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*

*2.* LIMIT SWITCHES. — With the flexible shaft connected to the motor, adjust the outer limit switches to stop the motor at tab-up and tab-down limits with the elevator in neutral. To make this adjustment, loosen the screws on the adjusting arms, adjust the arms, tighten the screws, and install the safety wire. Seal the screws with glyptal No. 1201, manufactured by General Electric Company, to insure better locking in position, and to indicate any change of setting.

*(c)* REMOVAL.—Run tab to full down position until the limit switch operates. Remove electrical disconnect plug. Disconnect flexible shaft from actuator. Remove four bolts and nuts, and remove the actuator.

*(d)* INSTALLATION.—Reverse removal procedure. See paragraph 15*d*(5), this section, for adjustment of tabs.

*m.* AILERON TAB ACTUATOR CIRCUIT. *(See figures 134, 203, and 203A.)*

(1) GENERAL.—The left aileron is equipped with an electrically operated trim tab. On airplanes with the type B-7 control stick grip (figure 212A) the aileron tab is controlled from a switch on this grip through relays in the cockpit aft junction box. On airplanes with the old type control stick grip (figure 212), the aileron tab switch is on the cockpit left shelf, and energizes the tab motor directly. The aileron-tab jack screw is driven by a flexible shaft from the actuator. The actuator is mounted near the inboard end of the aileron, immediately aft of the wing rear beam.

(1a) On airplanes incorporating T.O. 1F-80-151 an elevator trim tab override switch is installed in the cockpit under the left canopy sill. When the override switch is placed in the "OFF" position the aileron tabs cannot be controlled from the switch on the control stick.

(2) ACTUATOR.

*(a)* DESCRIPTION.—The actuator for driving the aileron tab is of the same general type as that used for controlling the elevator tab, except that the switch box does not incorporate a neutral position switch. See paragraph *l*(2) preceding for description of the actuator. Access to the actuator is through access panel No. 19 in the wing (figure 7).

*(b)* ADJUSTMENT. *(See figure 202.)*

*1.* Set actuator limit switches to obtain 160 to 164 revolutions of output shaft. If further adjustment is needed to obtain 20 (+2, —0) degrees of up travel and 20 (+2, —0) degrees of down travel, comply with instructions contained in steps 2 and 3.

*2.* Run the tab up and turn the up adjusting screw in the limit switch box until up limit switch operates.

*3.* Run the tab down and turn the down adjusting screw in the limit switch box until the down limit switch operates.

*4.* Seal the screws with glyptal No. 121 manufactured by General Electric Company, to insure better locking in position and to indicate any change of setting.

*(c)* REMOVAL.

*1.* Remove access panel No. 19 (figure 7) from the wing, and perform removal operation through this opening if the aileron is installed. If the aileron is not installed, perform the operation through the opening left in the aft edge of the wing.

*2.* Remove electrical terminal panel from its clips, and push it aside.

*3.* Loosen aileron cables at the turnbuckles, if the aileron is installed.

*4.* Remove four bolts attaching actuator to wing rib. If aileron is installed, it will be necessary to remove the limit switch cover, as shown in view C of figure 202, to get at the two upper bolts.

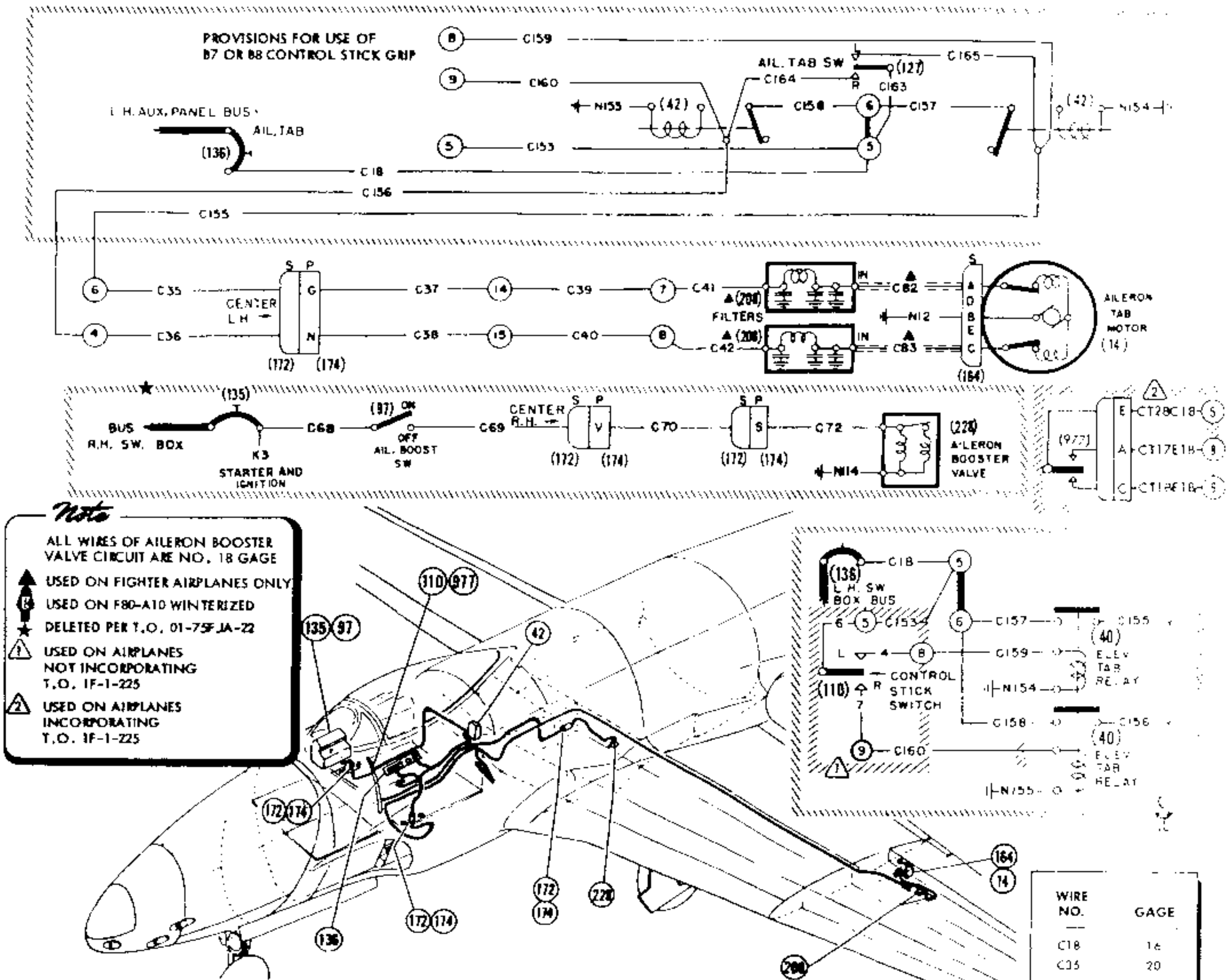
*5.* Remove the actuator, either through the aft edge of the wing or through panel No. 19.

*n.* AILERON BOOSTER CONTROL CIRCUIT. *(See figures 203 and 203A.)*—All airplanes except F-80A-1 have an electric solenoid-actuated shut-off valve in the hydraulic line to the aileron booster. Through this control the hydraulic pressure to the aileron booster may be shut off in case of malfunction of the booster. Previous to the installation of this electrically operated valve, the booster was shut off by turning off the generator. On airplanes modified by T.O. 01-75FJA-22, the solenoid-actuated aileron booster control valve is replaced by a manual control valve.

The booster control unit on the early F-80A-5 airplanes is an actuator identical to the dive flap selector-valve actuator, which operates a shut-off valve in the aileron booster hydraulic line. Other airplanes have a solenoid operated valve. The aileron booster control switch is on the cockpit right shelf and is normally in the "ON" position. In the "OFF" position the valve is energized, to shut off the booster. The circuit is protected by the same 10-ampere push-to-reset circuit protector that is in the starter and ignition circuit. Access to the control valve is through the lower access doors to the engine compartment. On winterized F-80A-10 airplanes, the shut-off valve is encased in a heated boot. The valve is accessible through a zipper.

*o.* PITOT HEATER CIRCUIT. *(See figures 197 and 197A.)*

(1) DESCRIPTION.—The pitot head employs an integral heater to prevent or remove the accumulation of ice. This insures correct operation of the air-speed




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 14 | MOTOR | LEAR | | 157V | LH WING |
| 40 | RELAY | | | AN3350-1 | COCKPIT AFT JCT BOX |
| 42 | RELAY | EL PROD SUP | | NB-52-C | COCKPIT AFT JCT BOX |
| ★ 97 | SWITCH | | | AN3021-2 | MAIN SWITCH BOX |
| 110 | SWITCH | | B-7 | | CONTROL STICK |
| 127 | SWITCH | | | AN3021-7 | COCKPIT LH SHELF |
| ★ 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SW BOX |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | LH AUXILIARY PANEL |
| 164 | CONNECTOR | | | AN3106-16S-8S | MOTOR |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P 28-11P | |
| ▲ 208 | FILTER | POTTER | | B-120 | LH WING |
| ★ 228 | SOLENOID VALVE | ADEL | | 13701-B | ENGINE COMPARTMENT |
| 977 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

| WIRE NO. | GAGE |
|---|---|
| C18 | 16 |
| C35 | 20 |
| C36 | 20 |
| C37 | 20 |
| C38 | 20 |
| C39 | 20 |
| C40 | 20 |
| C41 | 20 |
| C42 | 20 |
| ▲ C82 | 20 |
| ▲ C83 | 20 |
| C153 | 16 |
| C155 | [illegible] |
| C156 | [illegible] |
| C157 | [illegible] |
| [illegible] | [illegible] |
| C159 | [illegible] |
| [illegible] | [illegible] |
| [illegible] | [illegible] |
| [illegible] | |
| [illegible] | [illegible] |

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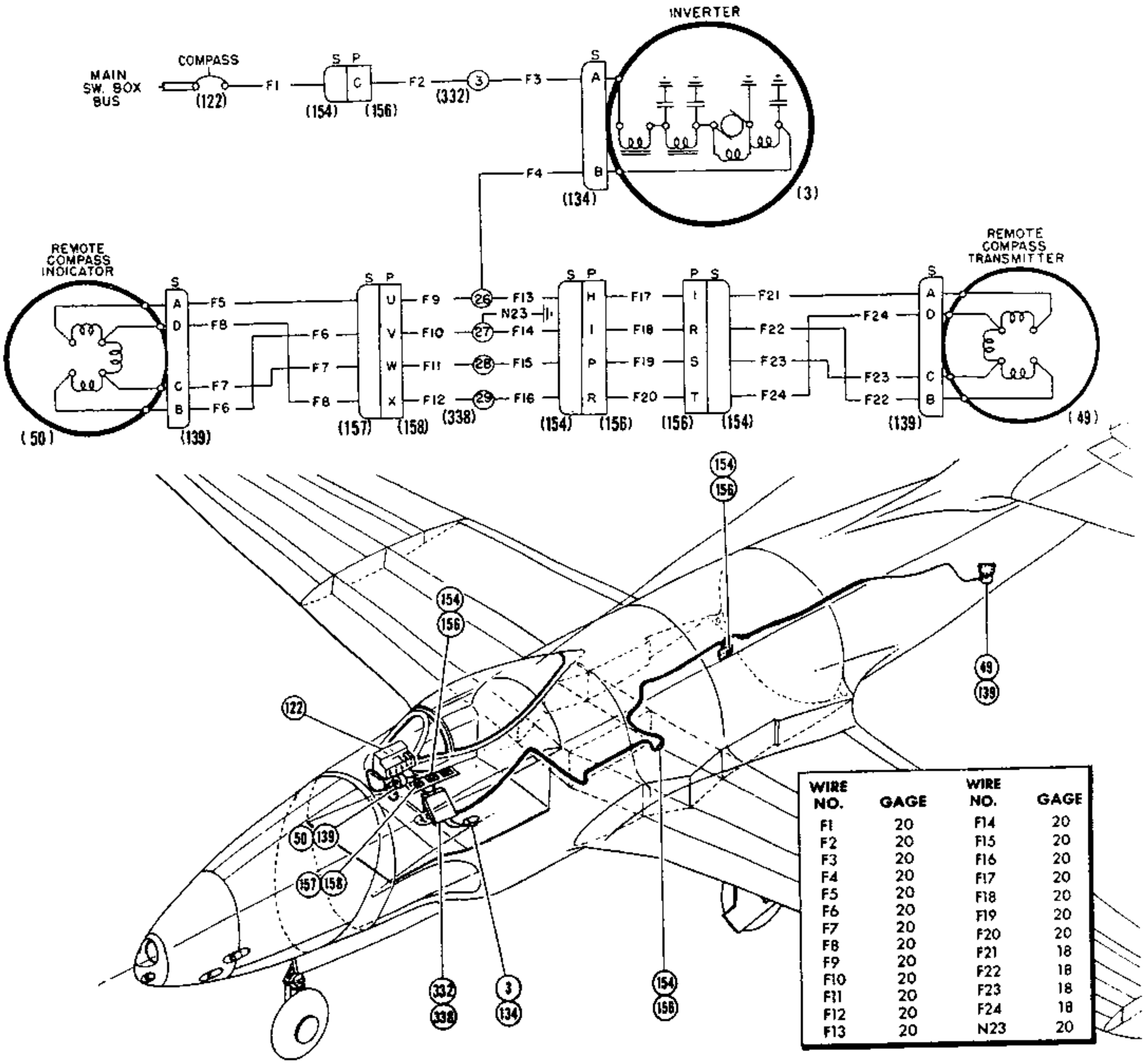
Figure 203A — Aileron Tab and Booster Control Circuit, F-80A-10 and RF-80A-10 Airplanes




| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| F1 | 20 | F14 | 20 |
| F2 | 20 | F15 | 20 |
| F3 | 20 | F16 | 20 |
| F4 | 20 | F17 | 20 |
| F5 | 20 | F18 | 20 |
| F6 | 20 | F19 | 20 |
| F7 | 20 | F20 | 20 |
| F8 | 20 | F21 | 18 |
| F9 | 20 | F22 | 18 |
| F10 | 20 | F23 | 18 |
| F11 | 20 | F24 | 18 |
| F12 | 20 | N23 | 20 |
| F13 | 20 | | |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 3 | INVERTER MOTOR | G.F.E. | 6 V.A. | 32270 | SUB-COCKPIT |
| 49 | REMOTE COMPASS TRANSMITTER | G.F.E. | | AN5730-3 | TAIL CONE |
| 50 | REMOTE COMPASS INDICATOR | G.F.E. | | AN5730-2a | INSTRUMENT PANEL |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 134 | CONNECTOR | | | AN3106-12S-3S | SUB-COCKPIT |
| 139 | CONNECTOR | | | AN3106-14S-2S | |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | RH SUB-COCKPIT JUNCTION BOX |
| 338 | TERMINAL PANEL | LOCKHEED | | LS1929-26 | RH SUB-COCKPIT JUNCTION BOX |

*Figure 204 — Remote Compass and Inverter Circuit, P-80A-1, P-80A-5, and FP-80A-5 Airplanes*

indicator. The pitot head on all airplanes except the F-80A-10 is attached to a mast which extends forward from the fin tip. The pitot head on F-80A-10 airplanes is under the fuselage nose. Control of the heater is by a 10-ampere switch-type circuit breaker on the main switch box.

(2) REMOVAL FROM FIN TIP.

*(a)* Remove fin tip. (See paragraph 2*b*(4), this section.)

*(b)* Disconnect electrical wiring.

*(c)* Disconnect and immediately cap the air line from the pitot head.

*(d)* Remove three screws attaching pitot head to the support. Remove pitot tube by pulling it forward.

(2A) REMOVAL FROM UNDER FUSELAGE NOSE.

*(a)* From inside armament compartment, remove left center gun.

*(b)* From forward inboard side of empty gun trough, remove clip from pitot pressure line.

*(c)* Disconnect line from forward end of elbow adjacent to hole where line goes through wall.

*(d)* From beneath airplane, remove six screws holding pitot tube bracket to bottom of airplane.

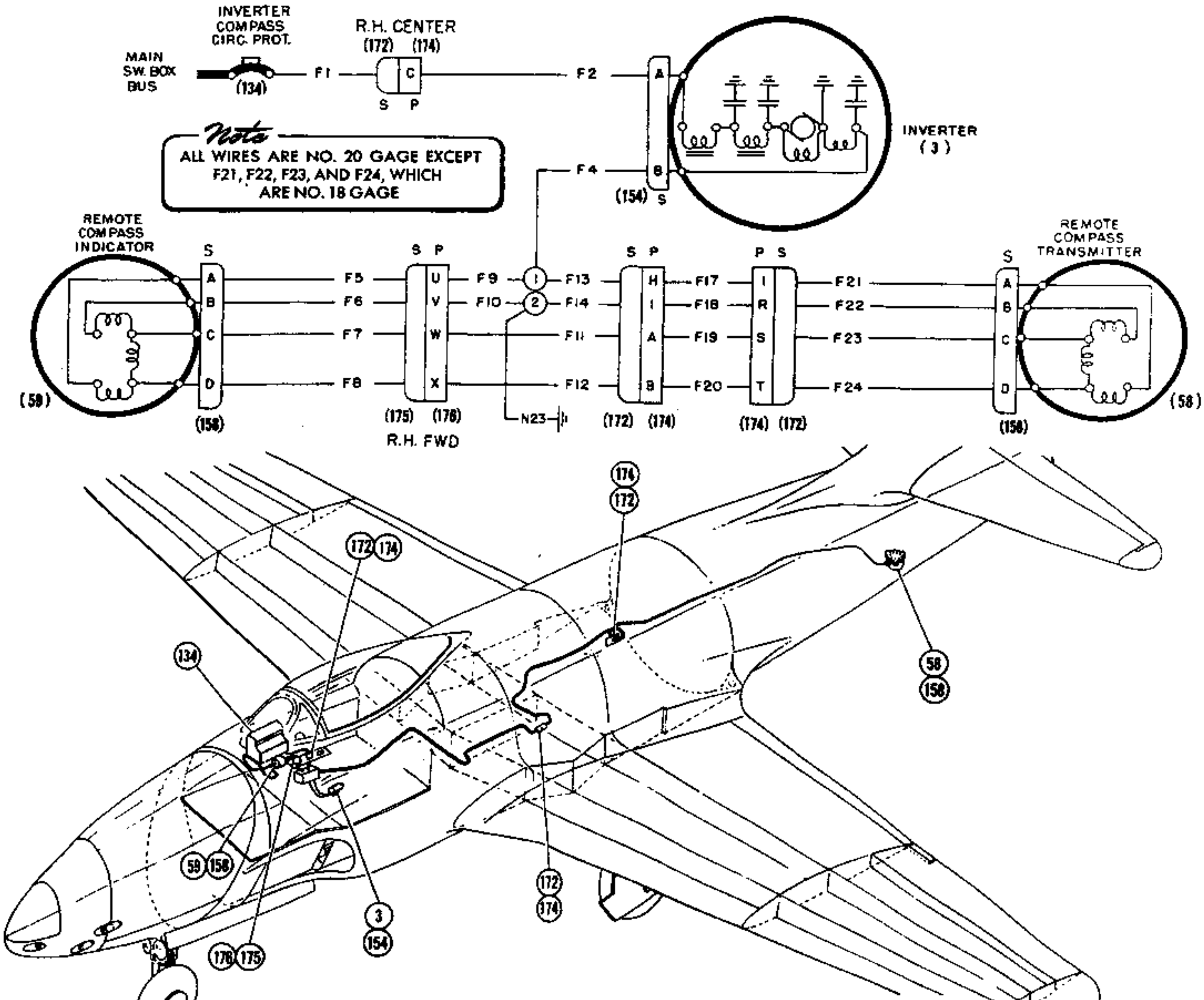
*(e)* Lower pitot tube a short distance, and remove electrical plug.

*(f)* Pull tube down until all plumbing is clear.

*p.* REMOTE COMPASS AND INVERTER CIRCUIT. *(See figures 204 and 204A.)*

(1) DESCRIPTION.—The compass heading is indicated by a remote-compass indicating system. The magnetic element of the compass is located in the aft section of the airplane, and drives the rotor of an autosyn transmitter as the heading is changed. The transmitter actuates the autosyn indicator at the instrument panel.

The remote indicating system operates on a 26-volt, 400-cycle alternating-current supply. This power is derived from a 6 volt-ampere inverter in the sub-cockpit compartment. The inverter derives its power from the 28-volt direct-current supply, and employs a 5-ampere circuit protector in the direct-current line.




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 3 | INVERTER | G.F.E. | 6VA | 32270 | SUB-COCKPIT |
| 58 | TRANSMITTER | G.F.E. | | AN5730-3 | TAIL CONE |
| 59 | INDICATOR | G.F.E. | | AN5730-2a | INSTRUMENT PANEL |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 154 | CONNECTOR | | | AN3106-12S-3S | INVERTER |
| 158 | CONNECTOR | | | AN3106-14S-2S | |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 175 | CONNECTOR | | | AN3106-28-12S | RH FLOOR |
| 176 | CONNECTOR | | | AN3102P-28-12P | RH FLOOR |

*Figure 204A — Remote Compass and Inverter Circuit, P-80A-10 and FP-80A-10 Airplanes*

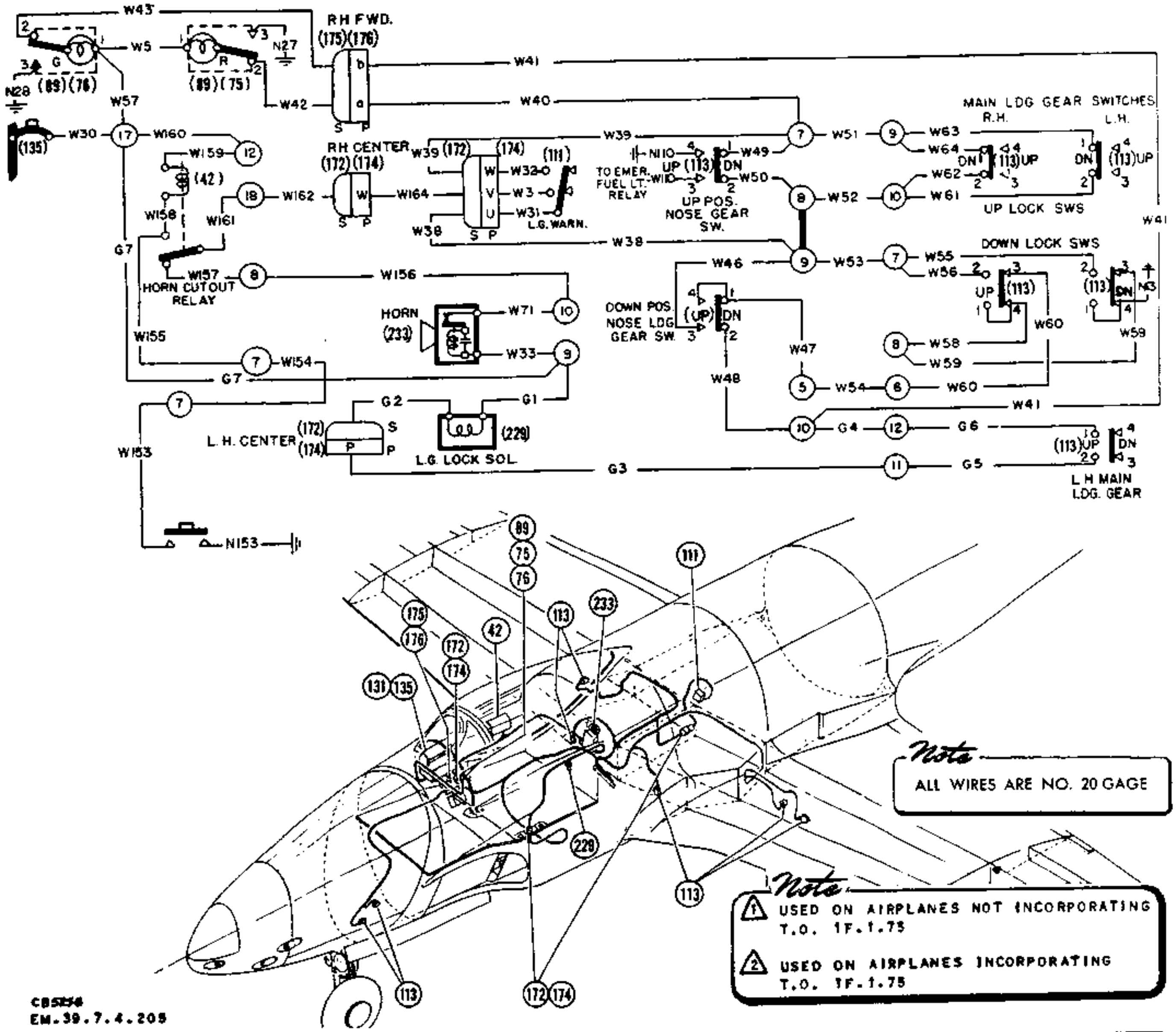
(2) COMPASS TRANSMITTER.—For detailed information and adjustment of the compass, see paragraph 14*b*(22)(*d*), this section.

**Note**

When replacing the access panel over the compass transmitter, use only non-magnetic screws.

(3) INVERTER.

(*a*) DESCRIPTION.—The 400-cycle, 26-volt inverter is rated at 6 volt-amperes. The unit contains an integral filter to reduce radio interference. The inverter is mounted on the right side of the sub-cockpit compartment.




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 42 | RELAY | EL PROD SUP | | NB.57.C | R.H. AUX SWITCH BOX |
| 75 | LIGHT | SEARLE | RED | AN3157.2 | INSTRUMENT PANEL |
| 76 | LIGHT | SEARLE | GREEN | AN3157.3 | INSTRUMENT PANEL |
| 89 | LIGHT | | | AN3121.313 | INSTRUMENT PANEL |
| 111 | THROTTLE SWITCH | MICROSW | | AN3218.1 | ENGINE COMPARTMENT |
| ⚠1 113 | SWITCH | G.E. | | CR.1070D110C3 | LANDING GEAR |
| ⚠2 113 | SWITCH | G.E. | | CR.1070D194G3 | LANDING GEAR |
| 125 | SWITCH | CUT. HAM. | | 8872 | L.H. SWITCH BOX |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM.5 | MAIN SWITCH BOX |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM.10 | |
| 172 | CONNECTOR | | | AN3106.28.11S | |
| 174 | CONNECTOR | | | AN3102P.28.11P | |
| 175 | CONNECTOR | | | AN3106.28.12S | R.H. FLOOR |
| 176 | CONNECTOR | | | AN3102P.28.12P | R.H. FLOOR |
| 229 | LOCK SOLENOID | CANNON | | W.5L | L.H. COCKPIT SHELF |
| 233 | HORN | ELECT. SUP | J.2 | 32462 | COCKPIT |

*Figure 205 — Alighting Gear Warning Circuit*

PAGES 310A AND 310B DELETED.

FIGURES 205A AND 205B DELETED.

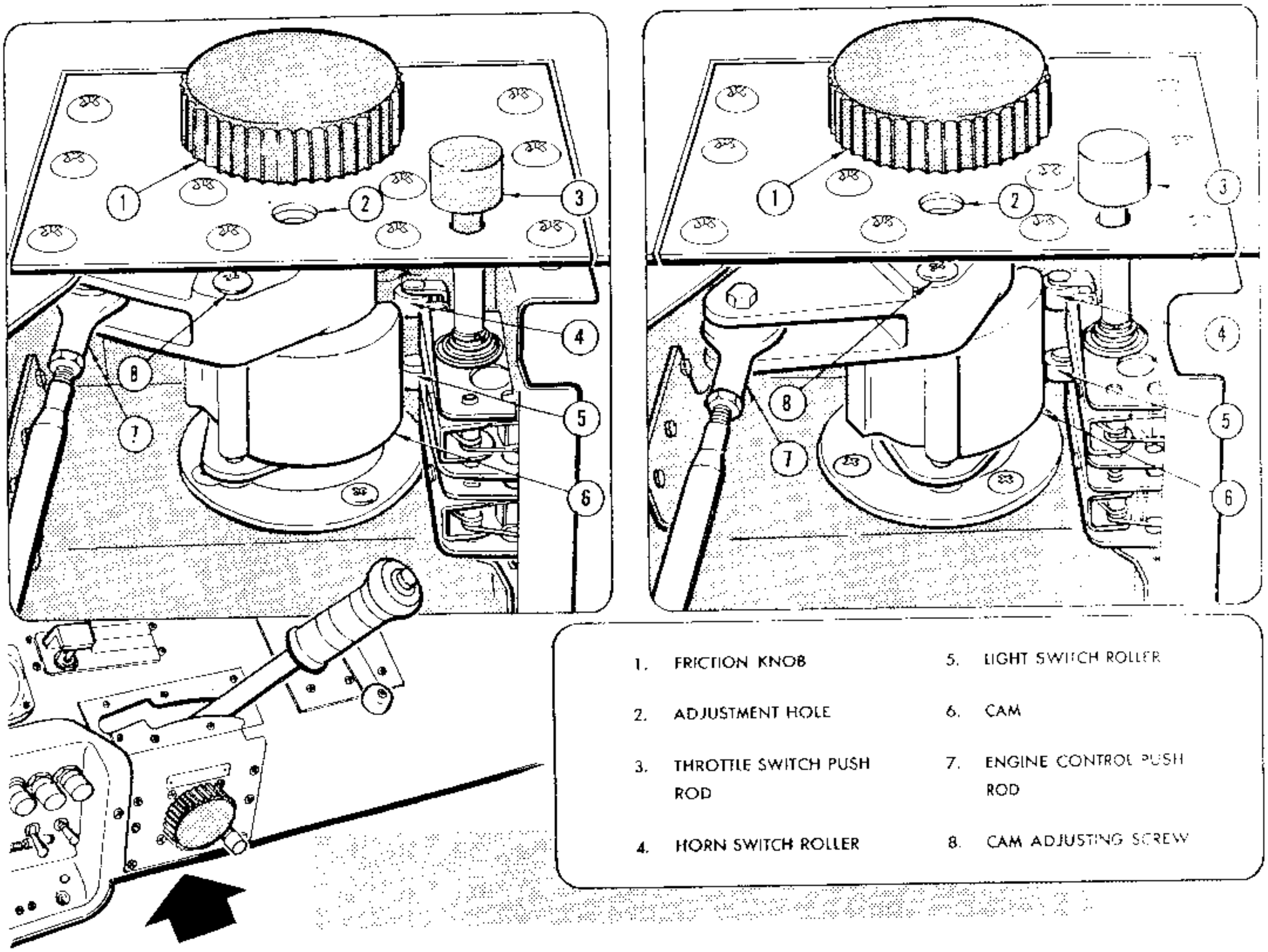



*Figure 206 — Throttle Switch Adjustment, P-80A-1, P-80A-5, and FP-80A-5 Airplanes*

*(b)* REMOVAL. — Remove electrical disconnect plug. Remove four screws and nuts, and remove the inverter.

*q.* ALIGHTING GEAR CIRCUIT.
*(See figures 205, 205A, and 205B.)*

(1) GENERAL.—Alighting gear circuits provide for the following functions:

*(a)* To indicate all gears locked in down position.

*(b)* To indicate all gears locked in up position.

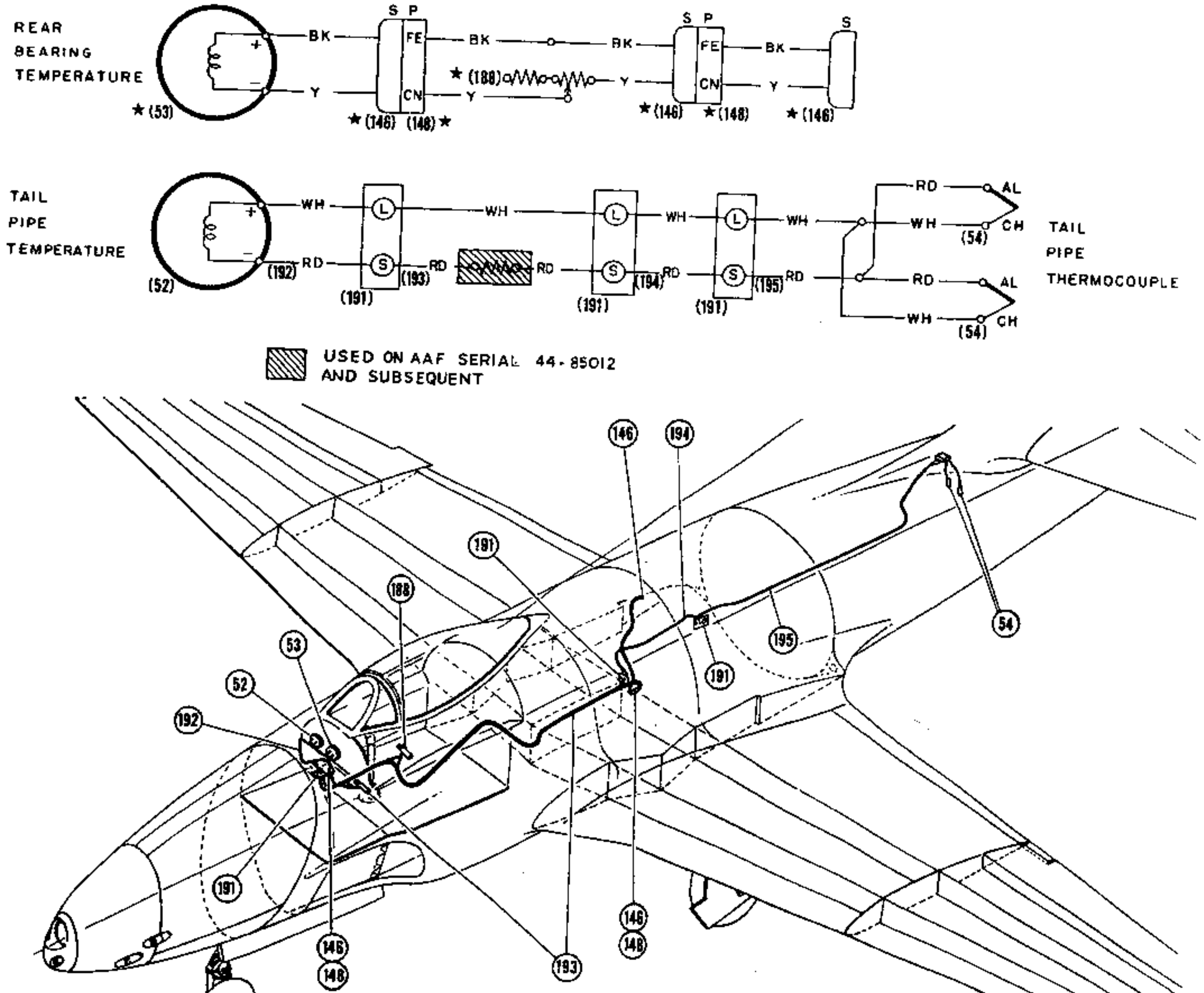
*(c)* To prevent the operation of the alighting-gear operating lever to the "GEAR UP" position until the weight of the airplane is removed from the gears.

*(d)* To give warning, visually and audibly, when the engine throttle is closed without all gears being down and locked.

(2) DOWN LOCK SWITCHES.—Down lock switches at each of the alighting gears actuate a green indicator light to show when all the gears are down and locked. The down lock switches are single-pole, double-throw switches. The nose-gear switch is mounted on the gear drag strut, and the main-gear switches are mounted on the side struts. The down lock contacts of the three switches are wired in series and grounded at the left gear switch. The switches in this position are in series with a green indicator light on the instrument panel. When the gears are all down and locked, the green-light circuit is completed to ground through the switches.

(3) UP LOCK SWITCHES.—Up lock switches at each of the three gears are wired in parallel to give an indication when the gears are up and locked. Until the three gears are up and locked, a red warning light on the instrument panel indicates an unlocked condition.

The nose-gear up lock switch is actuated by the up lock engagement fitting on the strut. This switch also operates a relay which opens the circuit to the emergency fuel system red indicator light, to turn the light off. (See paragraph *f*(6) preceding.) The main-gear up lock switches are actuated by the inner-door operating mechanism.



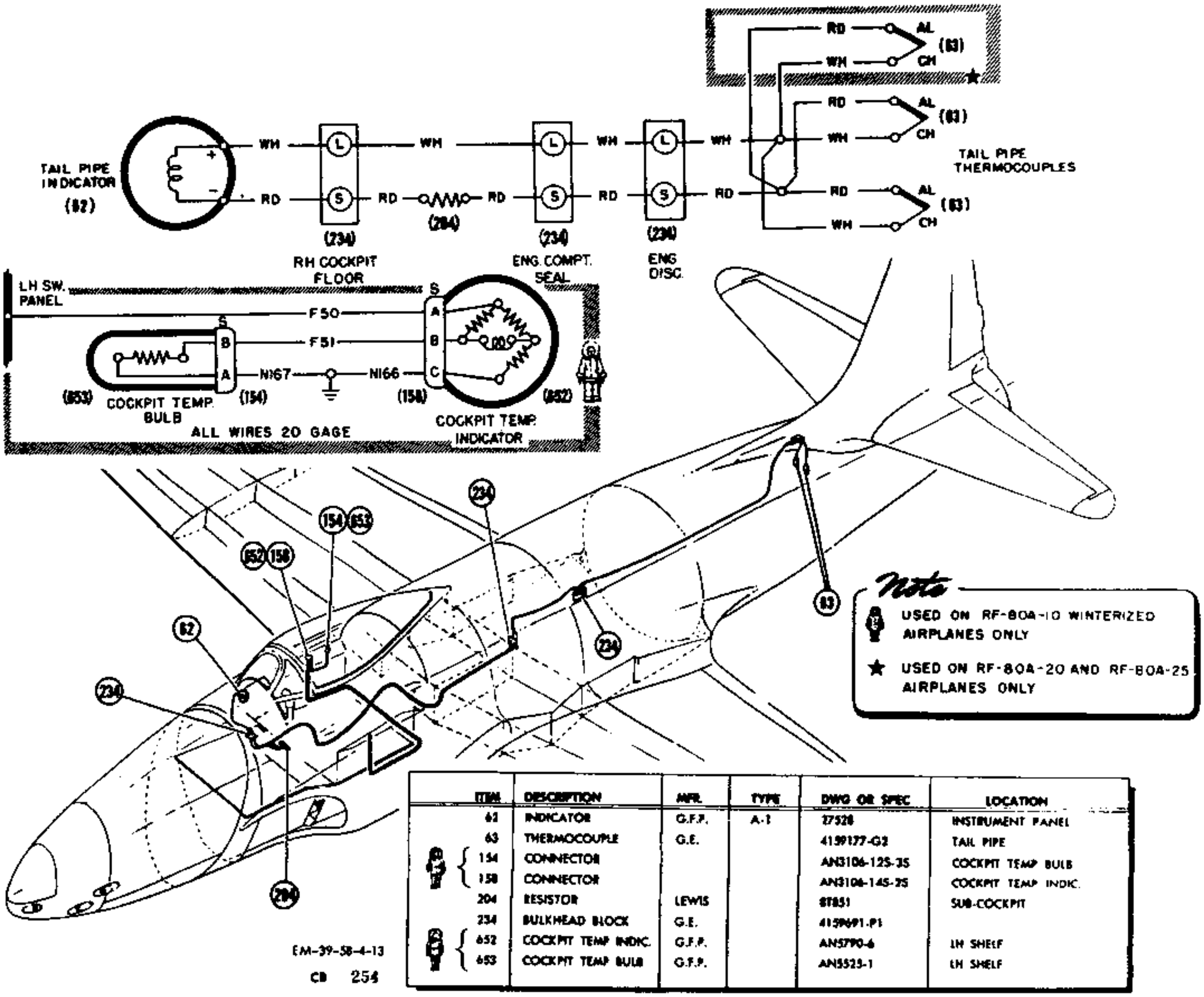

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 52 | TAIL PIPE TEMPERATURE INDICATOR | G.F.E. | A-1 | 27528 | INSTRUMENT PANEL |
| ★ 53 | REAR BEARING TEMPERATURE INDICATOR | G.F.E. | A-2 | 27529 | INSTRUMENT PANEL |
| 54 | THERMOCOUPLE | G.E. | | 4159177-G2 | TAIL PIPE |
| ★ 146 | CONNECTOR | | | AN3106-16-13S | |
| ★ 148 | CONNECTOR | CANNON | | 2307-7 | |
| ★ 188 | RESISTOR | OHMITE | | AN5535-1 | |
| 191 | BULKHEAD BLOCK | G.E. | | 4159691-P1 | SUB-COCKPIT |
| 192 | THERMOCOUPLE LEAD | G.E. | | 4159233-G4 | COCKPIT |
| 193 | THERMOCOUPLE LEAD | G.E. | | 4159262-62 | SUB-COCKPIT |
| 193 | THERMOCOUPLE LEAD | G.E. | | 4159318G-1 | SUB-COCKPIT |
| 194 | THERMOCOUPLE LEAD | G.E. | | 4159262-G1 | ENGINE COMPT |
| 195 | THERMOCOUPLE LEAD | G.E. | | 4159234-G8 | AFT FUSELAGE |

★INSTALLED AIRPLANE SERIAL NOS. AAF 44-84992 THRU 44-85256

*Figure 207 — Tail Pipe Thermocouple Circuit, P-80A-1, P-80A-5, and FP-80A-5 Airplanes*

(4) TORQUE ARM SWITCH AND ALIGHTING-GEAR SELECTOR VALVE LOCK SOLENOID. Operation of the alighting-gear selector valve lever to the "GEAR-UP" position when the weight of the airplane is on the gears, is prevented by the emergency release lever (3, figure 154). A solenoid, located behind the left-hand cockpit shelf and connected to the alighting-gear emergency release lever (2, figure 154) unlocks the selector valve when the weight of the airplane is off the gears.

The solenoid receives its power from the main switch box bus through a relay in the main switch box and is grounded through the torque arm switch on the left main alighting gear. When the airplane is on the ground, the switch is open. When the weight of the airplane is removed from the struts, the torque arms move to operate the switch, completing the circuit to the solenoid. This energizes the solenoid which lifts the emergency release lever, permitting operation of the alighting-gear control lever to the "GEAR-UP" position. On F-80A-1 and early F-80A-5 airplanes, the solenoid




| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 62 | INDICATOR | G.F.P. | A-1 | 27528 | INSTRUMENT PANEL |
| 63 | THERMOCOUPLE | G.E. | | 4159177-G2 | TAIL PIPE |
| 154 | CONNECTOR | | | AN3106-12S-3S | COCKPIT TEMP BULB |
| 158 | CONNECTOR | | | AN3106-14S-2S | COCKPIT TEMP INDIC. |
| 204 | RESISTOR | LEWIS | | 87851 | SUB-COCKPIT |
| 234 | BULKHEAD BLOCK | G.E. | | 4159691-P1 | |
| 652 | COCKPIT TEMP INDIC. | G.F.P. | | AN5790-6 | LH SHELF |
| 653 | COCKPIT TEMP BULB | G.F.P. | | AN5525-1 | LH SHELF |

*Figure 207A — Cockpit and Tail Pipe Temperature Circuits, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 Airplanes*

relay is operated through two more relays in such a way that it is energized until the nose alighting gear is up and locked, and the emergency fuel system is turned off. (See figures 189, 196B, 205, 205A, and 205B.)

(*a*) ADJUSTMENT OF ALIGHTING GEAR TORQUE ARM SWITCH.

*1.* Jack airplane with nose and wing jacks until tires are off the ground.

*2.* Place wheel jack under jacking lug of left main landing gear and compress the strut approximately three-quarters of an inch or compress by lowering the left wing jack.

*3.* Adjust torque arm lever by bending so that the arm opens the micro switch. (Bend lever as little as possible.)

*4.* Recheck by slowly compressing the strut, noting that the switch is actuated between one-half inch to one inch from the fully extended position.

*5.* After the switch has been adjusted to operate within the limits prescribed above, the strut should be fully compressed completely plunging the switch to determine that the switch does not "bottom-out". In addition, the tip of the switch lever must clear the shock strut by a minimum of 0.010 inch.

(5) ALIGHTING GEAR WARNING HORN CIRCUIT.

(*a*) GENERAL.—A warning horn located on the cockpit aft bulkhead gives an audible warning if any alighting gear is not locked in the down position when the throttle lever is moved near idle position during flight. The warning circuit includes the horn, a throttle switch assembly, and the down lock switches. A red indicator light on the instrument panel gives a visual warning of the same condition. The light is actuated by the throttle switch assembly, and is grounded through the down lock switches.

The engine-control-lever switch assembly on P-80A-1, P-80A-5, and FP-80A-5 airplanes consists of two switches actuated by a cam on the engine control lever. One switch controls the warning horn, and the other controls the indicator light. On airplanes with separate throttle and stopcock controls, when the throttle lever is moved to one inch (± 1/32 inch) in advance of the fully retarded position, both the horn and light are energized and give warning if the gears are not down and locked. On airplanes with the single throttle control lever, the switches are adjusted to operate 5/16 (± 1/32) inch in advance of the idle position. If it is desired to cut out the audible horn warning, the throttle-switch push rod may be operated to open the switch controlling the horn.

The engine-control lever switch assembly on P-80A-10 and FP-80A-10 airplanes consists of two switches mounted in the engine compartment on the forward bulkhead. The switches are operated by separately adjustable cams on a serrated spindle. One of the two switches is the alighting-gear warning-horn operating switch, and is set to blow the horn when the engine control lever switch is adjusted as described in paragraph (5)*(c)* following. If it is desired to stop the warning horn, press the button on the cockpit left shelf adjacent to the engine control lever. This operates a relay which disconnects the horn circuit.

Whenever the warning horn is silenced, the indicator light is not affected. To reset the warning horn switch, it is necessary only to advance the throttle.

*(b)* ENGINE CONTROL LEVER SWITCH ADJUSTMENT ON P-80A-1, P-80A-5, AND FP-80A-5 AIRPLANES. *(See figure 206.)*—The switches are operated by the adjustable cam on the throttle lever, and are adjusted as follows:

*1.* Remove cockpit trim panel No. 10 (See figure 248.) Move throttle lever to one inch (±1/16 inch) forward of the fully retarded position.

*2.* Through the adjusting hole directly below the friction adjusting knob, loosen adjusting screw enough to move the cam. Adjust the cam to the point where both switches just click when the throttle lever is one inch in advance of idle position.

*3.* Tighten the adjusting screw, and replace trim panel No. 10.

*(c)* ADJUSTMENT OF ENGINE CONTROL LEVER SWITCHES ON P-80A-10 AND FP-80A-10 AIRPLANES. *(See figure 196A.)*

*1.* Pull out two hinge pins and remove cover from switches.

*2.* For alighting gear warning-horn switch, turn adjusting screw in cam until switch clicks when engine control lever is placed 5/16 (± 1/32) inch forward of idle position.

**Note**

Alighting-gear warning horn limit switch is the one to which "WG" wires are attached.

*3.* For adjustment of fluid injection switch, see paragraph *gA*(2) preceding.

*4.* Replace cover and hinge pins.

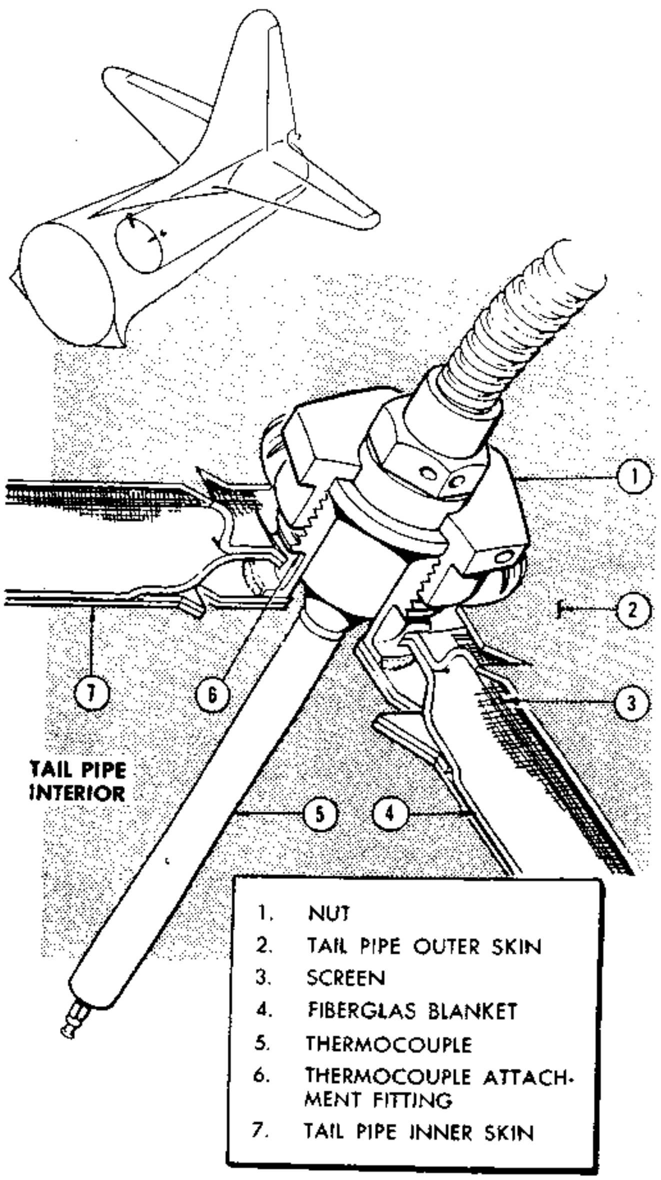



*Figure 208 — Tail Pipe Thermocouple Installation*

*r.* THERMOCOUPLE CIRCUIT.
*(See figures 207, 207A, and 208.)*

(1) GENERAL.—A thermocouple circuit employing two thermocouples is provided to indicate tail pipe temperature. The two leads from the thermocouple are of Alumel and Chromel. An indicator on the instrument panel registers tail pipe temperature from these two thermocouples.

The thermocouple circuit generates its own current and is therefore independent of the airplane electrical system. The thermocouple circuits of airplanes Serial Nos. AF44-85012 and subsequent employ a fixed resistor mounted in the sub-cockpit compartment. Other airplanes do not have this resistor. The leads from the thermocouple units (hot junction) to the indicator (cold junction) are of specific length, resistance, and material, and must not be altered in any way.

(2) ADJUSTMENTS.

*(a)* Connect a jumper across the terminals of the tail pipe temperature indicator. Disconnect lead at one end of the series resistor in the sub-cockpit compartment, and insert the test instrument in the circuit.

*(b)* Adjust resistor to obtain a circuit resistance value of 8.0 ohms (±0.1 ohm) as follows: Remove cover and unwind resistance wire from spool (coil) until the desired resistance value is obtained. Cut off surplus wire and solder end of remaining wire to lug provided for that purpose.

**Note**

The second coil of resistance wire is for service replacement only and should not be used unless resistance is less than 8.0 ohms.

*(c)* Disconnect test instrument, reconnect lead to resistor, and remove jumper from terminals of indicator.

(3) EXHAUST JET TEMPERATURE CHECK PROCEDURE. Equipment required: one B and H Instrument Co., "Jet Cal Tester", No. BH112F-15 (Stock No. 7-CAD-807200) one set of four B and H Instrument Co. Heater Probe-¼-inch, No. BH372, and one N-3 Field Test Set.

*(a)* Connect heater harness to long four pin cable. Connect long four pin cable to four hole plug on tester.

*(b)* Position tester controls as follows:

Variac—Zero.
Switch No. 1—Normal.
Switch No. 2—Off.
Heat Range Switch—Center.
Zero SC Switch—Center.
Standard Cell Rheostat—Off.

*(c)* Connect tester to 110 volt, 50-60 cycle alternating current power supply.

**Note**

Use a constant voltage power source. A power source whose voltage varies will cause temperature fluctuations in the equipment.

*(d)* Place Zero SC switch in zero position.

*(e)* Zero galvanometer using knob above meter dial.

*(f)* Place Zero SC switch in SC position.

*(g)* Zero galvanometer by turning Standard Cell rheostat clockwise until meter needle registers zero.

*(h)* Place switch No. 2 in "ON" position. Allow approximately two minutes for test probe to heat. Place Heat Range switch in 0°—300°C position.

*(i)* Place heaters, one at a time, over test probe and watch for temperature rise indication on galvanometer. This is to check for errors in calibration due to one or more heaters being inoperative.

*(j)* Set Variac control for maximum heat output. Place Heat Range switch in 300°—1000°C position.

*(k)* When heater temperature rises to approximately 500°C, use heater unit and place it momentarily over each engine thermocouple unit. Airplane exhaust temperature indicator shall show a rise as heater is placed over thermocouple. This is to check for errors in calibration due to one or more thermocouples being inoperative.

**Note**

Heater temperature may be read by rotating potentiometer knob until galvanometer needle reads zero. Potentiometer scale will then read number of degrees Centigrade.

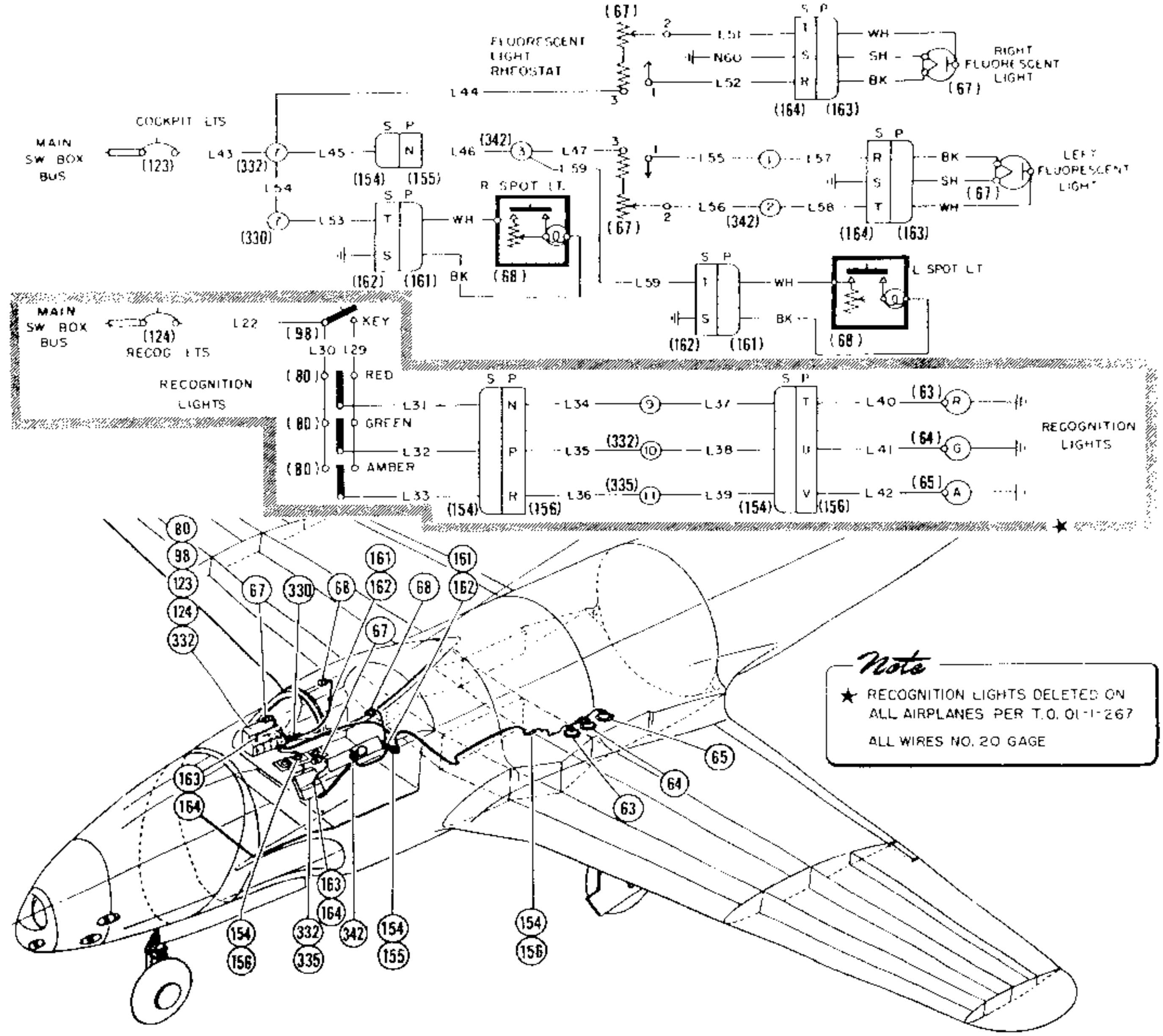
*(l)* Place heaters over each engine thermocouple. Make certain that heaters are fully installed and held firmly in place.

*(m)* Place cover over tail cone when making check outside hanger or when in any area where the wind is blowing.

*(n)* Adjust Variac to a point where potentiometer shall read 700°C.

**CAUTION**

Do not exceed 900°C at any time.




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 63 | RECOGNITION LIGHT | GFAE | E-2 RED | AN3096-5 |
| 64 | RECOGNITION LIGHT | GFAE | E-2 GREEN | AN3096-6 |
| 65 | RECOGNITION LIGHT | GFAE | E-2 AMBER | AN3096-4 |
| 67 | FLUORESCENT LIGHT | | C-5 | AN3038-1 |
| 68 | SPOT LIGHT | | C-4 | 94-32294 |
| 80 | SWITCH | C.H. | | AN3021-1 |
| 98 | SWITCH | MICROSW. | | AN3210-1 |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 |
| 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 |
| 154 | CONNECTOR | | | AN3106-28-11S |
| 155 | CONNECTOR | | | AN3102-28-11P |
| 156 | CONNECTOR | CANNON | | 2312-41 |
| 161 | CONNECTOR | MALLORY | | PL-55 |
| 162 | CONNECTOR | MALLORY | | SC-1 |
| 163 | CONNECTOR | MALLORY | | PL-68 |
| 164 | CONNECTOR | MALLORY | | SCA-28 |
| 330 | TERMINAL PANEL | LOCKHEED | | LS1906-2 |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 |
| 335 | TERMINAL PANEL | LOCKHEED | | LS1926-12 |
| 342 | TERMINAL PANEL | LOCKHEED | | LS1902-2 |

EM-39-58-4-25

CB 251

*Figure 209 — Cockpit and Recognition Lights Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*

**Note**

Stabilize temperature at above settings by adjusting potentiometer to read desired setting when galvanometer reads zero and by adjusting Variac to maintain a zero setting on galvanometer.

*(o)* Allow temperature to stabilize at setting called out in step n., for approximately two minutes.

*(p)* Read exhaust temperature indicator and potentiometer scale. Readings should agree within ±5°C.

*(q)* If readings are not within tolerance, disconnect thermocouple leads at the following points: exhaust temperature indicator, system resistor, and airplane to engine disconnect.

*(r)* Clean all connections with No. 280 wet or dry type tbrasive paper, wipe with methyl-ethyl-ketone, Federal Specification TT-M-261, air dry. Wipe with clean flannel cloth, and reassemble without any foreign contact with connection.

**Note**

Connections between system resistors and thermocouple leads must be a direct lead contact rather than a nut contact. Any hand contact with connections will start a corrosive film.

*(s)* Perform a system resistance check per paragraph 17*r*(2).

*(t)* Recheck system calibration per steps 1 through p.

*(u)* If indicator and potentiometer scale do not agree within ±20°C. from potentiometer reading, adjust indicator using N-3 Field Test Set set to zero at temperature settings given in step n.

**Note**

If indicator and potentiometer scale readings vary more than ±20°C., replace indicator.

*(v)* Set limit pointer of indicator, to a position 1/64-inch above 1000°C graduation.

*(w)* Paint a line approximately 1/32-inch wide through the slot in the indicator zero adjusting screw and extending 1/8-inch onto cover glass on either side of screw, using white lacquer, Stock No. 7300-529858.

*rA.* COCKPIT TEMPERATURE INDICATOR, F-80A-10 WINTERIZED AIRPLANES. *(See figure 209.)* —A resistance type cockpit temperature bulb and indicator are mounted on the cockpit left shelf. The indicator has a range of from −70° to +150°C (−94° to +302° F). Both units are powered from the cockpit left bus.

*s.* RECOGNITION LIGHTS CIRCUIT. *(See figures 209 and 209A.)*—Red, green, and amber lights for aircraft recognition are located on the bottom of the fuselage, on the fuel compartment access door. The lights may be controlled individually by switches on the main switch box, or keyed by a keying switch adjacent to the individual switches. (See figure 246.) The circuit is protected by a 15-ampere circuit protector in the main switch box. Limit ground operation of recognition lights to 10 seconds.

**Note**

Recognition light components are not required on aircraft operating within the continental limits of the United States. (Refer to T.O. 01-1-267.)

*sA.* NAVIGATION AND POSITION LIGHTS.

**Note**

Early F-80A-1, F-80A-5, RF-80A-5, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20, and RF-80A-25 airplanes not modified in accordance with T.O. No. 1F-80-41 are equipped with one tail light assembly. Airplanes modified in accordance with T.C. No. 1F-80-41 are equipped with two tail light assemblies. (Refer to figures 210 and 210B.) Lockheed Aircraft Serivce modified airplanes have two white and two yellow tail light assemblies installed.

Position lights and a flasher unit are added and navigation lights are relocated according to Air Force Drawing Nos. X50J7370, 50H7883, and 50D7888. (Refer to figure 210C.)

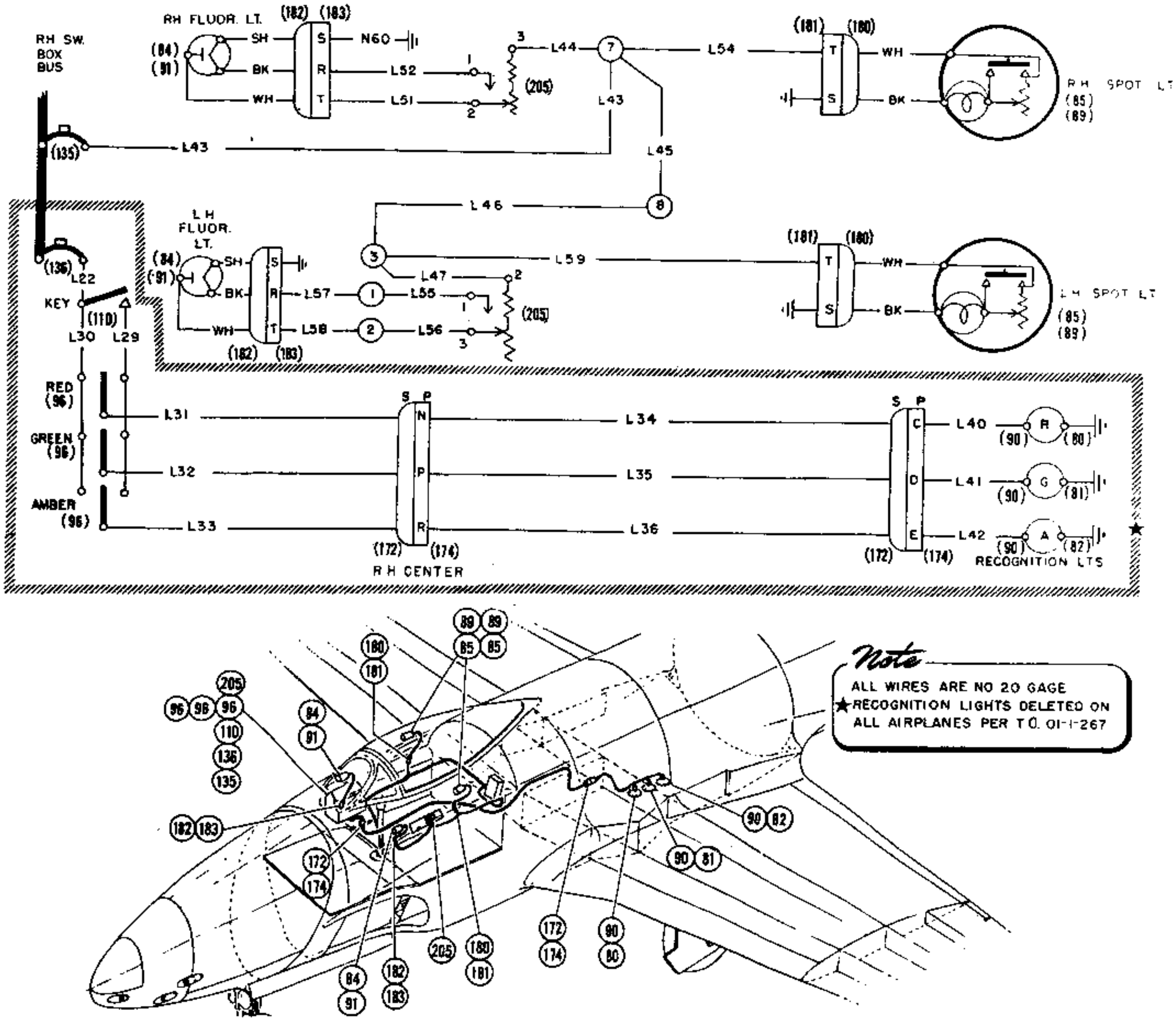
On Lockheed Aircraft Service modified airplanes, two sets of position lights, a flasher unit, and two wing tip and four tail lights are installed. One set of position lights is mounted in a fitting with a plastic lens on top of the fuselage aft section. The other set is mounted in the same type fitting at the bottom of the fuselage aft section. Each fitting contains a six-watt lamp and a 100-watt lamp. Two tail position lights are mounted one above the other on each side of and near the top of the fin. The top light incorporates a yellow lens, and the bottom light a frosted white lens.

*sB.* FLASHER UNIT.—This unit is mounted in the top of the armament compartment on fighter airplanes, and at the rear of the camera compartment on photographic airplanes. It regulates two flashing sequences. The first sequence alternately flashes both wing tip lights and the white tail lights and then the yellow tail lights at the rate of 40 cycles per minute. The second sequence flashes the fuselage 100-watt position lights in a series of dots and dashes to reproduce any one of the 12 code letters selected on the code selector switch. The dot flash is 0.5 second long, and the dash 1.5 seconds. The interval between dots and dashes of one letter is 0.5 second; the interval between letters is approximately 1.5 seconds.

*t.* NAVIGATION AND POSITION LIGHTS CIRCUIT. *(See figures 210, 210A, 210B, and 219.)*—The function of this circuit is to flash the wing tip lights, tail lights, and 100-watt position lights. The flasher unit is controlled by one of the two navigation light switches on the cockpit right shelf. This switch has "STEADY," "OFF," and "FLASH" positions. The second switch has "BRIGHT" and "DIM" positions. All navigation and position lights are controlled by these two switches.

*u.* LANDING LIGHT CIRCUIT. *(See figure 210.)*

(1) DESCRIPTION.—On F-80A-1 and early F-80A-5 airplanes Serial Nos. AF44-84992 through 44-85376, an adjustable landing light is provided in the nose of the fuselage behind a transparent plastic enclosure. The light may be adjusted from the cockpit for landing position or for night combat position by a




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 80 | LIGHT | | RED | AN3096-5 | ENGINE COMPARTMENT |
| 81 | LIGHT | | GREEN | AN3096-6 | ENGINE COMPARTMENT |
| 82 | LIGHT | | AMBER | AN3096-4 | ENGINE COMPARTMENT |
| 84 | LIGHT | | C-5 | AN3038-1 | COCKPIT |
| 85 | SPOT | | C-4A | 94-32294 | COCKPIT |
| 89 | LAMP | | | AN3121-313 | COCKPIT |
| 90 | LAMP | G.F.E. | | AN3120-1047 | ENGINE COMPARTMENT |
| 91 | LAMP | | | AN3125-1 | COCKPIT |
| 96 | SWITCH | | | AN3021-1 | MAIN SWITCH BOX |
| 110 | SWITCH, KEY | | | AN3210-1 | MAIN SWITCH BOX |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | MAIN SWITCH BOX |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 180 | CONNECTOR | MALLORY | | PL-55 | |
| 181 | CONNECTOR | MALLORY | | SC-1 | |
| 182 | CONNECTOR | MALLORY | | PL-68 | |
| 183 | CONNECTOR | MALLORY | | SCA-28 | |
| 205 | RHEOSTAT | GRIMES | | A-2334A | LH AUX SWITCH PANEL |

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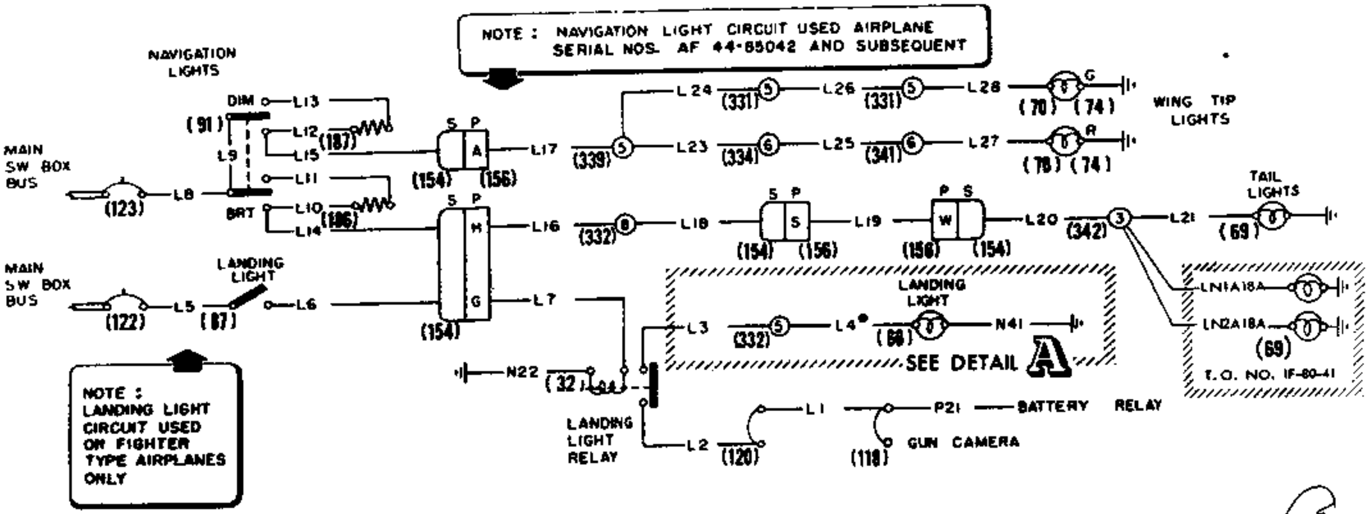
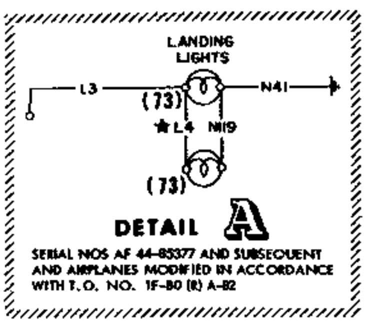
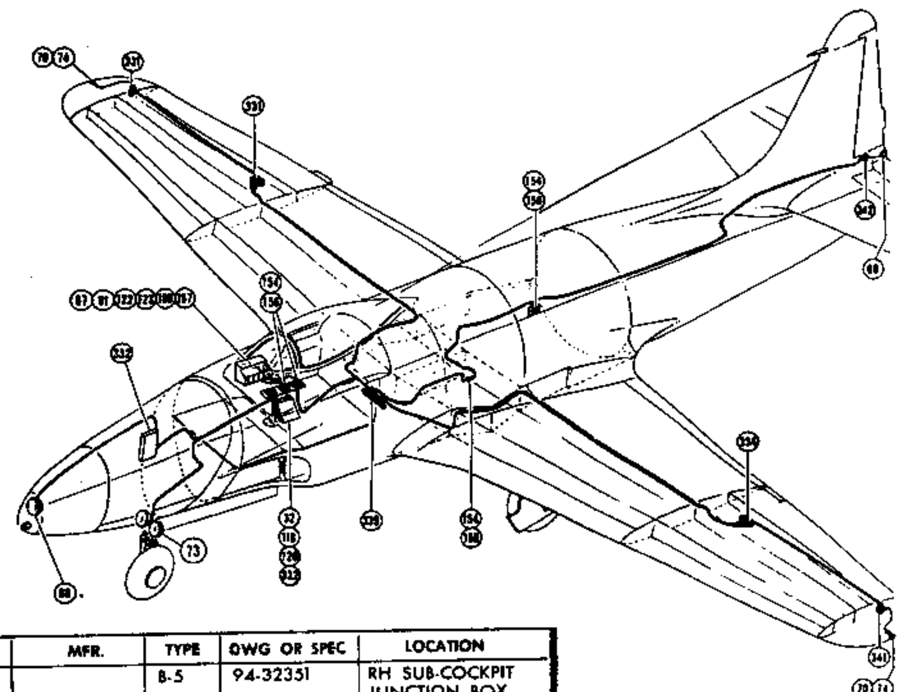
*Figure 209A — Cockpit and Recognition Lights Circuit, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20, and RF-80A-25 Airplanes*



| WIRE NO. | GAGE |
|---|---|
| L1 | 12 |
| L2 | 12 |
| L3 | 12 |
| ★L4 | 18 |
| •L4 | 12 |
| L5 | 20 |
| L6 | 20 |
| L7 | 20 |
| L8 | 20 |
| L9 | 20 |
| L10 | 20 |
| L11 | 20 |
| L12 | 20 |
| L13 | 20 |
| L14 | 20 |
| L15 | 20 |
| L16 | 20 |
| L17 | 20 |
| L18 | 20 |
| L19 | 20 |
| L20 | 18 |
| L21 | 18 |
| L23 | 20 |
| L24 | 20 |
| L25 | 20 |
| L26 | 20 |
| L27 | 20 |
| L28 | 20 |
| N22 | 20 |
| N41 | 12 |
| N119 | 18 |
| P21 | 12 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 32 | RELAY | | B-5 | 94-32351 | RH SUB-COCKPIT JUNCTION BOX |
| 66 | LANDING LIGHT | G.F.A.E. | G.E. | 4541 | NOSE |
| 69 | TAIL LIGHT | G.F.A.E. | | AN3091-2 | TAIL |
| 70 | WING TIP LIGHT | GRIMES | | A1825 | WING TIP |
| 73 | LANDING LIGHT | G.E. | | AN3129-4523 | NOSE GEAR |
| 74 | LAMP | | CLEAR | AN3122-1524 | WING TIP |
| 87 | SWITCH | C.H. | | AN3022-4B | MAIN SWITCH BOX |
| 91 | SWITCH | C.H. | | AN3027-1 | MAIN SWITCH BOX |
| 118 | CIRCUIT PROTECTOR | SPENCER | | PA-10 | RH SUB-COCKPIT JUNCTION BOX |
| 120 | CIRCUIT PROTECTOR | SPENCER | | PA-35 | RH SUB-COCKPIT JUNCTION BOX |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 186 | RESISTOR | I.R.C. | MW-2 | 125 | MAIN SWITCH BOX |
| 187 | RESISTOR | OHMITE | DIVBE | 15Ω25W | MAIN SWITCH BOX |
| 331 | TERMINAL PANEL | LOCKHEED | | LS1904-2 | RH WING |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | ARM. JUNC BOX |
| 334 | TERMINAL PANEL | LOCKHEED | | LS1907-2 | LH WING |
| 339 | TERMINAL PANEL | LOCKHEED | | LS1909-2 | WING FUSELAGE |
| 341 | TERMINAL PANEL | LOCKHEED | | LS1905-2 | LH WING |
| 342 | TERMINAL PANEL | LOCKHEED | | LS1902-2 | TAIL |

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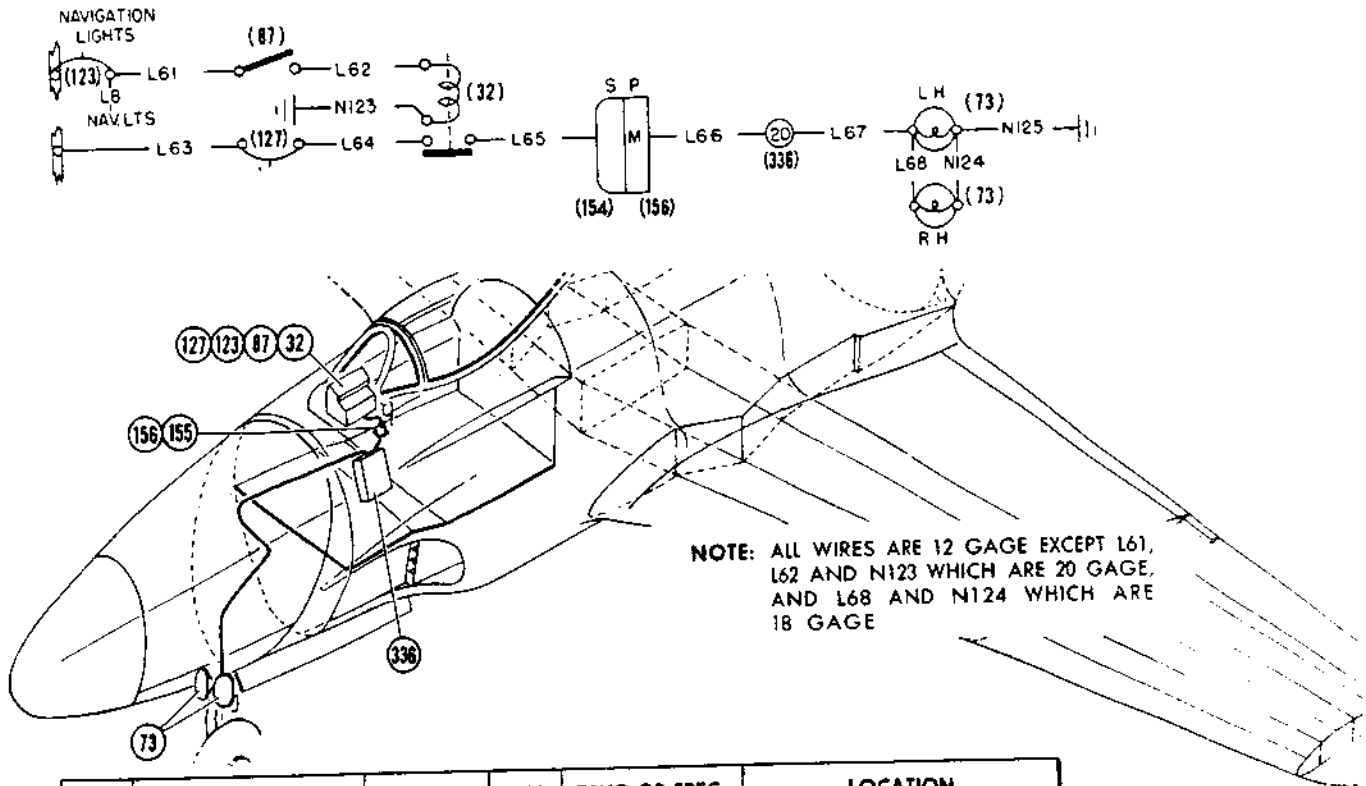
*Figure 210 — Landing and Navigation Lights Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*




| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 32 | RELAY | | B-5 | 94-32351 | RH SWITCH BOX |
| 73 | LIGHT | G.F.E. | | AN3129-4523 | NOSE GEAR |
| 87 | SWITCH | | | AN3022-4B | RH SWITCH BOX |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | RH SWITCH BOX |
| 127 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | RH SWITCH BOX |
| 154 | CONNECTOR | | | AN3106-28-11S | RH FLOOR |
| 156 | CONNECTOR | | | AN3102P-28-11P | RH FLOOR |
| 336 | TERMINAL PANEL | LOCKHEED | | LS1926-19 | RH SUB-COCKPIT JUNC BOX |

***Figure 210A — Landing Light Circuit, RF-80A-5 Airplanes***

flexible shaft. Access to the light is through the plastic cover. Photographic airplanes previous to serial Nos. AF45-8438 have no landing light. Later F-80A-5, RF-80A-5, RF-80A-10, all F-80A-10 airplanes, and airplanes modified in accordance with T. O. No. 1F-80(R)A-82 have two landing lights mounted on the nose alighting gear. These lights turn with the gear, and are not adjustable.

A switch on the cockpit left shelf controls the landing lights through a B-5A relay. The circuit and relay are protected by a five-ampere push-to-reset circuit protector in the main switch box. On fighter airplanes this relay is in the sub-cockpit right junction box, and connects the landing lights to the battery relay through a 35-ampere automatic resetting circuit protector in the same junction box On photographic airplanes, this relay is under the cockpit right shelf, and connects the lights to the main switch box bus through a 35-ampere push-to-reset circuit protector in the main switch box.

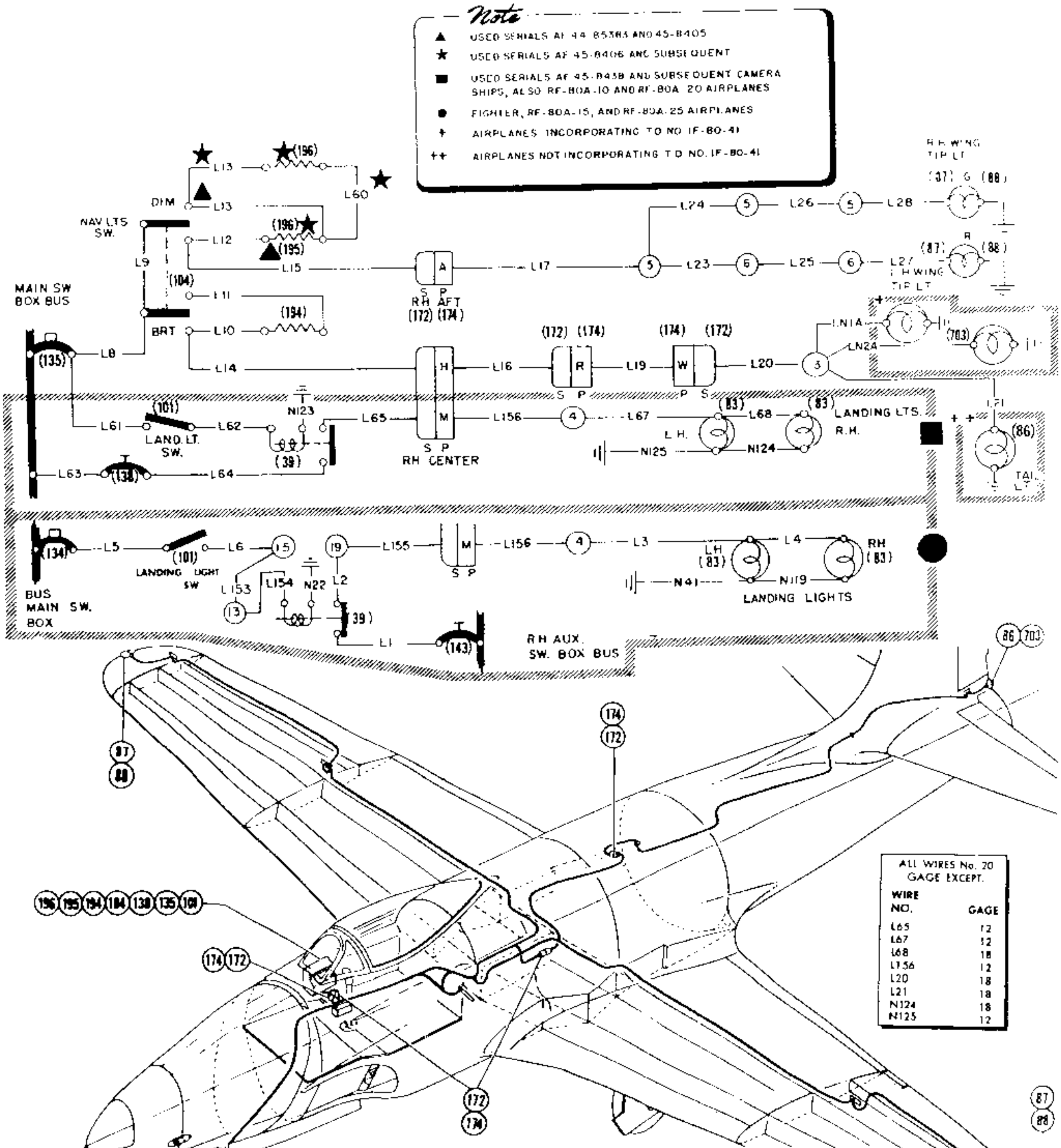
**CAUTION**

The landing lights must not be left on for longer than five minutes at any one time.

(2) LANDING LIGHT.

(*a*) DESCRIPTION.

*1.* F-80A-1 AND EARLY F-80A-5 AIRPLANES. *(See figure 211.)* — The landing light is a sealed-beam unit which is attached to an adapter mounted to an adjustable bracket assembly. A flexible




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 39 | RELAY | | B-5 | AN3350-1 | RH AUX SWITCH BOX |
| 83 | LIGHT | | | AN3129-4523 | NOSE GEAR |
| + 86 | LIGHT | G.E.A.E. | | AN3091-2 | TAIL |
| 87 | LIGHT | GRIMES | | A1875 | WING TIP |
| 88 | LAMP | | | AN3122-1524 | WING TIP |
| 101 | SWITCH | | | AN3022-4B | MAIN SWITCH BOX |
| 104 | SWITCH | | | AN3027-1 | MAIN SWITCH BOX |
| ● 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| ▲ 138 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | RH AUX SWITCH BOX |
| ● 143 | CIRCUIT PROTECTOR | | | AN3161-P35 | RH AUX SWITCH BOX |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 194 | RESISTOR | I.R.C. | MW-2 | 125Ω | MAIN SWITCH BOX |
| ▲ 195 | RESISTOR | OHMITE | | 15Ω 25W | MAIN SWITCH BOX |
| ★ 196 | RESISTOR | OHMITE | | 7.5Ω 25W | MAIN SWITCH BOX |
| ++ 703 | LIGHT | | | AN3092-2 | TAIL |

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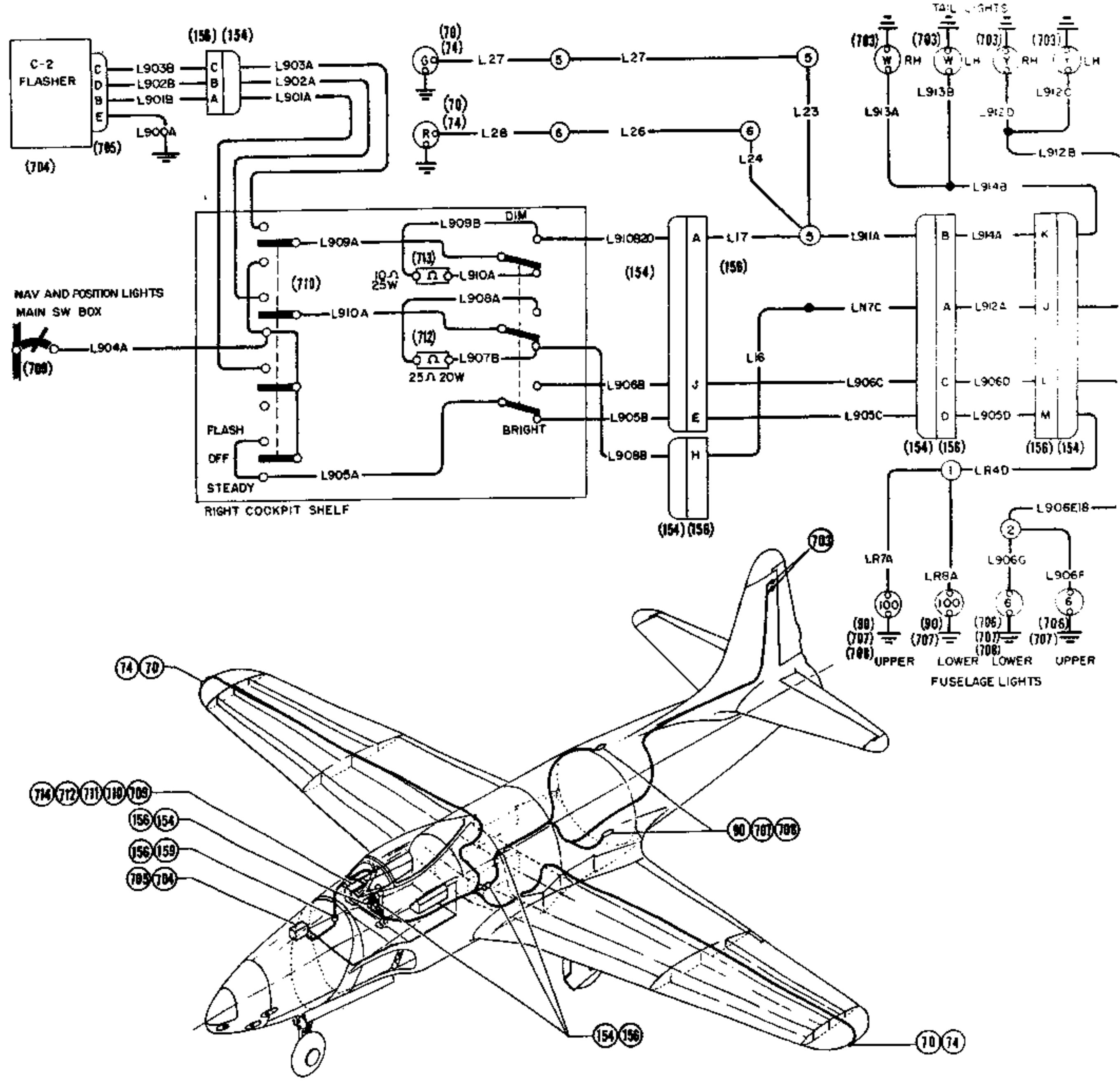
*Figure 210B — Landing and Navigation Lights Circuit, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 Airplanes*




| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 70 | LIGHT | GRIMES | | A1825 | WING TIP |
| 74 | LAMP | | CLEAR | AN3122-1524 | WING TIP |
| 90 | LAMP | | 100W | AN3120-1047 | AFT FUSELAGE |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 703 | LIGHT | | | AN3092-2 | TAIL |
| 704 | FLASHER MOTOR | | C-2 | 32660 | FUSELAGE NOSE |
| 705 | CONNECTOR | | | AN3108-16S-8S | FUSELAGE NOSE |
| 706 | LAMP | | 6W | AN3131-303 | AFT FUSELAGE |
| 707 | LIGHT | | | AN3177-9 | AFT FUSELAGE |
| 708 | LENS | | CLEAR | AN3099-7 | AFT FUSELAGE |
| 709 | CIRCUIT PROTECTOR | | | AN3160-15 | RH FWD SW BOX |
| 710 | SWITCH | | | AN3227-1 | RH FWD SW BOX |
| 711 | SWITCH | | | AN3226-3 | RH FWD SW BOX |
| 712 | RESISTOR | OHMITE | 20W 25Ω | 1011 | RH FWD SW BOX |
| 713 | RESISTOR | OHMITE | 25W10Ω | 0200B | RH FWD SW BOX |

**Note**

ALL WIRES ARE 20 GAGE EXCEPT LR8A, LR7A, LR4D, LR4C, L914B, L914A, L912B, L912A, L906G, L906F, L906E, L905D AND L906D WHICH ARE 18 GAGE. THIS CIRCUIT APPLIES TO ALL AIRPLANES MODIFIED ACCORDING TO AF DRAWINGS 50J7370, 50H7893, AND 50D7888.

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*Figure 210C — Navigation and Position Lights Circuit, Airplanes Modified By Lockheed Aircraft Service* shaft controlled from the cockpit controls the position of the bracket assembly which rotates about two bushings attached to two rigid side supports. A spring-loaded toggle positions the lamp against the stops in both the landing position and the horizontal position.

*2.* LATER F-80A-5, RF-80A-5, RF-80A-10, AND ALL F-80A-10 AIRPLANES.—The landing lights are sealed-beam units. A bracket mounted on the shimmy-damper supports holds the two lights in a fixed position with relation to the wheel.

*(b)* ADJUSTMENT

(F-80A-1 and early F-80A-5).

*1.* COMBAT POSITION.—Place the lamp so that the plane of the adapter is parallel to the plane of the fuselage bulkhead. Place the head of the adjustment bolt against the lug on the bottom of the adapter. Lock adjustment bolt in place with the locking nut.

*2.* LANDING POSITION.—The landing position stop is automatically fixed by a spacer, $^{15}/_{16}$ inch long, on the adjustment bolt. The landing-position stop nut should be drawn up tight against the spacer. Be sure a washer is between the nut and the spacer.

*(c)* REMOVAL OF LAMP

(F-80A-1 and early F-80A-5).

*1.* Remove outer row of screws around plastic window. Remove window and frame.

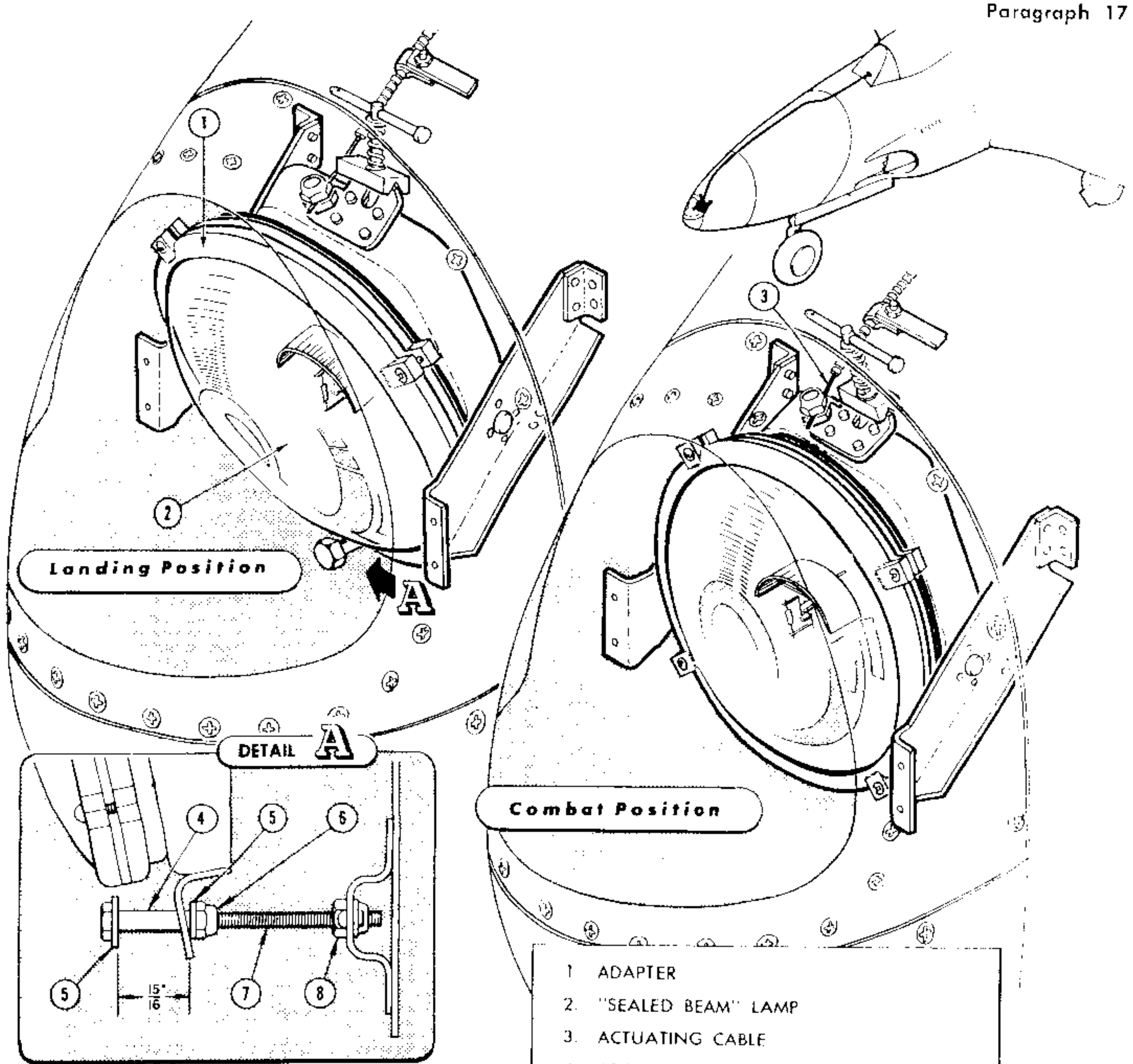
*2.* Remove four screws mounting lamp to adapter, and remove lamp.

*(d)* INSTALLATION OF LAMP (F-80A-1 and early F-80A-5).—Reverse removal procedure. Install lamp with filament shield up to protect pilot from glare.

*v.* COCKPIT LIGHT CIRCUIT. *(See figures 209 and 209A.)*—Cockpit lighting is derived from two type C-5 fluorescent lights and two C-4A focusing cockpit lights. One fluorescent and one incandescent light are mounted on each side of the cockpit, and operate from the 24-volt direct-current supply.

The light circuit is protected by a 10-ampere push-to-reset circuit breaker on the main switch panel. The fluorescent lights are controlled by a rheostat. A jack for the light plug is mounted on each cockpit shelf.

To provide better instrument panel lighting, two alternate sockets for instrument panel lights are installed. One socket is installed on the right longeron at station 131, and one on the left longeron at approximately station 128.5.



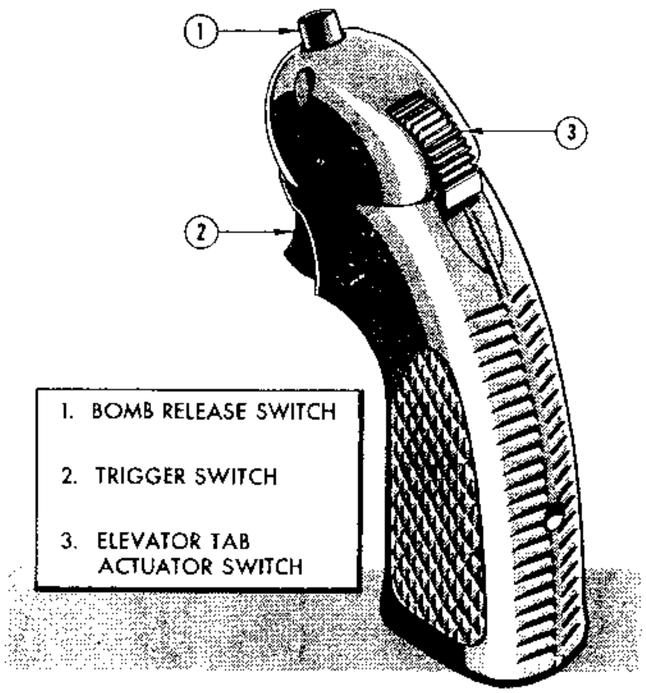

1. ADAPTER
2. "SEALED BEAM" LAMP
3. ACTUATING CABLE
4. ADJUSTMENT SPACER
5. WASHER
6. ADJUSTMENT NUT (LANDING POSITION)
7. ADJUSTMENT BOLT
8. ADJUSTMENT-BOLT LOCK NUT

*Figure 211 — Landing Light Installation, F-80A-1 and Early F-80A-5 Airplanes*

*w.* GUN HEATER CIRCUIT. *(See figure 213.)*—A gun heater incorporating a spring type housing is attached to each gun. The spring housing provides a firm grip upon the gun cover and assures a good contact between the heating pad and the side of the gun. The heaters are wired in parallel and are controlled by a 35-ampere switch-type circuit breaker.

*x.* GUNNERY CIRCUITS.

(1) GENERAL.—The gunnery circuits are controlled by the armament master switch, the machine-gun trigger switch, the gun firing safety switch, and a ground test switch. A 10-ampere circuit breaker protects the circuit. The armament master switch is a three-position switch with "GUNS," "CAMERA," and "OFF" positions. (See figure 235.) The trigger switch is on the




A07755

*Figure 212 — Control Stick Grip*

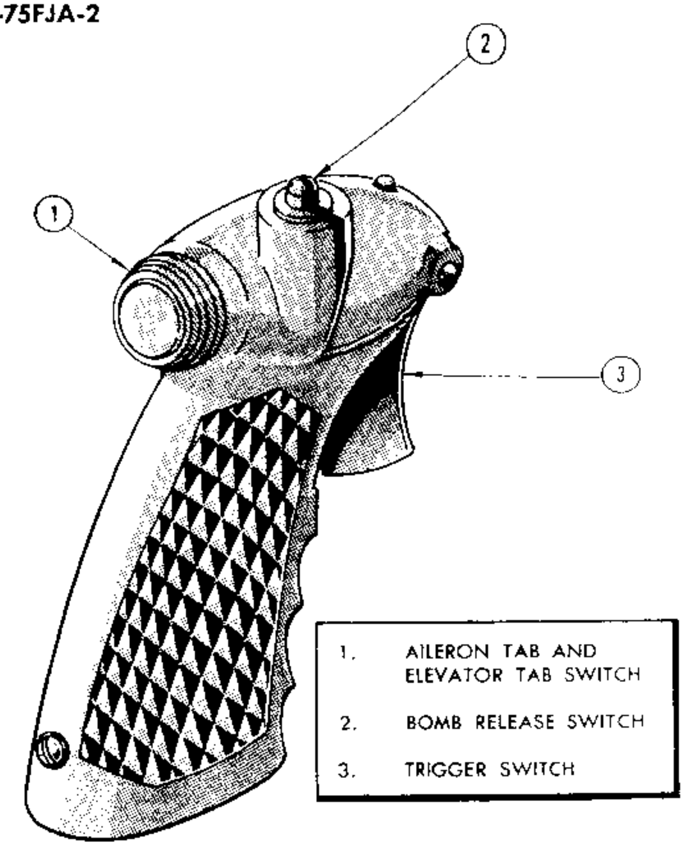



*Figure 212A — Control Stick Grip, Type B-7*

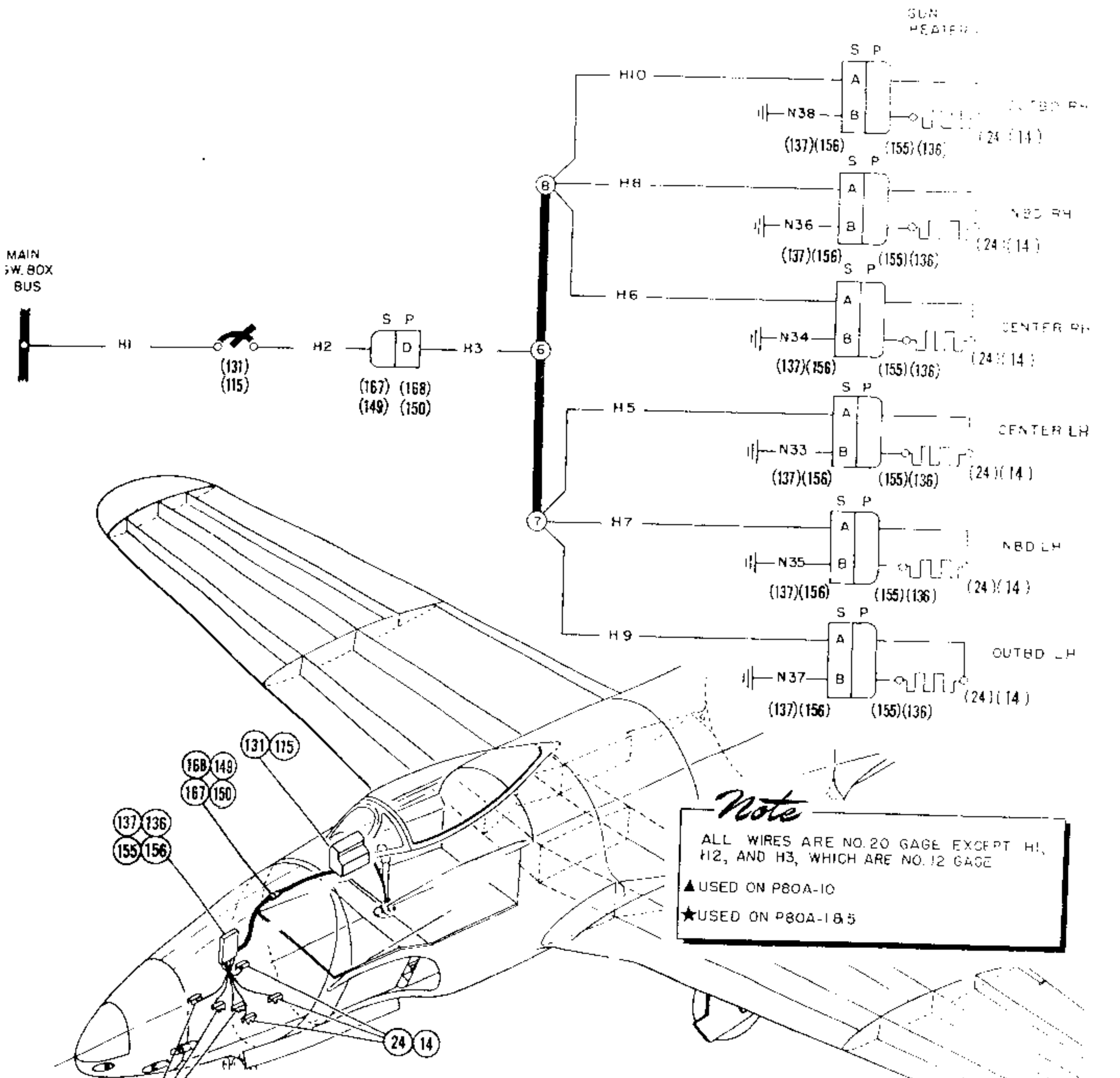
forward side of the control stick, and is an integral part of the stick grip. (See figures 212 and 212A.) The gun firing safety switch on the cockpit left shelf is actuated by the alighting gear control lever when in the "DOWN" position. The ground test switch is a two-position switch with "OFF" and "ON" positions, and is on the right side of the nose wheel well. With the alighting gear control lever down (airplane on ground), gun firing is not possible unless the ground test switch is "ON." Operation of the armament master switch to "GUNS" position affects five circuits; the gun-sight circuit is energized, turning on the gun-sight light; the cockpit pressure-regulator circuit is energized, allowing the cockpit pressure differential to drop to 1.5 psi; and the case ejection door circuit, the gun-firing-solenoid circuit, and the gun camera circuit are connected to the trigger switch. Operating the armament master switch to "CAMERA" energizes the camera, gun sight, and cockpit pressure regulator circuits. The "OFF" position disconnects all gunnery circuits. A switch guard protects the armament master switch in its closed position.

(2) COCKPIT PRESSURE REGULATOR CIRCUIT. *(See figures 215, 215A, 215C, and 216.)*—On early P-80A-1 airplanes the armament master switch operates the cockpit pressure regulator directly, but on later models, the switch operates a single-pole double-throw relay which operates the pressure regulator. On photographic airplanes the cockpit pressure regulator is controlled by a two-position switch on the main switch box. When the switch is in the "NORMAL" position, the pressure regulator operates at its normal differential up to 2.75 psi. Switching to the "COMBAT" position lowers the pressure differential to 1.5 psi. The circuit on both fighter and photographic airplanes is protected by a 10-ampere push-to-reset circuit protector in the main switch box. For information on the cockpit pressure regulator, see paragraph 23, this section

(3) GUN FIRING SOLENOID CIRCUIT. *(See figures 214 and 214A.)*—Six machine gun firing solenoids are operated simultaneously through a type B-5 relay, located in the armament compartment junction box. The relay is controlled by the trigger switch and the armament master switch. The master switch must be in the "GUNS" position to fire the guns. Circuit protection is afforded the gun firing solenoids by three 15-ampere push-to-reset circuit protectors, one for each pair of guns. These circuit-protector push buttons are on top of the armament compartment junction box. (See figure 217.)

(4) CASE EJECTION DOOR CIRCUIT.
*(See figures 214 and 214A.)*

*(a)* GENERAL. — Operation of the trigger switch, when the armament master switch is in the "GUNS" position, energizes the case ejection door cir-




**Note**

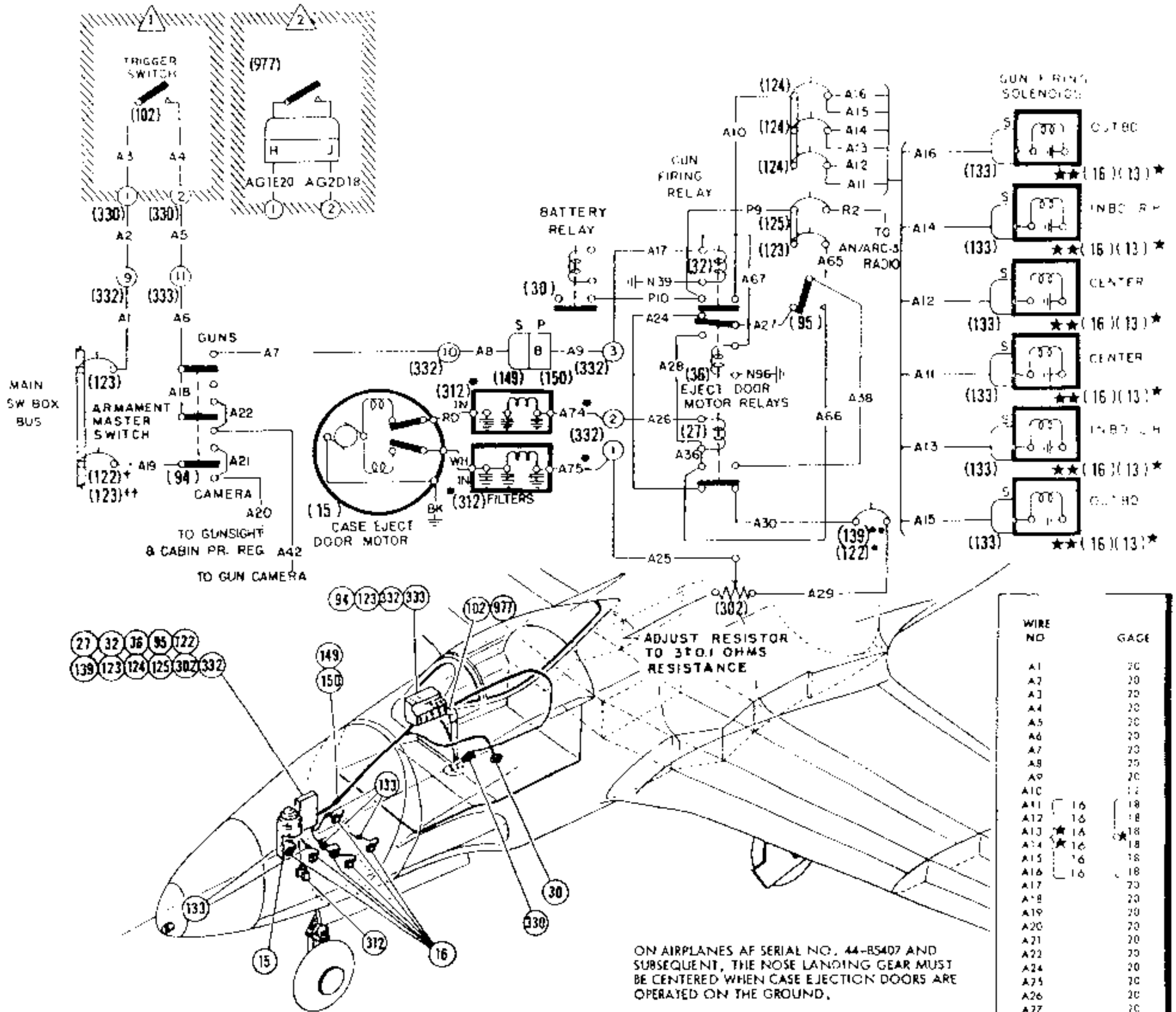
ALL WIRES ARE NO. 20 GAGE EXCEPT H1, H2, AND H3, WHICH ARE NO. 12 GAGE

▲USED ON P80A-10

★USED ON P80A-1 & 5

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| ★14 | HEATER | G.F.E. | J-4 | 249 46 | ARMAMENT COMPARTMENT |
| ▲24 | HEATER | G.F.E. | J-4 | 44B25259 | ARMAMENT COMPARTMENT |
| ★115 | CIRCUIT BREAKER | | | AN3160-35 | MAIN SWITCH BOX |
| ▲131 | CIRCUIT BREAKER | | | AN3160-35 | MAIN SWITCH BOX |
| ★136 | CONNECTOR | G.F.E. | | AN3106-12S-3P | ARMAMENT JUNC BOX |
| ★137 | CONNECTOR | | | AN3102-12S-3S | ARMAMENT JUNC BOX |
| ★149 | CONNECTOR | | | AN3106-18-9S | ARMAMENT COMPARTMENT |
| ★150 | CONNECTOR | CANNON | | 2308-17 | ARMAMENT COMPARTMENT |
| ▲155 | CONNECTOR | | | AN3106-12S-3P | ARMAMENT JUNC BOX |
| ▲156 | CONNECTOR | | | AN3102-12S-3S | ARMAMENT JUNC BOX |
| ▲167 | CONNECTOR | | | AN3106-18-9S | COCKPIT |
| ▲168 | CONNECTOR | | | AN3102P 18-9P | ARMAMENT COMPARTMENT |

*Figure 213 — Gun Heaters Circuit — P-80A Airplanes*




ON AIRPLANES AF SERIAL NO. 44-85407 AND SUBSEQUENT, THE NOSE LANDING GEAR MUST BE CENTERED WHEN CASE EJECTION DOORS ARE OPERATED ON THE GROUND.

| WIRE NO | | GAGE |
|---|---|---|
| A1 | | 20 |
| A2 | | 20 |
| A3 | | 20 |
| A4 | | 20 |
| A5 | | 20 |
| A6 | | 20 |
| A7 | | 20 |
| A8 | | 20 |
| A9 | | 20 |
| A10 | | 12 |
| A11 | 16 | 18 |
| A12 | 16 | 18 |
| A13 | ★16 | ★18 |
| A14 | ★16 | 18 |
| A15 | 16 | 18 |
| A16 | 16 | 18 |
| A17 | | 20 |
| A18 | | 20 |
| A19 | | 20 |
| A20 | | 20 |
| A21 | | 20 |
| A22 | | 20 |
| A24 | | 20 |
| A25 | | 20 |
| A26 | | 20 |
| A27 | | 20 |
| A28 | | 20 |
| A29 | | 20 |
| A30 | | 20 |
| A36 | | 20 |
| A18 | | 20 |
| A42 | | 20 |
| A49 | | 20 |
| A65 | | 20 |
| A66 | | 20 |
| N39 | | 20 |
| P10 | | 12 |
| P9 | | 12 |
| A67 | | 20 |
| N96 | | 20 |
| ●A74 | | 20 |
| ●A75 | | 20 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| ★13 | GUN FIRING SOLENOID | GFAE | G-11 | 93-24746 | ARMAMENT COMPARTMENT |
| 15 | EJECTION DOOR MOTOR | LEAR | | 404C OR D | ARMAMENT COMPARTMENT |
| ★★16 | GUN FIRING SOLENOID | GFAE | G-19 | 24895 | ARMAMENT COMPARTMENT |
| 27 | RELAY | LEACH | | 1253-465 | ARMAMENT JUNCTION BOX |
| 30 | BATTERY RELAY | GFAE | B-14 | 32490 | SUB-COCKPIT |
| 32 | RELAY | | B-5 | 94-32351 | ARMAMENT JUNCTION BOX |
| 36 | RELAY | EL. PROD. | | NB-57-C | ARMAMENT JUNCTION BOX |
| 94 | ARMAMENT MASTER SW. | C.H. | | 8742K6 | MAIN SWITCH BOX |
| 95 | DOOR GRND OPERAT SW | C.H. | | 8804K5 | ARMAMENT COMPARTMENT |
| △1 102 | CONTROL STICK SWITCH | MASON | | 212 | CONTROL STICK |
| ●●139 | CIRCUIT PROTECTOR | | | AN3161-P5 | ARMAMENT JUNCTION BOX |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | ARMAMENT JUNCTION BOX |
| 125 | CIRCUIT PROTECTOR | SPENCER | | PSM 20 | ARMAMENT JUNCTION BOX |
| 133 | CONNECTOR | | | AN3106-10S-2S | ARMAMENT COMPARTMENT |
| 149 | CONNECTOR | | | AN3106-18-9S | ARMAMENT COMPARTMENT |
| 150 | CONNECTOR | CANNON | | 2308-17 | ARMAMENT COMPARTMENT |
| 302 | RESISTOR | OHMITE | | 5 Ω 50W | ARMAMENT JUNCTION BOX |
| 330 | TERMINAL PANEL | LOCKHEED | | LS1906-2 | COCKPIT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | MAIN SWITCH BOX |
| 333 | TERMINAL PANEL | LOCKHEED | | LS1929-12 | MAIN SWITCH BOX |
| ●†122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| ●312 | FILTER | POTTER | | B-120 | ARMAMENT COMPARTMENT |
| △2 977 | SWITCH | GFAE | 3-8 | MIL-S-5210 | CONTROL STICK |

# NOTE

★ USED AF SERIAL NO. 44-84992 THRU 44-85336

★★ USED AF SERIAL NO. 44-85337 AND SUBSEQUENT, ON FIGHTER AIRPLANES ONLY

●● USED AF SERIAL NO. 44-85377 AND SUBSEQUENT AND AIRPLANES INCORPORATING T.O. NO. 1F-80A-27

● USED AF SERIAL NO. 44-84992 THRU 44-85376, NOT INCORPORATING T.O. NO. 1F-80A-27

† USED AF SERIAL NO. 44-84992 THRU 44-85491 AND 45-8301 THRU 45-8335

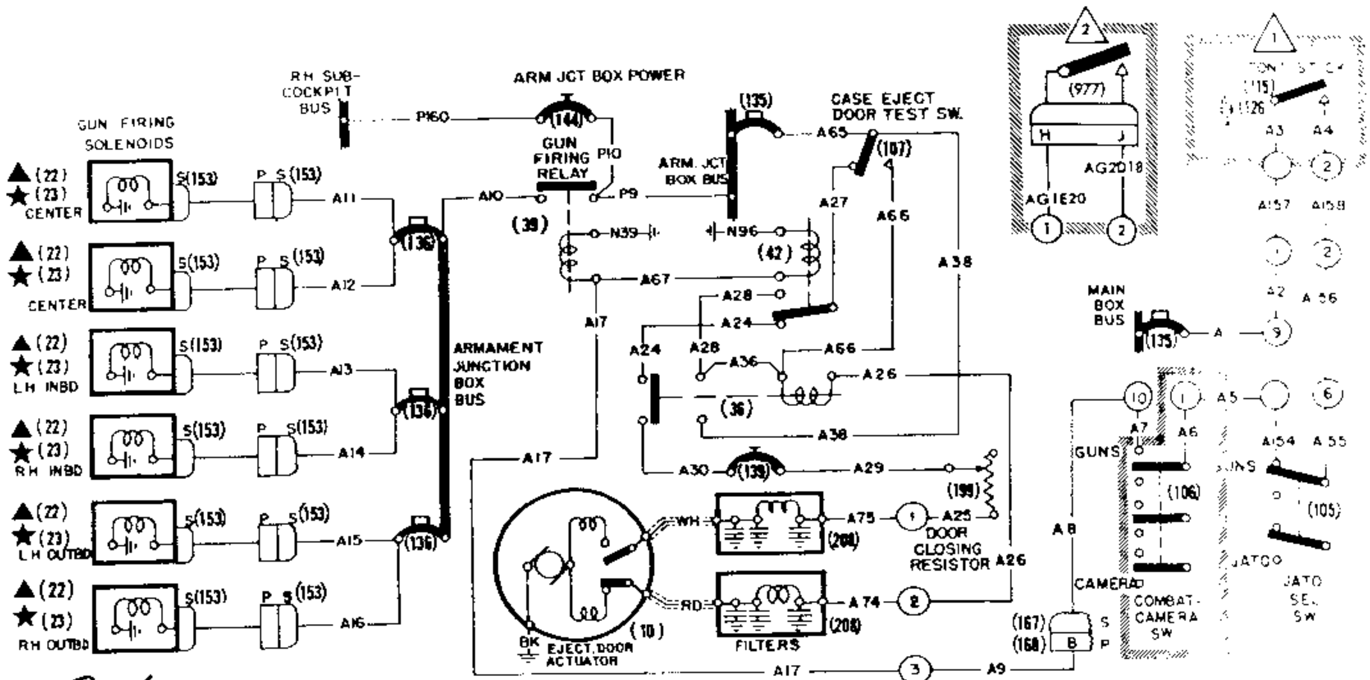
†† USED AF SERIAL NO. 45-8336 AND SUBSEQUENT

△1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

△2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

FB 4636
EM-39-30-4 21A

*Figure 214 — Gun Firing and Case Ejection Door Circuit, F-80A-1 and F-80A-5 Airplanes*




**Note**

▲ FOR AF SERIALS 44-84992 THRU 44-85336

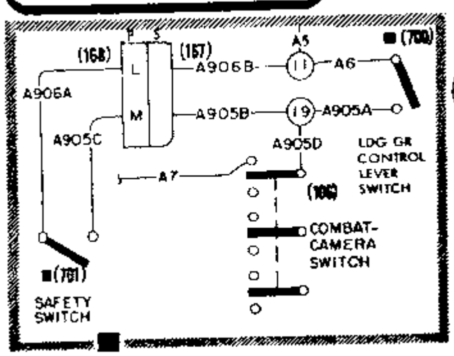
★ FOR AF SERIALS 44-85337 AND SUBSEQUENT

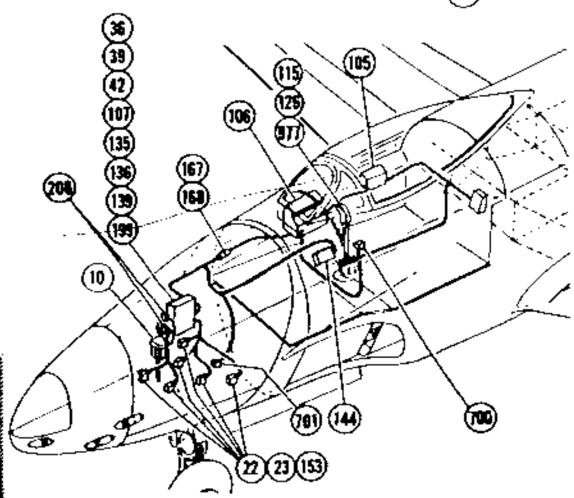
F80A-10 WINTERIZED AIRPLANES

■ ALL AIRPLANES ( AF DWG X50C4262)

⚠1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

⚠2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225



| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| ■ A905A | 20 | A26 | 20 |
| ■ A905B | 20 | A27 | 20 |
| ■ A905C | 20 | A28 | 20 |
| ■ A905D | 20 | A29 | 20 |
| ■ A906A | 20 | A30 | 20 |
| ■ A906B | 20 | A36 | 20 |
| A1 | 20 | A38 | 20 |
| A2 | 20 | A65 | 20 |
| A5 | 20 | A66 | 20 |
| A6 | 20 | A67 | 20 |
| A7 | 20 | A74 | 20 |
| A8 | 20 | A75 | 20 |
| A9 | 20 | A154 | 20 |
| A10 | 12 | A155 | 20 |
| A11 | 16 | A156 | 20 |
| A12 | 16 | A157 | 20 |
| A13 | 16 | A158 | 20 |
| A14 | 16 | N39 | 20 |
| A15 | 16 | N96 | 20 |
| A16 | 16 | P9 | 12 |
| A17 | 20 | P10 | 12 |
| A24 | 20 | P160 | 12 |
| A25 | 20 | | |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 10 | EJECTION DOOR MOTOR | LEAR | | 404D | ARM. COMPT |
| ▲ 22 | SOLENOID GUN FIRING | GFAE | G-11 | H42D11690 | ARM. COMPT |
| ★ 23 | SOLENOID GUN FIRING | GFAE | G-19 | 24895 | ARM. COMPT |
| 36 | RELAY | LEACH | | 1253-465 | ARM. JUNCT BOX |
| 39 | RELAY | | | AN3350-1 | ARM. JUNCT BOX |
| 42 | RELAY | EL PROD | | N8-57-C | ARM. JUNCT BOX |
| 105 | SWITCH | | | AN3027-3 | RH AUX SW BOX |
| 106 | SWITCH | CUT. HAM. | | 8742K6 | MAIN SW BOX |
| 107 | SWITCH | CUT. HAM. | | 8804K6 | ARM. JUNCT BOX |
| ⚠1 115 | SWITCH | MASON | | 212C-1 | CONTROL STICK |
| ⚠1 126 | SWITCH | GFAE | B-7 | | CONTROL STICK |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | ARM. JUNCT BOX |
| 139 | CIRCUIT PROTECTOR | | | AN3161-P5 | ARM. JUNCT BOX |
| 144 | CIRCUIT PROTECTOR | | | AN3161-P50 | RH SUB CKPT JUNCT BOX |
| 153 | CONNECTOR | | | AN3106-105-25 | ARM. COMPT |
| 167 | CONNECTOR | | | AN3106-18-9S | ARM. COMPT |
| 168 | CONNECTOR | | | AN3102P-18-9P | ARM. COMPT |
| 199 | RESISTOR | OHMITE | 5Ω 50W | 0560 | ARM. JUNCT BOX |
| 208 | FILTER | POTTOR | | B-120 | ARM. COMPT |
| ■ 700 | SWITCH | MICROSWITCH | | YZ-2RL2-A7 | LH SIDE PANEL |
| ■ 701 | SWITCH | | | AN3022-8 | NOSE WHEEL WELL |
| ⚠2 977 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

FB 4586

EM39-20-4-214A

*Figure 214A — Gun Firing and Case Ejection Door Actuator Circuit, F-80A-10 Airplanes* cuit and opens the case ejection door. The door actuator motor is controlled through two relays. The first relay applies power to the motor through the second relay. The second relay is wired in such a way that current will still be directed to the motor after the trigger switch is released. The actuator will complete the door opening cycle and will be stopped by a limit switch when the door is open. The release of the trigger switch reverses the current to the motor, so that at the end of the opening action, the door will close. A resistor in the door closing circuit limits the speed of the actuator during the closing cycle to approximately one-half the opening speed. The resistor is set at 3 ohms (± 0.1 ohm) resistance. A switch to operate the case ejection door actuator on the ground is located at the forward end of the armament junction box. (See figure 217.) Circuit protection is provided by a 10-ampere push-to-reset circuit protector in the trigger switch circuit, and another in the actuator circuit.

**CAUTION**

The nose gear on which landing lights are installed must be centered when the case ejection door is operated on the ground to prevent interference between case ejection door and light bracket.

*(b)* EJECTION DOOR ACTUATOR.
*(See figure 218.)*

*1.* DESCRIPTION.—The ejection door actuator employs a direct current, series wound, split field motor with electromagnetic clutch and brake. The motor is rated 24 volts, is reversible, and is for intermittent duty only. A thermal switch mounted on the end of the motor housing protects the motor against overheating. A switch box on the actuator contains adjustable limit switches to control the operating range of the motor.

The actuator opens the case ejection door by means of a jointed push rod. The door is hinged along its forward end with a continuous hinge. A spring-loaded deflector plate is hinged at the aft end of the door. As the door opens, the deflector plate drops down and retains the empty cases until the door has opened to a distance of two inches below the fuselage. This deflects the ejected cases and links away from the fuselage. This actuator is located in the armament compartment, forward of the junction box. Access to the actuator is through the armament compartment doors.

*2.* REMOVAL.

a. Remove the four screws from the upper roller support bracket directly under the actuator, which attach the bracket to the ammunition tray supports. Remove the screw from the ammunition tray support forward of the actuator and directly below the upper roller support bracket.

b. Slide the upper roller support bracket down until bolt through upper rollers is clear. Remove the bolt. Retain the rollers.

c. Disconnect wires from relays. Remove actuator attaching bolt from brackets above actuator, and remove actuator.

*3.* ADJUSTMENTS.

a. Remove five screws and lower the upper roller bracket to the point where the rollers are free of the tracks.

b. Adjust actuator jack screw so that the distance between the center line of the bolt in the upper rollers and the center line of the actuator attaching bolt is 7.7 inches. Adjust limit switch to turn off at this point. (See figure 202.)

*(1)* Remove limit switch box cover, and remove lock wire from rider holding bar. Lift out bar.

*(2)* Turn upper rider nut until upper limit switch just closes. Replace rider holding bar.

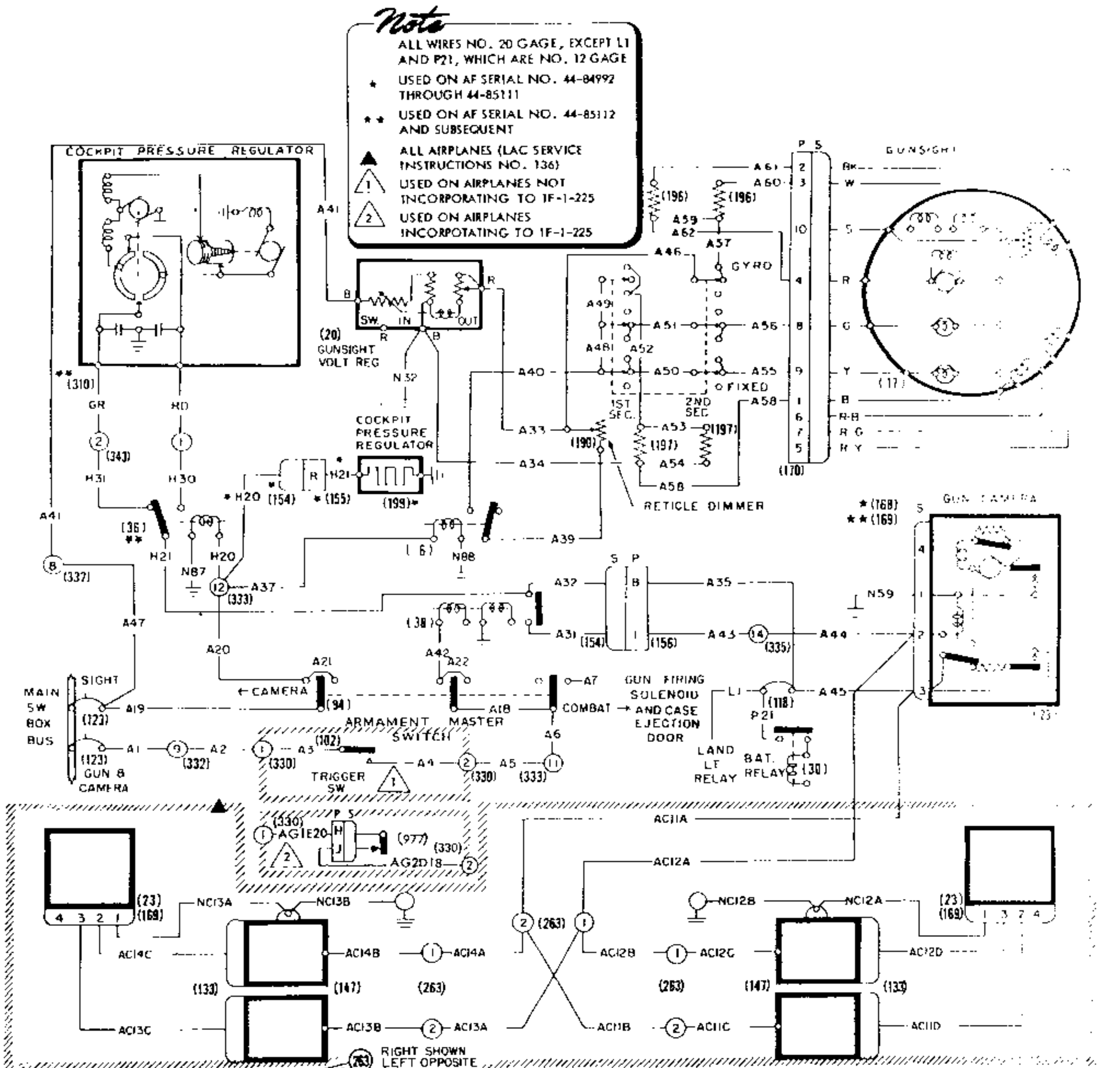
c. Run actuator jack screw down to the point where the stroke, or distance between up position and down position is 2.5 inches. Overtravel of 0.08 inch is permissible. Adjust limit switch to close at this point by moving lower rider in limit switch box to the point where the lower limit switch just closes. Do not allow lug on bottom of actuator shaft to turn during this adjustment.

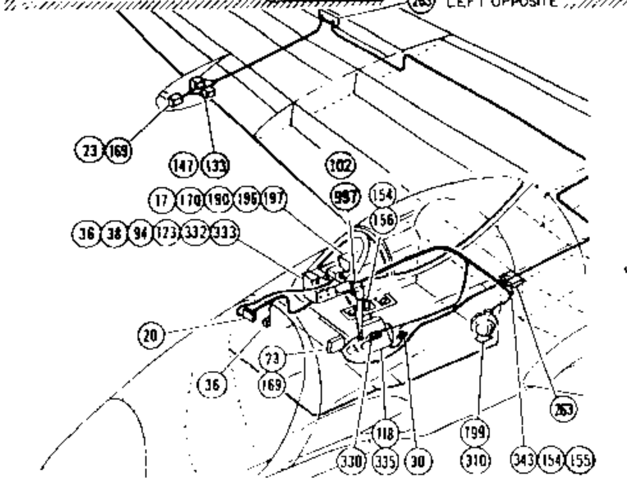
d. Replace lock wire on rider holding bar.

e. Run actuator to the up position. Connect actuator to push rod and rollers, and replace upper roller bracket. Turn push-rod adjusting sleeve to the point where the door fits snugly.

(5) GUN SIGHT CIRCUIT.
*(See figures 215, 215A, and 215B.)*

*(a)* GENERAL.—The gun sight light circuit is controlled by the armament master switch with the switch in either "GUNS" or "CAMERA" position. The gyroscope circuit is connected directly to the bus and operates when the bus is energized. The equipment consists of the type K-14C gun sight, the sight selector, the camera reticle dimmer, the voltage regulator, and the range control. On later F-80A-5 and all F-80A-10 airplanes, a radio noise filter is used. Accurate operation of the sight requires that the voltage supplied be maintained at 22 (±0.5) volts. For adjustment of the gun sight voltage regulator, see paragraph *(b)* following. The sight selector and the reticle dimmer are located one on each side of the sight support casting. The voltage regulator and radio noise filter are at the top aft side of the cockpit forward bulkhead. For information on the operation of the sight, see paragraph 20*c* (2) this section. Spare lamps for the gun sight are held in place by rubber grommets inside the gun sight support casting.

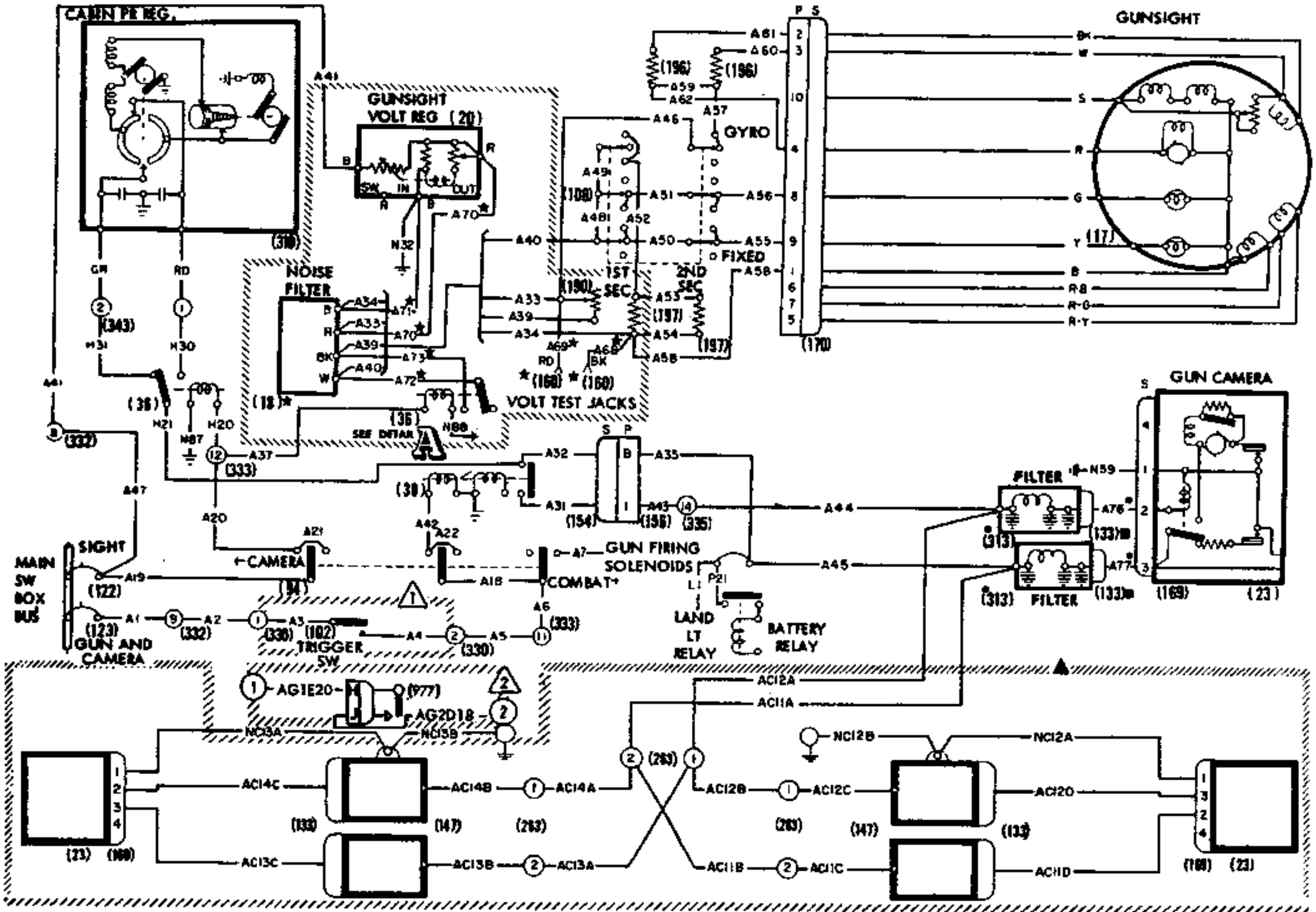


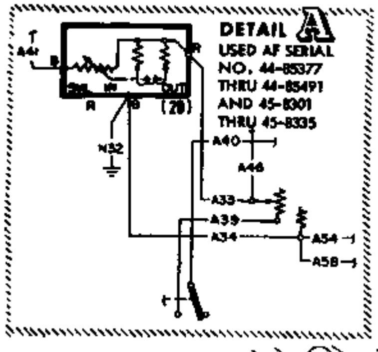



| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 17 | GUNSIGHT | GFAE | K-14 | |
| 20 | VOLTAGE REGULATOR GUNSIGHT | GFAE | | 5581371 |
| 23 | GUN CAMERA | GFAE | N 6 | 75 368 |
| 30 | BATTERY RELAY | GFAE | B 4 | 94 32324 |
| ** 36 | RELAY | EL PROD. SUP. | | NB 37 L |
| 38 | RELAY | LEACH | | 1251 383 |
| 94 | ARMAMENT MASTER SWITCH | C.H. | | 8747K6 |
| ⚠1 102 | CONTROL STICK SWITCH | MASON | | 212 |
| 118 | CIRCUIT PROTECTOR | SPENCER | | [illegible] |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM [illegible] |
| 133 | CONNECTOR | | | AN [illegible] |
| 147 | FILTER | LEWIS | | [illegible] |
| 154 | CONNECTOR | | | AN [illegible] |
| 155 | CONNECTOR | | | AN [illegible] |
| 156 | CONNECTOR | CANNON | | [illegible] |
| *168 | CONNECTOR | BREEZE | | [illegible] |
| **169 | CONNECTOR | KERWOOD | | [illegible] |
| 170 | GUNSIGHT CONNECTOR | GFAE | | 558-559 |
| 190 | RHEOSTAT | OHMITE | J | [illegible] |
| 196 | RESISTOR | PRESTO | 69 1% | 5581452 |
| 197 | RESISTOR | OHMITE | DIVRR | [illegible] |
| *199 | COCKPIT PRESSURE REGULATOR | AIRESEARCH | | [illegible] |
| 263 | TERMINAL PANEL | LOCKHEED | | [illegible] |
| **310 | COCKPIT PRESSURE REGULATOR | AIRESEARCH | 16 | [illegible] |
| 330 | TERMINAL PANEL | LOCKHEED | | [illegible] |
| 337 | TERMINAL PANEL | LOCKHEED | | [illegible] |
| 333 | TERMINAL PANEL | LOCKHEED | | 151929 12 |
| 335 | TERMINAL PANEL | LOCKHEED | | 151926 12 |
| 342 | TERMINAL PANEL | LOCKHEED | | [illegible] |
| ⚠2 977 | SWITCH | GFAE | 8 8 | MIL S 5710 |

FB 4500 EM39-20-4-215

***Figure 215 — Gun Sight, Camera, and Cockpit Pressure Regulator Circuit, F-80A-1 and F-80A-5 Airplanes, AF Serial No. 44-84992 through 44-85376***



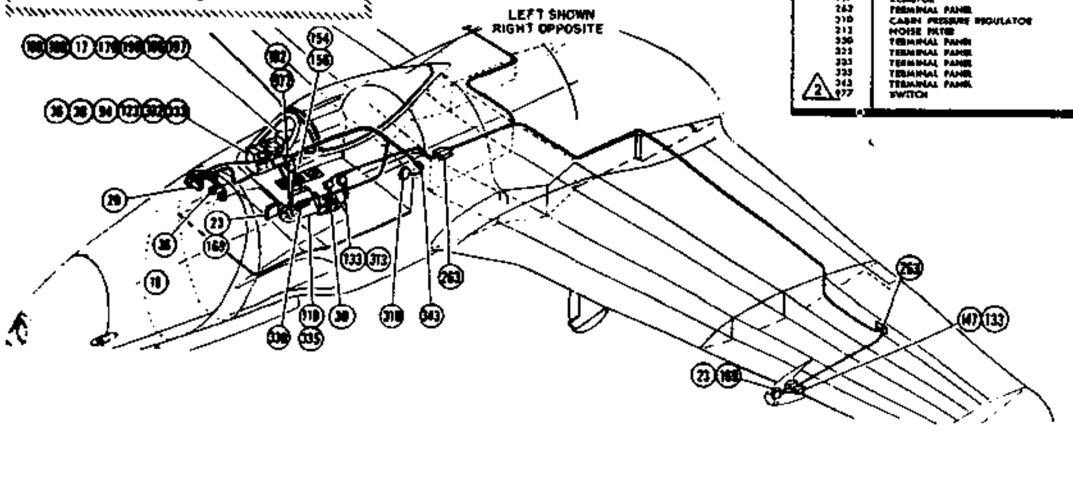




# NOTE

ALL WIRES NO. 20 GAGE, EXCEPT L1 AND P21, WHICH ARE NO. 12 GAGE

- ★ USED ON AF SERIALS 45-8336 AND SUBSEQUENT
- ● USED ON AF SERIALS 44-85377 AND SUBSEQUENT
- ▲ ALL AIRPLANES (LAC SERVICE INSTRUCTION NO. 136)
- ■ DISCONNECTED FROM FILTERS (LAC SERVICE INSTRUCTION NO. 136)
- ⚠1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225
- ⚠2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

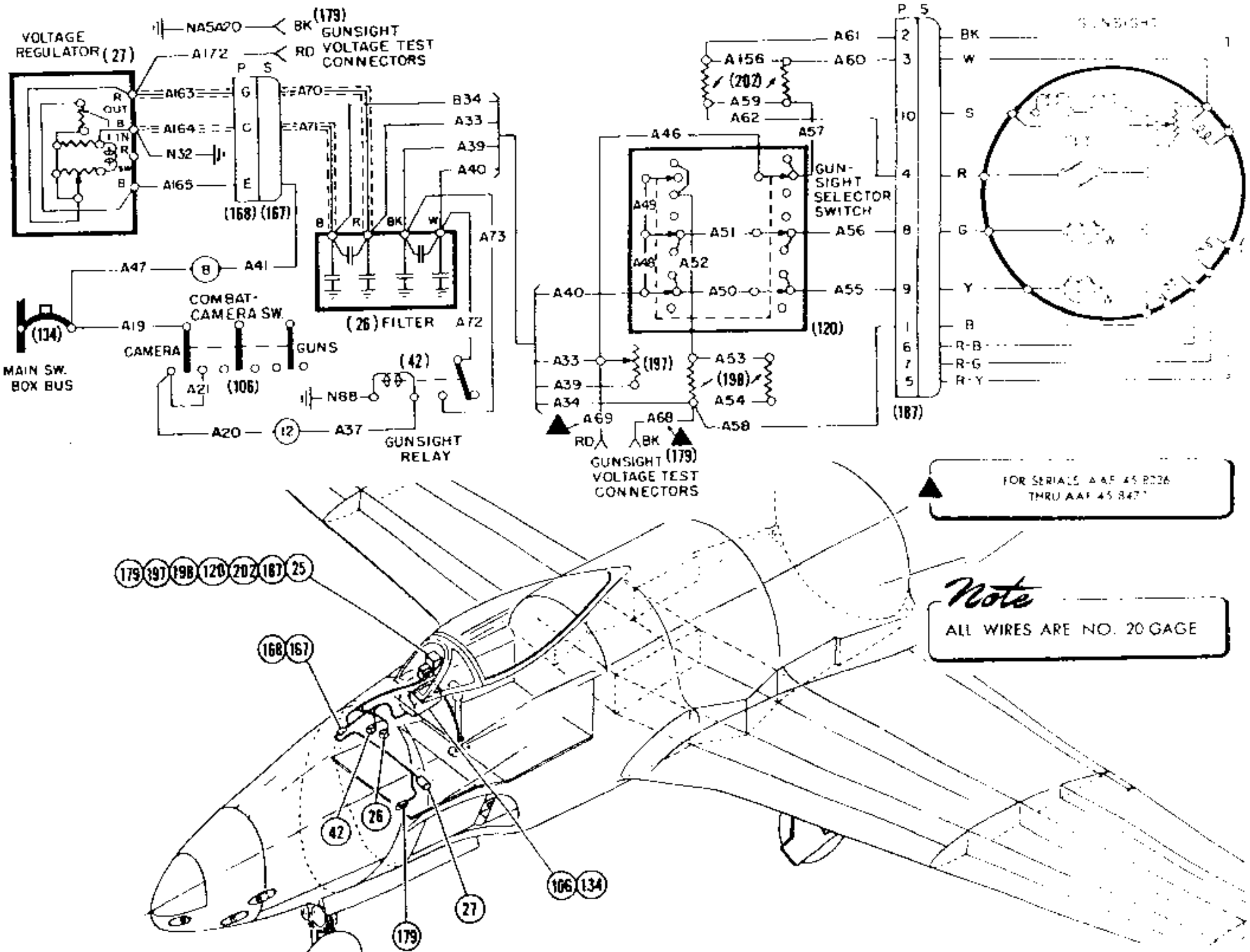
| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 17 | GUNSIGHT | GFAE | K-14C | |
| 18 | NOISE FILTER | | | N45816419 |
| 20 | VOLTAGE REGULATOR GUNSIGHT | GFAE | | 5501371 |
| 23 | GUN CAMERA | GFAE | N-6 | 75-364 |
| 30 | BATTERY RELAY | GFAE | B-14 | 32490 |
| 36 | RELAY | G.P.S. | | MQ-27-C |
| 38 | RELAY | LEACH | | 1231-353 |
| 94 | SWITCH | C.H. | | 0742E6 |
| ⚠1 102 | CONTROL STICK SWITCH | MASON | | 212 |
| 108 | GUNSIGHT SELECTOR | CENTRALAB | HW | 3MH37901 |
| 118 | CIRCUIT PROTECTOR | SPENCER | | PA-20 |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 |
| 133 | CONNECTOR | | | AN3106-10S-2S |
| 147 | FILTER | LEWIS | | B-125A |
| 154 | CONNECTOR | | | AN3106-20-11S |
| 156 | CONNECTOR | CANNON | | 2312-41 |
| 160 | VOLTAGE TEST JACKS | AMPHENOL | | 75-1P |
| 169 | CONNECTOR | KENWOOD | | 115-8 |
| 170 | GUNSIGHT CONNECTOR | G.F.E. | | 5501557 |
| 190 | RHEOSTAT | OHMITE | J | 0065-50W |
| 196 | RESISTOR | PRESTO | | 5501059 |
| 197 | RESISTOR | OHMITE | | 50R25W |
| 263 | TERMINAL PANEL | LOCKHEED | | 177614-901 |
| 310 | CABIN PRESSURE REGULATOR | AIRESEARCH | 16 | 13014-A |
| 313 | NOISE FILTER | POTTER | | B-135 |
| 330 | TERMINAL PANEL | LAC | | 151906-1 |
| 332 | TERMINAL PANEL | LAC | | 151920-2 |
| 333 | TERMINAL PANEL | LAC | | 151929-12 |
| 335 | TERMINAL PANEL | LAC | | 151926-13 |
| 343 | TERMINAL PANEL | LAC | | 89901-2 |
| ⚠2 977 | SWITCH | GFAE | B-8 | MR-5-3310 |




FB 4591

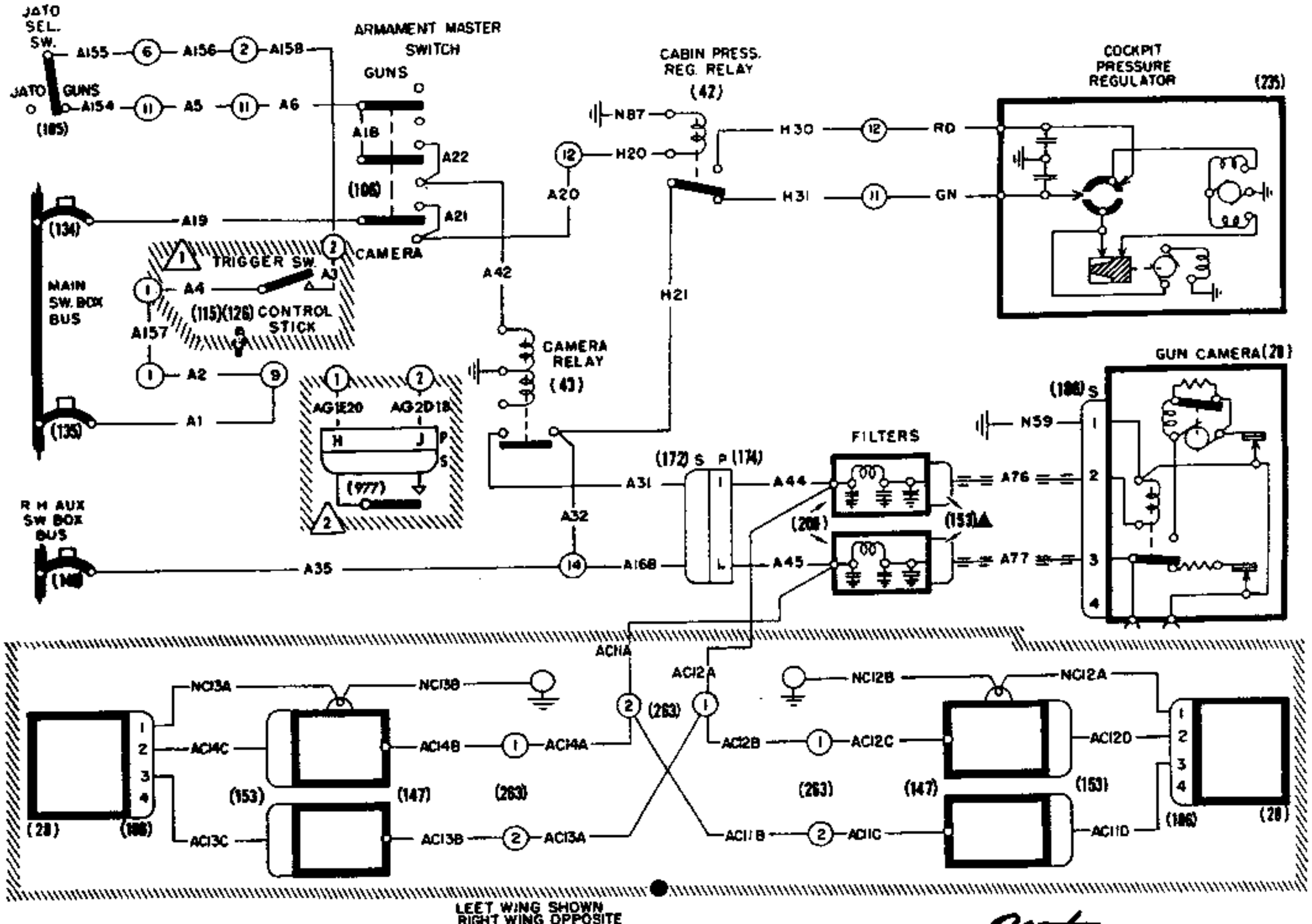
EM-39-20-4-215A

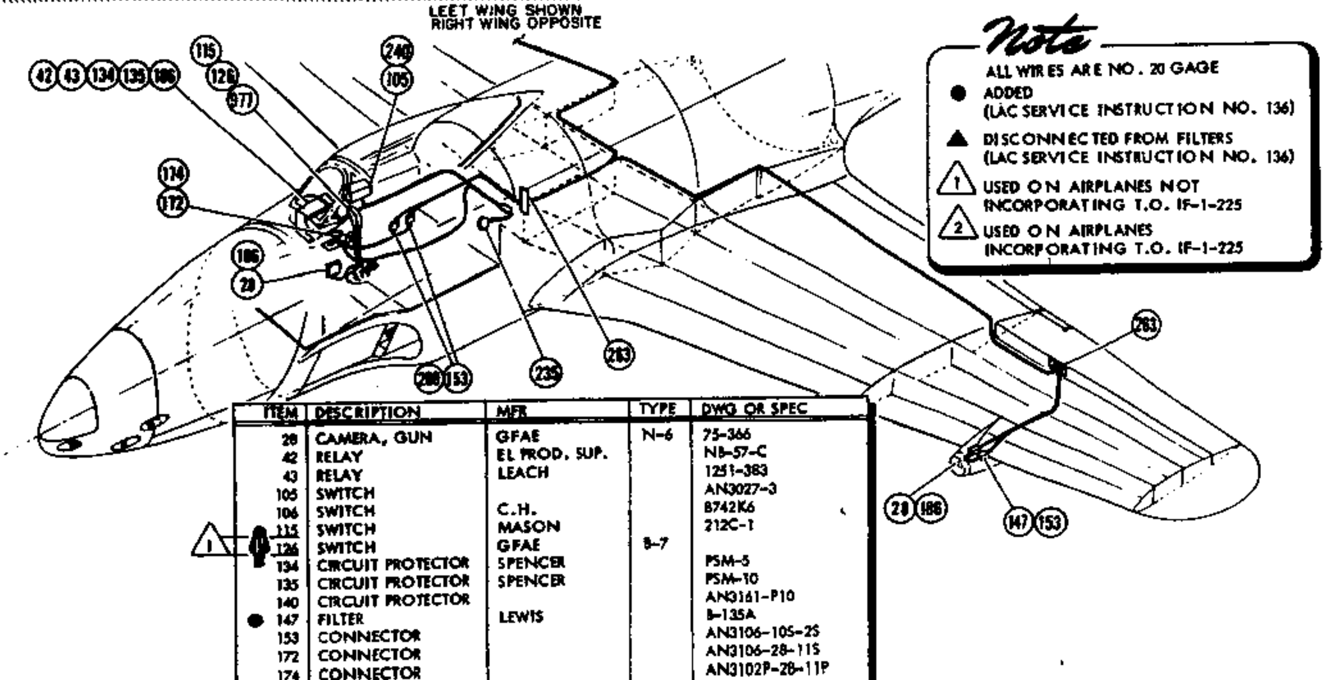
*Figure 215A — Gun Sight, Camera, and Cockpit Pressure Regulator Circuits, F-80A-5 Airplanes, AF Serial No. 44-85377 and Subsequent*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 25 | GUN SIGHT | G.F.E. | K-14B | R-24955 | COCKPIT |
| 26 | FILTER | G.F.E. | | H45816419 | COCKPIT |
| 27 | VOLTAGE REGULATOR | G.F.E. | | 5581371 | FWD PRESSURE BULKHEAD |
| 42 | RELAY | EL. PROD. SUP. | | NB-57-C | MAIN SWITCH BOX |
| 106 | SWITCH | CUT. HAM. | | 874 2K6 | MAIN SWITCH BOX |
| 120 | SWITCH | CENTRALAB | HW | 78HX7901 | MAIN SWITCH BOX |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 167 | CONNECTOR | | | AN3106-18-9S | FWD PRESSURE BULKHEAD |
| 168 | CONNECTOR | | | AN3102P 18-9P | FWD PRESSURE BULKHEAD |
| 179 | CONNECTOR | AMPHENOL | | 78-1P | |
| 187 | CONNECTOR | G.F.E. | | 5581559 | COCKPIT |
| 197 | RESISTOR | OHMITE | J | 80 Ω 50W | SELECTOR SWITCH |
| 198 | RESISTOR | OHMITE | | 50 Ω 25W | SELECTOR SWITCH |
| 202 | RESISTOR | PRESTO | | 5581859 69 Ω | SELECTOR SWITCH |

*Figure 215B — Gun Sight Circuit, P-80A-10 Airplanes*



**Note**

ALL WIRES ARE NO. 20 GAGE

● ADDED (LAC SERVICE INSTRUCTION NO. 136)

▲ DISCONNECTED FROM FILTERS (LAC SERVICE INSTRUCTION NO. 136)

⚠1 USED ON AIRPLANES NOT INCORPORATING T.O. IF-1-225

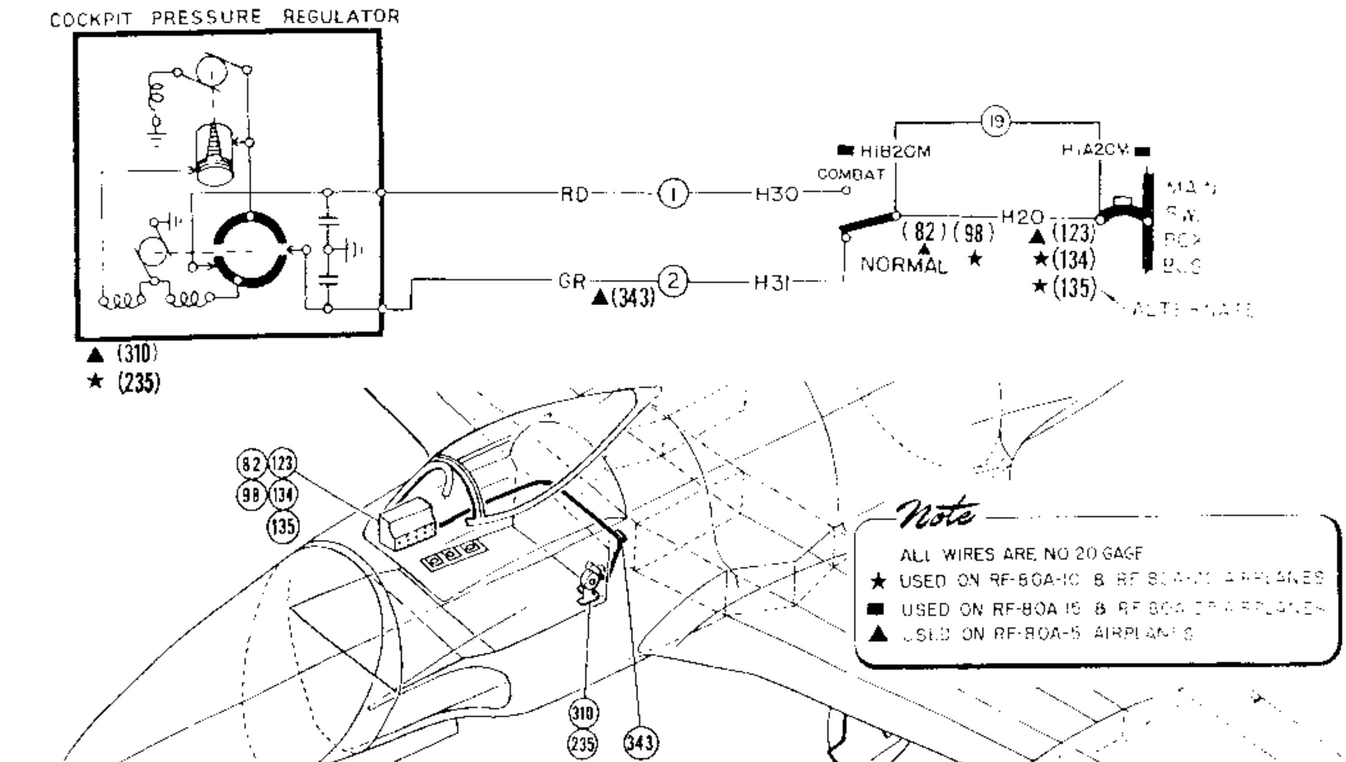
⚠2 USED ON AIRPLANES INCORPORATING T.O. IF-1-225

| | ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|---|
| | 28 | CAMERA, GUN | GFAE | N-6 | 75-366 |
| | 42 | RELAY | EL PROD. SUP. | | NB-57-C |
| | 43 | RELAY | LEACH | | 1251-383 |
| | 105 | SWITCH | | | AN3027-3 |
| | 106 | SWITCH | C.H. | | 8742K6 |
| ⚠1 | 115 | SWITCH | MASON | | 212C-1 |
| ⚠1 | 126 | SWITCH | GFAE | B-7 | |
| | 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 |
| | 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 |
| | 140 | CIRCUIT PROTECTOR | | | AN3161-P10 |
| ● | 147 | FILTER | LEWIS | | B-135A |
| | 153 | CONNECTOR | | | AN3106-10S-2S |
| | 172 | CONNECTOR | | | AN3106-28-11S |
| | 174 | CONNECTOR | | | AN3102P-28-11P |
| | 186 | CONNECTOR | KERWOOD | | 115-0 |
| | 209 | FILTER | POTTER | | B-135 |
| | 235 | PRESSURE REGULATOR | AIRESEARCH | 16 | 13014-4 |
| ● | 263 | TERMINAL PANEL | | | 177614-901 |
| ⚠2 | 977 | SWITCH | GFAE | B-8 | MIL-S-5210 |

FB 4590

E M 39-20-4-215C

*Figure 215C — Gun Camera and Cockpit Pressure Regulator Circuit, F-80A-10 Airplanes*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| ▲ 82 | SWITCH | | | AN3021-3 | MAIN SWITCH BOX |
| ★ 98 | SWITCH | | | AN3021-3 | MAIN SWITCH BOX |
| ▲ 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| ★ 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| ★ 135 | CIRCUIT PROTECTOR | SPENCER | | PLM-10 | MAIN SWITCH BOX |
| ★ 235 | PRESSURE REGULATOR | AIRESEARCH | 16 | 13014-4 | LH SHELF |
| ▲ 310 | COCKPIT PRESSURE REGULATOR | AIRESEARCH | 16 | 13014-4 | LH SHELF |
| ▲ 343 | TERMINAL PANEL | LOCKHEED | | LS1901-2 | LH SHELF |

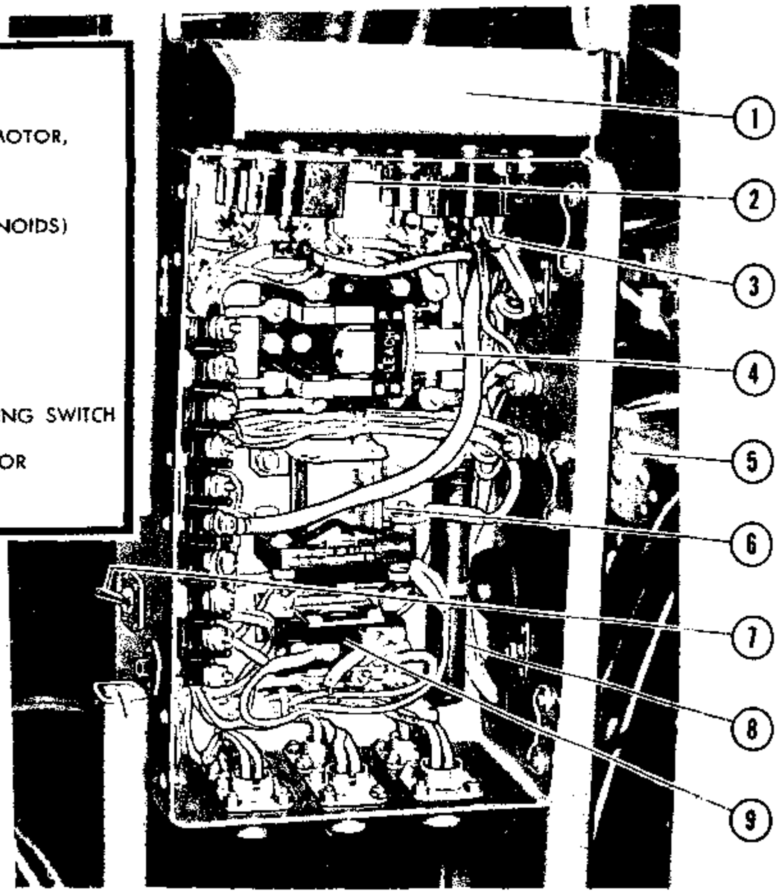
***Figure 216 — Cockpit Pressure Regulator Circuit — RF-80A Airplanes***

(*b*) GUN SIGHT VOLTAGE REGULATOR ADJUSTMENT.—To adjust the voltage regulator, a warm-up period of 10 minutes must be allowed with the sight "ON," selector at "FIXED," and dimmer at "BRIGHT." To check the input voltage, connect the leads of a portable voltmeter (range 0-30 volts) to the input terminals (marked with blue dots). The input voltage should be between 24 and 29 volts. If the voltage does not fall within this range, check the source of supply. With the correct input voltage, connect the portable voltmeter to the output terminals. On F-80A-1 and early F-80A-5 airplanes, use terminals on the voltage regulator. On later F-80A-5 airplanes test terminals are located on the gunsight casting. (See figure 239.) With the sight still operating, the output voltage must be between 21.5 and 22.5 volts. If the output is within 1.1 volts of being correct, adjust to the correct value by the following procedure. Loosen the two core screw locking screws one-half turn. The core screw is the large screw above the terminal board. While carefully observing the voltmeter reading, adjust the output voltage by turning the core screw very slowly and carefully (clockwise to increase voltage). Tighten the core screw locking screws, and again check the output voltage to be sure the locking operation has not disturbed the voltage setting.

**Note**

If output voltage is less than 20.4 or higher than 23.6, replace the regulator and return it to the fourth echelon for repair.

(6) GUN CAMERA CIRCUIT. (*See figures 215, 215A, and 215C.*)—Two circuits are necessary to operate the gun cameras, the camera relay circuit and the camera operating circuit. A relay inside each camera, operated by the camera relay circuit, connects the camera operating circuit to the camera motor. The camera relay circuit is operated through a relay located in the main switch box by the trigger switch when the armament master switch is in either "GUNS" or "CAMERA" position. The camera operating circuit on all airplanes is always energized, but cannot operate the camera until it is connected to the camera motor by the camera internal relay. On F-80A-1 and F-80A-5 air-




1. AMMUNITION TRAY SUPPORTS
2. CIRCUIT PROTECTORS (EJECTION DOOR MOTOR, COMMAND RADIO)
3. CIRCUIT PROTECTORS (GUN FIRING SOLENOIDS)
4. SHELL EJECTION DOOR SECOND RELAY
5. RADIO RACK
6. GUN FIRING RELAY
7. SHELL EJECTION DOOR GROUND OPERATING SWITCH
8. RESISTOR SHELL EJECTION DOOR ACTUATOR
9. SHELL EJECTION DOOR FIRST RELAY

*Figure 217 — Armament Compartment Junction Box — F-80A Airplanes*

planes, the camera operating circuit is protected by a 10-ampere automatic reset circuit protector in the sub-cockpit right-hand junction box. On F-80A-10 airplanes the camera operating circuit is protected by a 10-ampere push-to-reset circuit protector on the cockpit right shelf. A receptacle for a lens heater is located on the front of the camera, and is energized whenever the airplane battery switch is "ON."

*y.* BOMB AND DROPPABLE TANK CIRCUIT.—*(See figures 37, 219, 219A, 219B, 220, and 220A.)*—The bomb release circuit (droppable tank circuit) on early F-80A-1 airplanes consists of a type A-4 bomb release unit in each wing tip, two amber indicator lights, an arming switch, a bomb selector switch, and a bomb release switch. The bomb release switch is on the control stick. (See figure 212.)

The release unit consists of two solenoids for arming and releasing the bomb, and a cut-out switch for controlling the indicator light.

With the arming switch in the "SAFE" position, the amber indicator lights will glow to indicate that their respective bomb shackles are loaded and not armed. The lights are extinguished as the bombs or tanks are dropped. The indicator lights do not glow if the arming switch is in the "ARMED" position.

The bomb selector switch allows the pilot a choice between dropping both bombs together or dropping them separately. To drop them separately, place the selector switch in "TRAIN" position, the arming switch in "SAFE," and press the bomb release switch on the control stick. The left bomb will drop. The releasing solenoid in the bomb release unit actuates a sequence switch at the end of its releasing cycle. The sequence switch directs the next electrical impulse to the right-hand bomb release unit, and the right bomb will drop on the next operation of the release switch. With the arming switch in "ARM," the sequence switch diverts the current to the right release unit with a delay of approximately $\frac{1}{10}$ second. The light switch in the release unit opens the indicator light circuit when the bombs are dropped. To drop both bombs together, operate the selector switch to "ALL" and press the release switch. The bombs may be dropped either armed or safe.

**CAUTION**

Do not hold bomb release switch on for longer than 30 seconds, or releasing solenoid may be damaged.

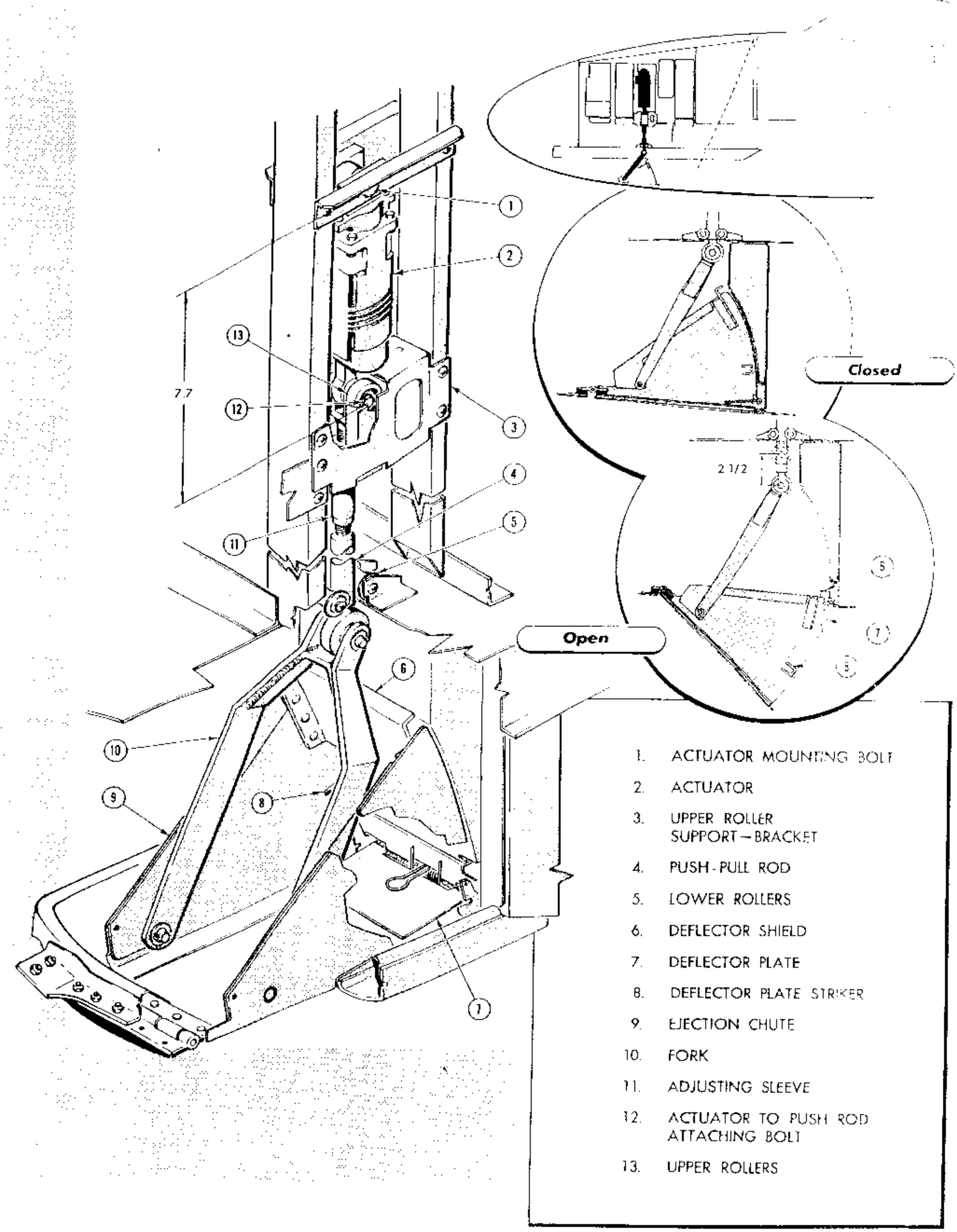
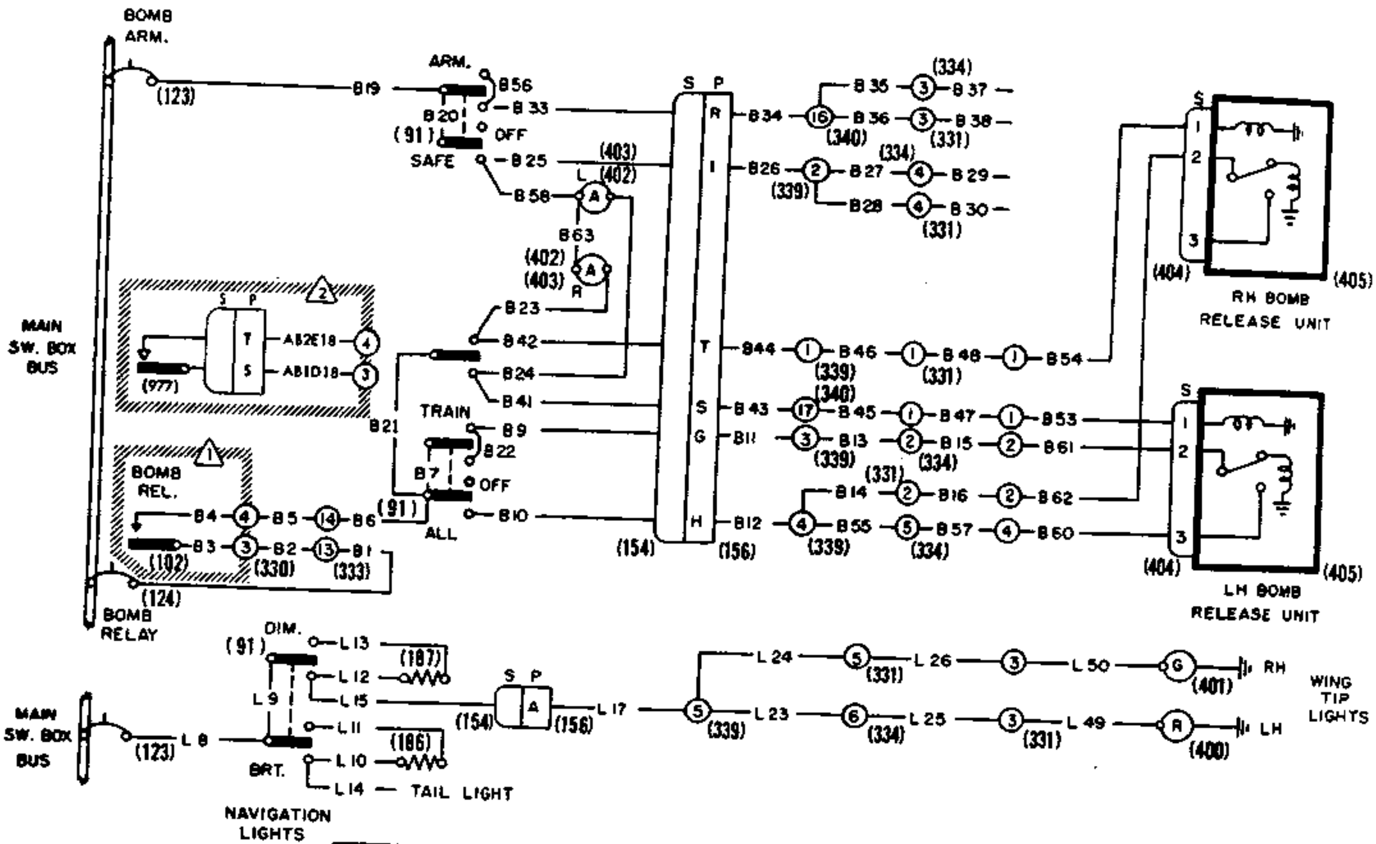



*Figure 218 — Case Ejection Door and Actuator — P-80A Airplanes*




**NOTE**

THIS CIRCUIT DIAGRAM TO BE USED ONLY ON THOSE AIRPLANES EQUIPPED WITH TYPE A-4 BOMB RELEASES AND TYPE B-10 BOMB SHACKLES.

WIRES B 21, B 25, B 29, B 30, B 33, B 37 AND B 38 ARE DEAD ENDED AS SHOWN. THESE WIRES WILL BE USED WHEN TYPE S-1 BOMB SHACKLES ARE INSTALLED.

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 91 | SWITCH | | | AN3027-1 |
| 102 (1) | CONTROL STICK SWITCH | C.H. MASON | | 212 |
| 123 | CIRCUIT PROTECTOR | | | PSM-10 |
| 124 | CIRCUIT PROTECTOR | | | PSM-15 |
| 154 | CONNECTOR | | | AN3106-28-11S |
| 156 | CONNECTOR | CANNON | | 2312-41 |
| 186 | RESISTOR | I.R.C. | MW-2 | 125Ω |
| 187 | RESISTOR | OHMITE | 15925W | 0364 |
| 330 | TERMINAL PANEL | LOCKHEED | | LS1906-2 |
| 331 | TERMINAL PANEL | | | LS1904-2 |
| 333 | TERMINAL PANEL | | | LS1929-12 |
| 334 | TERMINAL PANEL | | | LS1907-2 |
| 339 | TERMINAL PANEL | | | LS1909-2 |
| 400 | LIGHT | | | AN3032-3 |
| 401 | LIGHT | | | AN3032-4 |
| 402 | LIGHT | | | 40A7419-1 |
| 403 | LAMP | G.E. | | 3V .19AT 1 1/4 |
| 404 | CONNECTOR | GFAE | A-1 | 24843 |
| 405 | BOMB RACK | GFAE | A-4 | 24848 |
| 977 (2) | SWITCH | GFAE | B-8 | MIL-S-5210 |

| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| B1 | 18 | B41 | 20 |
| B2 | 18 | B42 | 20 |
| B3 | 18 | B43 | 20 |
| B4 | 18 | B44 | 20 |
| B5 | 18 | B45 | 20 |
| B6 | 18 | B46 | 20 |
| B7 | 18 | B47 | 20 |
| B9 | 18 | B48 | 20 |
| B10 | 18 | B53 | 20 |
| B11 | 18 | B54 | 20 |
| B12 | 18 | B55 | 18 |
| B13 | 18 | B57 | 18 |
| B14 | 18 | B58 | 20 |
| B15 | 18 | B60 | 18 |
| B16 | 18 | B61 | 18 |
| B19 | 20 | B62 | 18 |
| B20 | 20 | B63 | 20 |
| B21 | 20 | L8 | 20 |
| B22 | 18 | L9 | 20 |
| B23 | 20 | L10 | 20 |
| B24 | 20 | L11 | 20 |
| B25 | 20 | L12 | 20 |
| B26 | 20 | L13 | 20 |
| B27 | 20 | L14 | 20 |
| B28 | 20 | L15 | 20 |
| B29 | 20 | L17 | 20 |
| B30 | 20 | L23 | 20 |
| B33 | 20 | L24 | 20 |
| B34 | 20 | L25 | 20 |
| B35 | 20 | L26 | 20 |
| B36 | 20 | L49 | 20 |
| B37 | 20 | L50 | 20 |
| B38 | 20 | | |

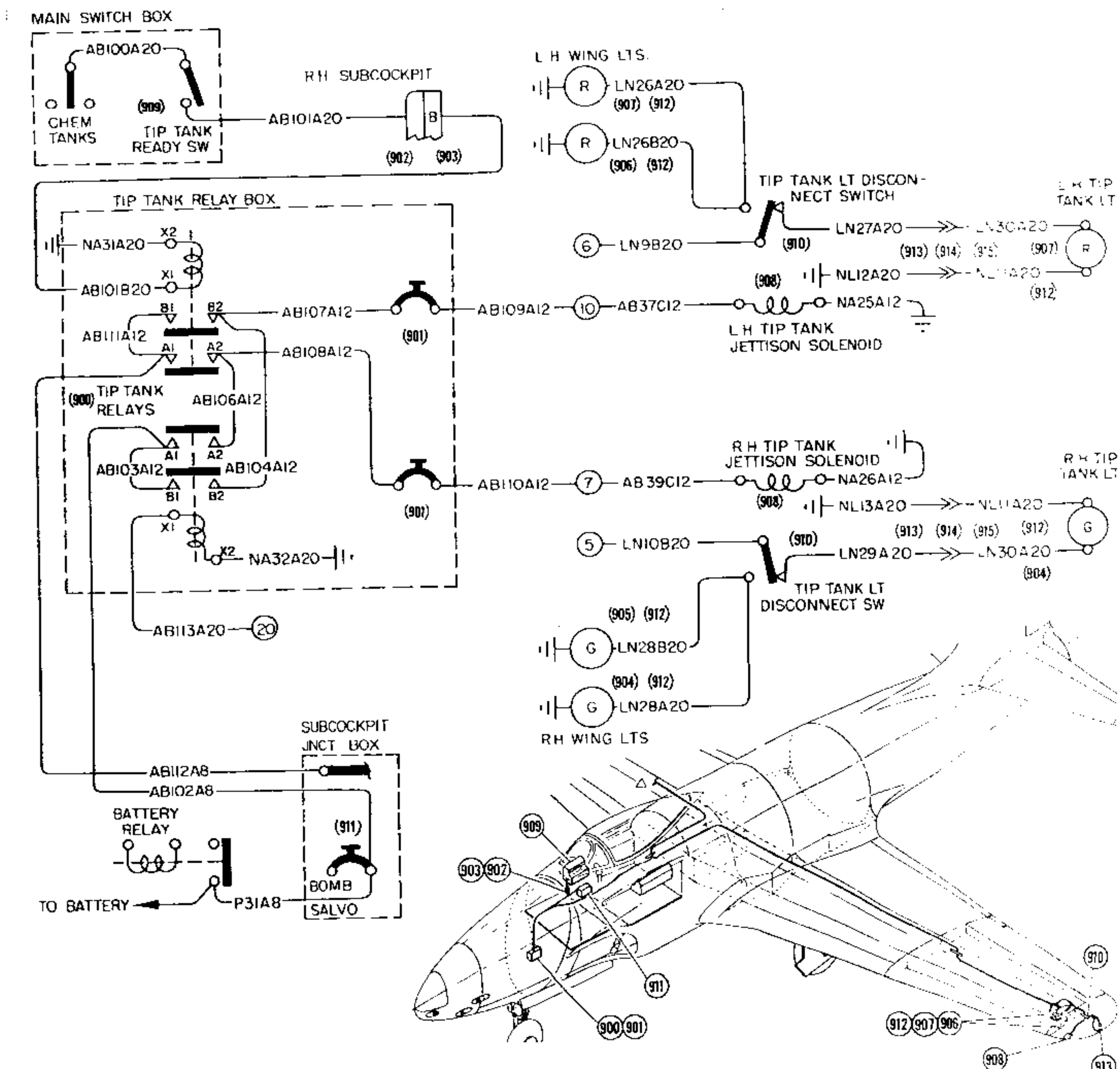
**NOTE**

(1) USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

(2) USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

FB 4584 EM39-20-4-219

*Figure 219 — Bombs and Wing Tip Lights Circuit, F-80A-1 Airplanes, AF Serial No. 44-84992 through 44-85041*



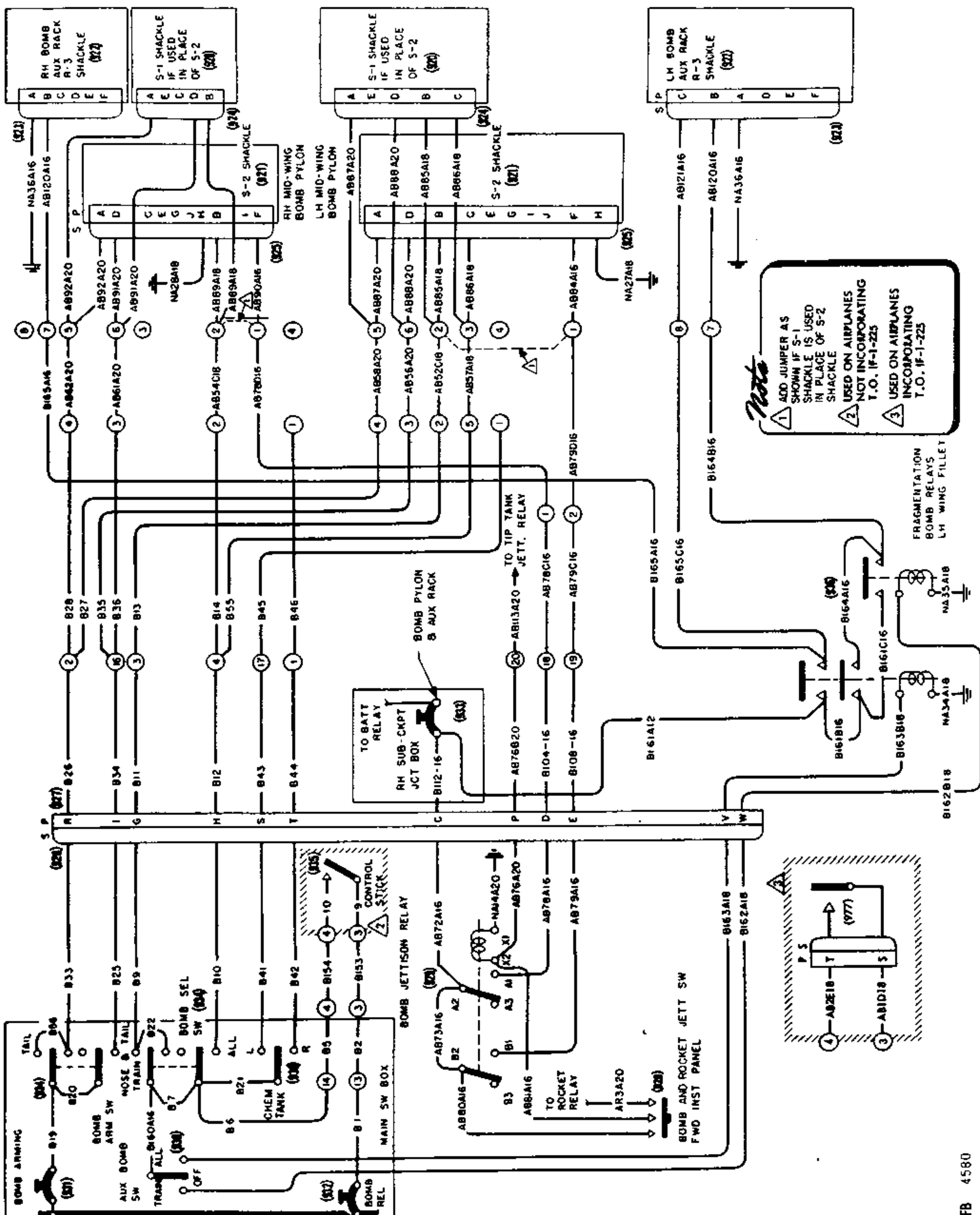

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 900 | RELAY | | | AN3352-1 |
| 901 | CIRCUIT PROTECTOR | | | AN3161-P25 |
| 902 | CONNECTOR | | | AN3106-28-11S |
| 903 | CONNECTOR | CANNON | | AN3102P-28-11P OR 2312-41 |
| 904 | LIGHT | | GREEN | AN3033-8 |
| 905 | LIGHT | | GREEN | 210209-4 |
| 906 | LIGHT | | RED | 210209-3 |
| 907 | LIGHT | | RED | AN3033-7 |
| 908 | SOLENOID | CANNON | | 18488 |
| 909 | SWITCH | | | AN3022-2 |
| 910 | SWITCH | | | AN3210-1 |
| 911 | CIRCUIT PROTECTOR | | | AN3161-P15 |
| 912 | LAMP | | #7 | AN3122-1574 |
| 913 | COUPLER | | | AN7538-1 |
| 914 | INSERT | THOM & BETTS | | AB154 |
| 915 | TIP | | | AN753A-1 |

*Note*

△ RT WING SAME AS LEFT. LIGHTS ARE ITEMS 904, AND 905

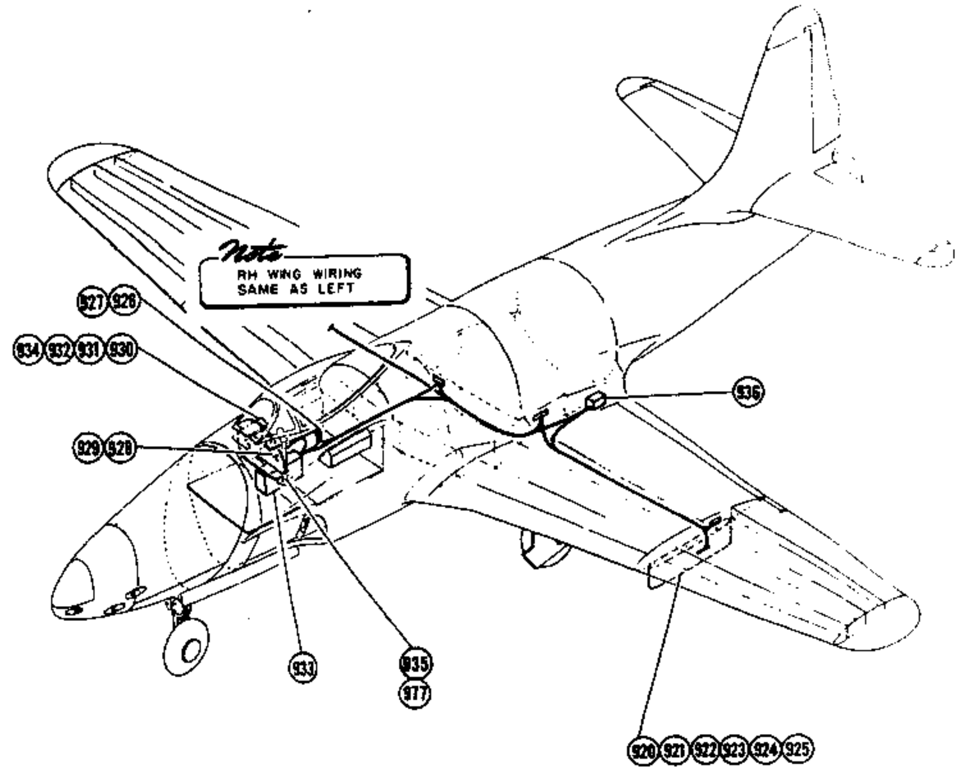
AB 7399

***Figure 219A — Centerline Droppable Tank Circuit (Airplanes Incorporating T.O. 01-75F-42)***




FB 4580
EAC9-20-4-219B(1)

*Figure 219B — Bomb Pylon Circuit, Airplanes Incorporating T. O. 01-75F-42 (Sheet 1 of 2 Sheets)*

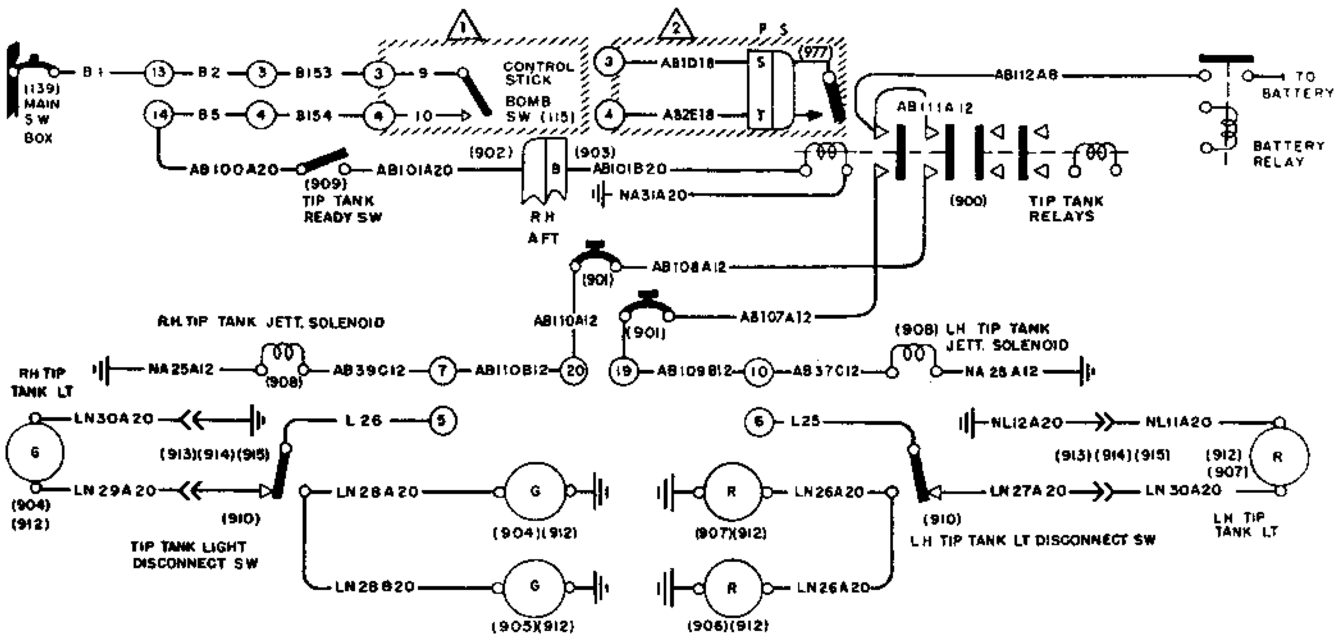


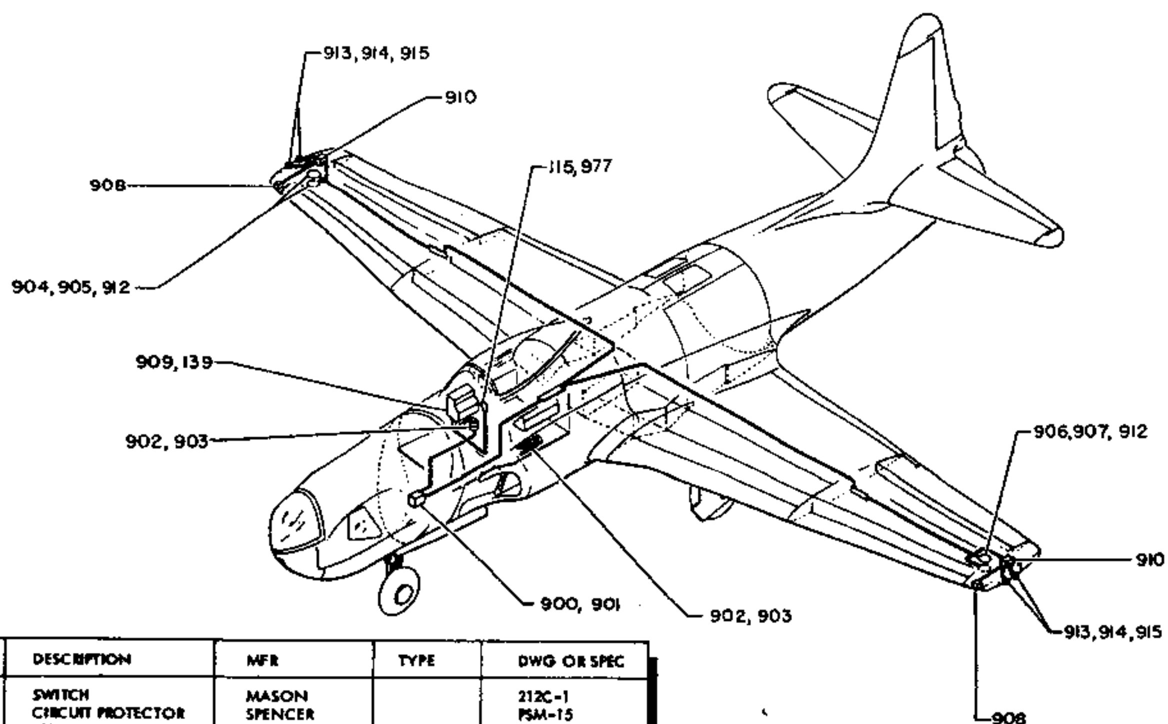

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 920 | BOMB SHACKLE | GFAE | S-1 | 24935 |
| 921 | BOMB SHACKLE | GFAE | S-2 | 24993 |
| 922 | BOMB SHACKLE | GFAE | R-3 | 24938 |
| 923 | CONNECTOR | | | AN3106-18-12S (with coupling ring removed) |
| 924 | CONNECTOR | | | AN3106-16S-8S |
| 925 | CONNECTOR | | | AN3101B-18-1S |
| 926 | CONNECTOR | | | AN3106-28-11S |
| 927 | CONNECTOR | | | AN3102P-28-11P |
| 928 | SWITCH | HETHERINGTON | | A14600 |
| 929 | RELAY | LEACH | | 237-EAU |
| 930 | SWITCH | | | AN3021-1 |
| 931 | CIRCUIT PROTECTOR | | | AN3161-P10 |
| 932 | CIRCUIT PROTECTOR | | | AN3161-P15 |
| 933 | CIRCUIT PROTECTOR | | | AN3161-P25 |
| 934 | SWITCH | | | AN3027-1 |
| 2 935 | SWITCH | GFAE | B-7 | |
| 936 | RELAY | | | AN3352 |
| 3 977 | SWITCH | GFAE | B-8 | MIL-S-5210 |

EM39-20-4-219B(2)

FB 1 08

*Figure 219B — Bomb Pylon Circuit, Airplanes Incorporating T. O. 01-75F-42 (Sheet 2 of 2 Sheets)*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 1 115 | SWITCH | MASON | | 212C-1 |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 |
| 900 | RELAY | | | AN3352-1 |
| 901 | CIRCUIT PROTECTOR | | | AN3161-P25 |
| 902 | CONNECTOR | | | AN3106-28-11S |
| 903 | CONNECTOR | | | AN3102P-28-11P |
| 904 | LIGHT | | GREEN | AN3033-8 |
| 905 | LIGHT | | GREEN | 210209-4 |
| 906 | LIGHT | | RED | 210209-3 |
| 907 | LIGHT | | RED | AN3033-7 |
| 908 | SOLENOID | CANNON | | 18488 |
| 909 | SWITCH | | | AN3022-2 |
| 910 | SWITCH | | | AN3210-1 |
| 912 | LAMP | | | AN3122-1524 |
| 913 | COUPLER | | #7 | AN7538-1 |
| 914 | INSERT | THOM & BETTS | | AB154 |
| 915 | TIP | | | AN753A-1 |
| 2 977 | SWITCH | GFAE | B-8 | MIL-S-5210 |

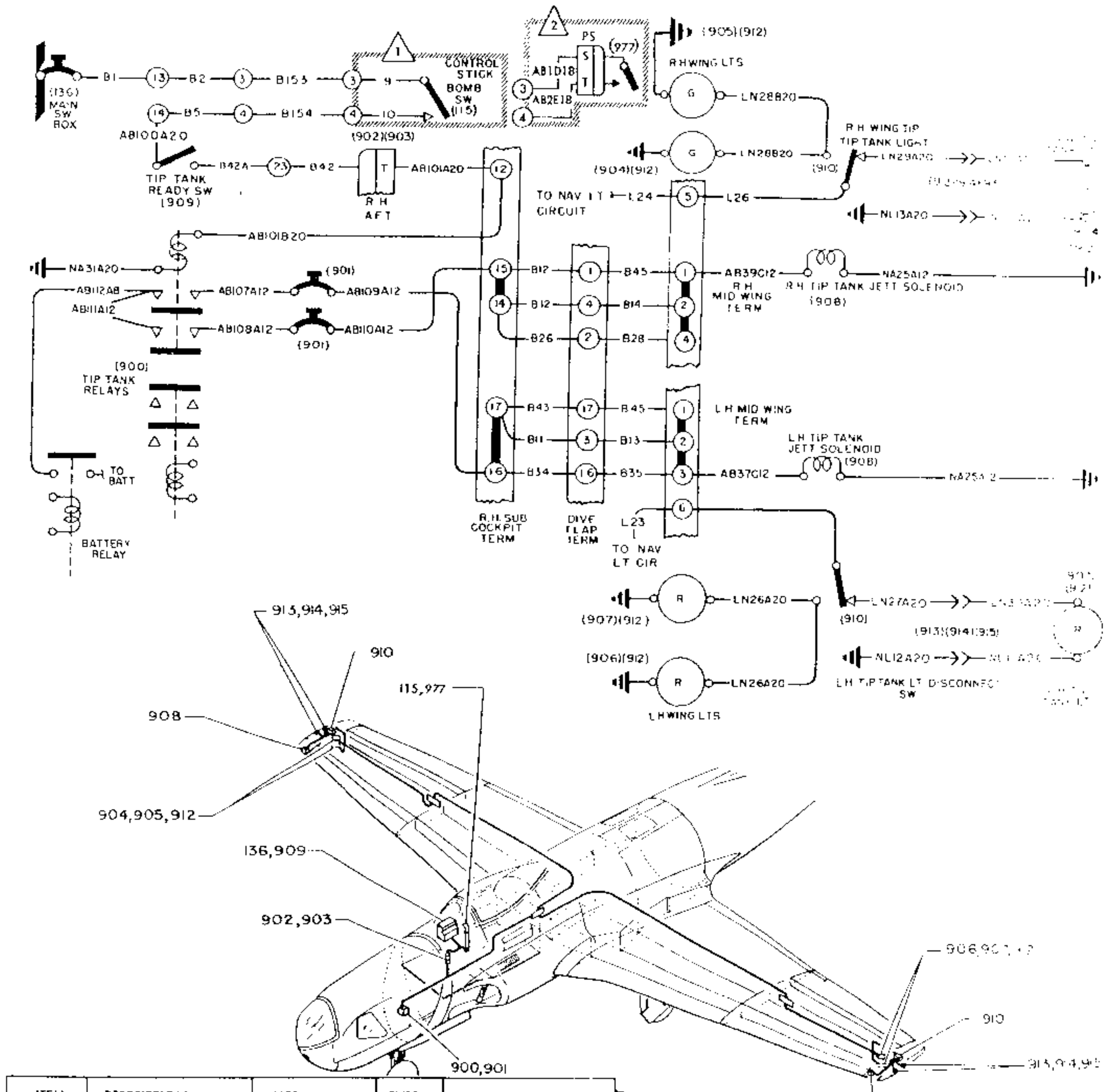
# NOTE

1 USED ON AIRPLANES NOT INCORPORATING T.O. IF-1-225

2 USED ON AIRPLANES INCORPORATING T.O. IF-1-225

FB 4689
EM39-20-4-17

*Figure 219C — Centerline Droppable Tank Circuit, RF-80A-20 Airplanes*



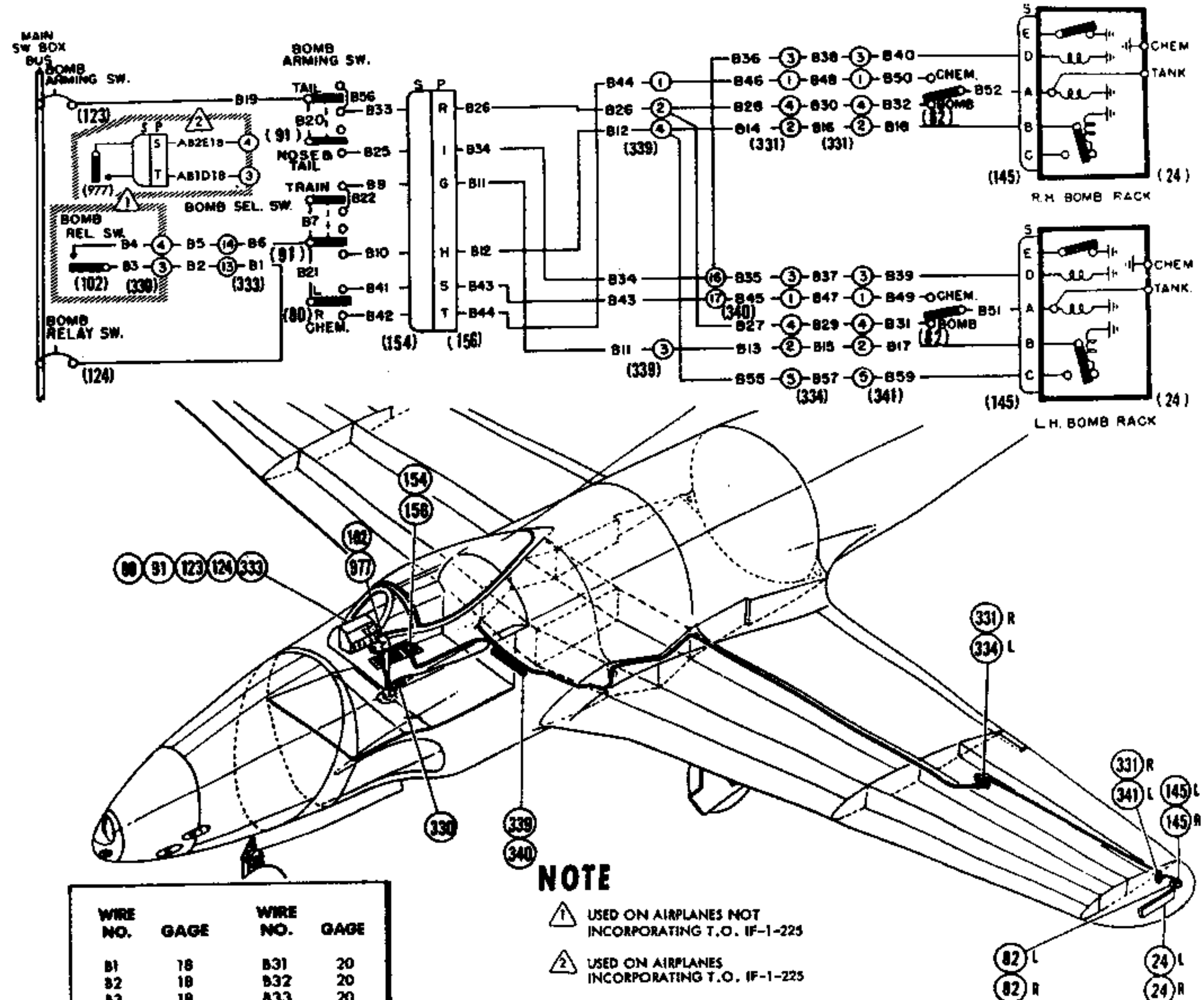

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| ⚠1 115 | SWITCH | MASON | | 212C-1 |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 |
| 900 | RELAY | | | AN3352-1 |
| 901 | CIRCUIT PROTECTOR | | | AN3161-P25 |
| 902 | CONNECTOR | | | AN3106-28-11S |
| 903 | CONNECTOR | | | AN3102P-28-11P |
| 904 | LIGHT | | GREEN | AN3033-8 |
| 905 | LIGHT | | GREEN | 210209-4 |
| 906 | LIGHT | | RED | 210209-3 |
| 907 | LIGHT | | RED | AN3033-7 |
| 908 | SOLENOID | CANNON | | 18488 |
| 909 | SWITCH | | | AN3022-2 |
| 910 | SWITCH | | | AN3210-1 |
| 912 | LAMP | | | AN3122-1524 |
| 913 | COUPLER | | #7 | AN753B-1 |
| 914 | INSERT | THOM & BETTS | | AB154 |
| 915 | TIP | | | AN753A-1 |
| ⚠2 977 | SWITCH | GFAE | B-8 | MIL-S-5210 |

*Note*

⚠1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

⚠2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

***Figure 219D — Centerline Droppable Tank Circuit, RF-80A-25 Airplanes***




**NOTE**

⚠1 USED ON AIRPLANES NOT INCORPORATING T.O. IF-1-225

⚠2 USED ON AIRPLANES INCORPORATING T.O. IF-1-225

| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| B1 | 18 | B31 | 20 |
| B2 | 18 | B32 | 20 |
| B3 | 18 | B33 | 20 |
| B4 | 18 | B34 | 20 |
| B5 | 18 | B35 | 20 |
| B6 | 18 | B36 | 20 |
| B7 | 18 | B37 | 20 |
| B9 | 18 | B38 | 20 |
| B10 | 18 | B39 | 20 |
| B11 | 18 | B40 | 20 |
| B12 | 18 | B41 | 20 |
| B13 | 18 | B42 | 20 |
| B14 | 18 | B43 | 20 |
| B15 | 18 | B44 | 20 |
| B16 | 18 | B45 | 20 |
| B17 | 18 | B46 | 20 |
| B18 | 18 | B47 | 20 |
| B19 | 20 | B48 | 20 |
| B20 | 20 | B49 | 20 |
| B21 | 20 | B50 | 20 |
| B22 | 18 | B51 | 20 |
| B25 | 20 | B52 | 20 |
| B26 | 20 | B55 | 18 |
| B27 | 20 | B56 | 20 |
| B28 | 20 | B57 | 18 |
| B29 | 20 | B59 | 18 |
| B30 | 20 | | |

| | ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|---|
| | 24 | BOMB RACK | GFAE | S-1 | 24935 | WING TIP |
| | 80 | SWITCH | C.H. | | AN3021-1 | MAIN SWITCH BOX |
| | 82 | SWITCH | C.H. | | AN3021-3 | WING TIP |
| | 91 | SWITCH | C.H. | | AN3027-1 | MAIN SWITCH BOX |
| ⚠1 | 102 | CONTROL STICK SWITCH | MASON | | 212-C | CONTROL STICK |
| | 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| | 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | MAIN SWITCH BOX |
| | 145 | CONNECTOR | | | AN3106-16S-8S | WING TIP |
| | 154 | CONNECTOR | | | AN3106-28-11S | RH SUB-COCKPIT |
| | 156 | CONNECTOR | CANNON | | 2312-41 | RH SUB-COCKPIT |
| | 331 | TERMINAL PANEL | LOCKHEED | | LS1904-2 | RH WING |
| | 334 | TERMINAL PANEL | LOCKHEED | | LS1907-2 | LH MID WING |
| | 339 | TERMINAL PANEL | LOCKHEED | | LS1909-2 | FUSELAGE WING |
| | 341 | TERMINAL PANEL | LOCKHEED | | LS1905-2 | LH WING TIP |
| | 330 | TERMINAL PANEL | LOCKHEED | | LS1906-2 | COCKPIT |
| | 333 | TERMINAL PANEL | LOCKHEED | | LS1929-12 | MAIN SWITCH BOX |
| | 340 | TERMINAL PANEL | LOCKHEED | | LS1909-12 | FUSELAGE WING |
| ⚠2 | 977 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

FB 4691
EM39-20-4-220

*Figure 220 — Bombs and Chemical Tank Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes, AF Serial No. 44-85042 and Subsequent*

All other airplanes employ a type S-1 bomb shackle in each wing tip. This shackle contains the release unit as an integral part. The wing tip also contains a toggle switch to be operated only when chemical tanks are used. The shackle is controlled with three switches on the armament switch panel of the main switch box in the cockpit. (See figure 235.) The three switches are the bomb arming, bomb selector, and the chemical-tank operating switches. The arming switch is a three-position switch and bombs may be dropped safe, tail armed, or nose and tail armed. The bomb selector switch allows the pilot to choose between dropping both the bombs together or dropping them separately. To drop them separately, the selector switch is placed in "TRAIN" position, and the bomb release switch on the control stick pressed. The left bomb will drop. Releasing the bomb release switch throws a sequence switch in the left bomb shackle which diverts the next electrical impulse to the right shackle. The right bomb will drop on the next operation of the bomb release switch.

A push-botton type drop tank or bomb jettison switch is mounted on the instrument panel. The circuit is wired around both bomb selector and trigger switches, and is protected by the 15-ampere push-to-reset bomb-release circuit protector. The switch is operated to jettison both tanks in case of emergency.

When chemical tanks are used, the toggle switch in the wing tip is turned to "CHEMICAL" upon installation of the tanks. To operate the chemical tanks, move the chemical switch on the armament switch panel to whichever tank is selected. If the toggle switch in the wing tip has been left on "BOMBS" both chemical tanks can be operated together, but not separately, by operating the arming switch to "NOSE AND TAIL." Circuit protection is afforded on the bomb arming circuit by a 10-ampere push-to-reset circuit protector. The bomb release and chemical operating circuit is protected by a 15-ampere push-to-reset circuit protector. Both circuit protectors are located in the main switch box below the armament switches.

*yA.* CENTERLINE DROPPABLE TANK AND BOMB PYLON CIRCUITS. (AIRPLANES INCORPORATING T.O. 01-75F-42). *(See figures 36A, 219A, and 219B.)* This circuit employs a solenoid in each wing tip to release the droppable fuel tank, and provisions in the wing for an S-1 or S-2 bomb rack to be carried in an under-the-wing pylon. The tank-dropping solenoid is controlled by two relays, the tip tank jettison switch, and the bomb dropping switch. The tanks are also jettisoned when the bomb and rocket jettison salvo switch is operated. The bomb racks are controlled through the bomb selector switch and the bomb dropping switch. To drop the bombs normally, the bomb selector switch must be in either "TRAIN" or "ALL." In the "OFF" position, bombs may not be dropped electrically except by the bomb and rocket jettison salvo switch. The bomb dropping switch is on the control stick. (See figure 212 or 212A.)

*yB.* ROCKET CIRCUITS. *(See figure 220B.)*—Provisions are installed for carrying four rockets under each wing. These rockets are controlled by three circuits: rocket arming, rocket firing (ignition), and rocket jettisoning. All circuits are protected by push-to-reset circuit protectors.

Rocket arming solenoids are energized only when the single-pole double-throw switch on the cockpit left shelf is placed in the "INST" position. The "OFF" and "TIME DELAY" positions of this switch are not wired.

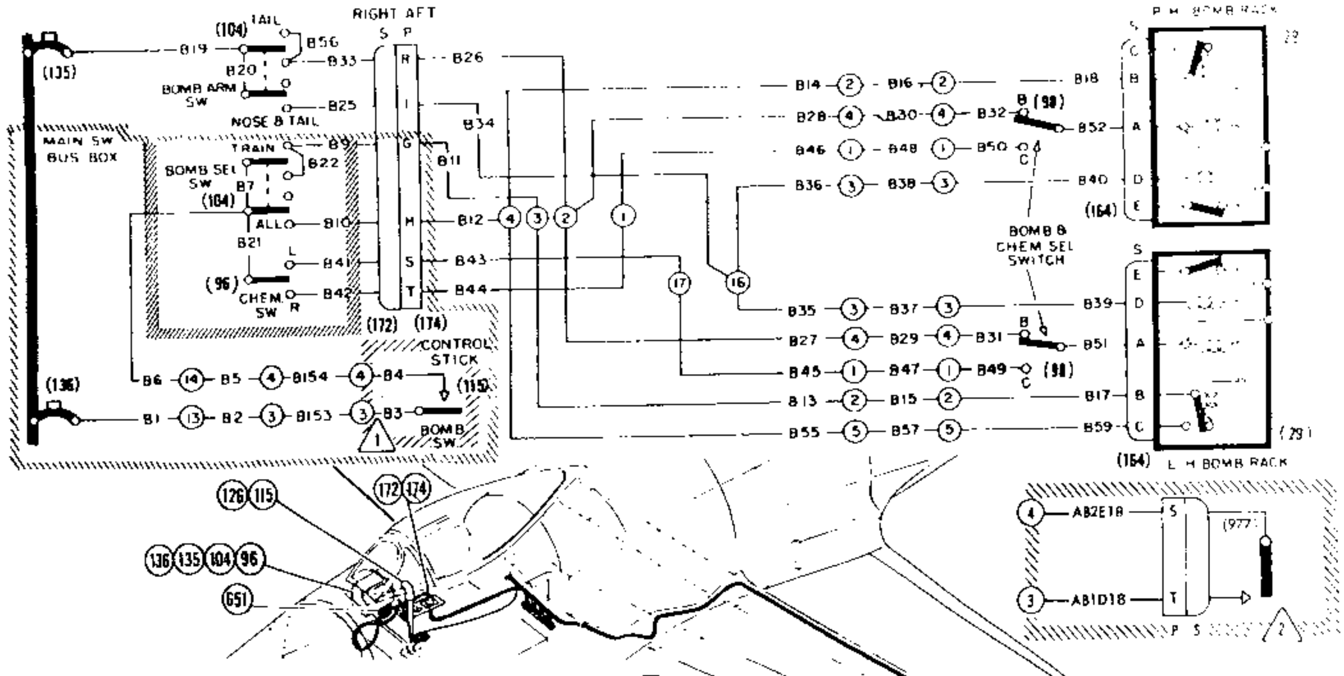
Rockets are fired by the bomb-dropping switch on the control stick. Rocket firing interval is controlled at $\frac{1}{10}$-second intervals by the A-3 projector release when the rocket selector switch is set at "AUTO." With the selector switch set at "SINGLE," any one rocket may be fired.

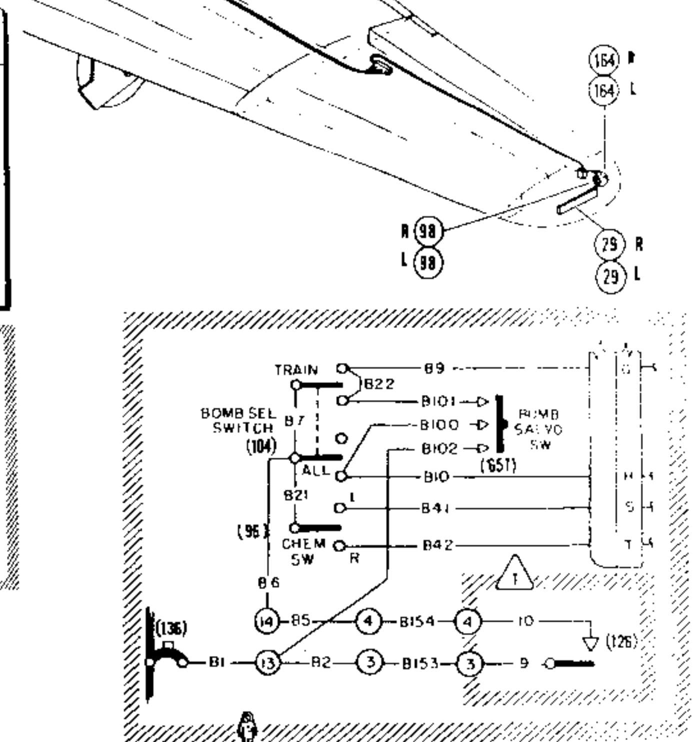
Rockets are jettisoned with bombs or drop tanks through the bomb jettison switch. Rockets are also jettisoned by placing the rocket jettison switch in "JETTISON READY" position and pressing the bomb dropping switch on the control stick. When the airplane is on the ground, the jettison relay circuit is kept open by a scissors switch on the right main gear. A test switch is located in the right wheel well to permit testing the jettison solenoids.

*z.* DIVE FLAPS CIRCUIT.
*(See figures 58, 211, and 221A.)*

(1) GENERAL.—On early airplanes, serial Nos. AF44-84992 through 44-85005, the dive flap circuit consists of a reversible actuator, two limit switches, a push-to-reset circuit protector, and a single-pole double-throw switch. These units operate the dive-flap hydraulic selector valve. All other airplanes have a Geneva-loc type actuator with a limit switch and a selector switch, both integral with the actuator. The dive flap switch is in the cockpit behind the throttle handle.

Access to the actuator is through the dive flaps opening in the bottom of the fuselage.





| WIRE NO. | GAGE | WIRE NO. | GAGE | WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|---|---|---|---|
| 9 | 18 | B16 | 18 | B32 | 20 | B46 | 20 |
| 10 | 18 | B17 | 18 | B33 | 20 | B47 | 20 |
| B1 | 18 | B18 | 18 | B34 | 20 | B48 | 20 |
| B2 | 18 | B19 | 20 | B35 | 20 | B49 | 20 |
| B5 | 18 | B20 | 20 | B36 | 20 | B50 | 20 |
| B6 | 18 | B21 | 20 | B37 | 20 | B51 | 20 |
| B7 | 18 | B22 | 18 | B38 | 20 | B52 | 20 |
| B9 | 18 | B25 | 20 | B39 | 20 | B55 | 18 |
| B10 | 18 | B26 | 20 | B40 | 20 | B56 | 20 |
| B11 | 18 | B27 | 20 | B41 | 20 | B57 | 18 |
| B12 | 18 | B28 | 20 | B42 | 20 | B59 | 18 |
| B13 | 18 | B29 | 20 | B43 | 20 | B153 | 18 |
| B14 | 18 | B30 | 20 | B44 | 20 | B154 | 18 |
| B15 | 18 | B31 | 20 | B45 | 20 | | |

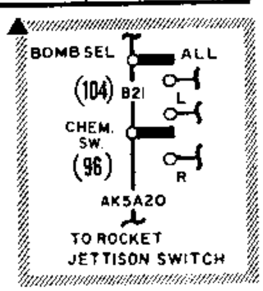
*Note*

USE ON F-80A-10 WINTERIZED AIRPLANES

▲ T.O. 1F-80A-24

1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225



| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 29 | BOMB RACK | GFAE | S-1 | 44G4996 | WING TIP |
| 96 | SWITCH | C.H. | | AN3021-1 | MAIN SWITCH BOX |
| 98 | SWITCH | C.H. | | AN3021-3 | WING TIP |
| 104 | SWITCH | C.H. | | AN3027-1 | MAIN SWITCH BOX |
| 1 115 | SWITCH | MASON | | 212C-1 | CONTROL STICK |
| 126 | SWITCH | | B-7 | | CONTROL STICK |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | MAIN SWITCH BOX |
| 136 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | MAIN SWITCH BOX |
| 164 | CONNECTOR | | | AN3106-16S-8S | WING TIP |
| 172 | CONNECTOR | | | AN3106-28-11S | RH FLOOR |
| 174 | CONNECTOR | | | AN3102P-28-11P | RH FLOOR |
| 2 651 | SWITCH | HETHERINGTON | | A14600 | INST PANEL |
| 977 | SWITCH | GFAE | B-8 | MIL-S-5210 | CONTROL STICK |

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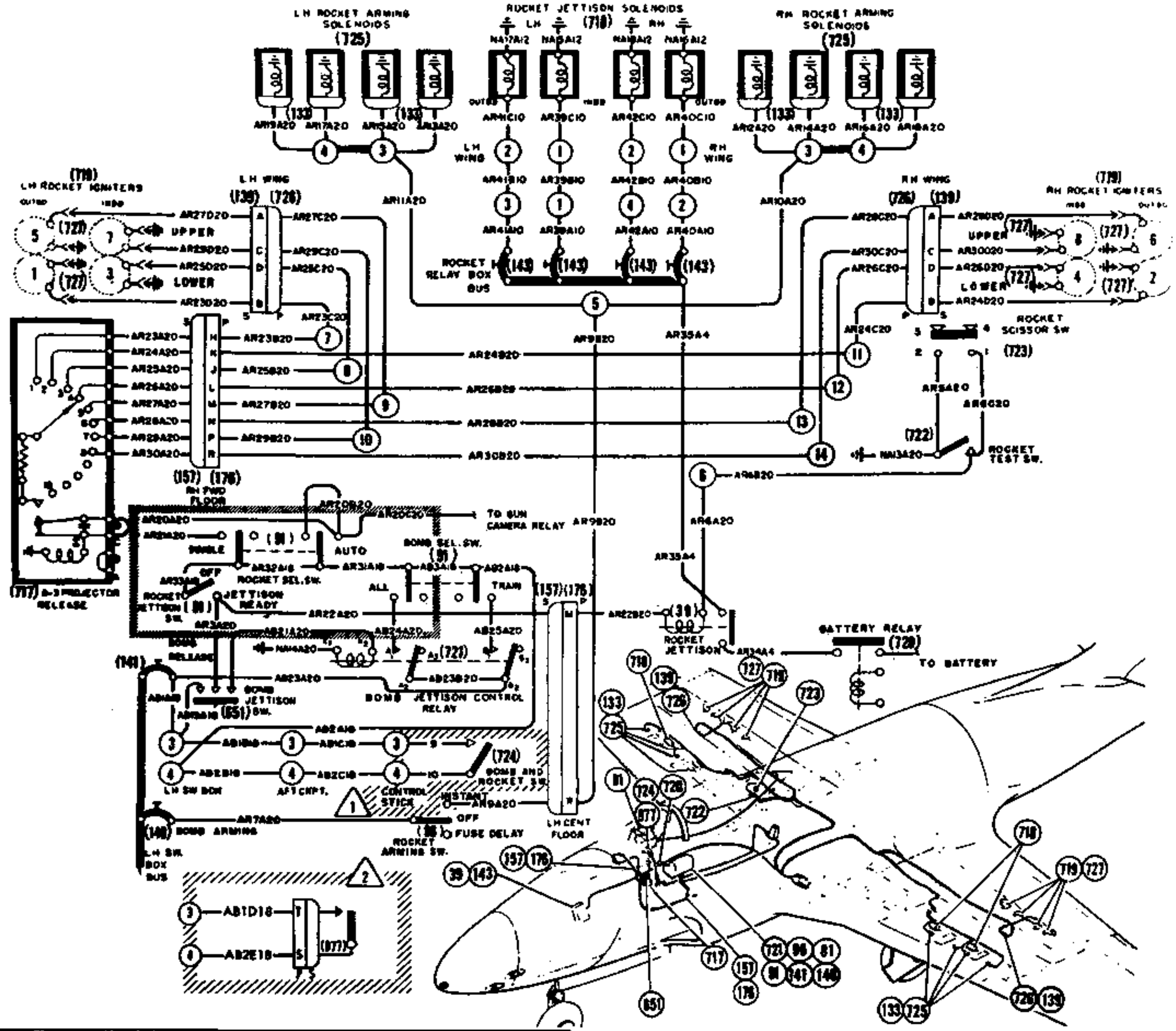
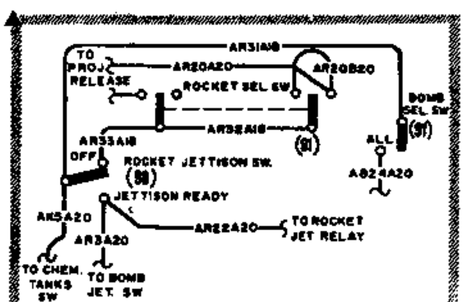
EM39-20-4-220A

*Figure 220A — Bombs and Chemical Tanks Circuit, F-80A-10 and RF-80A-10 Airplanes*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 39 | ROCKET JETTISON RELAY | | | AN3370-1 |
| 81 | ROCKET JETTISON SWITCH | | | AN3021-2 |
| 91 | SWITCH | | | AN3027-1 |
| 96 | ROCKET ARMING SWITCH | CH | | AN3021-1 |
| ▲ 98 | ROCKET JETTISON SWITCH | CH | | AN3021-3 |
| 133 | ARMING SOL. CONNECT. | | | AN3106-10S-2S |
| 139 | ROCKET IGN CONNECTOR | | | AN3101-14S-2S |
| 140 | BOMB ARMING CIRC PROT | | | AN3161-P10 |
| 141 | BOMB RELEASE CIRC PROT | | | AN3161-P15 |
| 143 | ROCKET CIRCUIT PROT | | | AN3161-P35 |
| 157 | CONNECTOR | | | AN3106-28-12S |
| 176 | CONNECTOR | | | AN3102P-28-12P |
| 651 | BOMB JETTISON SWITCH | HETHERINGTON | | A14600 |
| 717 | PROJECTOR RELEASE | GFAE | A-3 | COCKPIT |
| 718 | JETTISON SOLENOID | CANNON | | 16928 |
| 719 | IGNITERS | GFAE | | 45A133310 |
| 720 | BATTERY RELAY | | | AN3380-1 |
| 721 | BOMB JETTISON RELAY | LEACH | | 237-EAU |
| 722 | ROCKET TEST SWITCH | | | AN3022-8 |
| 723 | ROCKET SCISSORS SW | G.E. | | CR1070-103R3 |
| ⚠1 724 | BOMB & ROCKET SWITCH | GFAE | B-7 | |
| 725 | ROCKET ARMING SOLENOID | GFAE | A-2 | |
| 726 | ROCKET IGN CONNECTOR | | | AN3106-14S-2P |
| 727 | ROCKET LAUNCHER | LOCKHEED | | 205031 |
| ⚠2 977 | SWITCH | GFAE | B-8 | MIL-S-5210 |

**Note**

▲ AIRPLANES INCORPORATING T.O. 1F-80-84

⚠1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-1-225

⚠2 USED ON AIRPLANES INCORPORATING T.O. 1F-1-225

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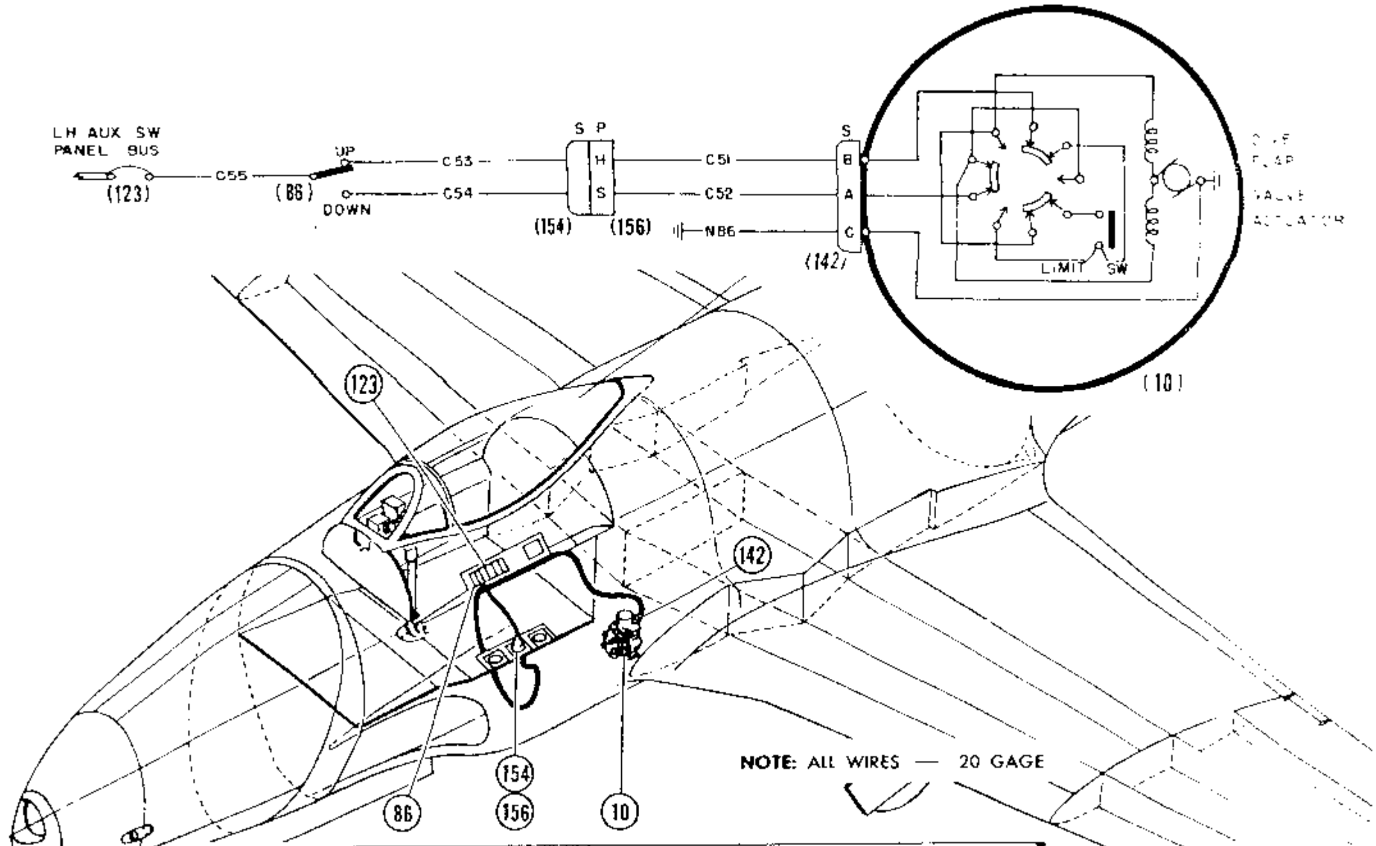
*Figure 220B — Rocket Circuits*




| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 86 | SWITCH | C.H. | | AN3022-3 | LH AUXILIARY SWITCH PANEL |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH AUXILIARY SWITCH PANEL |
| 154 | CONNECTOR | | | AN3106-28-11S | LH SUB-COCKPIT |
| 156 | CONNECTOR | CANNON | | 2312-41 | LH SUB-COCKPIT |
| 10 | DIVE FLAP MOTOR | BENDIX | | 405381 | HYDRAULIC COMPARTMENT |
| 142 | CONNECTOR | | | AN3106-14S-7S | HYDRAULIC COMPARTMENT |

*Figure 221 — Dive Flap Selector Valve Actuator Circuit, F-80A-1, F-80A-5 and RF-80A-5 Airplanes*

(2) DIVE FLAP SELECTOR VALVE ACTUATOR.

*(a)* DESCRIPTION.—The actuator for the dive flap selector valve on early airplanes employs a reversible, intermittent duty motor having an electro-magnetic clutch and brake. The motor is series wound with split field, and is rated 24 volts. The actuator is mounted with the hydraulic selector valve, connection between the two being made with a combination cam and adapter. The limit switches are placed between the actuator and the selector valve, and are operated by the cam.

All other airplanes have a different electrical actuator with a Geneva action cam. The actuator has one integral limit switch and an integral selector switch. Adjustment of the limit switch is not necessary on this actuator. The motor comes up to top speed under no load, then engages the cam and maintains maximum load past the breakaway position, after which the actuator opens a limit switch and operates a selector switch. This actuator is also mounted on the hydraulic selector valve and actuates the valve.

*(b)* OPERATION.—The dive flap selector valve is operated by an electric actuator. The actuator is started by the dive flap switch and is stopped by limit switches. There are no intermediate positions of the flaps.

*(c)* REMOVAL. (Early Airplanes).

*1.* Disconnect red wire from one limit switch and white wire from the other switch. Mark terminals to insure correct replacement of wires.

2. Remove five screws attaching actuator housing to adapter housing.

3. Remove actuator. Adapter will remain with the selector valve.

4. Mark switches and disconnect remaining wires.

**Note**

Although switches are interchangeable, they will be difficult to rewire if they are not returned to their original positions.

5. Remove mounting nut on each switch and detach switches.

*(d)* REMOVAL (Other Airplanes). — Remove four bolts holding actuator to selector valve and remove the actuator.

*(e)* ADJUSTMENTS (Early Airplanes Only).

*1.* ADJUSTMENT FOR CAM POSITION.— Remove adapter cam. Replace adapter cam, being careful to align center line of cam arm with slot in shaft of the selector valve.

*2.* ADJUSTMENT OF LIMIT SWITCHES (Early Airplanes Only). With adapter cam in the flap up position, adjust position of limit switch by means of the two mounting lock nuts until switch just clicks. With adapter cam in the flap down position, adjust the other limit switch in the same manner.

*aa.* OVERHEAT WARNING SYSTEM. *(See figures 222 and 222A.*—The overheat warning system originally installed by the contractor is shown in figure 222 for F-80A-1, F-80A-5, and RF-80A-5 airplanes. The system as shown consists of seven thermal fire detectors on bulkheads around the tail pipe in the fuselage aft section (figure 61) and a warning light on the instrument panel. The warning light is a push-to-test light. Each new 232.2° C (450°F) fire detecor is pre-set by the manufacturer and the adjusting screw locked and covered with a metal cap permanently secured in place, and further adjustment cannot be made. The fire detectors will operate in from two to three seconds when subjected to temperatures of 1093°C (2000°F), (operation slower at lower temperature), and will reset automatically upon cooling to temperatures below 232.2° (450°F). When malfunction of the system occurs due to faulty fire detectors, replace all detectors with like items from stock. Return old detectors to base activity for test. Serviceable detectors will be returned to stock, and the defective ones will be condemned.

On F-80A-10 and RF-80A-10 airplanes (figure 222A), nine additional detectors are installed. Four are spaced evenly around the engine, four around a bulkhead in the fuselage mid-section engine compartment, and one on the engine compartment forward bulkhead. All detectors are preset by the manufacturer, and are not adjustable.

aaA. THERMAL SWITCH CALIBRATION CHECK. Special equipment required: BH112G-15 Jet Cal tester (includes BH115-2 Temp Cal Kit), and megohmmeter. If the fire and overheat warning light glows on ground run-up of the engine, perform the normal ground check. If no leakage or mulfunction can be found, proceed as follows:

(1) Deenergize circuit by pulling "FIRE WARN." circuit protector.

(2) Loosen right lower circuit protector panel in forward cockpit in order to gain access to aft side of "FIRE WARN." circuit protector.

3. Using megohmmeter, apply 500 volts direct-current between system and ground by placing one probe on wire W1 at "FIRE WARN." circuit protector and other probe on airplane structure. Insulation leakage should not exceed 100 megohms.

(4) Position tester controls as follows:

Variac — Zero

Switch No. 1 — Normal

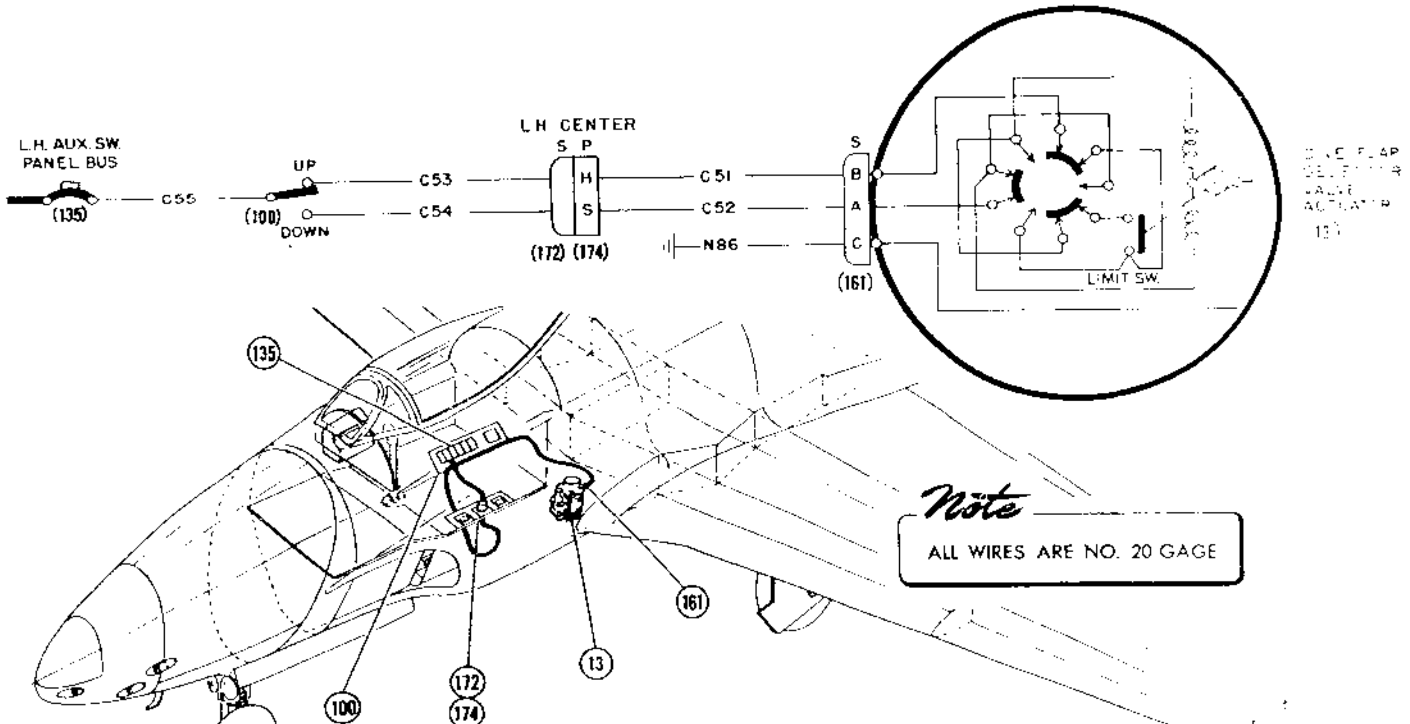
Switch No. 2 — Off

Heat Range Switch — Center

Zero-SC Switch — Center

Standard Cell Rheostat — Off

(5) Connect tester to 110 volt, 50-60 cycle alternating current power supply.




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 13 | MOTOR | BENDIX | | 405381 | HYDRAULIC COMPARTMENT |
| 100 | SWITCH | | | AN3022-3 | LH AUX SWITCH PANEL |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | LH AUX SWITCH PANEL |
| 161 | CONNECTOR | | | AN3106-14S-7S | HYDRAULIC COMPARTMENT |
| 172 | CONNECTOR | | | AN3106-28 11S | LH FLOOR COCKPIT |
| 174 | CONNECTOR | | | AN3102P-28-11P | LH FLOOR COCKPIT |

*Figure 221A — Dive Flap Selector Valve Actuator Circuit, F-80A-10 and RF-80A-10 Airplanes*

**Note**

Use a constant voltage power source. A power source whose voltage varies will cause temperature fluctuations in the test equipment.

(6) Place Zero-SC switch in zero position.

(7) Zero galvanometer using knob above meter dial.

(8) Place Zero-SC switch in SC position.

(9) Zero galvanometer by turning Standard Cell rheostat clockwise until meter needle registers zero.

(10) Place heat range switch in "0-300" position.

(11) Insert overheat thermoswitch (Fenwal 17343-16-450) into Temp Cal Kit.

**CAUTION**

Do not bend thermoswitch. Thermoswitch case is part of switch. Any bending of case will cause misreadings.

(12) When thermoswitch actuates, turn off heat at tester and wait until circuit opens. This point is the true temperature reading. Temperature reading must be between 217° C and 246° C.

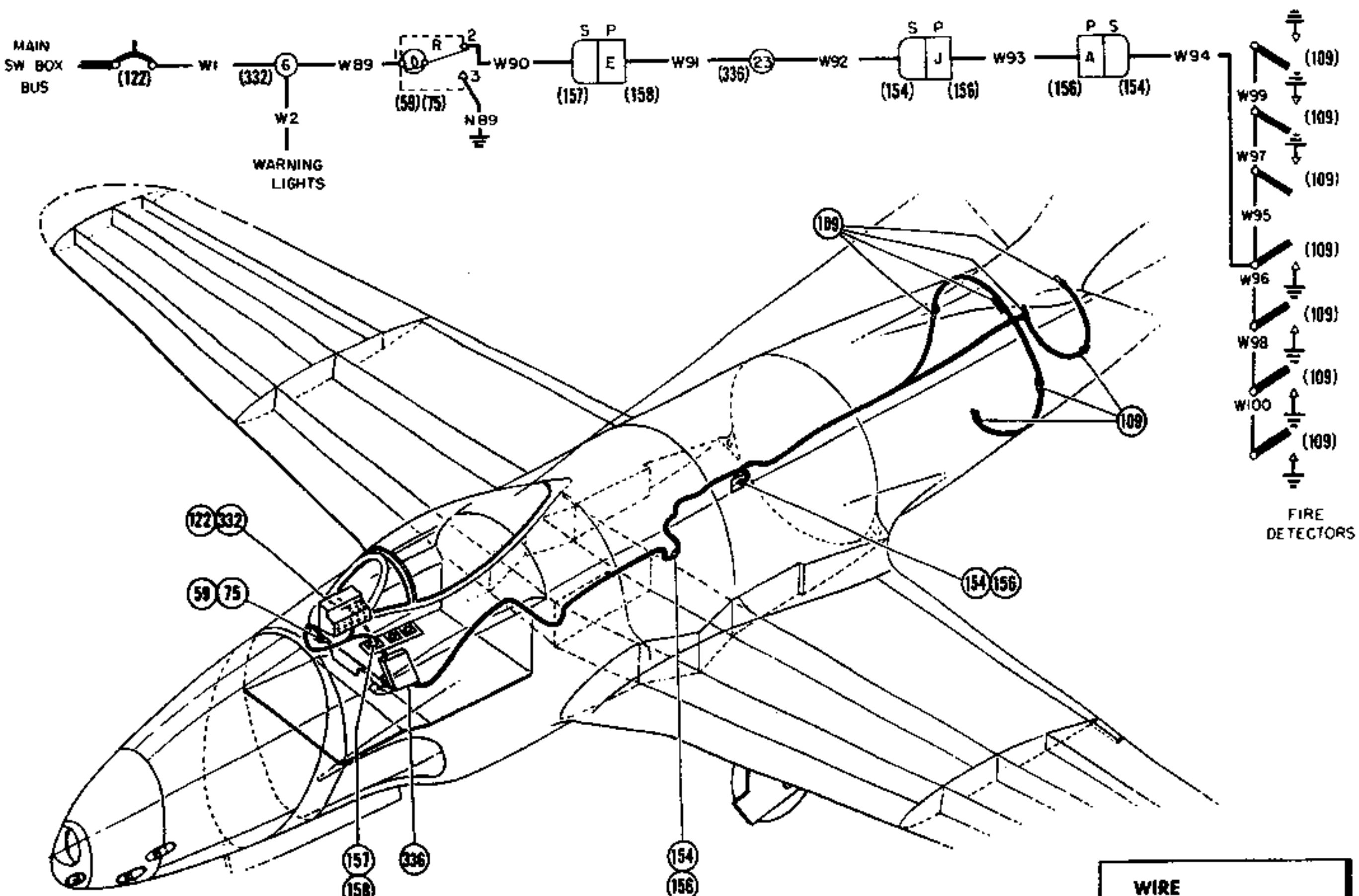
(13) Allow Temp Cal Kit to cool approximately 70° C (13° F) below minimum temperature in step 12 before inserting next thermoswitch into Temp Cal Kit.

(14) Upon completion of check, remove special equipment, and install right lower circuit protector panel in forward cockpit.

*bb.* PHOTOGRAPHIC CIRCUITS.
*(See figures 223, 223A and 223B.)*

(1) GENERAL.—The camera installation is operated from the control box and three intervalometers located on the instrument panel. A junction box in the camera compartment contains switches to allow any one of the several camera installations to be operated from the control box.

A temperature indication system shows both outside air temperature and camera compartment air temperature.




| WIRE NO. | GAGE |
|---|---|
| N89 | 20 |
| W1 | 20 |
| W2 | 20 |
| W89 | 20 |
| W90 | 20 |
| W91 | 20 |
| W92 | 20 |
| W93 | 20 |
| W94 | 18 |
| W95 | 18 |
| W96 | 18 |
| W97 | 18 |
| W98 | 18 |
| W99 | 18 |
| W100 | 18 |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 59 | LIGHT | SEARLE | RED | VM400-6 | SUB-INSTRUMENT PANEL |
| 75 | LAMP | | CLEAR | AN3121-313 | SUB-INSTRUMENT PANEL |
| 109 | FIRE DETECTOR | FENWAL | 400° | S2223 | TAIL CONE |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 154 | CONNECTOR | | | AN3106-28-11S | |
| 156 | CONNECTOR | CANNON | | 2312-41 | |
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | MAIN SWITCH BOX |
| 336 | TERMINAL PANEL | LOCKHEED | | LS1926-19 | RH SUB-COCKPIT JUNCTION BOX |

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*Figure 222 — Fire Warning Circuit, F-80A-1, F-80A-5, and RF-80A-5 Airplanes*

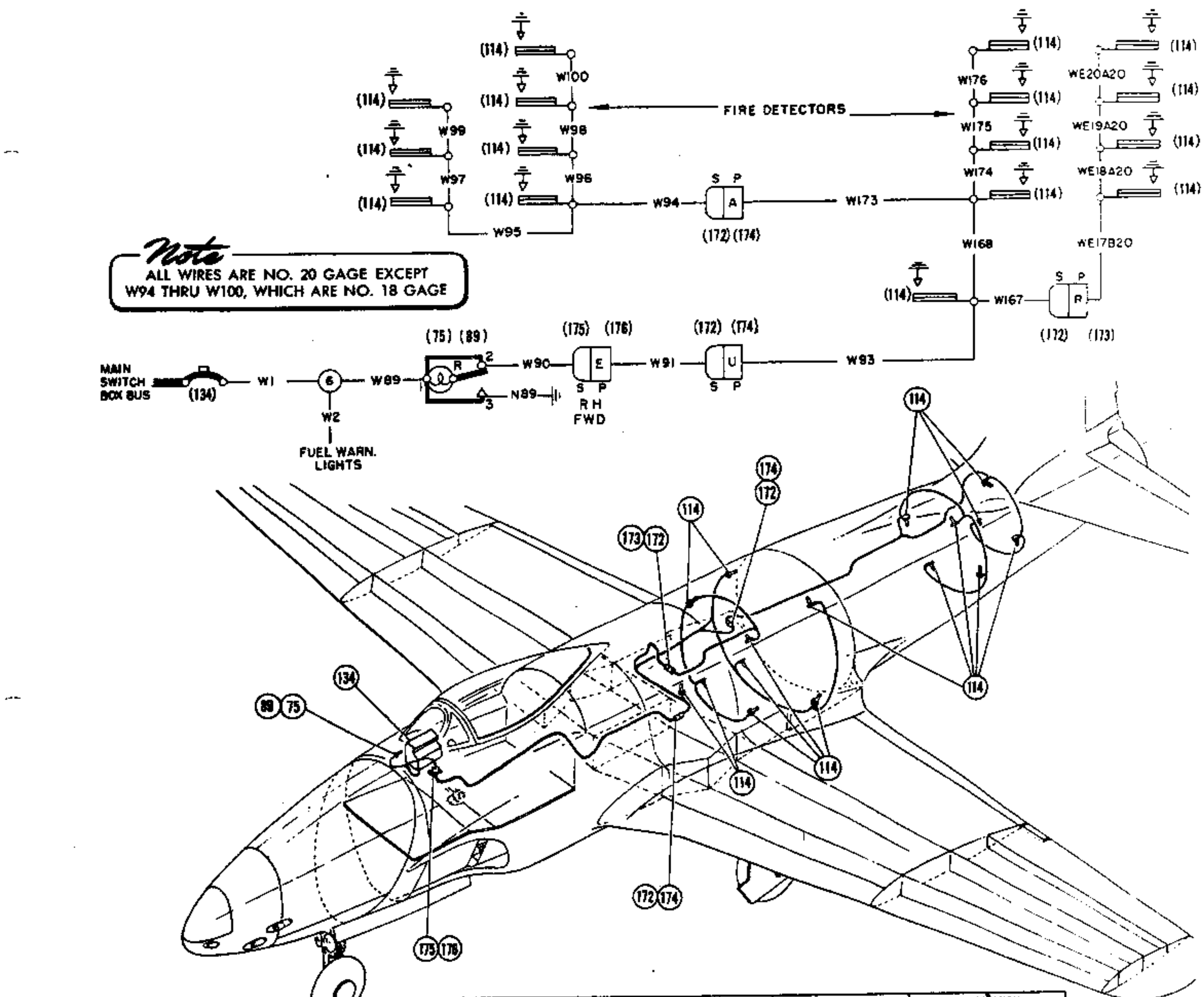
The camera compartment is heated through a hot air duct from the engine. A valve operated by an electric motor controls the air flow. The motor is controlled by a thermostat in the camera compartment.

The vacuum backs of the cameras are operated by two electrically driven vacuum pumps in front of the radio rack.

**Note**

On RF-80-A-15 airplanes the electrically operated pumps for camera vacuum have been deleted. Vacuum is supplied by an air ejector pump located on the right side of the nose wheel well, fed by an air pressure line tapping the cabin air source at the engine.

The electrical installation has provisions for various camera arrangements in all three bays. (See paragraph 26*b*, this section.) Strap clips are provided in the camera compartment to stow electrical plugs when the cameras are not installed. The K-22 cameras used in the mid and aft bays, and the forward aiming K-22 in the forward bay must be reworked. (See paragraph 26*c*, this section.)




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 75 | LIGHT | | RED | AN3157-2 | INSTRUMENT PANEL |
| 89 | LAMP | | | AN3121-313 | INSTRUMENT PANEL |
| 114 | SWITCH | FENWALL | 450° | 17343-6-450 | |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 173 | CONNECTOR | | | AN3102-28-11P | ENGINE |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 175 | CONNECTOR | | | AN3106-28-12S | RH FLOOR |
| 176 | CONNECTOR | | | AN3102P-28-12P | RH FLOOR |

*Figure 222A — Overheat Warning Circuit, P-80A-10 and FP-80A-10 Airplanes*

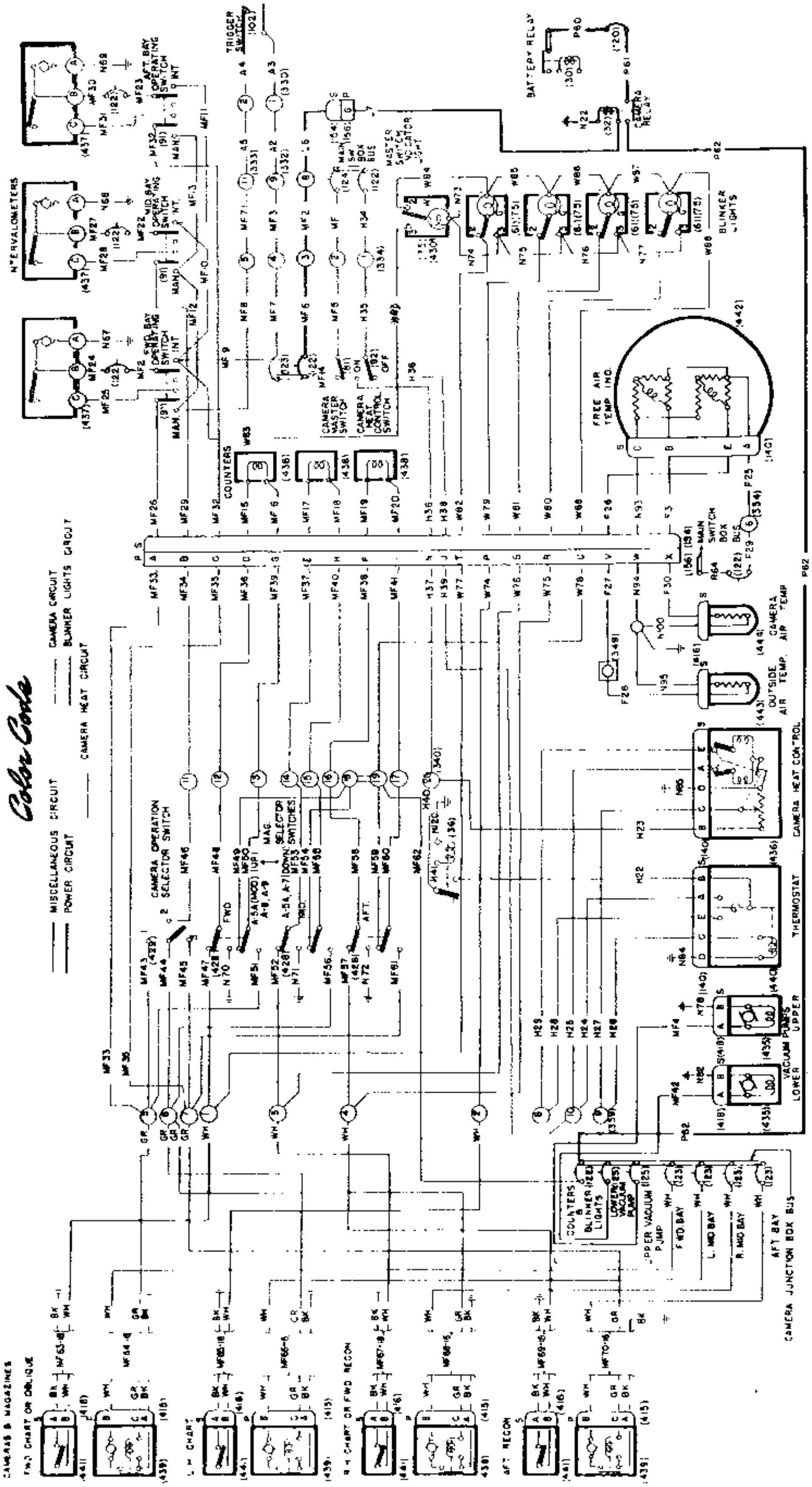
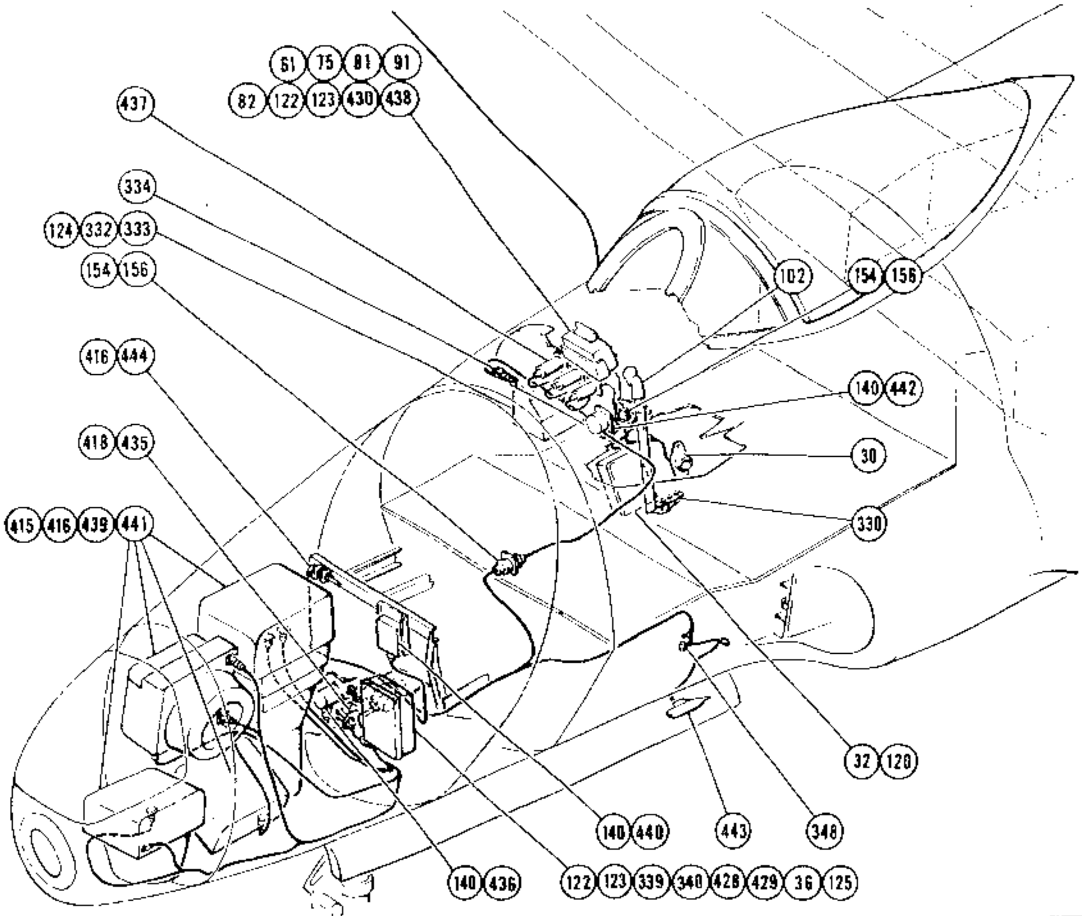



*Figure 223 (Sheet 1 of 2 Sheets) — Camera Equipment Wiring Diagram — FP-80A-5 Airplanes*




| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 30 | BATTERY RELAY | G.F.E. | B-4 | 94-32324 | SUB-COCKPIT |
| 32 | RELAY | | B-5 | 94-32351 | SUB-COCKPIT |
| 36 | RELAY | EL PROD. | | NB-57-C | CAMERA COMPARTMENT |
| 61 | LIGHT | SEARLE | GREEN | VM400-3 | INSTRUMENT PANEL |
| 75 | LAMP | | CLEAR | AN3121-313 | INSTRUMENT PANEL |
| 81 | SWITCH | C.H. | | AN3021-2 | MAIN SWITCH BOX |
| 82 | SWITCH | C.H. | | AN3021-3 | INSTRUMENT PANEL |
| 91 | SWITCH | C.H. | | AN3027-1 | INSTRUMENT PANEL |
| 102 | CONTROL STICK SWITCH | MASON | | 212 | COCKPIT |
| 120 | CIRCUIT PROTECTOR | SPENCER | | PA-35 | SUB-COCKPIT |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | INSTRUMENT PANEL |
| 123 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | CAMERA COMPARTMENT |
| 124 | CIRCUIT PROTECTOR | SPENCER | | PSM-15 | MAIN SWITCH BOX |
| 125 | CIRCUIT PROTECTOR | SPENCER | | PSM-20 | CAMERA COMPARTMENT |
| 140 | CONNECTOR | | | AN3106-14S-5S | INSTRUMENT PANEL |
| 154 | CONNECTOR | | | AN3106-28-11S | COCKPIT |
| 156 | CONNECTOR | CANNON | | 2312-41 | COCKPIT |
| 330 | TERMINAL PANEL | LOCKHEED | | LS1906-2 | COCKPIT |
| 332 | TERMINAL PANEL | LOCKHEED | | LS1929-2 | MAIN SWITCH BOX |
| 333 | TERMINAL PANEL | LOCKHEED | | LS1929-12 | MAIN SWITCH BOX |
| 334 | TERMINAL PANEL | LOCKHEED | | LS1907-2 | COCKPIT |
| 339 | TERMINAL PANEL | LOCKHEED | | LS1909-2 | CAMERA COMPARTMENT |
| 340 | TERMINAL PANEL | LOCKHEED | | LS1909-12 | CAMERA COMPARTMENT |
| 348 | TERMINAL PANEL | LOCKHEED | | LS.940-2 | CAMERA COMPARTMENT |
| 415 | CONNECTOR | | | AN3106-16S-6P | CAMERA COMPARTMENT |
| 416 | CONNECTOR | | | AN3106-12S-3S | CAMERA COMPARTMENT |
| 418 | CONNECTOR | | | AN3106-16-11S | CAMERA COMPARTMENT |
| 428 | SWITCH | C.H. | | AN3027-3 | CAMERA COMPARTMENT |
| 429 | SWITCH | C.H. | | 8905K671 | CAMERA COMPARTMENT |
| 430 | LIGHT | SEARLE | | VM400-1 | INSTRUMENT PANEL |
| 435 | VACUUM PUMP | ECLIPSE | | 1511-1 | CAMERA COMPARTMENT |
| 436 | MOTOR | BAR. COL. | | FYLC-2126 | CAMERA COMPARTMENT |
| 437 | INTERVALOMETER | G.F.E. | B-5 | 75-279 | INSTRUMENT PANEL |
| 438 | COUNTER | G.F.E. | | S7 95 & S7-43 | INSTRUMENT PANEL |
| 439 | CAMERA | G.F.E. | | AS REQ | CAMERA COMPARTMENT |
| 440 | THERMOSTAT | BAR. COL. | | CYLD2128-1 | CAMERA COMPARTMENT |
| 441 | MAGAZINE | G.F.E. | | AS REQ | CAMERA COMPARTMENT |
| 442 | FREE AIR TEMPERATURE INDICATOR | G.F.E. | | AN5795T6 | COCKPIT |
| 443 | FREE AIR TEMPERATURE BULB | LOCKHEED | | 177746 | CAMERA COMPARTMENT |
| 444 | TEMPERATURE BULB | | | AN5525-1 | CAMERA COMPARTMENT |

| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| A2 | 20 | MF44 | 20 |
| A3 | 20 | MF45 | 20 |
| A4 | 20 | MF46 | 20 |
| A5 | 20 | MF47 | 20 |
| F25 | 20 | MF48 | 20 |
| F26 | 20 | MF49 | 20 |
| F27 | 20 | MF50 | 20 |
| F28 | 20 | MF51 | 20 |
| F29 | 20 | MF52 | 20 |
| F30 | 20 | MF53 | 20 |
| F31 | 20 | MF54 | 20 |
| H22 | 20 | MF55 | 20 |
| H23 | 20 | MF56 | 20 |
| H24 | 20 | MF57 | 20 |
| H25 | 20 | MF58 | 20 |
| H26 | 20 | MF59 | 20 |
| H27 | 20 | MF60 | 20 |
| H28 | 20 | MF61 | 20 |
| H29 | 20 | MF62 | 18 |
| H34 | 20 | MF63* | |
| H35 | 20 | MF64† | |
| H36 | 20 | MF65* | |
| H37 | 20 | MF66† | |
| H38 | 20 | MF67* | |
| H39 | 20 | MF68† | |
| H40 | 20 | MF69* | |
| H41 | 20 | MF70† | |
| L6 | 20 | MF71 | 20 |
| L7 | 20 | N22 | 20 |
| MF1 | 18 | N67 | 20 |
| MF2 | 20 | N68 | 20 |
| MF3 | 20 | N69 | 20 |
| MF4 | 18 | N70 | 20 |
| MF5 | 18 | N71 | 20 |
| MF6 | 20 | N72 | 20 |
| MF7 | 20 | N73 | 20 |
| MF8 | 20 | N74 | 20 |
| MF9 | 18 | N75 | 20 |
| MF10 | 18 | N76 | 20 |
| MF11 | 18 | N77 | 20 |
| MF12 | 20 | N78 | 18 |
| MF13 | 20 | N82 | 18 |
| MF14 | 18 | N84 | 20 |
| MF15 | 20 | N85 | 20 |
| MF16 | 20 | N93 | 20 |
| MF17 | 20 | N94 | 20 |
| MF18 | 20 | N95 | 20 |
| MF19 | 20 | N100 | 20 |
| MF20 | 20 | N120 | 20 |
| MF21 | 20 | P60 | 10 |
| MF22 | 20 | P61 | 10 |
| MF23 | 20 | P62 | 10 |
| MF24 | 20 | R64 | 20 |
| MF26 | 20 | W74 | 20 |
| MF27 | 20 | W75 | 20 |
| MF28 | 20 | W76 | 20 |
| MF29 | 20 | W77 | 20 |
| MF30 | 20 | W78 | 20 |
| MF31 | 20 | W79 | 20 |
| MF32 | 20 | W80 | 20 |
| MF33 | 20 | W81 | 20 |
| MF34 | 20 | W82 | 20 |
| MF35 | 20 | W83 | 20 |
| MF36 | 20 | W84 | 20 |
| MF37 | 20 | W85 | 20 |
| MF38 | 20 | W86 | 20 |
| MF39 | 20 | W87 | 20 |
| MF40 | 20 | W88 | 20 |
| MF41 | 20 | | |
| MF42 | 18 | | |
| MF43 | 20 | | |

* 18 GAGE TWO CONDUCTOR CABLE
† 16 GAGE THREE CONDUCTOR CABLE

*Figure 223 (Sheet 2 of 2 Sheets) — Camera Equipment Wiring Diagram — FP-80A-5 Airplanes*

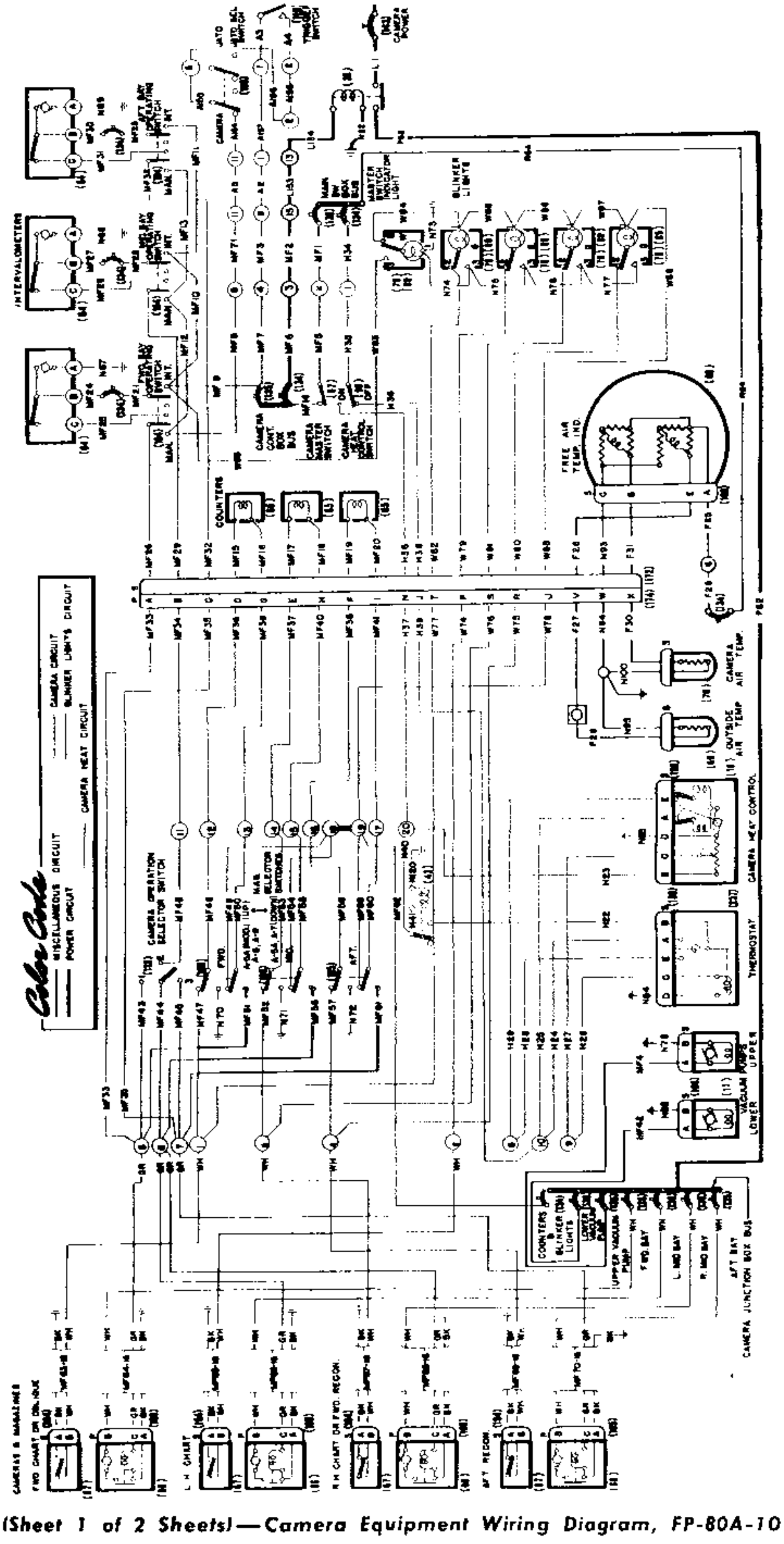
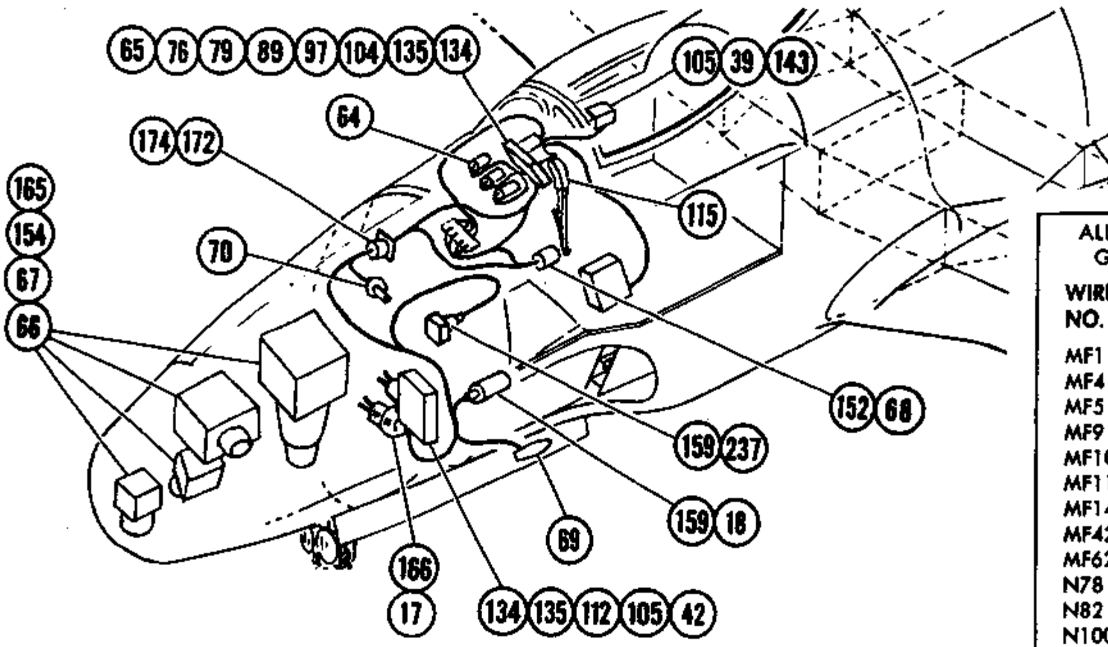


*Figure 223A (Sheet 1 of 2 Sheets)—Camera Equipment Wiring Diagram, FP-80A-10 Airplanes*




| ALL WIRES No. 20 GAGE EXCEPT: | |
|---|---|
| WIRE NO. | GAGE |
| MF1 | 18 |
| MF4 | 18 |
| MF5 | 18 |
| MF9 | 18 |
| MF10 | 18 |
| MF11 | 18 |
| MF14 | 18 |
| MF42 | 18 |
| MF62 | 18 |
| N78 | 18 |
| N82 | 18 |
| N100 | 18 |
| P62 | 10 |
| L1 | 12 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 17 | VACUUM PUMP | ECLIPSE | | 1511-1 | NOSE |
| 18 | HOT AIR VALVE | BAR. COL. | | FYLC-2126 | NOSE |
| 39 | RELAY | | B-5 | AN3350-1 | |
| 42 | RELAY | EL. PROD. SUP. | | NB-57-C | NOSE |
| 64 | INTERVALOMETER | G.F.E. | B-5 | 75-279 | CONTROL BOX |
| 65 | COUNTER | G.F.E. | | S7-95 | CONTROL BOX |
| 66 | CAMERA | G.F.E. | | AS REQ | NOSE |
| 67 | MAGAZINE | G.F.E. | | AS REQ | NOSE |
| 68 | AIR TEMP IND. | G.F.E. | | AN5795T6 | |
| 69 | TEMP BULB | LOCKHEED | | 177746 | NOSE |
| 70 | TEMP BULB | | | AN5525-1 | NOSE |
| 76 | LIGHT | | GREEN | AN3157-3 | CONTROL BOX |
| 79 | LIGHT | | WHITE | AN3157-1 | CONTROL BOX |
| 89 | LAMP | | | AN3121-313 | CONTROL BOX |
| 97 | SWITCH | | | AN3021-2 | CONTROL BOX |
| 98 | SWITCH | | | AN3021-3 | CONTROL BOX |
| 104 | SWITCH | | | AN3027-1 | CONTROL BOX |
| 105 | SWITCH | | | AN3021-2 | NOSE |
| 112 | SWITCH | | | 8905K671 | NOSE |
| 115 | SWITCH | MASON | | 212C-1 | CONTROL STICK |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | |
| 143 | CIRCUIT PROTECTOR | | | AN3161-P35 | COCKPIT LH SHELF |
| 154 | CONNECTOR | | | AN3106-12S-3S | |
| 159 | CONNECTOR | | | AN3106-14S-5S | |
| 165 | CONNECTOR | | | AN3106-16S-6P | |
| 166 | CONNECTOR | | | AN3106-16-11S | |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 237 | THERMOSTAT | BAR. COL. | | CYLD-2128-2 | NOSE |

*Figure 223A (Sheet 2 of 2 Sheets)—Camera Equipment Wiring Diagram, FP-80A-10 Airplanes*

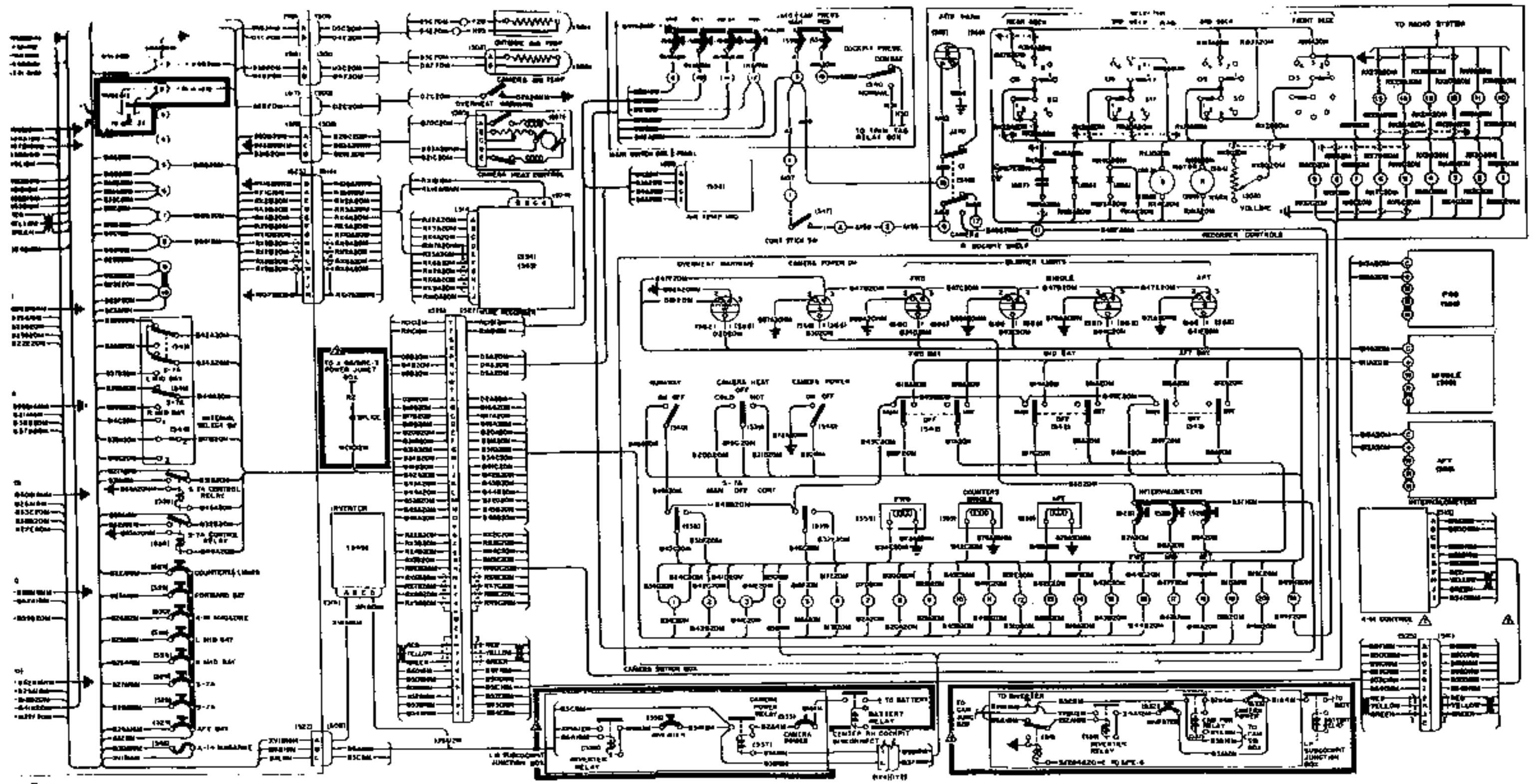


Figure 2238 (Sheet 1 of 2 Sheets) — Camera Equipment Wiring Diagram RF-80A-15 and RF-80A-25 Airplanes (Incorporating Lockheed Aircraft Service Corrections)

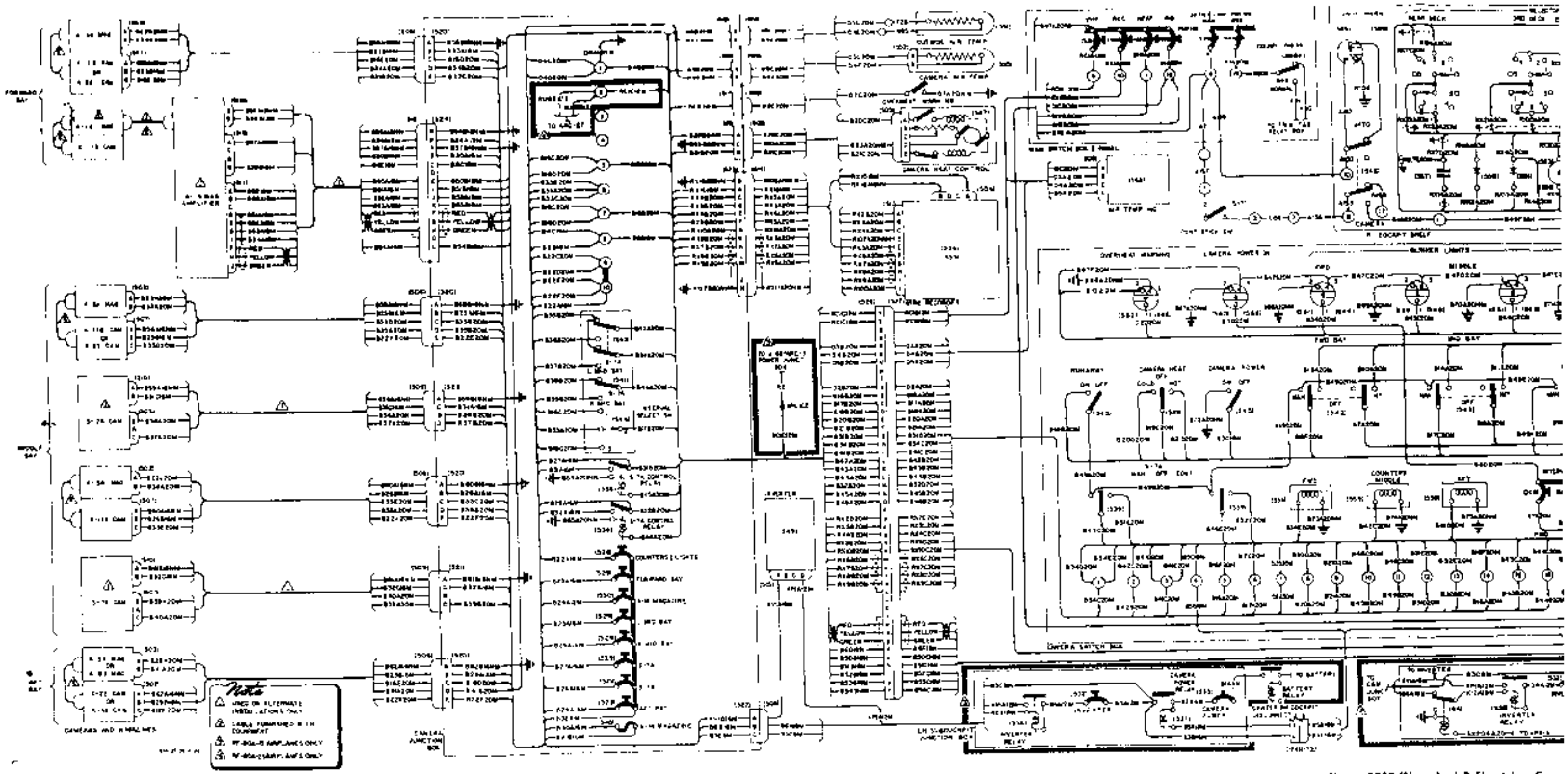
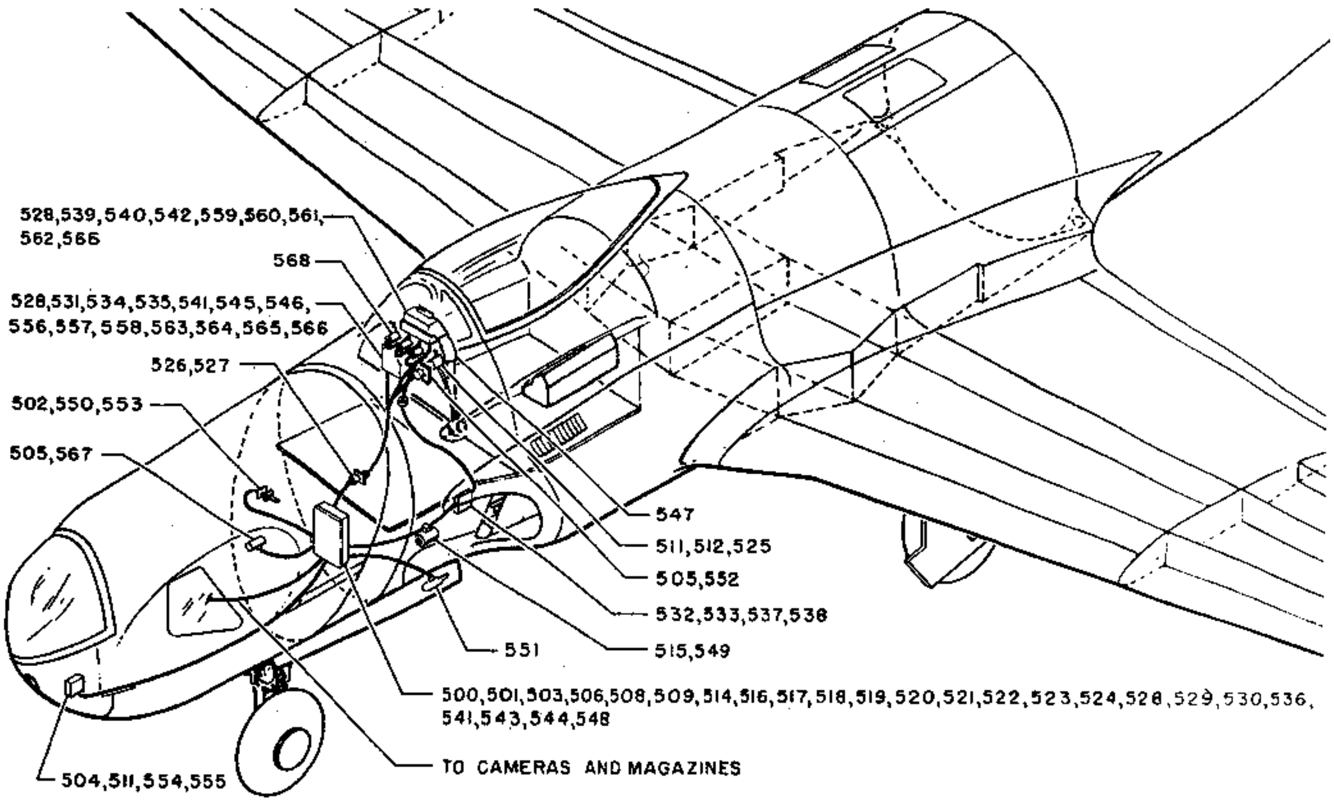



Figure 2238 (Sheet 1 of 2 Sheets) — Camer
(Incorporating




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 500 | CONNECTOR | | | AN3106B-8S-1P |
| 501 | CONNECTOR | | | AN3106B-10SL-4S |
| 502 | CONNECTOR | | | AN3106B-12S-3S |
| 503 | CONNECTOR | | | AN3106B-14S-1P |
| 504 | CONNECTOR | | | AN3106B-14S-2S |
| 505 | CONNECTOR | | | AN3106B-14S-5S |
| 506 | CONNECTOR | | | AN3106B-16S-8P |
| 507 | CONNECTOR | | | AN3106B-16S-6P |
| 508 | CONNECTOR | | | AN3106B-16-7S |
| 509 | CONNECTOR | | | AN3106B-16-9P |
| 510 | CONNECTOR | | | AN3106B-16-11S |
| 511 | CONNECTOR | | | AN3106B-18-1P |
| 512 | CONNECTOR | | | AN3106B-18-1S |
| 513 | CONNECTOR | | | AN3106B-18-10S |
| 514 | CONNECTOR | | | AN3106B-20-27P |
| 515 | CONNECTOR | | | AN3108B-22-4S |
| 516 | CONNECTOR | | | AN3106B-24-7P |
| 517 | CONNECTOR | | | AN3102A-8S-1S |
| 518 | CONNECTOR | | | AN3102A-10SL-4P |
| 519 | CONNECTOR | | | AN3102A-14S-1S |
| 520 | CONNECTOR | | | AN3102A-16S-8S |
| 521 | CONNECTOR | | | AN3102A-16-9S |
| 522 | CONNECTOR | | | AN3102A-16-7P |
| 523 | CONNECTOR | | | AN3102A-20-27S |
| 524 | CONNECTOR | | | AN3102A-24-7S |
| 525 | CONNECTOR | | | AN3102A-18-1S |
| 526 | CONNECTOR | | | AN3102M-36-8P |
| 527 | CONNECTOR | | | AN3106B-36-8S |
| 528 | CIRCUIT PROTECTOR | | | AN3161P5 |
| 529 | CIRCUIT PROTECTOR | | | AN3161P10 |
| 530 | CIRCUIT PROTECTOR | | | AN3161P25 |
| 531 | CIRCUIT PROTECTOR | | | AN3161P20 |
| 532 | CIRCUIT PROTECTOR | | | AN3161P35 |
| 533 | CIRCUIT PROTECTOR | SPENCER | | PLM-105 |
| 534 | CIRCUIT PROTECTOR | | | PSM-5 |
| 535 | CIRCUIT PROTECTOR | | | PSM-10 |
| 536 | RELAY | ELEC PROD SUPPLY CO | | NS-47-E |
| 537 | RELAY | ADVANCE RELAY CO | | B-6 |
| 538 | RELAY | ADVANCE RELAY CO | | B-5B |
| 539 | SWITCH | | | AN3021-1 |
| 540 | SWITCH | | | AN3021-2 |
| 541 | SWITCH | | | AN3021-3 |
| 542 | SWITCH | | | AN3027-1 |
| 543 | SWITCH | | | AN3027-3 |
| 544 | SWITCH | CUTLER-HAMMER | | 8747K3 |
| 545 | SWITCH | P. R. MALLORY CO | | 1345L |
| 546 | SWITCH | | | AN3027-3 |
| 547 | SWITCH | MASON | | 212 |
| 548 | FUSE | BUSSMAN MFG CO | 1A | 4AG-1 |
| 549 | INVERTER | GFAE | MG-149-F | 94-32270A |
| 550 | TEMPERATURE BULB | | | AN5525-1 |
| 551 | TEMPERATURE BULB | LOCKHEED | | 177746 |
| 552 | TEMPERATURE INDICATOR | | | AN5795T6 |
| 553 | OVERHEAT DETECTOR | PAUL HENRY CO | A | P-4203 |
| 554 | RECORDER | GFAE | | RD-15/ANQ-1A |
| 555 | MAGAZINE | GFAE | | MX-303A/ANQ-1 |
| 556 | RECTIFIER | FANSTEEL MET. CORP. | | BD429T |
| 557 | CAPACITOR | | 4 MFD | CP53B1FB405K |
| 558 | POTENTIOMETER | ALLEN BRADLEY | | JU-5011 |
| 559 | COUNTER | VEEDER-ROOT | | T-103103 |
| 560 | LIGHT ASSEMBLY | | | AN3157-4 |
| 561 | LIGHT ASSEMBLY | | | AN3157-3 |
| 562 | LIGHT ASSEMBLY | | | AN3157-1 |
| 563 | LIGHT ASSEMBLY | KORRY MFG. CO. | | 103-8GL |
| 564 | LIGHT ASSEMBLY | KORRY MFG. CO. | | 103-8RL |
| 565 | LIGHT ASSEMBLY | | | AN3157-2 |
| 566 | LAMP | | | AN3121-3 |
| 567 | MOTOR | BARBER-COLEMAN | | FYLC-2126 |
| 568 | INTERVALOMETER | GFAE | B-9 | 31479 |

A8 9064

*Figure 223B (Sheet 2 of 2 Sheets) — Camera Equipment Wiring Diagram RF-80A-15 and RF-80A-25 Airplanes (Incorporating Lockheed Aircraft Service Conversion)*

(2) CAMERA CIRCUITS.

*(a)* GENERAL.—The camera operating circuits consist of the camera power and the tripper circuits for each camera. Turning on the camera master switch closes the contacts of the camera relay in the sub-cockpit right junction box, completing the camera power circuit to the bus in the camera junction box. The vacuum pumps, the blinker lights, and the four cameras receive their power from this bus.

The tripper circuit operating through a relay in the camera, closes the power circuit to the camera operating mechanism. The tripper circuit is energized by the camera master switch, and controlled by either the intervalometers or the trigger switch, depending on the setting of the camera control switches. The jato selector switch must be in "CAMERAS" position in order for the trigger switch to be connected to the camera control switches. When the camera control switches are on manual, the cameras are operated through the trigger switch.

When the trigger switch is held "ON," the cameras will operate continuously, or runaway, until the trigger switch is released. However, cameras can be operated intermittently with the trigger switch.

Circuit protectors are installed in all camera circuits.

*(b)* CAMERA CONTROL BOX. *(See figure 125.)*—The camera control box is mounted in the cockpit at the top center of the instrument panel. The control box face contains a counter for each of the three camera bays, a blinker light for each camera, a camera control switch for each bay, the camera master switch, the master switch indicator light, and the camera heater switch. The indicator light glows when the camera master switch is on and the main switch box bus is energized.

The camera control switch for the mid bay controls the mid bay cameras under conditions B and C only. (See figure 224.) The camera control switch for the forward bay controls the two cameras in the mid bay under condition A. The camera control switch for the aft bay controls the mid bay camera under condition D.

The circuit protectors for the camera power relay and tripper circuits are located on the left side of the control box. Two spare lamps for the control box indicator lights are mounted on the box forward of these two circuit protectors. The three circuit protectors between the intervalometers and the cameras are located on the right side of the control box.

*(c)* INTERVALOMETERS. *(See figure 125.)*—Three intervalometers, one for each of the camera bays, are located directly below the camera control box. The intervalometers control the time interval between each cycle of operation of the cameras. The dials are calibrated from one-half to 60 seconds, in one-half second intervals. To start the intervalometer, turn the knob counterclockwise to the number corresponding to the desired time interval. To stop the intervalometer, turn the knob clockwise to the "OFF" position, where it will click into place. Turning the camera control switches off will also turn off the intervalometers.

**Note**

Do not set the intervalometer for a shorter period than the cycling time of the camera being used.

The intervalometer for the forward bay controls the cameras for that bay under all conditions, and in addition, controls the mid bay cameras under condition A. The intervalometer for the mid bay controls the cameras for that bay under conditions B or C. The intervalometer for the aft bay controls the camera for that bay under all conditions, and in addition, controls the mid bay cameras under condition D. For these conditions, see figure 224.

*(d)* CAMERA JUNCTION BOX. *(See figure 224.)*—The camera junction box is located in the camera nose and is mounted on the left side, forward of the radio rack. The front face of this junction box contains the camera operation selector switch and the camera magazine selector switches.

The camera operation selector switch is a three-position switch with the positions marked "A," "B or C," and "D." The camera magazine selector switches, one for each bay, are used to select the desired circuit, depending on the type of magazine in use. With the A-5 (modified), A-8, or A-9 magazine, the switch is placed in the up position. When the A-5A or A-7 magazine is to be used, the switch is placed in the down position.

Circuit protectors for the blinker lights circuit, the vacuum pumps circuit, and the three camera bay power circuits are located in the right side of the camera junction box.

(3) BLINKER LIGHTS AND COUNTER CIRCUITS. *(See figure 125.)*

*(a)* GENERAL.—The blinker lights circuit receives its power from the bus in the camera junction box, and is protected by a 5-ampere push-to-test circuit protector in the right side of that box. The blinker light circuit operates through the camera magazines, the cable being connected to the magazine through a receptacle.

**Note**

When only one camera is used in the mid bay, use blinker light cable No. MF67-18, as the mid bay counter is connected to this cable.

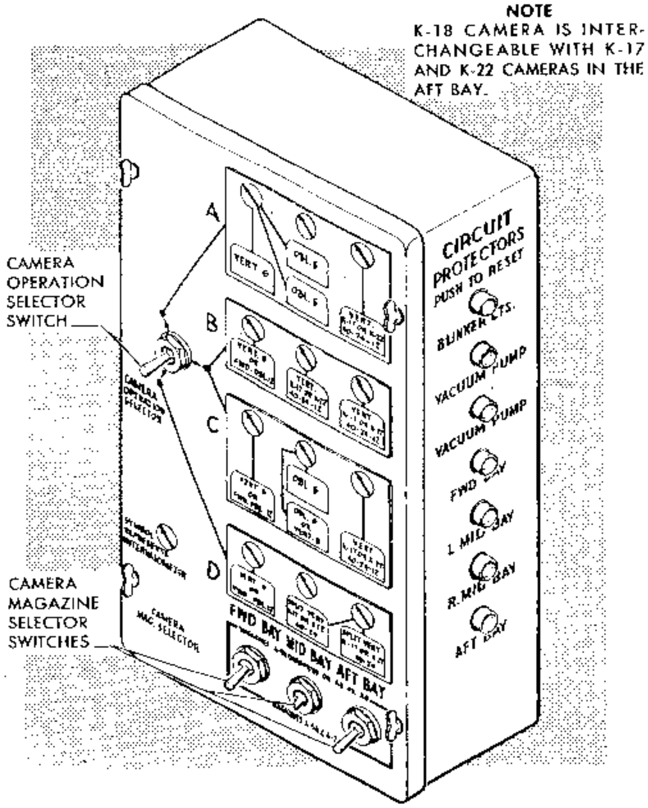



*Figure 224 — Camera Junction Box — FP-80A Airplanes*

The switch in the camera magazine closes the circuit from the blinker lights to ground with each cycle of the camera. The blinking of the green light on the camera control box indicates that the film is intact and in place. The circuit from the switch in the camera magazine is grounded in the camera junction box. The types A-5A (modified), A-8, and A-9 camera magazines contain the blinker light switch as an integral part. The types A-5A and A-7 magazines must be modified to add the blinker light switch. (See paragraph 26*d*, this section.)

*(b)* COUNTER CIRCUIT.—The counters are operated from the blinker circuit when the A-5A (modified), A-8, or A-9 camera magazine is used. In the mid bay, the counter operates from the circuit of the right-hand blinker light. When only one camera is used in the mid bay, be sure that the right-hand blinker light circuit is used, or the counter for the mid bay will not operate. When the A-5A or A-7 camera magazine is used, the counters operate from the tripper circuit pulse. This causes the counters to register the number of times the trigger switch is operated, and not necessarily the number of exposures.

(4) VACUUM PUMP CIRCUIT.

*(a)* GENERAL.—The two vacuum pumps receive their power from the camera junction box bus and turn on or off with the camera master switch. The circuit to each vacuum pump is protected by a 10-ampere push-to-reset circuit protector in the left side of the camera junction box.

*(b)* VACUUM PUMP MOTOR.—The vacuum pump motor is operated from the 28-volt direct-current system. The dry air pump is mounted on the same shaft as the motor armature. The motor is compound wound, rated at 0.20 brake horsepower, and runs at 10,000 rpm. The armature rotates counterclockwise when viewed toward the commutator end.

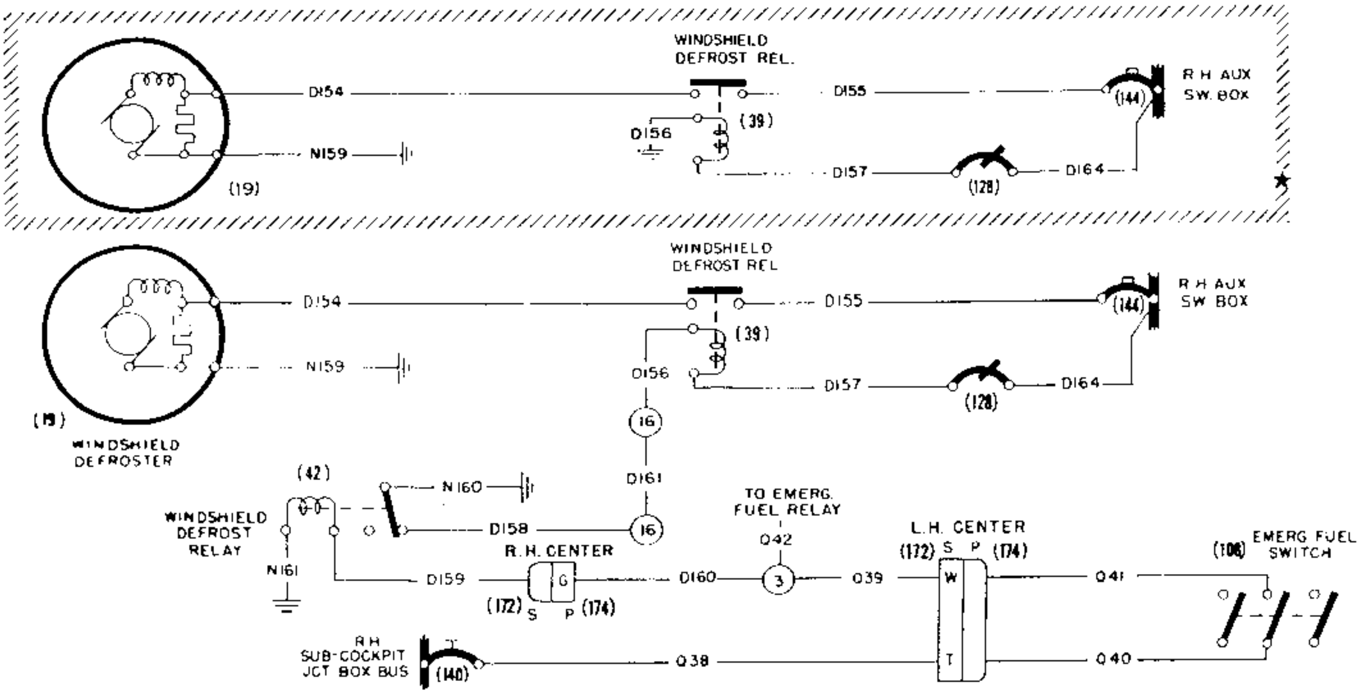
No lubrication is necessary for the vacuum pump or for the motor.

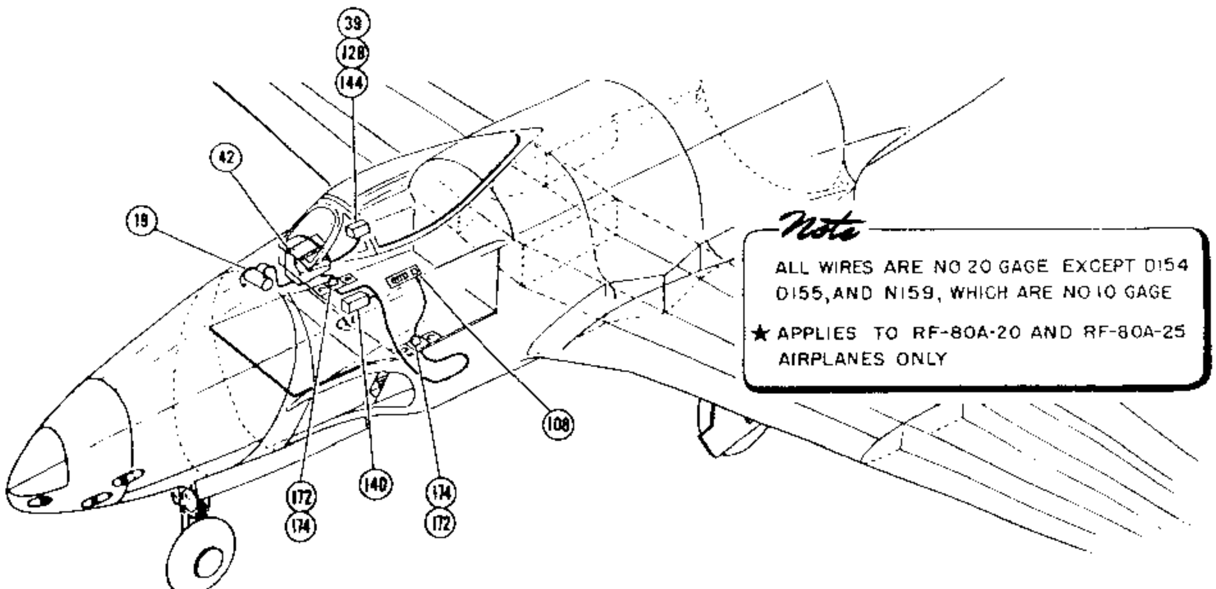
For information on the vacuum pump, see paragraph 25*c*, this section.

(5) CAMERA HEAT CONTROL CIRCUIT.

*(a)* GENERAL.—The camera heat control circuit is energized by a switch on the camera control box and is controlled by a thermostat located on the forward side of the radio rack. The circuit is protected by a 5-ampere push-to-reset circuit protector in the main switch box. The circuit operates a motor to open or close the valve in the line that supplies hot air to the camera compartment.

*(b)* OPERATION.—With the camera heat switch on, a relay in the camera junction box operates to energize the heat control circuit. This relay is to prevent an electrical feed-back between the thermostat and the heat control motor when the switch is off. On a decrease in temperature, the bimetallic element of the thermostat causes the magnetic contact tongue of the instrument to complete the circuit to the motor. This causes the control motor to rotate in a counterclockwise direction to open the valve in the hot air line. In so doing, the contact brush of the rheostat, which is keyed to the driving shaft of the control motor, moves in a direction to increase the magnetic force applied to the thermostat tongue, until the resultant pull is sufficient to position the tongue between the contacts. This breaks the control circuit, and stops the control motor with the valve at a new position of supply.




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 19 | WINDSHIELD DEFROSTER | JOY MFG. CO. | | U-702-2 | COCKPIT |
| 39 | RELAY | | B-5 | AN3350-1 | RH AUX SWITCH BOX |
| 42 | RELAY' | EL. PROD. SUP | | NB-57-C | MAIN SWITCH BOX |
| 108 | SWITCH | CUT. HAM. | | B905K728 | LH AUX SWITCH PANEL |
| 128 | CIRCUIT BREAKER | | | AN3160-5 | RH AUX SWITCH BOX |
| 140 | CIRCUIT PROTECTOR | | | AN3161-P10 | RH SUB-COCKPIT JUNC BOX |
| 144 | CIRCUIT PROTECTOR | | | AN3161-P50 | RH AUX SWITCH BOX |
| 172 | CONNECTOR | | | AN3106-28-11S | LH FLOOR |
| 174 | CONNECTOR | | | AN3102P-28-11P | LH FLOOR |

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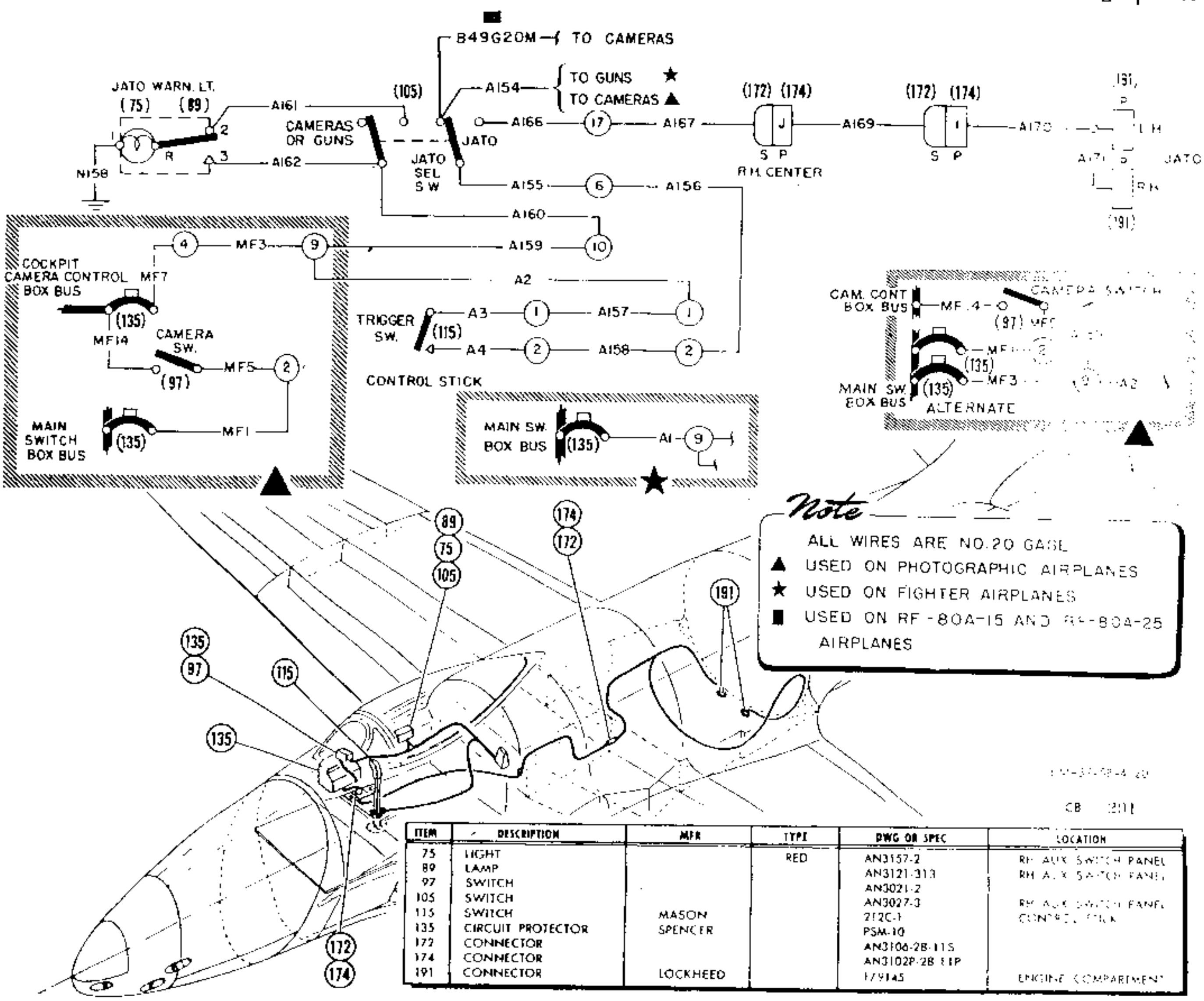
*Figure 224A — Windshield Auxiliary Defroster Circuit, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 Airplanes*



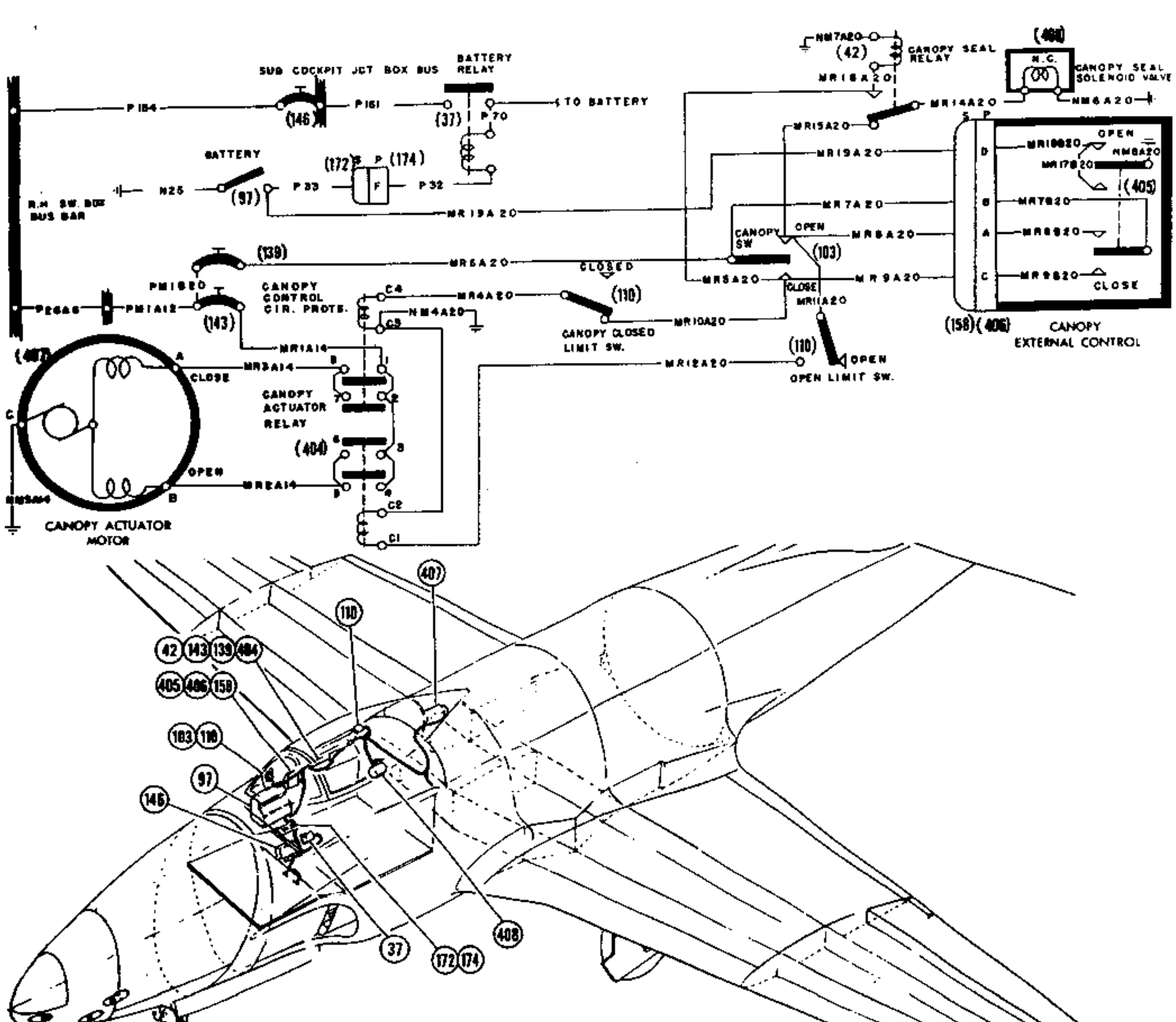

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 75 | LIGHT | | RED | AN3157-2 | RH AUX SWITCH PANEL |
| 89 | LAMP | | | AN3121-313 | RH AUX SWITCH PANEL |
| 97 | SWITCH | | | AN3021-2 | |
| 105 | SWITCH | | | AN3027-3 | RH AUX SWITCH PANEL |
| 115 | SWITCH | MASON | | 212C-1 | CONTROL STICK |
| 135 | CIRCUIT PROTECTOR | SPENCER | | PSM-10 | |
| 172 | CONNECTOR | | | AN3106-28-11S | |
| 174 | CONNECTOR | | | AN3102P-28-11P | |
| 191 | CONNECTOR | LOCKHEED | | 179145 | ENGINE COMPARTMENT |

***Figure 224B — Jato Ignition Circuit, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 Airplanes***

When the temperature increases, the contact tongue will complete the circuit to the opposite terminal causing the control motor to rotate in a clockwise direction to decrease the amount of heat supplied. Simultaneously, the magnetic force applied to the thermostat tongue is reduced by the rheostat in the control motor, causing the contact tongue to break the circuit. The control motor has a corresponding position for each increment of change in temperature, and full proportioning control is obtained. When the circuit is turned off, the heat control motor will run until the control valve is closed, at which time a limit switch in the motor unit will open, stopping the motor.

*(c)* HEAT CONTROL VALVE MOTOR.—The heat control valve motor in the forward end of the nose wheel well, is a direct-current reversible motor with built-in limit switches and a follow-up rheostat. The rheostat is keyed directly to the actuating shaft and turns through an arc of 90 degrees. The limit switches are preset at the factory to stop the motor when the 90-degree limit has been reached, and need no adjustment. Maximum power of the control motor is available at all points throughout the operating range of the unit.

*(d)* THERMOSTAT.—The temperature element of the thermostat consists of a bimetal coil mounted on a flexing hinge. The bimetal coil is not affected by barometric pressure changes. The proportioning coil is an electromagnet. Two silver contacts on the base and one on the balanced contact arm comprise the contact assembly. The thermostat is mounted on the forward side of the radio rack and is equipped with condensers to eliminate radio interference. An adjustment knob on the front face of the thermostat, with a dial calibrated in degrees Fahrenheit, permits adjustment through a range of −18° to +38°C (0° to 100°F).




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 37 | RELAY | GFP | B-14 | AN3380-1 | SUB-COCKPIT |
| 42 | RELAY | EL. PROD. | | NB-57-C | RH SILL |
| 97 | SWITCH | | | AN3021-2 | RH SWITCH BOX |
| 103 | SWITCH | | | AN3022-7 | RH SILL |
| 110 | SWITCH | MICROSW | | AN3210-1 | RH SILL |
| 139 | CIRCUIT PROTECTOR | | | AN3161-P5 | RH SILL |
| 143 | CIRCUIT PROTECTOR | | | AN3161-P35 | RH SILL |
| 146 | CIRCUIT PROTECTOR | SPENCER | | PLM-105 | SUB-COCKPIT JCT BOX |
| 158 | CONNECTOR | | | AN3106-14S-2S | EXTERNAL CONTROL BOX |
| 172 | CONNECTOR | | | AN3106-28-11S | RH AFT FLOOR |
| 174 | CONNECTOR | | | AN3102P-28-11P | RH AFT FLOOR |
| 404 | RELAY | LEACH | | 612769 | RH SILL |
| 405 | SWITCH | | | AN3027-7 | EXTERNAL CONTROL BOX |
| 406 | CONNECTOR | | | AN3102P-14S-2P | EXTERNAL CONTROL BOX |
| 407 | CANOPY ACTUATOR MOTOR | EL ENG & MFG | | D-357 | AFT OF LH COCKPIT |
| 408 | SOLENOID VALVE | ADEL | | 12257 | AFT COCKPIT |

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*Figure 224C — Canopy Actuator Circuit*

(5A) CAMERA HEAT CONTROL CIRCUIT (RF-80A-15 Airplanes only.)—A fixed-setting thermostat in the camera compartment energizes the camera overheat warning light on the camera switch box when the compartment temperature exceeds 90° F (32° C). The camera compartment heat control switch on the camera switch panel controls the heat valve to increase or decrease the flow of hot air to the camera equipment. See figure 223B for camera equipment wiring diagram.

(6) AIR TEMPERATURE CIRCUIT.—Two temperature bulbs, one to measure outside air temperature and one to measure camera compartment temperature, are connected to a dual reading thermometer indicator. The air temperature circuit, protected by a 5-ampere push-to-reset circuit protector, operates whenever the battery master switch is on, and obtains its power from the main switch box bus.

The outside temperature bulb is mounted in a nacelle at the bottom of a short streamlined strut on the left door of the nose alighting gear. The camera compartment temperature bulb, mounted on the forward side of the radio rack, is operated from the same source of power as the outside temperature bulb, and has a temperature range of −50° to +150°C (−58° to +302°F). The temperature indicator on the instrument sub-panel is a dual indicating electrical resistance type thermometer, and has a range of from −70° to +150°C (−94° to +302°F). The markings on the indicator dial are fluorescent.

*cc.* WINDSHIELD AUXILIARY DEFROSTER CIRCUIT. *(See figure 224A.)*

(1) GENERAL.—The windshield defroster circuit operates the heater-blower unit used as an auxiliary windshield defroster on the F-80A-10 and RF-80A-10 airplanes. It consists of a power and a control circuit, with two relays and a switch-type circuit breaker. The relays and switch are in the cockpit right auxiliary switch panel. The relays are in the control circuit, one connected into the power circuit, and the other into the emergency fuel pump circuit. The latter relay cuts out the heater-blower unit whenever the emergency fuel pump is turned on. The power circuit to the heater-blower unit is protected by a 50-ampere push-to-reset circuit protector in the cockpit right auxiliary switch panel. The heater blower unit is installed only in the winterized airplanes.

(2) HEATER-BLOWER UNIT.

*(a)* GENERAL. — The windshield defroster heater-blower unit is on the cockpit front bulkhead, on the right side. The unit is an electrically operated fan which blows air over a heater coil wired in parallel with the motor. The oil consists of five turns of No. 14 nichrome V wire wound on form blocks. The blocks act as straightening vanes for the air so that maximum flow of 65 cubic feet per minute can be obtained. The heater unit draws 38 amperes at 28 volts. The 27-volt blower motor is rated 0.1 horsepower at 12,000 rpm. The unit is connected to the windshield defroster tubes by a flexible hose. Access to the heater is gained by reaching under the instrument panel. For removal of units in the defroster system, other than the auxiliary heater-blower unit, see paragraph 24*b*, this section.

*(b)* REMOVAL OF HEATER-BLOWER UNIT.

*1.* Disconnect electrical wiring from aft side of unit.

*2.* At inboard end, remove hose clamp, and disconnect flexible hose.

*3.* Remove two screws and two nuts from bottom of unit.

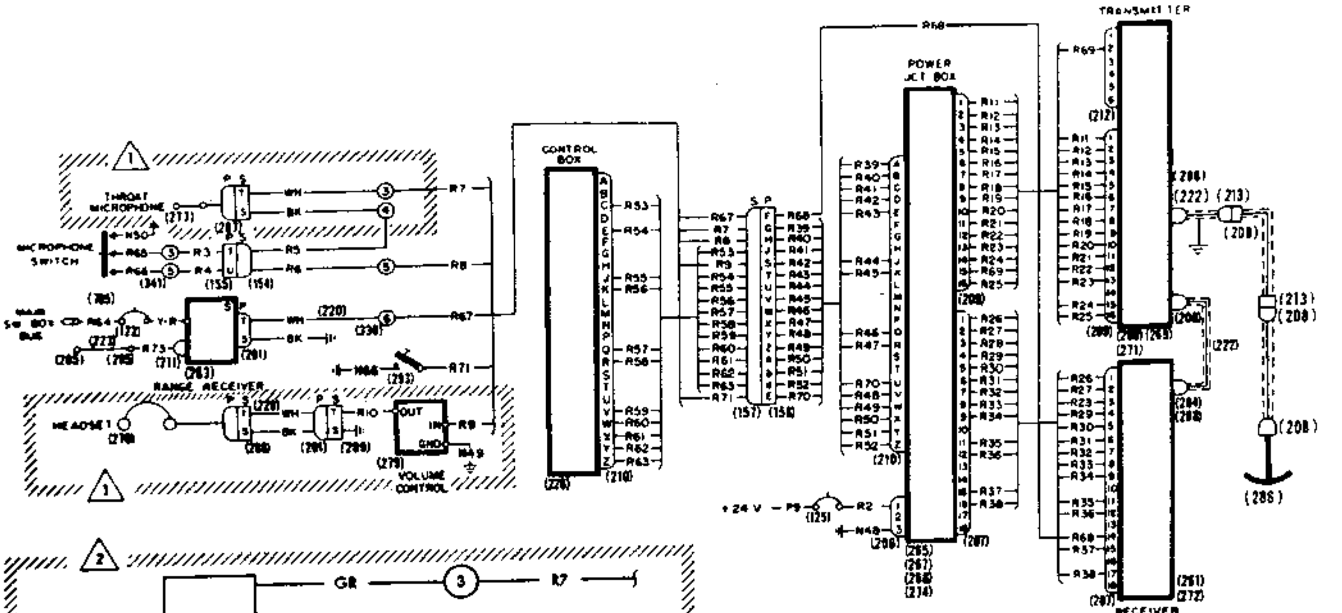
*4.* Remove unit aft, and retain clamp bolts.

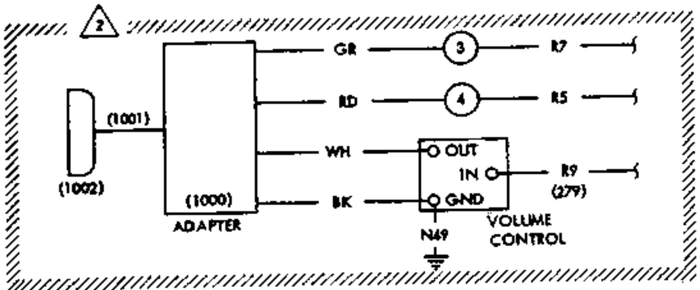
*dd.* JATO IGNITION CIRCUIT. *(See figure 224B.)*—The jato ignition circuit is energized from the main switch box bus through a 10-ampere push-to-reset circuit protector and a jato selector switch, both on the cockpit right shelf, and from the control stick trigger switch. A red light adjacent to the selector switch glows when the switch is placed in "JATO" position. Closing the trigger switch fires both jato units. Connectors for the jato units are mounted flush with the outside skin, one on each side of the airplane center line under the engine compartment.

*ee.* CANOPY ACTUATOR CIRCUIT. *(See figure 224C.)*

(1) DESCRIPTION.—This circuit controls an electric actuator through a relay in the sub-cockpit compartment. A single pole, double-throw, momentary contact canopy control switch is on the right side of the cockpit, forward of the canopy tracks. A double-pole, double-throw, momentary contact switch, for external use is on the outer right side of the airplane. The internal switch operates the canopy actuator through the actuator relay, and the canopy seal solenoid through the canopy seal relay. The external switch, in addition to operating the same two relays, closes the battery relay, putting the batteries on the bus so that the canopy can be operated from outside the airplane without external power, provided the batteries are installed. Two limit switches, one in the opening circuit, and one in the closing circuit, break the circuit to the actuator when the canopy reaches open or closed position. All circuits are protected by push-to-reset circuit protectors.

(2) CANOPY ELECTRIC ACTUATOR. — The canopy actuator consists of a split-field, reversible, intermittent duty motor with a magnetic clutch and brake, and an integral gear box. A one-minute cooling period must be allowed after each cycle of operation. For removal of the motor, see paragraph 3*c*(3)*(c)*3d, this section.




| | ITEM | DESCRIPTION | MFR. | DWG. OR SPEC. |
|---|---|---|---|---|
| | 122 | CIRCUIT PROTECTOR | SPENCER | PSM-5 |
| | 125 | CIRCUIT PROTECTOR | SPENCER | PSM-20 |
| | 154 | CONNECTOR | | AN3106-28-11S |
| | 155 | CONNECTOR | | AN3102-28-11P |
| | 157 | CONNECTOR | | AN3106-28-12S |
| | 158 | CONNECTOR | CANNON | 2312-23 |
| 1 | 201 | PLUG | GFAE | PL-55 |
| | 206 | PLUG | GFAE | PL-148 |
| | 207 | PLUG | GFAE | PL-153 |
| | 208 | PLUG | GFAE | PL-259 |
| | 209 | PLUG | GFAE | U-15/U |
| | 210 | PLUG | GFAE | U-16/U |
| | 211 | PLUG | GFAE | 228 |
| | 212 | PLUG | GFAE | PL-151 |
| | 222 | COAXIAL CABLE | GFAE | RG-8/U |
| | 223 | WIRE | GFAE | W-106( ) |
| | 260 | TRANSMITTER (ARC-3) | GFAE | T-67( )/ARC-3 |
| | 261 | RECEIVER (ARC-3) | GFAE | R-77( )/ARC-3 |
| | 263 | RECEIVER (RANGE) | GFAE | BC-1206( ) |
| | 265 | ARC-3 POWER JUNCTION BOX | GFAE | J-68( )/ARC-3 |
| | 266 | ARC-3 CONTROL BOX | GFAE | C-118( )/ARC-3 |
| | 267 | ARC-3 DYNAMOTOR | GFAE | DY-21( )/ARC-3 |
| | 268 | ARC-3 DYNAMOTOR | GFAE | DY-22( )/ARC-3 |
| | 269 | ARC-3 CRYSTAL UNIT | GFAE | DC-11( ) OR CR-1( )/ARC-3 |
| | 271 | MOUNTING | GFAE | MT-238( )/ARC-3 |
| | 272 | MOUNTING | GFAE | MT-237( )/ARC-3 |
| | 274 | MOUNTING | GFAE | MT-236( )/ARC-3 |
| 1 | 277 | MICROPHONE | GFAE | T-30P |
| 1 | 278 | HEADSET | GFAE | HS-33 |
| | 279 | VOLUME CONTROL | GFAE | C-197/ARC-3 |
| | 284 | ADAPTER | GFAE | M-359 |
| | 285 | INSULATOR | GFAE | IN-88 |
| | 286 | ANTENNA | LOCKHEED | 177250 |
| 1 | 287 | JACK | GFAE | JK-48 |
| 1 | 288 | JACK | GFAE | JK-26 |
| 1 | 289 | JACK | GFAE | JK-34 |
| | 293 | KEY | GFAE | SE-256 |
| | 330 | TERMINAL PANEL | LOCKHEED | LS-1906-2 |
| | 341 | TERMINAL PANEL | LOCKHEED | LS-1905-2 |
| | 705 | MICROPHONE SWITCH | UCINITE | 1381060 |
| 2 | 1000 | ADAPTER | GFAE | MX-1646/AIC |
| 2 | 1001 | CORD | | WF-14/U |
| 2 | 1002 | PLUG | | U-92A/U |

| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| N48 | 12 | R35 | 20 |
| N49 | 20 | R36 | 20 |
| N50 | 20 | R37 | 16 |
| N66 | 20 | R38 | 20 |
| P9 | 12 | R39 | 20 |
| R2 | 12 | R40 | 20 |
| R3 | 20 | R41 | 20 |
| R4 | 20 | R42 | 20 |
| R5 | 20 | R43 | 20 |
| R6 | 20 | R44 | 20 |
| R7 | 20 | R45 | 20 |
| R8 | 20 | R46 | 20 |
| R9 | 20 | R47 | 20 |
| R10 | 20 | R48 | 20 |
| R11 | 20 | R49 | 20 |
| R12 | 20 | R50 | 20 |
| R13 | 20 | R51 | 20 |
| R14 | 20 | R52 | 20 |
| R15 | 16 | R53 | 20 |
| R16 | 20 | R54 | 20 |
| R17 | 20 | R55 | 20 |
| R18 | 20 | R56 | 20 |
| R19 | 20 | R57 | 20 |
| R20 | 20 | R58 | 20 |
| R21 | 20 | R59 | 20 |
| R22 | 20 | R60 | 20 |
| R23 | 16 | R61 | 20 |
| R24 | 20 | R62 | 20 |
| R25 | 20 | R63 | 20 |
| R26 | 20 | R64 | 20 |
| R27 | 20 | R65 | 20 |
| R28 | 20 | R66 | 20 |
| R29 | 20 | R67 | 20 |
| R30 | 20 | R68 | 20 |
| R31 | 20 | R69 | 20 |
| R32 | 16 | R70 | 20 |
| R33 | 20 | R71 | 20 |
| R34 | 20 | R73 | 20 |

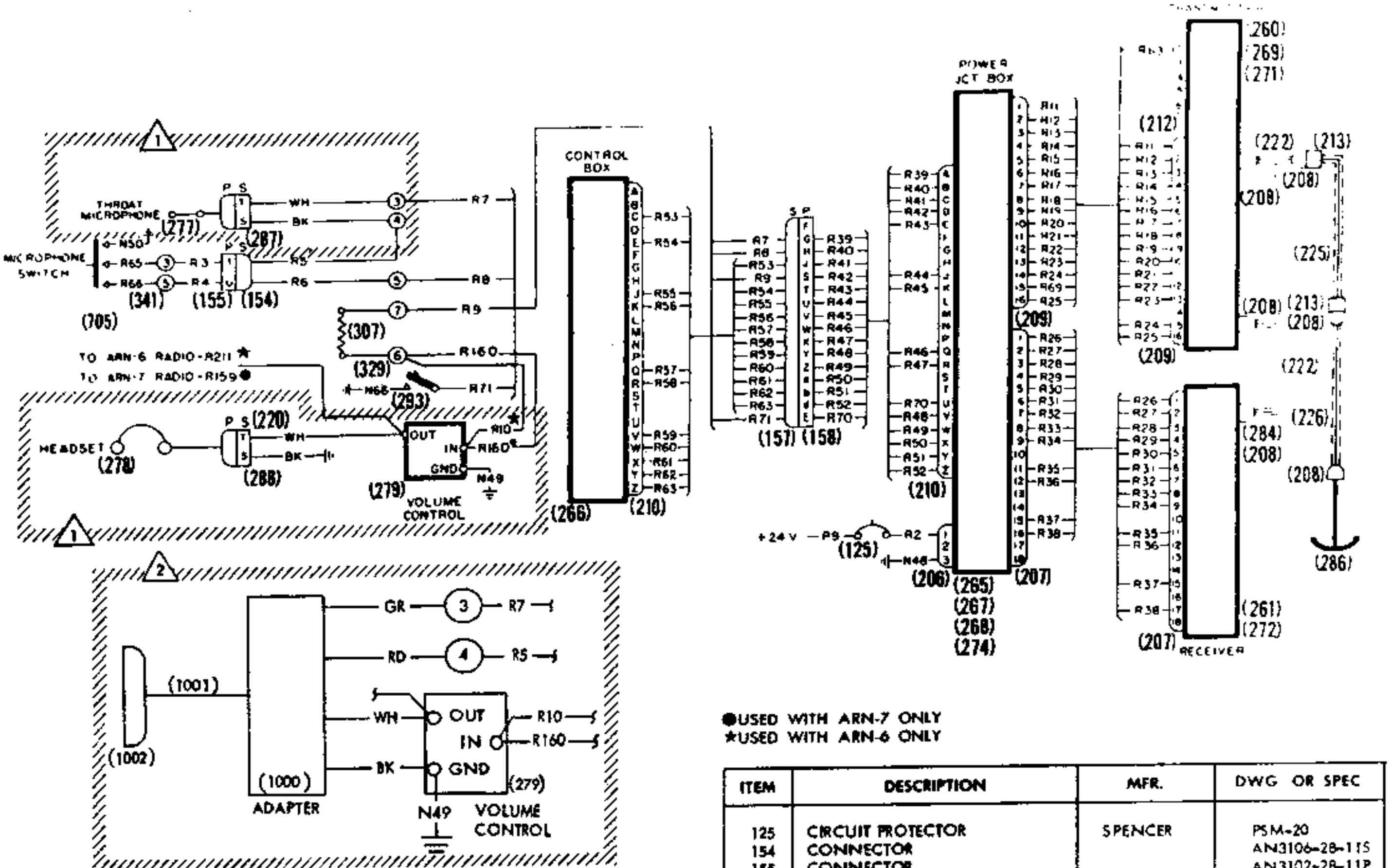
**NOTE**

1. USED ON AIRPLANES NOT INCORPORATING T.O.1F-80-508

2. USED ON AIRPLANES INCORPORATING T.O.1F-80-508

GB 535 M39-24-4-225

*Figure 225 — AN/ARC-3 and BC-1206 Radio Circuit, AF Serial No. 44-84992 through 44-85406 — F-80A-1 and F-80A-5 Airplanes*




●USED WITH ARN-7 ONLY
★USED WITH ARN-6 ONLY

## NOTE

△1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-80-508

△2 USED ON AIRPLANES INCORPORATING T.O. 1F-80-508

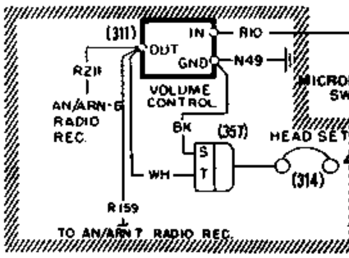
| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| N48 | 12 | R36 | 20 |
| N49 | 20 | R37 | 16 |
| N50 | 20 | R38 | 20 |
| N66 | 20 | R39 | 20 |
| P9 | 12 | R40 | 20 |
| R2 | 12 | R41 | 20 |
| R3 | 20 | R42 | 20 |
| R4 | 20 | R43 | 20 |
| R5 | 20 | R44 | 20 |
| R6 | 20 | R45 | 20 |
| R7 | 20 | R46 | 20 |
| R8 | 20 | R47 | 20 |
| R9 | 20 | R48 | 20 |
| R11 | 20 | R49 | 20 |
| R12 | 20 | R50 | 20 |
| R13 | 20 | R51 | 20 |
| R14 | 20 | R52 | 20 |
| R15 | 16 | R53 | 20 |
| R16 | 20 | R54 | 20 |
| R17 | 20 | R55 | 20 |
| R18 | 20 | R56 | 20 |
| R19 | 20 | R57 | 20 |
| R20 | 20 | R58 | 20 |
| R21 | 20 | R59 | 20 |
| R22 | 20 | R60 | 20 |
| R23 | 16 | R61 | 20 |
| R24 | 20 | R62 | 20 |
| R25 | 20 | R63 | 20 |
| R26 | 20 | R65 | 20 |
| R27 | 20 | R66 | 20 |
| R28 | 20 | R69 | 20 |
| R29 | 20 | R70 | 20 |
| R30 | 20 | R71 | 20 |
| R31 | 20 | R158 | 20 |
| R32 | 16 | ●R159 | 20 |
| R33 | 20 | ●R160 | 20 |
| R34 | 20 | ★R10 | 20 |
| R35 | 20 | ★R211 | 20 |

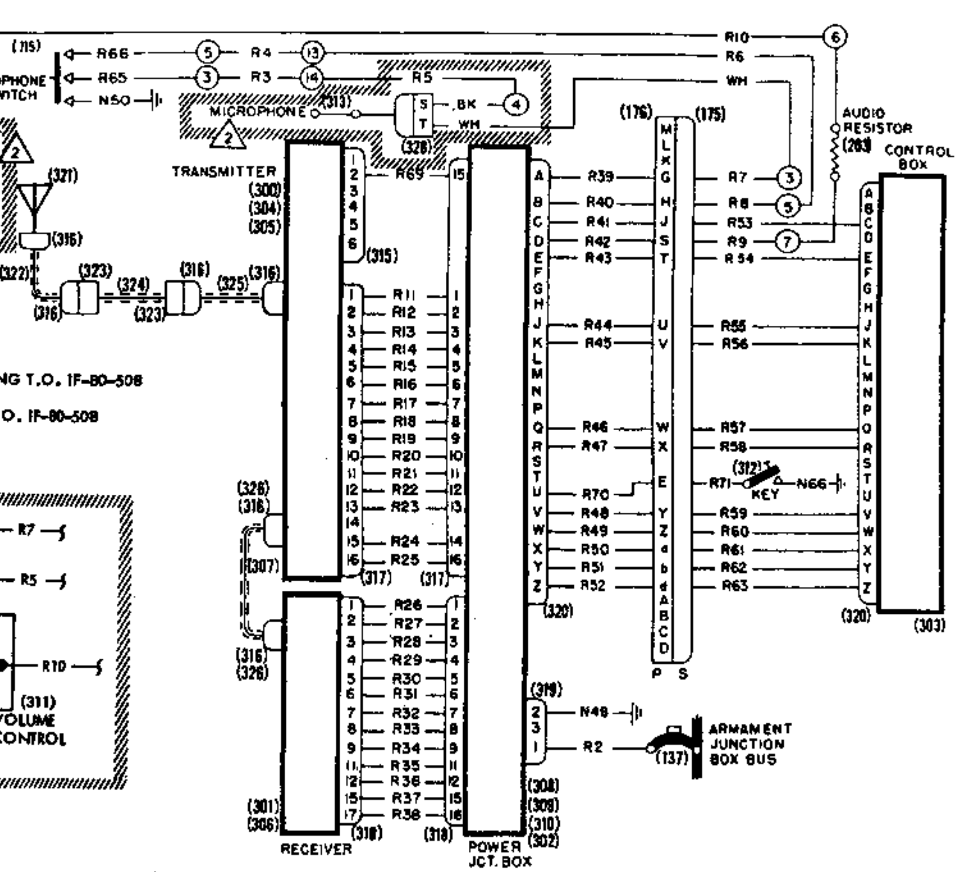
| ITEM | DESCRIPTION | MFR. | DWG OR SPEC |
|---|---|---|---|
| 125 | CIRCUIT PROTECTOR | SPENCER | PSM-20 |
| 154 | CONNECTOR | | AN3106-28-11S |
| 155 | CONNECTOR | | AN3102-28-11P |
| 157 | CONNECTOR | | AN3106-28-12S |
| 158 | CONNECTOR | CANNON | 2312-23 |
| 206 | PLUG | GFAE | PL-148A |
| 207 | PLUG | GFAE | PL-153A |
| 208 | PLUG | GFAE | PL-259A |
| 209 | PLUG | GFAE | U-15/U |
| 210 | PLUG | GFAE | U-16/U |
| 212 | PLUG | GFAE | PL-151A |
| 213 | CONNECTOR | ANDREWS | KX-10114-2 |
| 214 | PLUG | A.R.H. | 221 |
| 215 | PLUG | A.R.H. | 222 |
| 220 | CORDAGE | | CO-219 |
| 222 | COAXIAL CABLE | GFAE | RG-8/U |
| 225 | COAXIAL CABLE | ANDREWS | KX-10113 |
| 226 | COAXIAL CABLE | ROCKBESTOS | LRD-1 |
| 260 | TRANSMITTER (ARC-3) | GFAE | T-67/ARC-3 |
| 261 | RECEIVER (ARC-3) | GFAE | R-77/ARC-3 |
| 265 | ARC-3 POWER JUNCTION BOX | GFAE | J-68/ARC-3 |
| 266 | ARC-3 CONTROL BOX | GFAE | C-118/ARC-3 |
| 267 | ARC-3 DYNAMOTOR | GFAE | DY-21/ARC-3 |
| 268 | ARC-3 DYNAMOTOR | GFAE | DY-22/ARC-3 |
| 269 | ARC-3 CRYSTAL UNIT | GFAE | DC-11 OR CR-1/ARC-3 |
| 271 | MOUNTING | GFAE | MT-238A/ARC-3 |
| 272 | MOUNTING | GFAE | MT-237A/ARC-3 |
| 274 | MOUNTING | GFAE | MT-236A/ARC-3 |
| △1 277 | MICROPHONE | GFAE | T-30P OR LATER |
| △1 278 | HEADSET | GFAE | HS-33 |
| 279 | VOLUME CONTROL | GFAE | C-197/ARC-3 |
| 284 | ADAPTER | GFAE | M-359 |
| 286 | ANTENNA | LOCKHEED | 177250 |
| △1 287 | JACK | GFAE | JK-48 |
| △1 288 | JACK | GFAE | JK-26 |
| 293 | KEY | GFAE | SE-256 |
| 307 | RESISTOR | ERIE | 150 1/2W |
| 329 | TERMINAL PANEL | LOCKHEED | LS-1927-2 |
| 341 | TERMINAL PANEL | LOCKHEED | LS-1905-2 |
| 705 | MICROPHONE SWITCH | UCINITE | 138106D |
| △2 1000 | ADAPTER | GFAE | MX-1646/AIC |
| △2 1001 | CORD | | WF-14/U |
| △2 1002 | PLUG | | U-92A/U |

GB 596 EM39-24-4-227

***Figure 227 — AN/ARC-3 Command Radio Circuit, F-80A-5 and RF-80A-5 Airplanes, AF Serial No. 44-84377 and Subsequent***

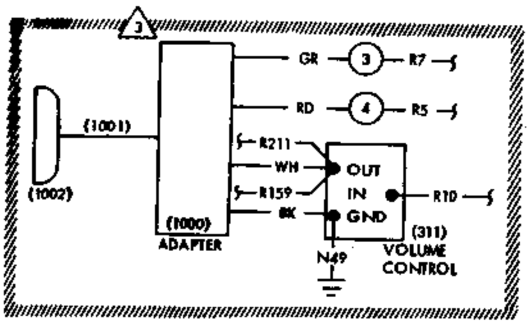
FIGURE 226 DELETED IN REVISION DATED 20 JANUARY 1947

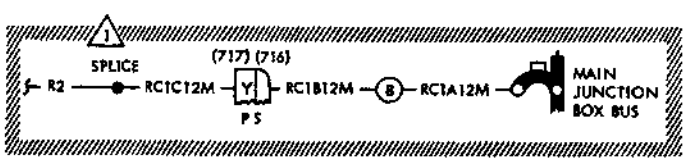



# NOTE

1. FOR RF-80A-15 AIRPLANES ONLY
2. USED ON AIRPLANES NOT INCORPORATING T.O. 1F-80-508
3. USED ON AIRPLANES INCORPORATING T.O. 1F-80-508




| ITEM | DESCRIPTION | MFR | DWG OR SPEC |
|---|---|---|---|
| 137 | CIRCUIT PROTECTOR | SPENCER | PSM-20 |
| 175 | CONNECTOR | | AN3106-28-12S |
| 176 | CONNECTOR | | AN3102P-28-12P |
| 203 | RESISTOR | ERIE | 150 Ω 1/2W |
| 300 | TRANSMITTER | GFAE | F-67/ARC-3 |
| 301 | RECEIVER | GFAE | R-77/ARC-3 |
| 302 | POWER JUNC BOX | GFAE | J-68/ARC-3 |
| 303 | CONTROL BOX | GFAE | C-118A/ARC-3 |
| 304 | CRYSTAL UNIT | GFAE | CR-1/ARC-3 |
| 305 | MOUNTING TRANSMITTER | GFAE | MT-238/ARC-3 |
| 306 | MOUNTING RECEIVER | GFAE | MT-237/ARC-3 |
| 307 | CABLE COAXIAL | GFAE | RG- |
| 308 | DYNAMOTOR | GFAE | DY-21/ARC-3 |
| 309 | DYNAMOTOR | GFAE | DY-22/ARC-3 |
| 310 | MTG POWER JUNC BOX | GFAE | MT-236/ARC3 |
| 311 | VOLUME CONTROL | GFAE | C-197/ARC-3 |
| 312 | KEY | GFAE | SE-256 |
| (2) 313 | MICROPHONE | GFAE | T-30P OR LATER |
| (2) 314 | HEADSET | GFAE | HS-33 |
| 315 | PLUG | GFAE | PL-151A |
| 316 | PLUG | GFAE | PL-259A |
| 317 | PLUG | GFAE | U-15/U |
| 318 | PLUG | GFAE | PL-153A |
| 319 | PLUG | GFAE | PL-148A |
| 320 | PLUG | GFAE | U-16/U |
| 321 | ANTENNA | LOCKHEED | 177250 |
| 322 | CABLE COAXIAL | ROCKBESTOS | LRD-1 |
| 323 | PLUG | AMPHENOL | SO-239 |
| 324 | CABLE COAXIAL | ANDREWS | KX-10113 |
| 325 | CABLE COAXIAL | GFAE | RG-31/U |
| 326 | ADAPTER | GFAE | M-359 |
| (2) 328 | MICROPHONE JACK | GFAE | JK-48 |
| (2) 357 | HEADSET JACK | GFAE | JK-26 |
| 715 | MICROPHONE SWITCH | UCINITE | 138106D |
| (1) 716 | CONNECTOR | | AN3106B-36-8S |
| (1) 717 | CONNECTOR | | AN3102M-36-8P |
| (3) 1000 | ADAPTER | GFAE | MX-1646/AIC |
| (3) 1001 | CORD | | WF-14/U |
| (3) 1002 | PLUG | | U-92A/U |

| ALL WIRES No. 20 GAGE EXCEPT: | |
|---|---|
| WIRE NO. | GAGE |
| N48 | 12 |
| R2 | 12 |
| R15 | 16 |
| R23 | 16 |
| R32 | 16 |
| R37 | 16 |
| RC1C12M | 12 |
| RC1B12M | 12 |
| RC1A12M | 12 |

6B 597

EM39-24-4-227A

*Figure 227A — AN/ARC-3 Command Radio Circuit, F-80A-10, RF-80A-10, and RF-80A-15 Airplanes*

## 18. COMMUNICATIONS SYSTEMS.

*a.* GENERAL.—The communications system consists of an AN/ARC-3 command radio, an SCR-695-A identification, and on F-80A-1 and early F-80A-5 airplanes a BC-1206C beacon receiver. Provisions are made for the use of BC-1206A or BC-1206B receiver in lieu of the BC-1206C. Later F-80A-5 and all F-80A-10 airplanes use an AN/ARN-6 radio compass instead of the BC-1206C radio. The AN/ARC-3 circuit employs a 20-ampere push-to-reset circuit protector in the armament compartment junction box. (See figure 217.) In the RF-80A-15, the AN/ARC-3 circuit protector is located in the main switch box in the cockpit. The BC-1206C circuit has a 5-ampere push-to-reset circuit protector in the main switch box. (See figure 246.) The SCR-695 radio circuit protector, a push-to-reset type, is on the identification radio control panel. The destructor circuit of the identification radio includes a 20-ampere push-to-reset circuit protector in the sub-cockpit righthand junction box. (See figure 193.)

AN/ARC-27 command equipment is installed in airplanes incorporating T. O. 1F-80(R)A-20.

**Note**

The BC-1206C beacon receiver is replaced with the BC-453B radio receiver on airplanes that do not have an AN/ARN-6 radio compass. (Refer to T. O. 1F-80A-40.) To materially reduce interference in the BC-453B receiver due to static, a resistor, part No. 3RC30BE105M, is installed between the BC-453B lead-in and ground. (Refer to T. O. 1F-80A-41.)

The SCR-695A identification radio is replaced by the AN/APX-6 identification radar equipment in those airplanes incorporating T. O. 1F-80A-25.

RF-80A-5 and RF-80A-10, photographic airplanes use an AN/ARN-7 radio compass which replaces the BC-1206C beacon receiver radio.

RF-80A-15 photographic airplanes use an AN/ARN-6 radio compass. The ADF loop antenna compensator bars have been removed as unnecessary in this installation.

All radios operate from the 28-volt direct current system except for the AN/ARN-7 radio compass which uses a 750 volt-ampere 400-cycle inverter for a power supply.

The AN/APX-6 identification radar operates from a three-phase, 115 volt, 400-cycle power supplied to the transponder through a control relay by an inverter.

The circuit wires for the command radio, beacon receiver, and radio compass are identified by the letter "R" preceding the wire number. The wires to the identification radio are identified by the letter "S" preceding the wire number.

The antenna wire for the beacon receiver radio on F-80A-1 and early F-80A-5 airplanes, and for the radio compass on other airplanes extends from within the cockpit canopy to the empennage fin. The mast for the identification-radio antenna is on the bottom of the fuselage below the right air-intake duct. The command radio antenna mast, on early airplanes, is on the bottom of the fuselage below the left air-intake duct; on later airplanes this antenna is built into the fin tip. (See figure 229.) For information on removal of the fin tip and antenna, see paragraph 2*b*(4), this section. A coaxial cable is routed from the antenna in the fin tip to the command radio, with a quick disconnect at the mid-section to aft-section joint in the right fillet.

**Note**

No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For testing, demonstration or drill purposes, radio equipment will be operated into a nonradiating dummy load instead of an antenna. Emergency (distress) frequencies are 500 kilocycles, 8364 kilocycles, 121.5 megacycles, and 243.0 megacycles.

*b.* COMMAND RADIO (AIRPLANES NOT INCORPORATING T. O. 1F-80(R)A-20). *(See figures 225, 227, and 227A.)*—The command radio installed in the airplane is an AN/ARC-3. This is a multi-channel aircraft radio with receiving and transmitting equip-

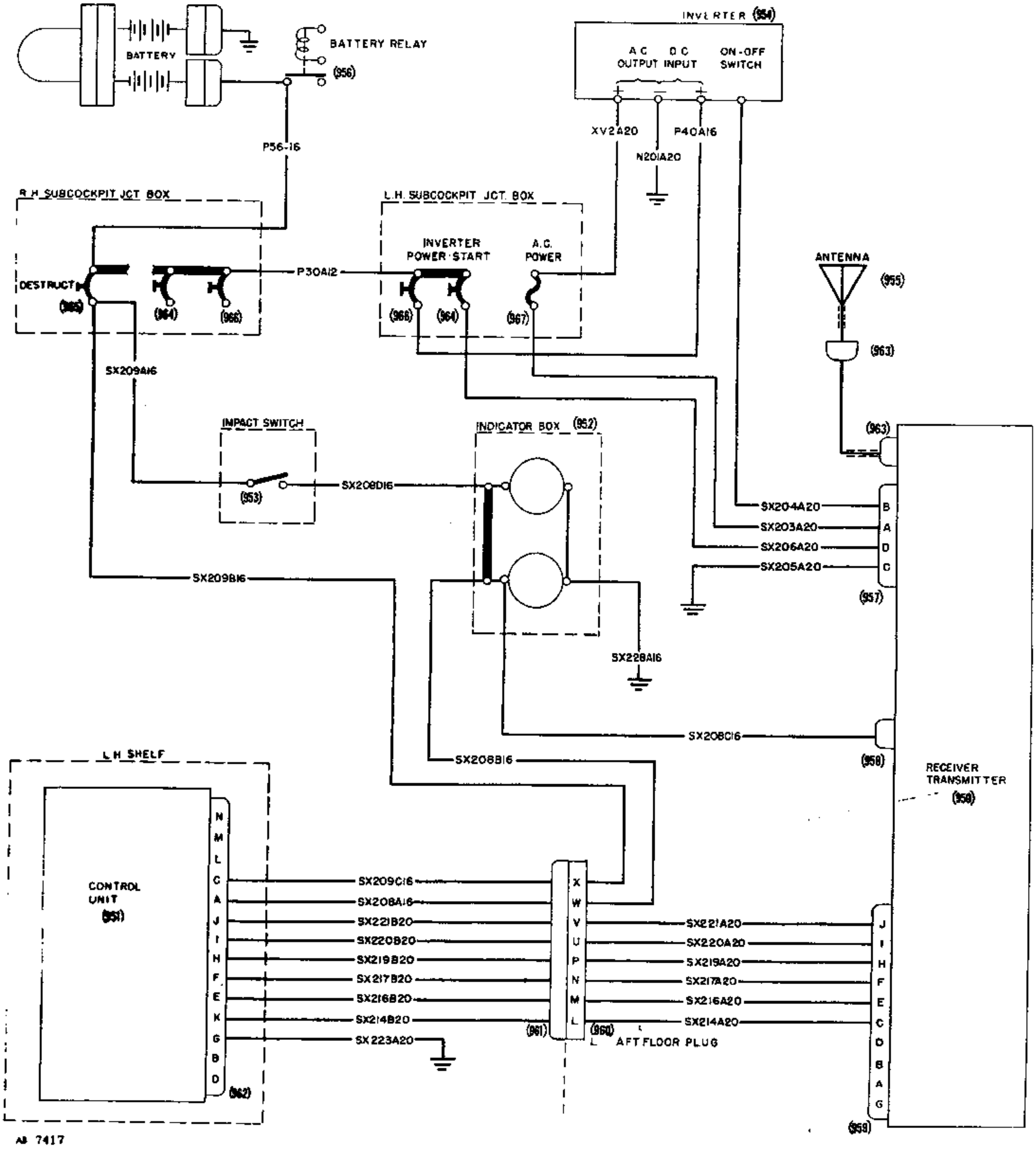
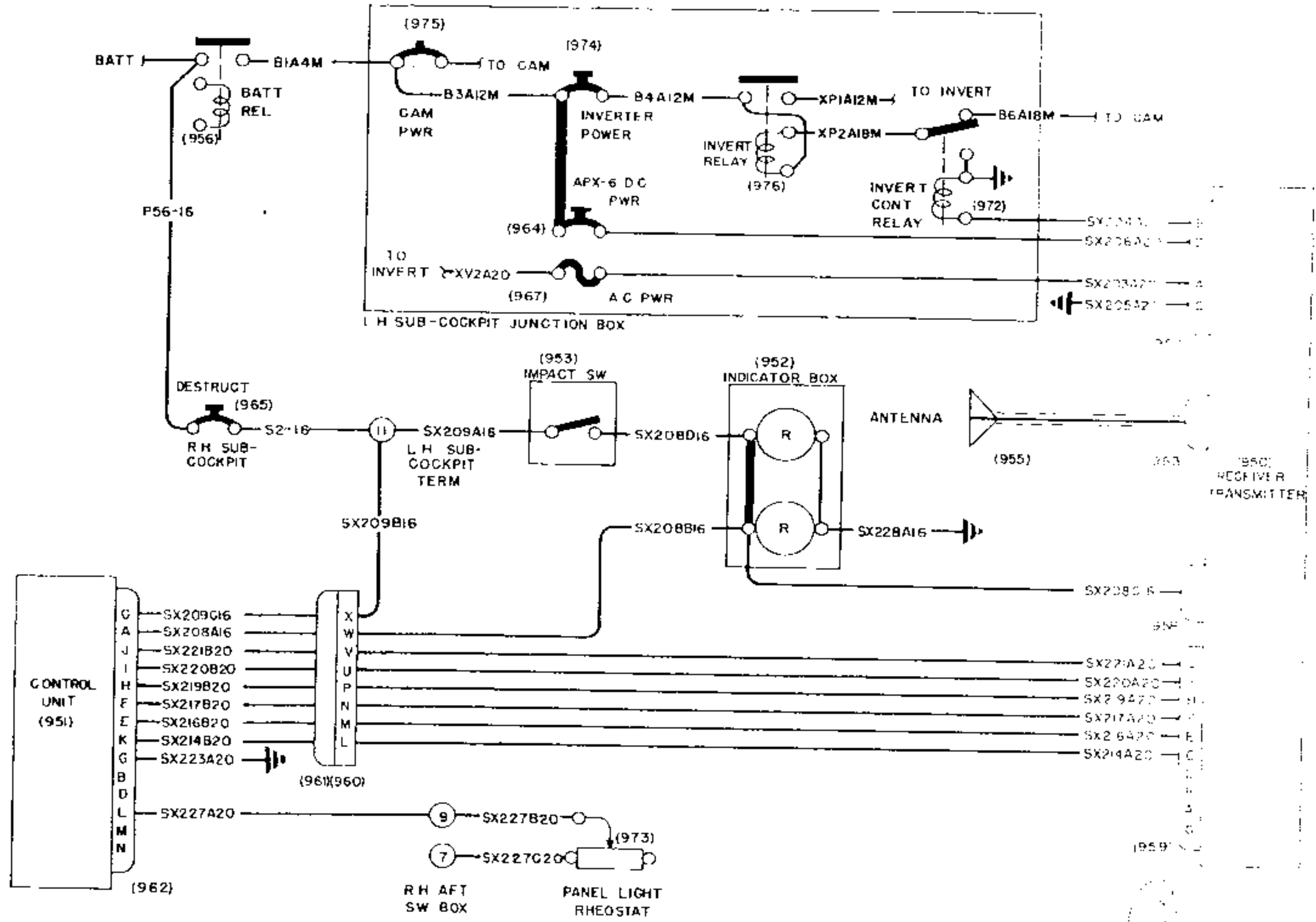
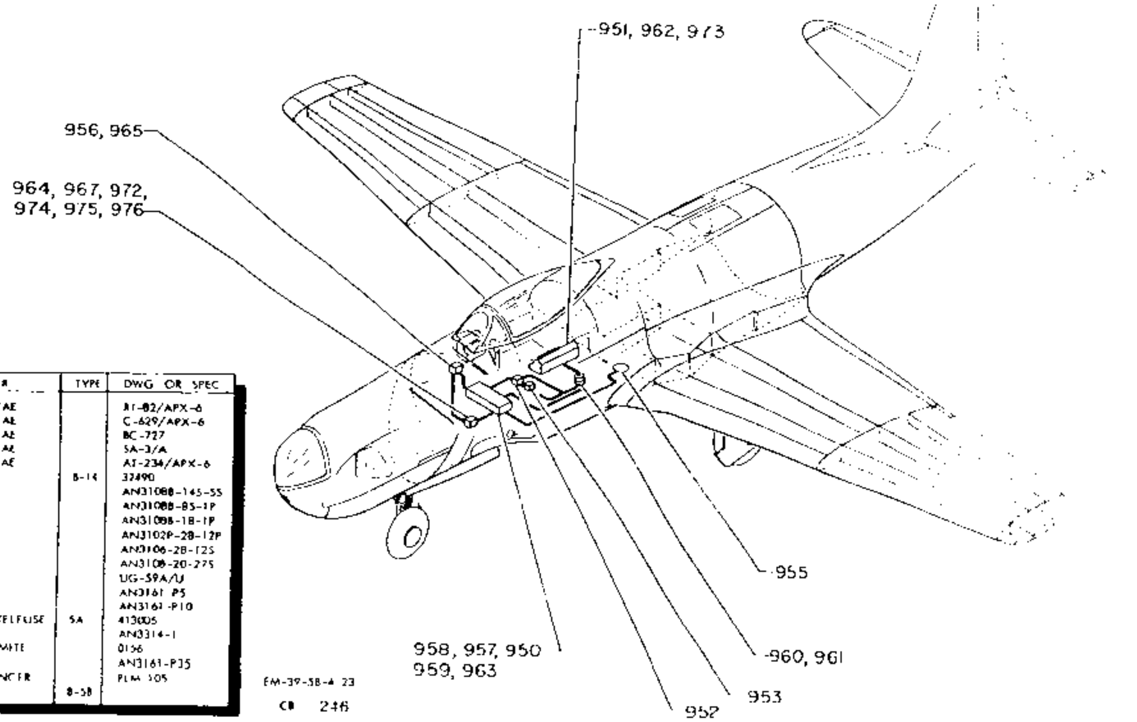


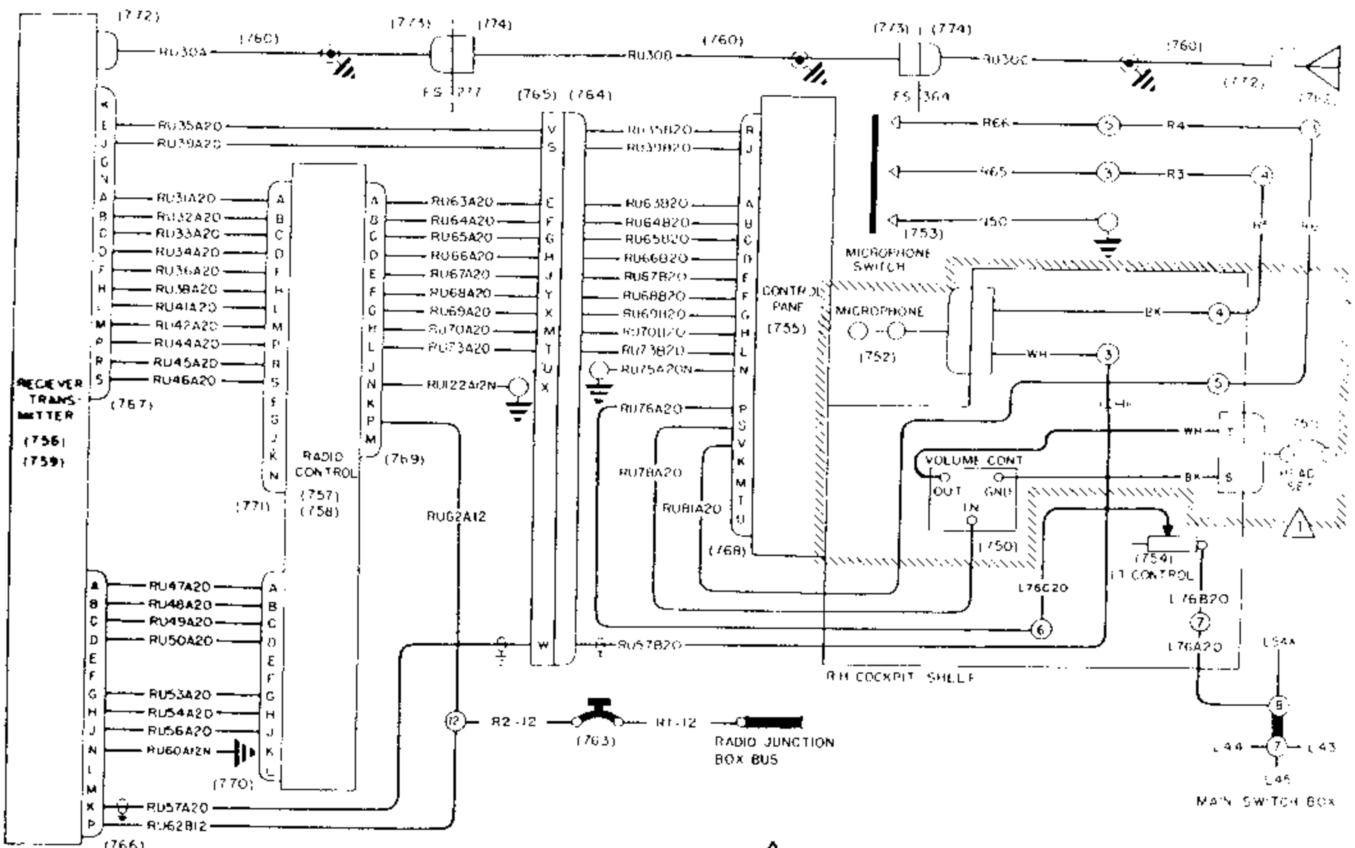

*Figure 228B (Sheet 1 of 2 Sheets) — AN/APX-6 Identification Radar Circuit (Airplanes Incorporating Service Bulletin F80/SB-115)*

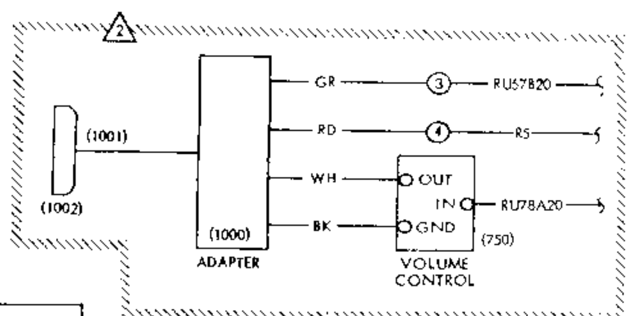



| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 950 | RECEIVER TRANSMITTER | GFAE | | RT-82/APX-6 |
| 951 | CONTROL UNIT | GFAE | | C-629/APX-6 |
| 952 | INDICATOR BOX | GFAE | | BC-727 |
| 953 | SWITCH | GFAE | | SA-3/A |
| 955 | ANTENNA | GFAE | | AT-234/APX-6 |
| 956 | RELAY | | B-14 | 32490 |
| 957 | CONNECTOR | | | AN3108B-14S-5S |
| 958 | CONNECTOR | | | AN3108B-8S-1P |
| 959 | CONNECTOR | | | AN3108B-18-1P |
| 960 | CONNECTOR | | | AN3102P-28-12P |
| 961 | CONNECTOR | | | AN3106-28-12S |
| 962 | CONNECTOR | | | AN3108-20-27S |
| 963 | CONNECTOR | | | UG-59A/U |
| 964 | CIRCUIT PROTECTOR | | | AN3161-P5 |
| 965 | CIRCUIT PROTECTOR | | | AN3161-P10 |
| 967 | FUSE | LITTELFUSE | 5A | 413005 |
| 972 | RELAY | | | AN3314-1 |
| 973 | RHEOSTAT | OHMITE | | 0156 |
| 974 | CIRCUIT PROTECTOR | | | AN3161-P35 |
| 975 | CIRCUIT PROTECTOR | SPENCER | | PLM 505 |
| 976 | RELAY | | B-58 | |

*Figure 228D — AN/APX-6 Identification Radar Circuit, RF-80A-25 Airplanes*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 750 | VOLUME CONTROL | GFAE | | C-197/ARC-3 |
| 751 | HEADSET | GFAE | | HS-33 |
| 752 | MICROPHONE | GFAE | | T-30P |
| 753 | MICROPHONE SWITCH | UCINITE | | 138106D |
| 754 | RHEOSTAT | OHMITE | | 0156 |
| 755 | CONTROL PANEL | GFAE | | C-628/ARC-27 |
| 756 | RECEIVER TRANSMITTER | GFAE | | RT-178/ARC-27 |
| 757 | RADIO CONTROL | GFAE | | C-626/ARC-27 |
| 758 | MOUNT-CONTROL | GFAE | | MT821/ARC-27 |
| 759 | MOUNT-REC. TRANS. | GFAE | | MT822/ARC-27 |
| 760 | CABLE COAXIAL | GFAE | | RG-8/U |
| 761 | ANGLE ADAPTER | | | UG-27B/U |
| 762 | ANTENNA | L.A.C. | | 452000 |
| 763 | CIRCUIT PROTECTOR | | | MS25005-25 |
| 764 | CONNECTOR | | | AN3106-28-12S |
| 765 | CONNECTOR | | | AN3102P-28-12P |
| 766 | CONNECTOR | | | AN3108-24-7S |
| 767 | CONNECTOR | | | AN3108-24-5S |
| 768 | CONNECTOR | | | AN3106-22-14S |
| 769 | CONNECTOR | | | AN3106-24-7S |
| 770 | CONNECTOR | | | AN3106-24-20P |
| 771 | CONNECTOR | | | AN3106-24-5P |
| 772 | CONNECTOR | | | UG-21C/U |
| 773 | CONNECTOR | AMPHENOL | | PL-259 |
| 774 | CONNECTOR | AMPHENOL | | SO-239 |
| 2 1000 | ADAPTER | GFAE | | MX-1646/AIC |
| 2 1001 | CORD | | | WF-14/U |
| 2 1002 | PLUG | | | U-92A/U |

**NOTE**

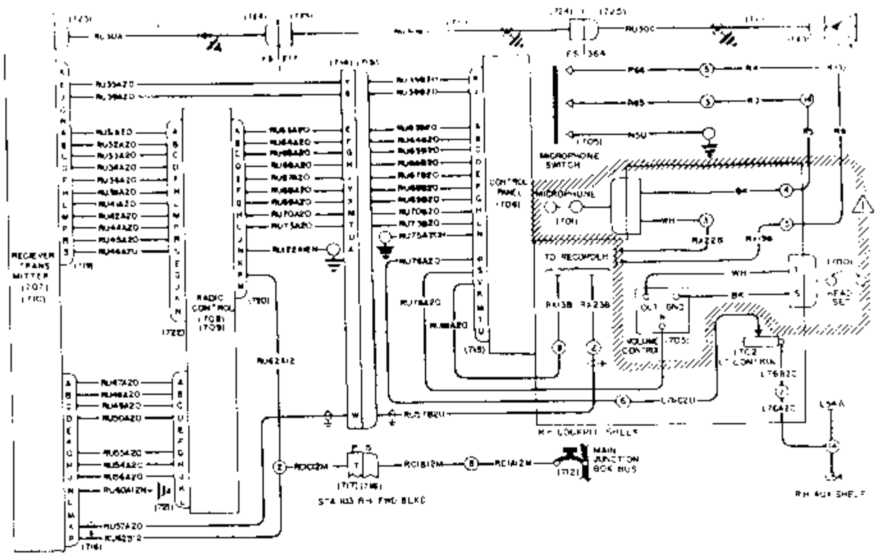
1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-80-508

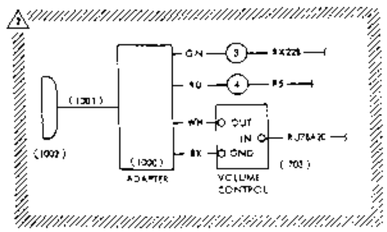
2 USED ON AIRPLANES INCORPORATING T.O. 1F-80-508

GB 533

EM39-24-4-1

*Figure 228E — AN/ARC-27 Command Radio Circuit, RF-80A-20 Airplanes*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| △1 700 | HEADSET | GFAE | | HS-33 |
| △1 701 | MICROPHONE | GFAE | | T-30P |
| 702 | RHEOSTAT | OHMITE | | 0156 |
| 703 | VOLUME CONTROL | GFAE | | C-197/ARC-3 |
| 704 | ANTENNA | L A C | | 452000 |
| 705 | MICROPHONE SWITCH | UCINITE | | 138106D |
| 706 | CONTROL PANEL | GFAE | | C-629/ARC-27 |
| 707 | RECEIVER TRANSMITTER | GFAE | | RT 178/ARC-27 |
| 708 | RADIO CONTROL | GFAE | | C-626/ARC-27 |
| 709 | MOUNT-CONTROL | GFAE | | MT821/ARC-27 |
| 710 | MOUNT-REC TRANS | GFAE | | MT822/ARC-27 |
| 711 | CABLE COAXIAL | GFAE | | RG-8/U |
| 712 | CIRCUIT PROTECTOR | | | MS25005-25 |
| 713 | CONNECTOR | | | AN3106-28-12S |
| 714 | CONNECTOR | | | AN3102P-28-12P |
| 715 | CONNECTOR | | | AN3106-22-14S |
| 716 | CONNECTOR | | | AN3106B-36-8S |
| 717 | CONNECTOR | | | AN3102M-36-8P |
| 718 | CONNECTOR | | | AN3108-24-7S |
| 719 | CONNECTOR | | | AN3108-24-5S |
| 720 | CONNECTOR | | | AN3106-24-7S |
| 721 | CONNECTOR | | | AN3106-24-20P |
| 722 | CONNECTOR | | | AN3106-24-5P |
| 723 | CONNECTOR | | | UG-21C/U |
| 724 | CONNECTOR | AMPHENOL | | PL-259 |
| 725 | CONNECTOR | AMPHENOL | | SO-239 |
| △2 1000 | ADAPTER | GFAE | | MX-1646/AIC |
| △2 1001 | CORD | | | WF-14/U |
| △2 1002 | PLUG | | | U-92A/U |

GB 534
FM-39-24-4-6

## NOTE

△1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-80-528

△2 USED ON AIRPLANES INCORPORATING T.O. 1F-80-528

Figure 228F — AN/ARC-27 Command Radio Circuit, RF-80A-25 Airplanes

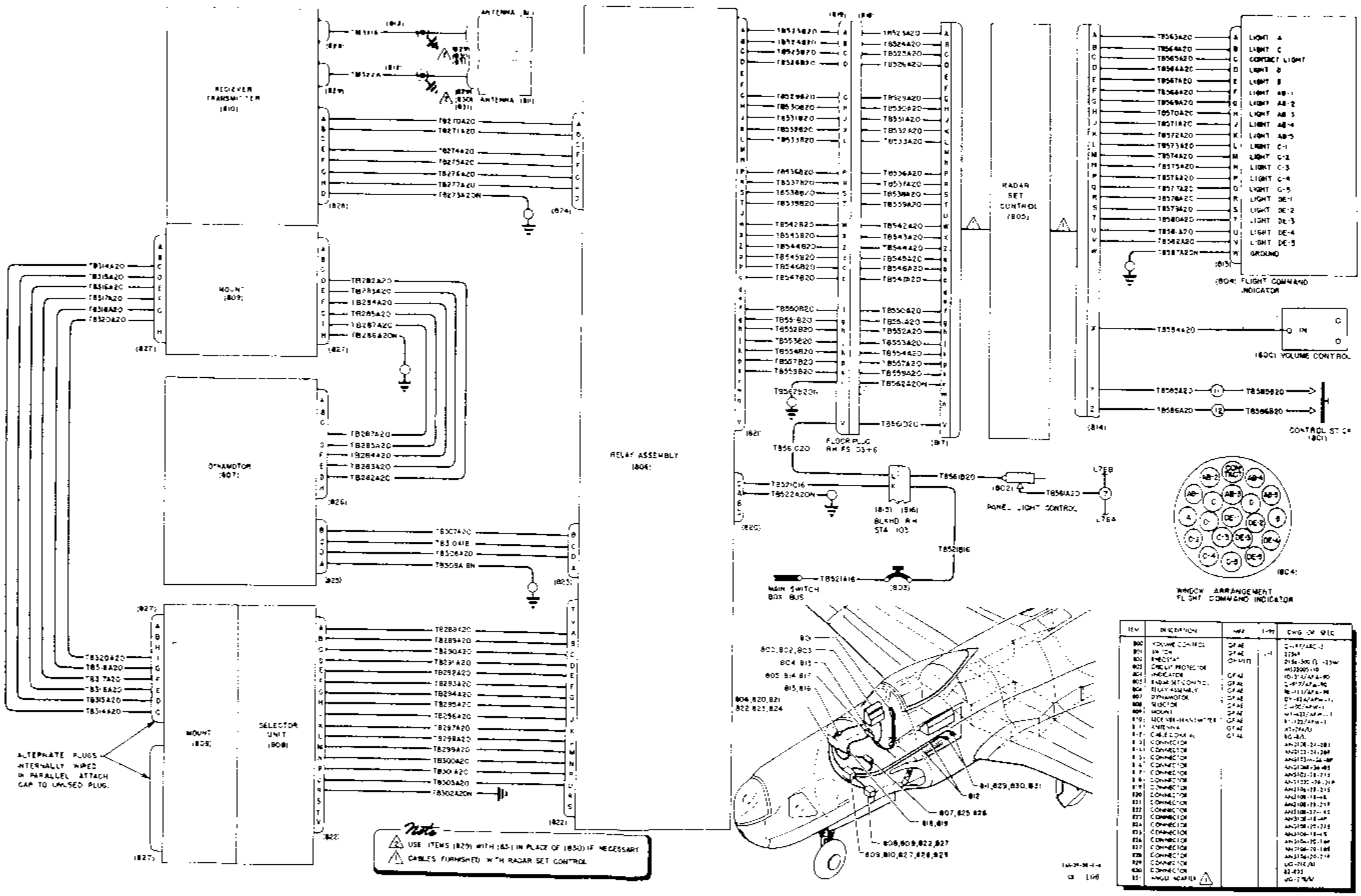
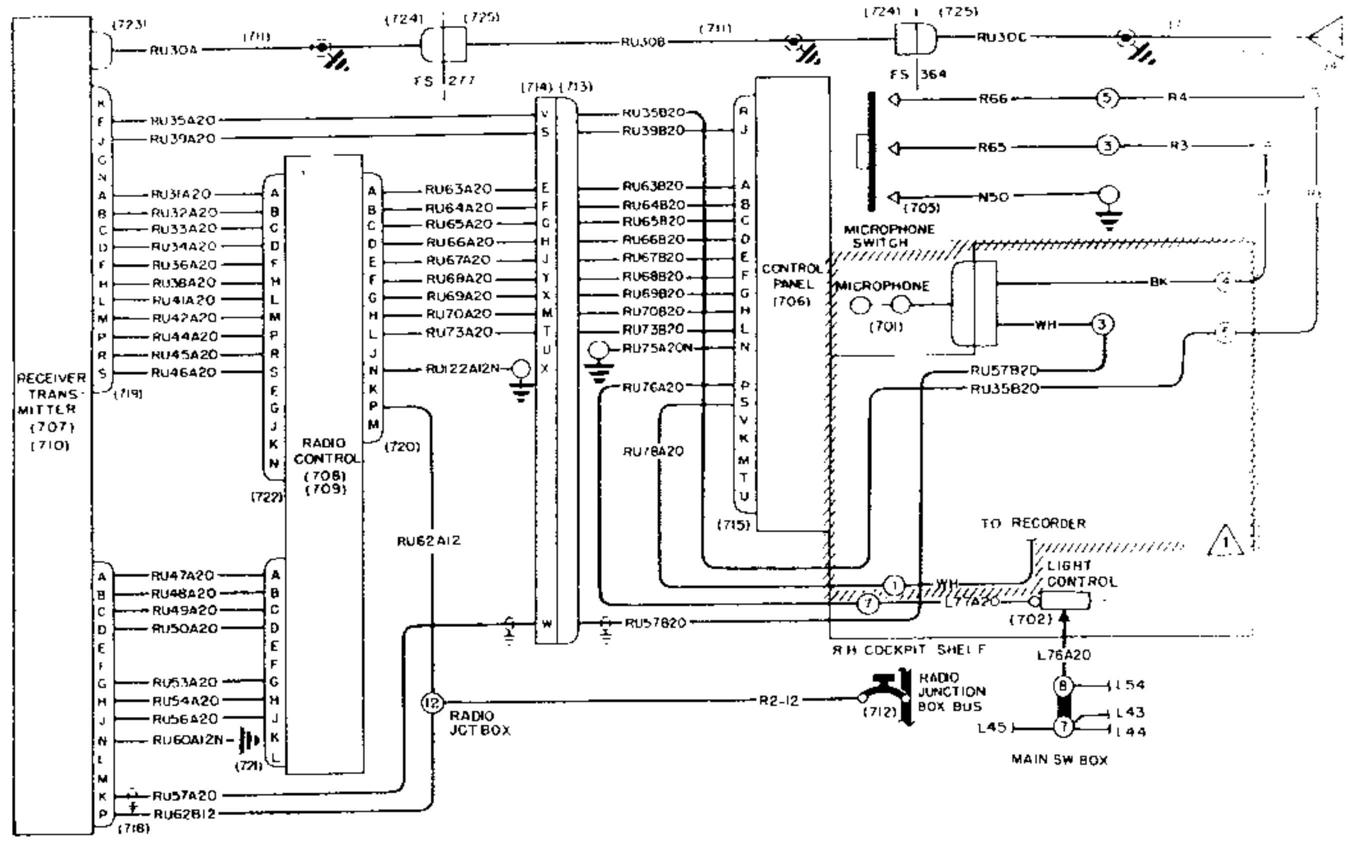
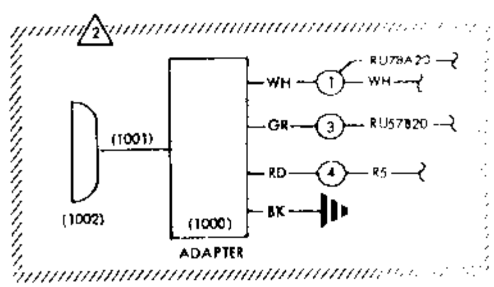



Figure 228G -- AN/APW-11 Identification Radar Circuit, RF-80A-20 and RF-80A-25 Airplanes




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| 1 700 | HEADSET | GFAE | | HS-33 |
| 1 701 | MICROPHONE | GFAE | | T-30P |
| 702 | RHEOSTAT | OHMITE | | 0156 |
| 703 | VOLUME CONTROL | GFAE | | C-197/ARC-3 |
| 704 | ANTENNA | LAC | | 452000 |
| 705 | MICROPHONE SWITCH | UCINITE | | 138106D |
| 706 | CONTROL PANEL | GFAE | | C-628/ARC-27 |
| 707 | RECEIVER TRANSMITTER | GFAE | | RT-178/ARC-27 |
| 708 | RADIO CONTROL | GFAE | | C-626/ARC-27 |
| 709 | MOUNT-CONTROL | GFAE | | MT821/ARC-27 |
| 710 | MOUNT-REC TRANS | GFAE | | MT822/ARC-27 |
| 711 | CABLE COAXIAL | GFAE | | RG-8/U |
| 712 | CIRCUIT PROTECTOR | | | MS25005-25 |
| 713 | CONNECTOR | | | AN3106-28-12S |
| 714 | CONNECTOR | | | AN3102P-28-12P |
| 715 | CONNECTOR | | | AN3106-22-14S |
| 716 | CONNECTOR | | | AN3106B-36-8S |
| 717 | CONNECTOR | | | AN3102M-36-8P |
| 718 | CONNECTOR | | | AN3108-24-7S |
| 719 | CONNECTOR | | | AN3108-24-5S |
| 720 | CONNECTOR | | | AN3106-24-7S |
| 721 | CONNECTOR | | | AN3106-24-20P |
| 722 | CONNECTOR | | | AN3106-24-5P |
| 723 | CONNECTOR | | | UG-21C/U |
| 724 | CONNECTOR | AMPHENOL | | PL-259 |
| 725 | CONNECTOR | AMPHENOL | | SO-239 |
| 2 1000 | ADAPTER | GFAE | | MX-1646/AIC |
| 2 1001 | CORD | | | WF-14/U |
| 2 1002 | PLUG | | | U-92A/U |

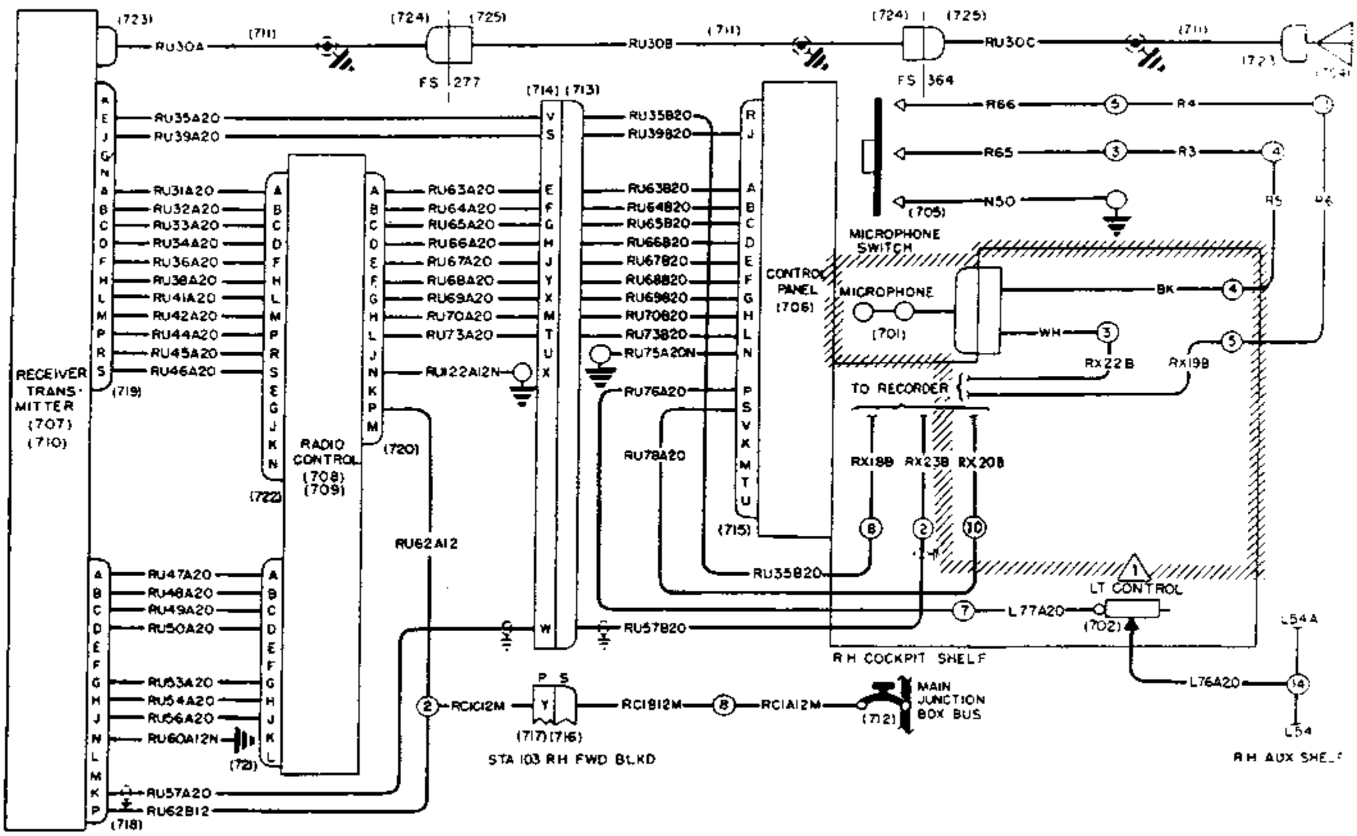
# NOTE

1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-80-508

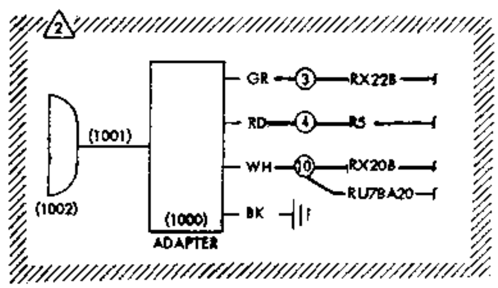
2 USED ON AIRPLANES INCORPORATING T.O. 1F-80-508

GB 536
EM39-24-4-228H

*Figure 228H — AN/ARC-27 Command Radio Circuit, RF-80A-5 and RF-80A-10 Airplanes*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC |
|---|---|---|---|---|
| △1 △2 700 | HEADSET | GFAE | | HS-33 |
| △1 701 | MICROPHONE | GFAE | | T-30P |
| 702 | RHEOSTAT | OHMITE | | 0156 |
| 703 | VOLUME CONTROL | GFAE | | C-197/ARC-3 |
| 704 | ANTENNA | L A C | | 452000 |
| 705 | MICROPHONE SWITCH | UCINITE | | 138106D |
| 706 | CONTROL PANEL | GFAE | | C-626/ARC-27 |
| 707 | RECEIVER TRANSMITTER | GFAE | | RT-178/ARC-27 |
| 708 | RADIO CONTROL | GFAE | | C-626/ARC-27 |
| 709 | MOUNT-CONTROL | GFAE | | MT821/ARC-27 |
| 710 | MOUNT-REC TRANS | GFAE | | MT822/ARC-27 |
| 711 | CABLE COAXIAL | GFAE | | RG-8/U |
| 712 | CIRCUIT PROTECTOR | | | MS25005-25 |
| 713 | CONNECTOR | | | AN3106-28-12S |
| 714 | CONNECTOR | | | AN3102P-28-12P |
| 715 | CONNECTOR | | | AN3106-22-14S |
| 716 | CONNECTOR | | | AN3106B-36-8S |
| 717 | CONNECTOR | | | AN3102M-36-8P |
| 718 | CONNECTOR | | | AN3108-24-7S |
| 719 | CONNECTOR | | | AN3108-24-5S |
| 720 | CONNECTOR | | | AN3106-24-7S |
| 721 | CONNECTOR | | | AN3106-24-20P |
| 722 | CONNECTOR | | | AN3106-24-5P |
| 723 | CONNECTOR | | | UG-21C/U |
| 724 | CONNECTOR | AMPHENOL | | PL-259 |
| 725 | CONNECTOR | AMPHENOL | | SO-239 |
| △2 1000 | ADAPTER | GFAE | | MX-1646/AIC |
| △2 1001 | CORD | | | WF-14/U |
| △2 1002 | PLUG | | | U-92A/U |




# NOTE

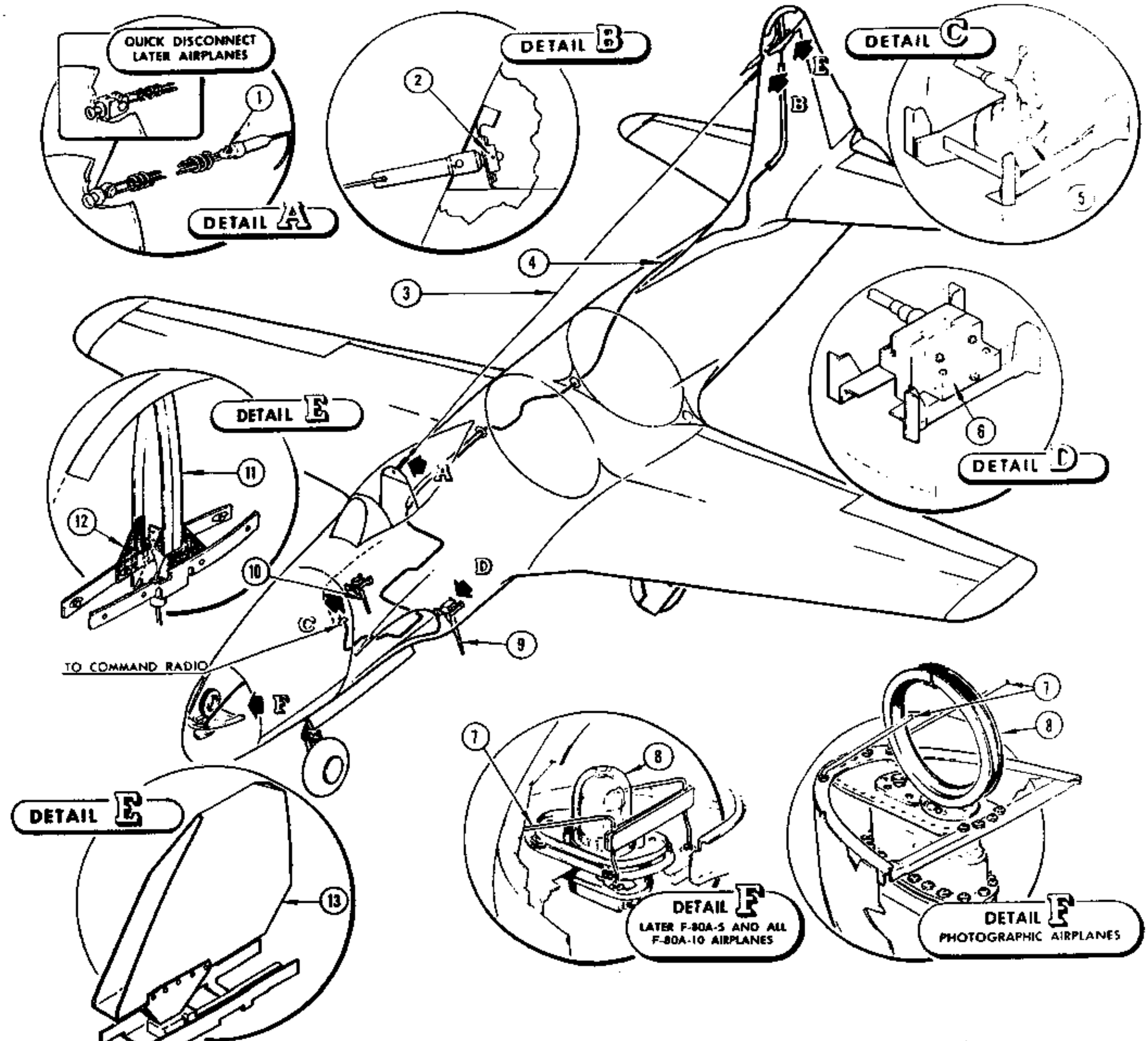
△1 USED ON AIRPLANES NOT INCORPORATING T.O. 1F-80-508

△2 USED ON AIRPLANES INCORPORATING T.O. 1F-80-508

GB 537

M-39-24-4-228J

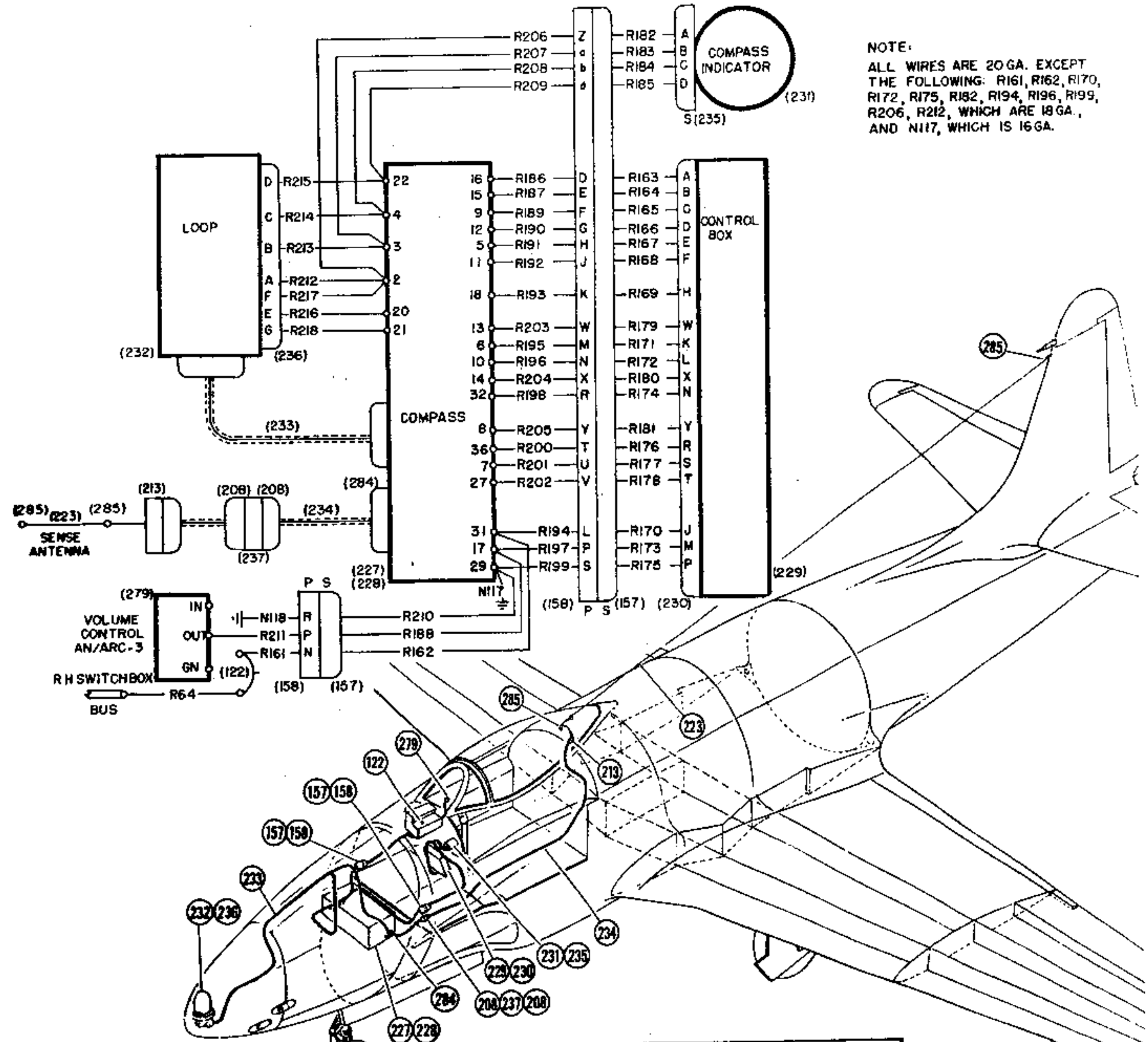
*Figure 228J — AN/ARC-27 Command Radio Circuit, RF-80A-15 Airplanes*




1 AN23-8A BOLT AND AN365-1032 NUT
2 ANTENNA-TO-FIN QUICK DISCONNECT
3 BEACON RECEIVER RADIO ANTENNA (EARLY AIRPLANES) RADIO COMPASS SENSE ANTENNA (PHOTOGRAPHIC AIRPLANES AND LATER FIGHTER AIRPLANES)
4 COMMAND RADIO COAXIAL CABLE (AF 44-85407 AND UP, AND AIRPLANES INCORPORATING T.O. 1F-80A-23)
5 IDENTIFICATION RADIO MAST INSULATOR
6 COMMAND RADIO MAST INSULATOR (AIRPLANES PRIOR TO AF 44-85407 NOT INCORPORATING T.O. 1F-80A-23)
7 COMPENSATOR BARS
8 RADIO COMPASS LOOP ANTENNA
9 COMMAND RADIO ANTENNA MAST (AIRPLANES PRIOR TO AF 44-85407 NOT INCORPORATING T.O. 1F-80A-23)
10 IDENTIFICATION RADIO ANTENNA MAST (REPLACED BY AT-234/APX-6 FLUSH ANTENNA ON AIRPLANES INCORPORATING T.O. 1F-80A-25)
11 COMMAND RADIO ANTENNA (AF 44-85407 AND UP, AND AIRPLANES INCORPORATING T.O. 1F-80A-23)
12 INSULATORS
13 COMMAND ANTENNA (AIRPLANES INCORPORATING T.O. 1F-80 (R)-A-20)

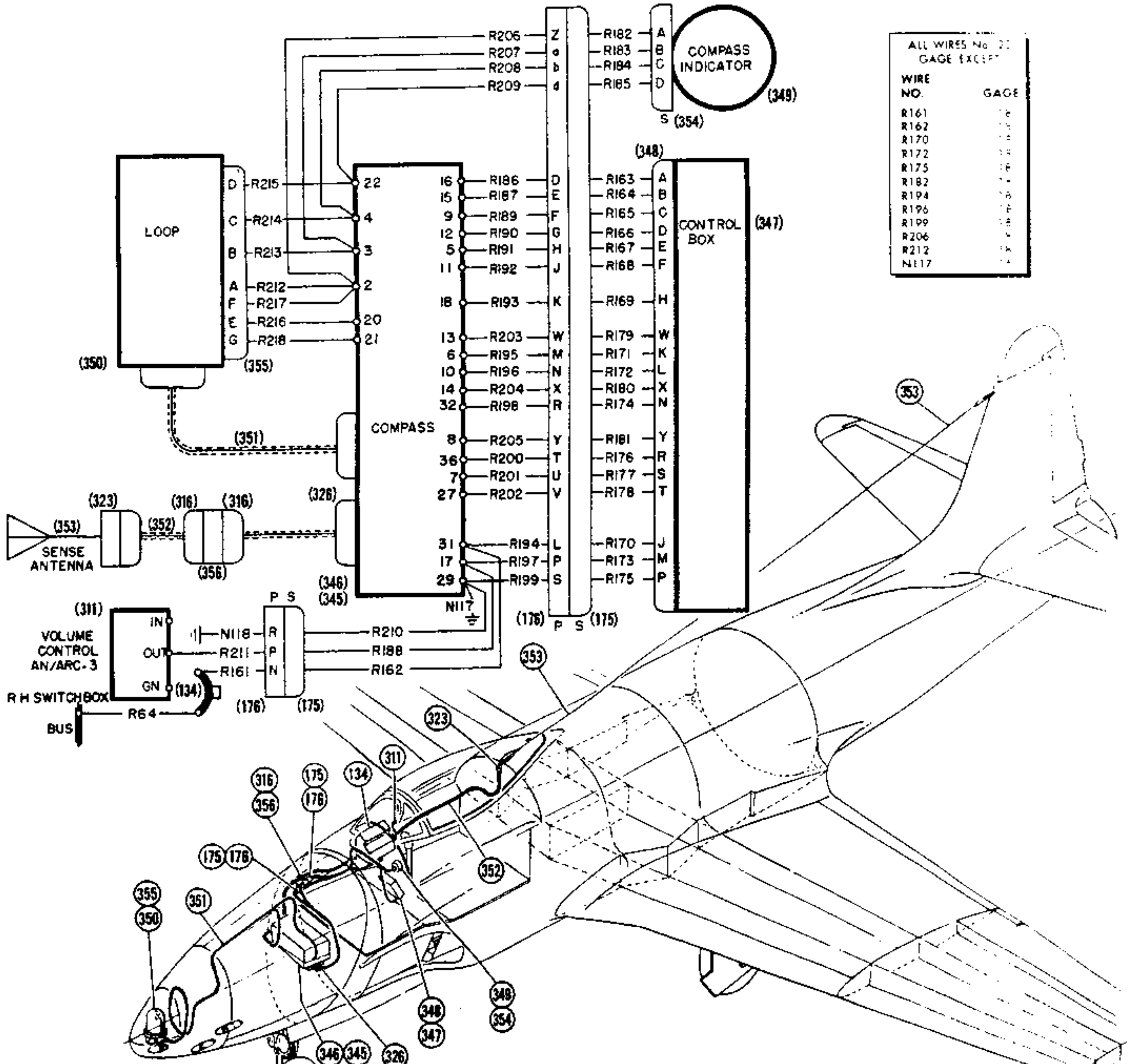
CB 7014
M39-15-4-229

*Figure 229 — Antenna System*




| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | RH SWITCH BOX |
| 157 | CONNECTOR | | | AN3106-28-12S | |
| 158 | CONNECTOR | | | 2312-23 | |
| 208 | PLUG | G.F.E. | | PL 259 (A) | PRESSURE BULKHEAD |
| 213 | PLUG | AMPHENOL | | SO 239 | ANTENNA |
| 223 | WIRE | | | W-106 | |
| 227 | RECEIVER COMPASS | G.F.E. | | R10/ARN-6 | RADIO RACK |
| 228 | MOUNTING COMPASS | G.F.E. | | MT-274/ARN-6 | RADIO RACK |
| 229 | CONTROL BOX | G.F.E. | | C-149/ARN-6 | COCKPIT |
| 230 | MOUNTING CONT. BOX | G.F.E. | | MT-275/ARN-6 | COCKPIT |
| 231 | INDICATOR COMPASS | G.F.E. | | ID-90/ARN-6 | INSTRUMENT PANEL |
| 232 | LOOP COMPASS | G.F.E. | | AS-313/ARN-6 | NOSE |
| 233 | CORD LOOP | G.F.E. | | CG-133/ARN-6 | NOSE |
| 234 | CORD COAXIAL | G.F.E. | | CG-320/ARN-6 | NOSE |
| 235 | PLUG INDICATOR | G.F.E. | | AN3106-14S-27 | INSTRUMENT PANEL |
| 236 | PLUG LOOP | G.F.E. | | AN3106-16-1S | NOSE |
| 237 | PLUG COAXIAL | G.F.E. | | PL 274 | PRESSURE BULKHEAD |
| 279 | VOLUME CONTROL | G.F.E. | | C-197/ARC3 | RH SHELF |
| 284 | ADAPTER | G.F.E. | | CD-695 | |
| 285 | INSULATOR | | | IN-88 | ANTENNA |

*Figure 229A — AN/ARN-6 Radio Compass Circuit, P-80A-5 Airplanes, Serial Nos. AF44-85337 and Subsequent*




| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | MAIN SWITCH BOX |
| 175 | CONNECTOR | | | AN3106-28-12S | FWD PRESSURE BULKHEAD |
| 176 | CONNECTOR | | | AN3102P-28-12P | FWD PRESSURE BULKHEAD |
| 311 | VOLUME CONTROL | G.F.E. | | C-197/ARC-3 | RH SHELF |
| 316 | PLUG COAXIAL CABLE | G.F.E. | | PL-259A | FWD PRESSURE BULKHEAD |
| 323 | PLUG COAXIAL CABLE | AMPHENOL | | SO-239 | ANTENNA |
| 326 | ADAPTER | G.F.E. | | M-359 | RADIO RACK |
| 345 | RECEIVER, COMPASS | G.F.E. | | R-101( )/ARN-6 | RADIO RACK |
| 346 | MOUNTING RECEIVER | G.F.E. | | MT-274/ARN-6 | RADIO RACK |
| 347 | CONTROL BOX | G.F.E. | | C-149/ARN-6 | COCKPIT |
| 348 | MTNG. CONTROL BOX | G.F.E. | | MT-275/ARN-6 | COCKPIT |
| 349 | INDICATOR, COMPASS | G.F.E. | | 10-91( )/ARN-6 | INSTRUMENT PANEL |
| 350 | LOOP ANTENNA | G.F.E. | | AS-313( )/ARN-6 | NOSE |
| 351 | LOOP CORD | G.F.E. | | CG-133( )/ARN-6 | NOSE |
| 352 | CORD, COAXIAL | G.F.E. | | CG-320( )/ARN-6 | |
| 353 | SENSE ANTENNA | LOCKHEED | | 175416 | |
| 354 | PLUG | G.F.E. | | AN3108-14S-2S | INDICATOR |
| 355 | PLUG | G.F.E. | | AN3106-16-1S | LOOP |
| 356 | PLUG | G.F.E. | | PL-274 | COAXIAL |

*Figure 229B — AN/ARN-6 Radio Compass Circuit, P-80A-10 Airplanes* ment. The receivers, transmitters, and dynamotor are mounted in the nose section of the airplane. The transmitter and receiver controls are on the right side of the cockpit, and the microphone button is on the engine throttle lever. The equipment is started by operating any one of the eight red selector buttons on the control panel. The equipment is turned off by the black "OFF" button and the small black lock button. The lock button prevents accidental turning off of the equipment. On the shelf directly behind the push-buttons are a volume control rheostat and a tone control switch. The tone control switch may be used when "MCW" operation is desired.

The equipment operates over a "line of sight" distance on all-frequency range of 100 to 156 megacycles. The frequency is controlled by eight selector buttons on top of the control box. The control box is coordinated with the receiver and transmitter in such a way that they both operate on preset frequency channels in combination with other radios similarly set. The radio is wired for high impedance.

## WARNING

Do not change tubes or make adjustments inside the radio with the high-voltage supply on.

*b.A.* COMMAND RADIO (RF-80A-20 and RF-80A-25 Airplanes Only). *(See figures 228E and 228F.)*

(1) GENERAL.—The command radio installed in the RF-80A-20 and -25 and airplanes incorporating T. O. 1-F80(R)A-20 is an AN/ARC-27. This multi-channel aircraft radio operates in the 225.00 to 399.90 megacycle frequency range between aircraft, or between aircraft and ground installations; and consists of a transmitter-receiver and radio control located in the nose just forward of fuselage station 103, and a control panel located on the cockpit right shelf. The antenna is in the fin tip. A guard frequency in the 238 and 248 megacycle band and 18 main frequencies are available to the pilot. A total of 1750 frequency channels is provided in the entire range. A screwdriver-operated control for adjustment of the sensitivity of the receiver and the threshold of squelch operation, a rotary switch with the required number of positions for connecting the test meter to various circuits of the unit, and a non-locking switch for disabling the squelch circuit of the receiver are provided.

### CAUTION

This set is pressurized to between 3 and 5 psi. Pressure must be maintained within these limits for maximum effectiveness.

The AN/ARC transmitter-receiver weighs 70.5 pounds.

(1a) PRESSURIZATION OF AN/ARC-27 RECEIVER-TRANSMITTER.

*(a)* Remove valve core from either one of valve stems on receiver-transmitter front casing.

*(b)* Connect a MK-20A/UP pressurizing unit or equivalent to second valve stem.

*(c)* Turn on radio equipment (refer to operating instructions). Pump clean dry air into case for several minutes.

**Note**

Heat generated within case during operation will aid in driving off any moisture.

*(d)* Replace valve core removed in step *a.* Continue pumping until case pressure is 13 to 15 psi as indicated by a Schrader 3715 pressure gage. Turn off radio equipment.

*(e)* After two hours, pressure gage must not drop more than one psi. REDUCE PRESSURE TO BETWEEN 3 TO 5 PSI.

*(f)* Remove pressurizing unit from receiver-transmitter.

(2) GROUND OPERATING CHECK OF AN/ARC-27 COMMAND RADIO.

*(a)* Test receiver-transmitter by connecting Thruline Wattmeter, Bird Model 43, at point A of Figure 229C. Turn Wattmeter plug-in element so that arrow points toward transmission line leading to antenna. Key transmitter and read transmitted power.

*(b)* Reverse Wattmeter plug-in element so that arrow points toward transmission line leading to transmitter. Key transmitter and read reflected power.

*(c)* Compute power ratio by dividing transmitted power by reflected power. If ratio is ten or greater and transmitted power is less than eight watts, replace R-T unit. The power output specifications for R-T unit is nine watts, eight watts is established to allow for input voltage variations, reflected antenna troubles, etc.

*(d)* If power ratio is ten or greater, antenna system is satisfactory. If less, proceed to check antenna and cable assembly to isolate defects.

*(e)* Insert Wattmeter at antenna, point D, Figure 229C, using test cable and read transmitted power, arrow pointing to antenna. Make test on unused frequencies in range of 350 to 400 mc. If power delivered is less than values listed below, a portion of cable is defective. Other readings at various disconnects will determine defective portion.

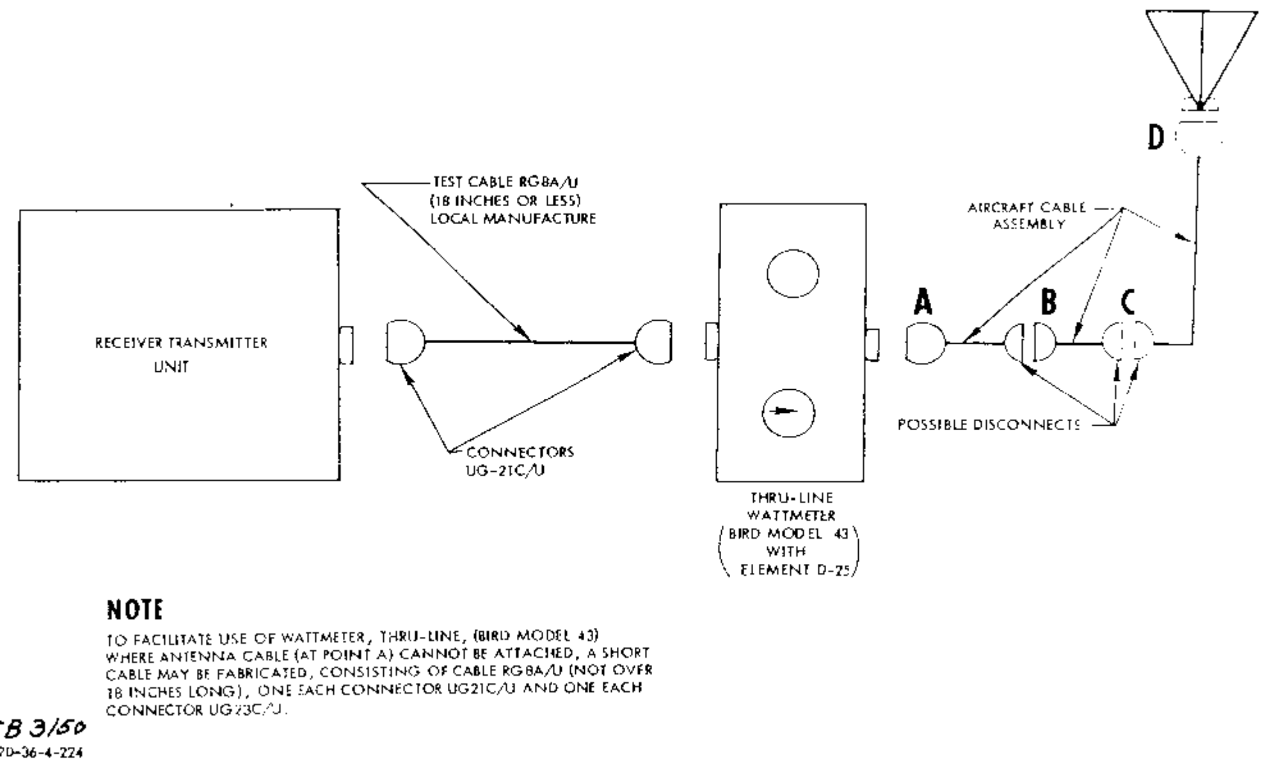



**Figure 229C — AN/ARC-27 Antenna Test Points**

| *Length of Cable RG8A/U or RG87A/U* | *Percent power delivered as compared to reading at point A Figure 229C* |
|---|---|
| 100 ft | 25% |
| 50 ft | 50% |
| 25 ft | 75% |
| 10 ft | 95% |

*(f)* Test antenna by inserting Wattmeter at point D of Figure 229C using test cable connected to antenna. Key transmitter and read; transmitted power, arrow pointed at antenna; reflected power, arrow pointed at R-T unit. Compute power ratio and if over seven, antenna is satisfactory. If less, antenna is defective.

*(g)* Place the local-remote switch on radio set control C-626/ARC-27 in "LOCAL."

*(h)* Operate the tone-voice switch to "VOICE."

*(i)* Operate the on-off switch to "ON."

*(j)* Check operation of the receiver by operation of the squelch switch on the front panel of the receiver-transmitter unit. If the receiver is operating normally, the "hiss" characteristic of set noise should be heard in the headset.

*(k)* With the "GUARD-BOTH-COMP" transmitter-receiver switch in "BOTH," operation of the guard channel receiver should be checked in the same manner as the receiver channel, described in step *(d)*.

*(l)* Check operation of the transmitter by observing the antenna current while the transmitter is being operated. With the meter switch in position 6, a TS-80/U meter plugged into the meter jack should be deflected two or more divisions on all channels.

*(m)* Operation of the transmitter should operate the side tone which will be heard in the headset.

*(n)* Repeat the above procedures on each of the preset frequencies.

*(o)* Check of complete system should be made by establishing two-way communication with ground station or another aircraft, when time permits.

**Note**

All checks should be made with battery cart capable of maintaining voltage, since transmitter power output will vary with battery voltage.

(3) REMOVAL OF COMMAND RADIO ANTENNA.

*(a)* Remove eight screws around base of fin tip.

*(b)* Lift fin tip up and disconnect the coaxial cable from the base of the antenna in the tip.

*(c)* Remove six screws from each side of the fin tip, and remove the antenna.

*c.* BEACON RADIO. *(See figure 225.)*—The beacon receiver radio, BC-1206, covers the frequency range from 200 to 400 kilocycles (beacon and weather channels). It is on the right side of the cockpit aft of the command radio control box.

*d.* IDENTIFICATION RADIO. *(See figure 228.)*—Radio set SCR-695-A is employed as the identification radio. The major components of the set include the BC-966-A receiver, BC-767 indicator box, type 93 antenna, coaxial transmission line and related plugs and wiring.

The radio is controlled by switches on the identification radio control panel on the left side of the cockpit. On early airplanes, the control switches for this radio consist of three double-throw toggle switches, three push-button switches, and a selector switch. The toggle switches are used for the "F" circuit, the "G" circuit, and the emergency circuit. A switch guard protects the emergency switch in the "OFF" position. The large push-button labeled "G" is used for intermittent operation of the "G" band. The two small push buttons on the control panel operate the destructor circuit. On later airplanes the "G" push-button switch is combined with the "G" toggle switch, a three-position switch having "OFF" "ON," and "MOMENTARY ON" positions. On some airplanes the wires of the "G" circuit are shielded.

The receiver, BC-706-A inertia switch, and indicator lamp box are mounted in the sub-cockpit compartment. The lights in the indicator lamp box indicate voltage applied to the destructor unit of the receiver.

## WARNING

Do not insert plug PL-177 into the destructor unit of the receiver when voltage is indicated at the plug contacts. Adjustments and servicing of the SCR-695-A radio should be made by authorized personnel only and reference should be made to the applicable technical orders.

dA. IDENTIFICATION RADAR EQUIPMENT. *(See figures 228B, 228C, 228D, 228G and 228G-1.)* - AN/APX-6 identification radar equipment is installed in those airplanes incorporating Service Bulletin F80/SB-115, replacing the radio set SCR-695A. AN/APW-11 identification radar equipment including the AN/APA-90 indicator is also installed in the RF-80A-20 and RF-80A-25 airplanes and on RF-80A-5, RF-80A-10 and RF-80A-15 airplanes incorporating T. O. No. 1F-80(R)-20.

The function of the radar equipment is to enable the airplane in which it is installed to identify itself automatically as friendly whenever it is properly challenged. The AN/APX-6 equipment consists of the transponder in the sub-cockpit compartment aft of the battery; the inverter in the left-hand section of the nose wheel well; the junction box, indicator box, and impact switch in the left-hand sub-cockpit; the control panel on the left-hand cockpit shelf; and the antenna mounted flush with the skin on the lower left-hand engine access door. Three-phase, 115-volt, 400-cycle power is supplied to the transponder through a control relay by an inverter.

The AN/APW-11 equipment consists of the radar set control located on the lower instrument panel; the flight command indicator located on the lower instrument panel; the selector unit, the receiver-transmitter, the dynamotor and the relay assembly, located in the nose just forward of bulkhead at fuselage station 103; and a receiving antenna and a transmitting antenna mounted flush with the skin in the area between the nose wheel well and dive flaps.

## WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position, due to charges retained by capacitors, etc. To avoid casualties, always discharge and ground circuits prior to touching them.

The AN/APW-11 radar equipment is designed to perform three functions. Under the ground control of one particular radar set it may act as an IFF unit and automatically reply when interrogated by a properly coded signal. Upon receipt of a properly modulated signal from a particular radar set it is capable of selectively energizing any one of 14 control circuits, or simultaneously energizing any pair of the first 6 control circuits. The equipment may also be used to telemeter information back to the ground control radar set.

Refer to the applicable Technical Orders for the operative checkout of the above equipments.

(1) REMOVAL OF RT-82/APX-6 TRANSPONDER.

*(a)* Disconnect four electrical connectors.

*(b)* Break safety wire and unscrew clamp at top of unit.

*(c)* Break safety wire between two clamping collars, and unscrew clamping collars.

*(d)* Pull unit outboard to disengage pins on back and clear clamp at top.

## WARNING

Immediately after RT-82/APX-6 transponder is removed from the airplane, all three destructors must be removed from their receptacles and stored in accordance with existing regulations governing destructors.

(2) INSTALLATION OF RT-82/APX-6 TRANSPONDER.

### CAUTION

Prior to installation of the transponder in the airplane, check the continuity of the transponder receptacle wiring of the transponder. MAKE SURE ALL THREE DESTRUCTORS ARE REMOVED. Check, using an ohmmeter, the continuity between the center contact of "DESTRUCT" jack "J-405" and the center contacs of each of the three "DESTRUCTOR" receptacles "J-406," "J-407," and "J-408." Check to see that the ohmmeter reads infinity between the center contacts and ground.

*(a)* Inspect transponder to determine that all dust covers, wrap-arounds, and front panel are secured properly.

## WARNING

Properly secured covers protect personnel from injury in the event a destructor explodes. Make sure all cables are disconnected from the transponder.

*(b)* Install destructors in each of the three destructor jacks "J-406," "J-407," and "J-408" on the transponder front panel, and secure.

*(c)* Install transponder, complete with destructors, on mounting base. Reverse procedures outlined in steps *(b)*, *(c)*, and *(d)* in paragraph 18 *dA* (1).

*(d)* Connect cables W-701, W-701A, and W-703 to transponder but DO NOT connect cable W-704 to jack labeled "DESTRUCT."

*(e)* Connect all interconnecting cables EXCEPT plug P-405.

*(f)* On AN/APX-6 control panel, check to see that MASTER switch S-501 is in "OFF." Remove safety wire on "DESTRUCT" guard, raise guard and turn "DESTRUCT" switch S-504 to "ON." Check direct-current voltage between center contact of P-405 and ground. Voltmeter should read approximately 28 volts.

### Note

The center contact is positive.

*(g)* Turn "DESTRUCT" switch on control panel to "OFF." Safety wire "DESTRUCT" guard in down position. Check to see that voltage at P-405 center contact is zero. Be sure that the positive voltage test clip is making contact.

### Note

Set the voltmeter at its lowest range to assure that the reading is zero.

*(h)* Check impact switch SA-3/A. Trip switch by removing safety wire and plastic cap, and displacing pendulum arm until a sharp snap is heard. The loose swinging of the pendulum arm indicates that switch is tripped and contacts closed. Check for a reading of approximately 28 volts at plug P-405.

*(i)* Reset impact switch by rotating sunken screw on right side of case counterclockwise as far as it will go.

*(j)* Allow spring inside case to rotate screwdriver SLOWLY clockwise until it catches.

*(k)* Notice that pendulum is now set firmly at about center of opening.

*(l)* If switch is not in its normal vertical position, hold pendulum in place while resetting with screwdriver.

*(m)* Check setting for resistance to minor jars and vibration by giving side of case a hard blow with the hand. The switch should not trip.

*(n)* If switch trips when struck with the hand, repeat steps *(h)* through *(m)*.

*(o)* If switch appears unduly sensitive or has lost its calibration, replace it. Do not attempt repair.

**Note**

All checks should be made with battery cart capable of maintaining voltage, since transmitter power output will vary with battery voltage.

(3) REMOVAL OF COMMAND RADIO ANTENNA.

*(a)* Remove eight screws around base of fin tip.

*(b)* Lift fin tip up and disconnect the coaxial cable from the base of the antenna in the tip.

*(c)* Remove six screws from each side of the fin tip, and remove the antenna.

*c.* BEACON RADIO. *(See figure 225.)*—The beacon receiver radio, BC-1206, covers the frequency range from 200 to 400 kilocycles (beacon and weather channels). It is on the right side of the cockpit aft of the command radio control box.

*d.* IDENTIFICATION RADIO. *(See figure 228.)*—Radio set SCR-695-A is employed as the identification radio. The major components of the set include the BC-966-A receiver, BC-767 indicator box, type 93 antenna, coaxial transmission line and related plugs and wiring.

The radio is controlled by switches on the identification radio control panel on the left side of the cockpit. On early airplanes, the control switches for this radio consist of three double-throw toggle switches, three push-button switches, and a selector switch. The toggle switches are used for the "F" circuit, the "G" circuit, and the emergency circuit. A switch guard protects the emergency switch in the "OFF" position. The large push-button labeled "G" is used for intermittent operation of the "G" band. The two small push buttons on the control panel operate the destructor circuit. On later airplanes the "G" push-button switch is combined with the "G" toggle switch, a three-position switch having "OFF" "ON," and "MOMENTARY ON" positions. On some airplanes the wires of the "G" circuit are shielded.

The receiver, BC-706-A inertia switch, and indicator lamp box are mounted in the sub-cockpit compartment. The lights in the indicator lamp box indicate voltage applied to the destructor unit of the receiver.

**WARNING**

Do not insert plug PL-177 into the destructor unit of the receiver when voltage is indicated at the plug contacts. Adjustments and servicing of the SCR-695-A radio should be made by authorized personnel only and reference should be made to the applicable technical orders.

dA. IDENTIFICATION RADAR EQUIPMENT. *(See figures 228B, 228C, 228D, 228G and 228G-1.)*—AN/APX-6 identification radar equipment is installed in those airplanes incorporating Service Bulletin F80/SB-115, replacing the radio set SCR-695A. AN/APW-11 identification radar equipment including the AN/APA-90 indicator is also installed in the RF-80A-20 and RF-80A-25 airplanes and on RF-80A-5, RF-80A-10 and RF-80A-15 airplanes incorporating T. O. No. 1F-80(R)-20.

The function of the radar equipment is to enable the airplane in which it is installed to identify itself automatically as friendly whenever it is properly challenged. The AN/APX-6 equipment consists of the transponder in the sub-cockpit compartment aft of the battery; the inverter in the left-hand section of the nose wheel well; the junction box, indicator box, and impact switch in the left-hand sub-cockpit; the control panel on the left-hand cockpit shelf; and the antenna mounted flush with the skin on the lower left-hand engine access door. Three-phase, 115-volt, 400-cycle power is supplied to the transponder through a control relay by an inverter.

The AN/APW-11 equipment consists of the radar set control located on the lower instrument panel; the flight command indicator located on the lower instrument panel; the selector unit, the receiver-transmitter, the dynamotor and the relay assembly, located in the nose just forward of bulkhead at fuselage station 103; and a receiving antenna and a transmitting antenna mounted flush with the skin in the area between the nose wheel well and dive flaps.

**WARNING**

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position, due to charges retained by capacitors, etc. To avoid casualties, always discharge and ground circuits prior to touching them.

The AN/APW-11 radar equipment is designed to perform three functions. Under the ground control of one particular radar set it may act as an IFF unit and automatically reply when interrogated by a properly coded signal. Upon receipt of a properly modulated signal from a particular radar set it is capable of selectively energizing any one of 14 control circuits, or simultaneously energizing any pair of the first 6 control circuits. The equipment may also be used to telemeter information back to the ground control radar set.

Refer to the applicable Technical Orders for the operative checkout of the above equipments.

(1) REMOVAL OF RT-82/APX-6 TRANSPONDER.

*(a)* Disconnect four electrical connectors.

*(b)* Break safety wire and unscrew clamp at top of unit.

*(c)* Break safety wire between two clamping collars, and unscrew clamping collars.

*(d)* Pull unit outboard to disengage pins on back and clear clamp at top.

## WARNING

Immediately after RT-82/APX-6 transponder is removed from the airplane, all three destructors must be removed from their receptacles and stored in accordance with existing regulations governing destructors.

(2) INSTALLATION OF RT-82/APX-6 TRANSPONDER.

**CAUTION**

Prior to installation of the transponder in the airplane, check the continuity of the transponder receptacle wiring of the transponder. MAKE SURE ALL THREE DESTRUCTORS ARE REMOVED. Check, using an ohmmeter, the continuity between the center contact of "DESTRUCT" jack "J-405" and the center contacs of each of the three "DESTRUCTOR" receptacles "J-406," "J-407," and "J-408." Check to see that the ohmmeter reads infinity between the center contacts and ground.

*(a)* Inspect transponder to determine that all dust covers, wrap-arounds, and front panel are secured properly.

## WARNING

Properly secured covers protect personnel from injury in the event a destructor explodes. Make sure all cables are disconnected from the transponder.

*(b)* Install destructors in each of the three destructor jacks "J-406," "J-407," and "J-408" on the transponder front panel, and secure.

*(c)* Install transponder, complete with destructors, on mounting base. Reverse procedures outlined in steps *(b)*, *(c)*, and *(d)* in paragraph 18 *dA* (1).

*(d)* Connect cables W-701, W-701A, and W-703 to transponder but DO NOT connect cable W-704 to jack labeled "DESTRUCT."

*(e)* Connect all interconnecting cables EXCEPT plug P-405.

*(f)* On AN/APX-6 control panel, check to see that MASTER switch S-501 is in "OFF." Remove safety wire on "DESTRUCT" guard, raise guard and turn "DESTRUCT" switch S-504 to "ON." Check direct-current voltage between center contact of P-405 and ground. Voltmeter should read approximately 28 volts.

**Note**

The center contact is positive.

*(g)* Turn "DESTRUCT" switch on control panel to "OFF." Safety wire "DESTRUCT" guard in down position. Check to see that voltage at P-405 center contact is zero. Be sure that the positive voltage test clip is making contact.

**Note**

Set the voltmeter at its lowest range to assure that the reading is zero.

*(h)* Check impact switch SA-3/A. Trip switch by removing safety wire and plastic cap, and displacing pendulum arm until a sharp snap is heard. The loose swinging of the pendulum arm indicates that switch is tripped and contacts closed. Check for a reading of approximately 28 volts at plug P-405.

*(i)* Reset impact switch by rotating sunken screw on right side of case counterclockwise as far as it will go.

*(j)* Allow spring inside case to rotate screwdriver SLOWLY clockwise until it catches.

*(k)* Notice that pendulum is now set firmly at about center of opening.

*(l)* If switch is not in its normal vertical position, hold pendulum in place while resetting with screwdriver.

*(m)* Check setting for resistance to minor jars and vibration by giving side of case a hard blow with the hand. The switch should not trip.

*(n)* If switch trips when struck with the hand, repeat steps *(h)* through *(m)*.

*(o)* If switch appears unduly sensitive or has lost its calibration, replace it. Do not attempt repair.

(*p*) If replacing switch does not correct trouble, check mounting installation.

(*q*) When action is satisfactory, replace plastic cap and safety-wire. Check to see that cap is screwed on tightly to prevent entry of moisture.

(*r*) Check with voltmeter to prove absence of voltage on destructor plug P-405, using successively more sensitive voltmeter ranges to be certain that no voltage is present.

(*s*) Connect P-405 to "DESTRUCT" jack "J-405."

## WARNING

Regardless of the setting of the "MASTER" control switch S-501, destructors will be fired if the "DESTRUCT" switch S-504 is turned on, or if the impact swtich is tripped.

All handling, testing, and storing of destructors must be done outside the airplane by qualified ordnance personnel. Destructors should always be carried in a closed metal box and never exposed to high-intensity r-f fields, such as prevail around radar equipment.

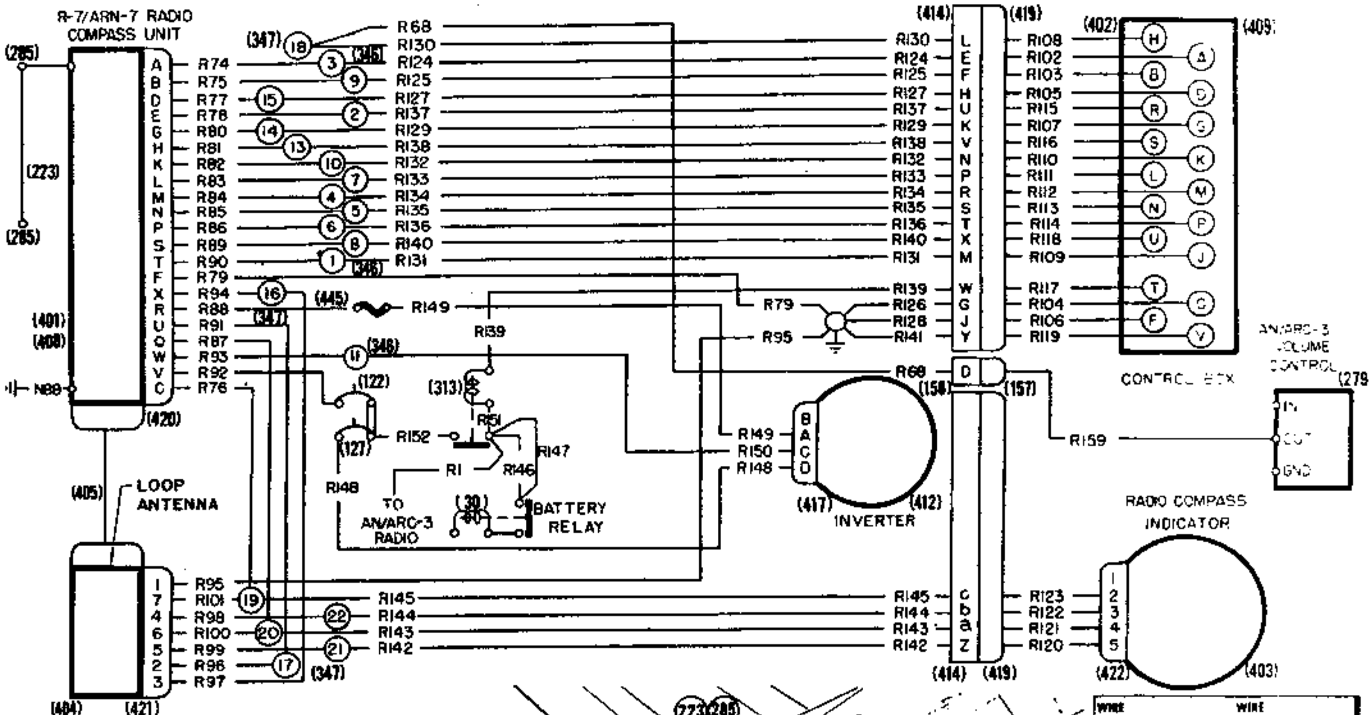
Never, under any circumstances, connect plug P-405 to "DESTRUCT" jack "J-405" on front panel of transponder until destructor firing circuits have been tested as described in this paragraph.

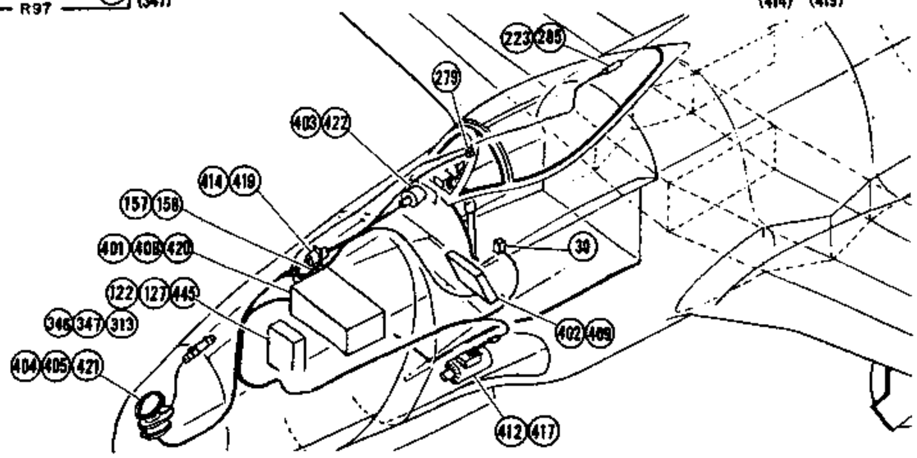
IMMEDIATELY after transponder is removed from airplane all three destructors MUST be removed from their receptacles and stored in accordance with existing regulations.

All three "DESTRUCT" receptacles are wired in parallel so that if a single destructor is left in place it will explode when voltage is applied to the firing circuit. All three destructors must be removed.

*e*. RADIO COMPASS. *(See figures 229, 229A, 230, and 230A.)*

(1) GENERAL.—The AN/ARN-6 radio compass used on later F-80A-5 airplanes, and the AN/ARN-7 radio compass used on RF-80A-5 airplanes are similar except that the power source for the AN-ARN-7 radio compass is a 750 volt-ampere 400-cycle inverter located in the nose wheel well. The airplane 28-volt system voltage is required to run the inverter and to operate the control relays and band switching mechanism. The AN/ARN-6 radio compass operates from the airplane 28-volt system. Basically the equipment of each set is a radio receiver using a superheterodyne circuit and additional circuits necessary for radio compass operation. Each radio compass has a frequency range of from 100 to 1750 kilocycles.

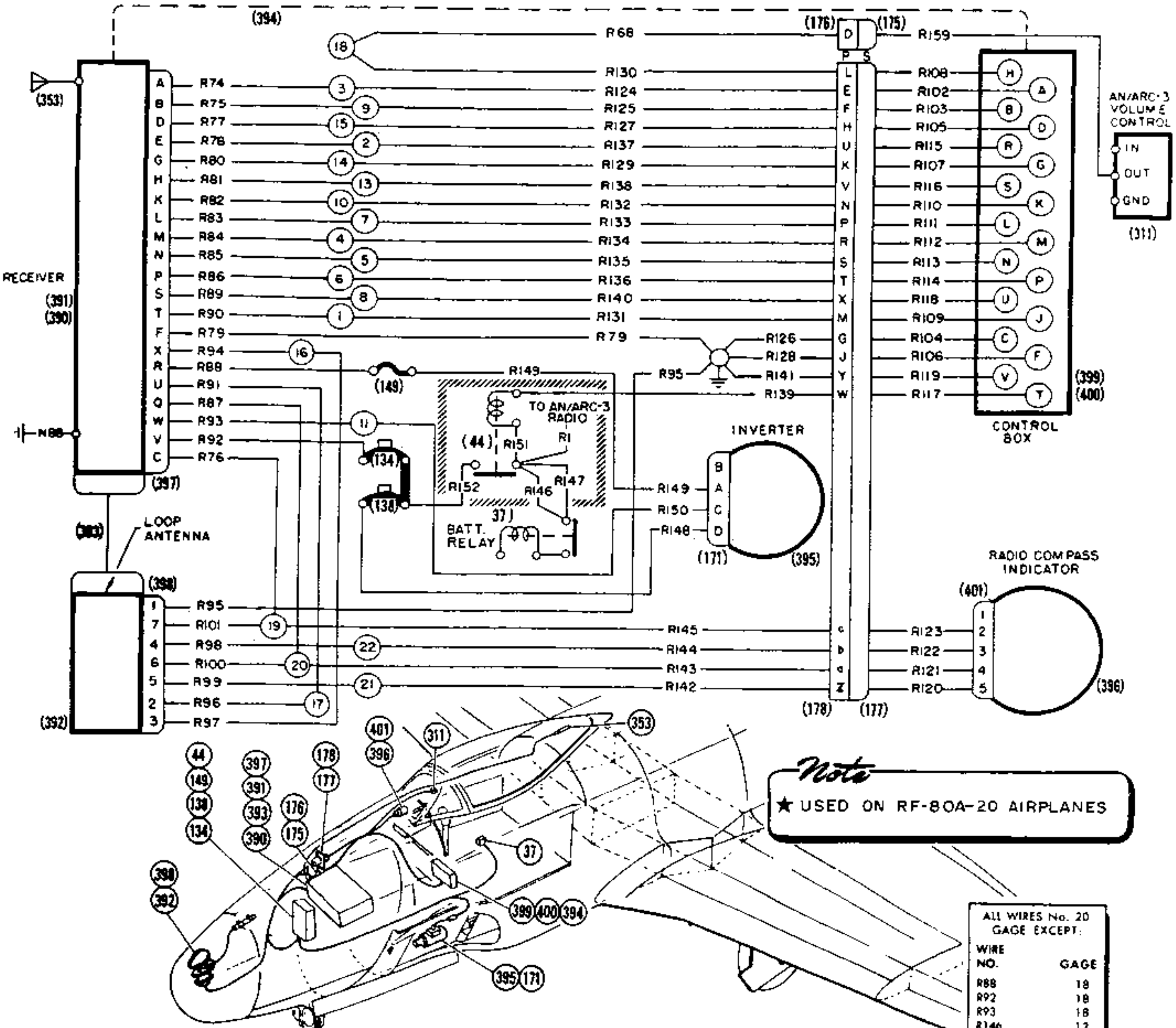


| WIRE NO. | GAGE | WIRE NO. | GAGE |
|---|---|---|---|
| N88 | 12 | R113 | 20 |
| R1 | 12 | R114 | 20 |
| R68 | 20 | R115 | 20 |
| R74 | 20 | R116 | 20 |
| R75 | 20 | R117 | 20 |
| R76 | 20 | R118 | 20 |
| R77 | 20 | R119 | 20 |
| R78 | 20 | R120 | 20 |
| R79 | 20 | R121 | 20 |
| R80 | 20 | R122 | 20 |
| R81 | 20 | R123 | 20 |
| R82 | 20 | R124 | 20 |
| R83 | 20 | R125 | 20 |
| R84 | 20 | R126 | 20 |
| R85 | 20 | R127 | 20 |
| R86 | 20 | R128 | 20 |
| R87 | 20 | R129 | 20 |
| R88 | 18 | R130 | 20 |
| R89 | 20 | R131 | 20 |
| R90 | 20 | R132 | 20 |
| R91 | 20 | R133 | 20 |
| R92 | 18 | R134 | 20 |
| R93 | 18 | R135 | 20 |
| R94 | 20 | R136 | 20 |
| R95 | 20 | R137 | 20 |
| R96 | 20 | R138 | 20 |
| R97 | 20 | R139 | 20 |
| R98 | 20 | R140 | 20 |
| R99 | 20 | R141 | 20 |
| R100 | 20 | R142 | 20 |
| R101 | 20 | R143 | 20 |
| R102 | 20 | R144 | 20 |
| R103 | 20 | R145 | 20 |
| R104 | 20 | R146 | 12 |
| R105 | 20 | R147 | 12 |
| R106 | 20 | R148 | 10 |
| R107 | 20 | R149 | 18 |
| R108 | 20 | R150 | 18 |
| R109 | 20 | R151 | 20 |
| R110 | 20 | R152 | 10 |
| R111 | 20 | R159 | 20 |
| R112 | 20 | | |

| ITEM | DESCRIPTION | MFR. | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 157 | CONNECTOR | | | AN3106-28-12S | RH SUB-COCKPIT |
| 158 | CONNECTOR | CANNON | | 2312-23 | RH SUB-COCKPIT |
| 30 | BATTERY RELAY | G.F.E. | B-4 | 94-32324 | SUB-COCKPIT |
| 445 | FUSE | LITTELFUSE | | 1162 | RADIO JUNCTION BOX |
| 122 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | RADIO JUNCTION BOX |
| 127 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | RADIO JUNCTION BOX |
| 223 | WIRE | | | W-106( ) | ANTENNA |
| 279 | VOLUME CONTROL | G.F.E. | | C-197/ARC-3 | COCKPIT |
| 285 | INSULATOR | | | IN-88 | ANTENNA |
| 346 | TERMINAL PANEL | LOCKHEED | | LS1911-2 | RADIO JUNCTION BOX |
| 347 | TERMINAL PANEL | LOCKHEED | | LS1911-14 | RADIO JUNCTION BOX |
| 401 | RADIO COMPASS UNIT (AN/ARN-7) | G.F.E. | | R-5/ARN-7 | NOSE |
| 402 | RADIO COMPASS CONTROL BOX (AN/ARN-7) | G.F.E. | | C-4/ARN-7 | COCKPIT |
| 403 | RADIO COMPASS INDICATOR (AN/ARN-7) | G.F.E. | | I-81-A | INSTRUMENT PANEL |
| 404 | LOOP ANTENNA (AN-ARN-7) | G.F.E. | | LP-31( ) | NOSE |
| 405 | CORD ASSEMBLY | G.F.E. | | CG-42/ARN-7 | NOSE |
| 408 | MOUNTING | G.F.E. | | FT-213A | NOSE |
| 409 | MOUNTING | G.F.E. | | FT-224A | COCKPIT |
| 412 | INVERTER | G.F.E. | MG-149F | 94-32270A | NOSE WHEEL WELL |
| 313 | INVERTER RELAY | | B-6B | 94-32352B | RADIO JUNCTION BOX |
| 414 | CONNECTOR | CANNON | | 2312-43 | COCKPIT |
| 417 | CONNECTOR | | | AN3108-22-4S | NOSE WHEEL WELL |
| 419 | CONNECTOR | | | AN3106-28-15S | COCKPIT |
| 420 | PLUG | G.F.E. | | PL-122 | NOSE |
| 421 | PLUG | G.F.E. | | PL-112 | NOSE |
| 422 | PLUG | G.F.E. | | PL-118 | INSTRUMENT PANEL |

*Figure 230 — AN/ARN-7 Radio Compass Circuit, FP-80A-5 Airplanes*




| ALL WIRES No. 20 GAGE EXCEPT: | |
|---|---|
| WIRE NO. | GAGE |
| R88 | 18 |
| R92 | 18 |
| R93 | 18 |
| R146 | 12 |
| R147 | 12 |
| R148 | 10 |
| R149 | 18 |
| R150 | 18 |
| R152 | 10 |
| N88 | 12 |

| ITEM | DESCRIPTION | MFR | TYPE | DWG OR SPEC | LOCATION |
|---|---|---|---|---|---|
| 44 | RELAY | | B-6B | 94-323528 | RADIO JUNC BOX |
| 134 | CIRCUIT PROTECTOR | SPENCER | | PSM-5 | RADIO JUNC BOX |
| 138 | CIRCUIT PROTECTOR | SPENCER | | PSM-35 | RADIO JUNC BOX |
| 149 | CIRCUIT PROTECTOR | LITTLEFUSE | | 1162 3A | RADIO JUNC BOX |
| 171 | CONNECTOR | | | AN3106-22-4S | |
| 175 | CONNECTOR | | | AN3106-28-12S | RH FLOOR |
| 176 | CONNECTOR | | | AN3102P-28-12P | RH FLOOR |
| 177 | CONNECTOR | | | AN3106-28-15S | FIRE WALL |
| 178 | CONNECTOR | | | AN3102P-28-15P | FIRE WALL |
| 311 | VOLUME CONTROL | | | C-197/ARC3 | RH SHELF |
| 353 | ANTENNA-SENSE | LOCKHEED | | 175416 | |
| 390 | COMPASS | G.F.E. | | R-5/ARN-7 | RADIO RACK |
| 391 | MOUNTING COMPASS | G.F.E. | | FT-213A | RADIO RACK |
| 392 | LOOP ANTENNA | G.F.E. | | LP-31AM | NOSE |
| 393 | CORD ASSEMBLY | G.F.E. | | C6-42/ARN7 | NOSE |
| 394 | TUNING SHAFT | G.F.E. | | MC-124 | |
| 395 | INVERTER | G.F.E. | MG-149F | 94-32270A | RADIO RACK |
| 396 | COMPASS INDICATOR | G.F.E. | | I-81-L | COCKPIT |
| 397 | PLUG | G.F.E. | | PL-122 | COMPASS |
| 398 | PLUG | G.F.E. | | PL-112 | LOOP |
| 399 | CONTROL BOX | G.F.E. | | C-4/ARN-7 | COCKPIT |
| 400 | MOUNTING CONTROL BOX | G.F.E. | | FT-224A | COCKPIT |
| 401 | PLUG | G.F.E. | | PL-118 | |

EM-39-58-4-21
CB 249

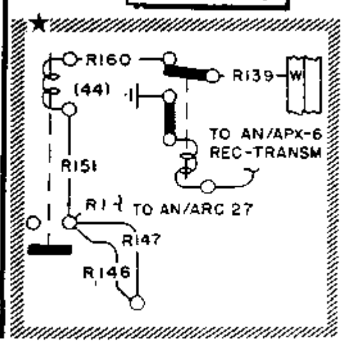



*Figure 230A — AN/ARN-7 Radio Compass Circuit, RF-80A-10 and RF-80A-20 Airplanes*

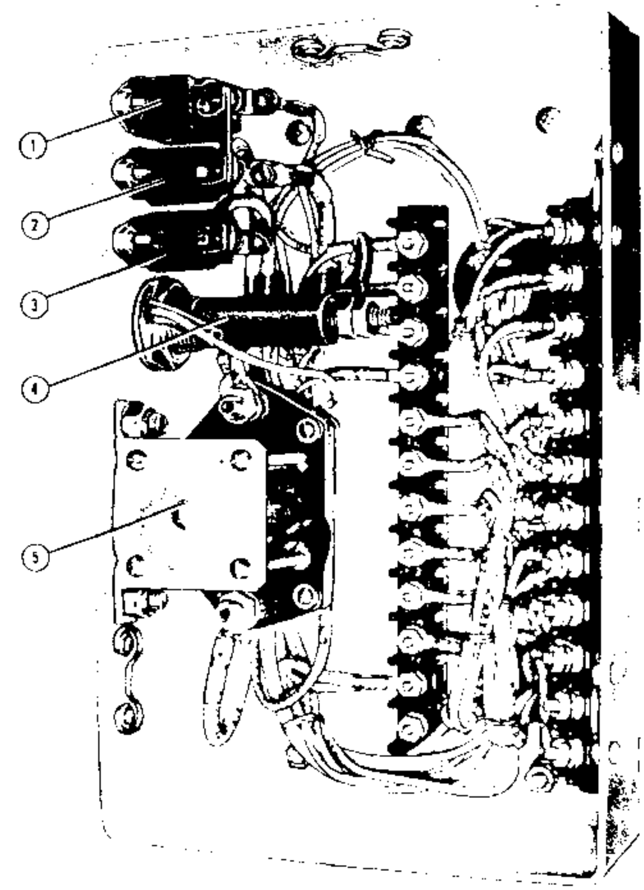
The radio compass can receive radio signals, guide the airplane to a transmitting station at its destination, or give bearings on a transmitting station. At all times, the indicator dial shows whether the airplane is headed to the right of, to the left of, or toward the transmitting station. While the equipment is acting as a radio compass, weather reports or other flight information can be received.

A remote control unit for the operation of the radio is located below the instrument sub-panel. (See figures 124 and 125.) The direction indicator is on the instrument panel. The radio compass unit is in the nose compartment above the command radio in the photographic airplanes, and below the command radio in the fighter airplanes. The loop antenna is in the nose of the airplane under a section of plastic skin. Compensator bars for the loop antenna are located one on each side of the loop and are adjusted by bending them inboard or outboard. The perpendicular distance between loop and compensator bars, when loop is closest to bars, shall be equal within .031 (1/32) inch. The loop dehydrator, for the AN/ARN-7 radio compass loop, is mounted vertically on the spare-glass case in the camera compartment hood, and is connected to the loop with a rubber hose. The non-directional sense antenna used for either radio extends from the cockpit canopy to the empennage fin. (See figure 229.) The equipment is tuned manually by a handle on the remote control unit.

On RF-80A-5 and RF-80A-10 photographic airplanes, a radio junction box containing the circuit protectors and an inverter relay for the AN/ARN-7 radio, is forward of the radio rack on the right side of the airplane. (See figure 231.) The inverter relay is operated by the 28-volt system, and is grounded through the direction indicator by turning the function switch to any position other than "OFF." The relay operates to close the 28-volt circuit to the inverter and the radio compass unit. The AN/ARN-6 radio is wired for low impedance (300 ohms).

(2) OPERATION.—To start the equipment, turn the function switch on the control box to "COMP," "ANT," or to "LOOP." To stop the equipment, turn the function switch "OFF."

To take a bearing on a transmitting station, switch the equipment to "COMP" and tune in the station. The direction indicator and loop will rotate until they show the heading of the airplane in relation to the position of the transmitting station. After a few seconds have been allowed for the indicator pointer to reach a stable position, read that bearing directly from the indicator. To establish definitely the position of the airplane, take several different bearings rapidly in this manner. When bearings are thus taken, the equipment acts as an automatic radio direction finder.




1. AN/ARN-7 RADIO COMPASS CIRCUIT PROTECTOR
2. INVERTER CIRCUIT PROTECTOR
3. AN/ARC-3 RADIO CIRCUIT PROTECTOR
4. AN/ARN-7 A-C CIRCUIT FUSE
5. AN/ARN-7 D-C CIRCUIT RELAY

*Figure 231 — Radio Junction Box — RF-80A-5 and RF-80A-10 Airplanes*

To fly the airplane toward a transmitting station, use the equipment as a homing radio compass. For this purpose, fly the airplane so that the indicator pointer is always at the index. Whenever the airplane goes off the course, the indicator pointer shows the deviation in degrees.

When the forward-aiming K-22 camera is installed on RF-80A-5 and RF-80A-10 photographic airplanes, the AN/ARN-7 radio compass loop must be removed. With the loop removed, the radio compass unit will not act as a homing device or as a direction finder.

(3) REMOVAL OF AN/ARN-6 LOOP ANTENNA.

*(a)* Remove screws around plastic antenna cover, and remove the cover.

*(b)* Disconnect electrical wires from aft end of loop casing.

*(c)* Remove 10 screws that hold the loop to the shock mount, and remove the loop.

**Note**

Do not bend compensator bars. Bars must be symmetrical about loop within 1/32 inch.

(3A) COMPENSATION FOR NEW AS313 AND AS313A LOOP.

**Note**

If loop other than the one originally installed in a F-80A airplane is used, it must be compensated as follows:

*(a)* Remove the loop from the airplane as directed in paragraph (3) preceding.

*(b)* With the loop connected to its power supply and to an inverter, so that it is in operation, use a screw driver to adjust the 12 screws as outlined below.

*(c)* Rotate the loop until the loop pointer is exactly at the heading which is to be compensated on the black scale. Turn the screw adjacent to the point to be compensated until the indicator shows the correct number of degrees has been added or subtracted, as shown on the AN/ARN-6 loop compensation table following.

| *Azimuth Degrees* | *Compensation Degrees* |
|---|---|
| 0 (AS313A) | + 1.0 |
| 15 | + 4.0 |
| 45 | + 9.0 |
| 75 | + 5.0 |
| 105 | — 3.0 |
| 135 | — 8.0 |
| 165 | — 3.0 |
| 195 | + 6.0 |
| 225 | +10.0 |
| 255 | + 6.0 |
| 285 | — 1.0 |
| 315 | — 6.0 |
| 345 | — 3.0 |

**CAUTION**

Never turn any of the compensating screws more than three complete revolutions at a time, to avoid putting a permanent bend in the cam strip.

*(d)* If large errors are to be corrected, or the rate of change per 30-degree sector is rapid, it may be necessary to set up one-half or one-third the required correction on all screws. Go around the circle once or twice more until all screws have been adjusted satisfactorily.

**Note**

After compensation, mark "COMP" in black ink in base of loop.

(4) REMOVAL OF AN/ARN-7 LOOP ANTENNA.

*(a)* Remove screws around plastic antenna cover and remove the cover. (See 25, figure 47.)

*(b)* Disconnect electrical wires at disconnect on side of casing.

*(c)* Disconnect the tube to the loop dehydrator.

*(d)* Remove bolts which attach loop to structure, and remove the loop.

(5) COMPENSATION FOR NEW LP-31A LOOP (RF-80A-5 and RF-809-10 Airplanes, Serials Nos. AAF45-8302 and Subsequent).

**Note**

If loop, other than the one originally installed in an RF-80A airplane is used, it must be compensated as follows:

*(a)* Remove the bottom cover plate.

*(b)* Take out four screws to disconnect the four connector lugs from the terminal board on the compensator assembly.

*(c)* Remove the three fillister head mounting screws and lift the compensator assembly from the loop base.

*(d)* Lay the compensator assembly with the azimuith scale up. Check to see that the black scale is showing. If the red scale is showing it must be changed by replacing it with a black one. Be sure to seal the screws with glyptal or a suitable cement to insure holding the scale in place.

*(e)* If a temporary clamp on the compensator holds the pointer at zero, remove and discard the clamp.

*(f)* Set the zero correction mark of the inner dial to a point opposite the degree marking on the azimuth scale.

*(g)* With the wrench mounted on the compensator assembly, adjust the compensator screw opposite this degree marking until the pointer reads the correct value shown in the table below. It is usually necessary to make the complete compensator adjustment in a series of from three to five cycles. To avoid permanent damage to the cam strip in the compensator, do not let the adjustment of individual screws exceed the adjustment of adjacent screws by as much as five degrees. This chart contains one point which is more than five degrees different from an adjacent adjustment, and this point should be adjusted last.

| *Direction Finder Bearing* | *Compensation (Degrees)* |
|---|---|
| 0 | + 1.5 |
| 15 | + 5.0 |
| 30 | + 8.5 |
| 45 | +10.5 |
| 60 | + 8.0 |
| 75 | + 3.5 |
| 90 | — 1.5 |
| 105 | — 7.0 |
| 120 | —11.0 |
| 135 | —13.0 |
| 150 | —11.5 |
| 165 | — 6.5 |
| 180 | — 1.5 |
| 195 | + 3.5 |
| 210 | + 7.5 |
| 225 | + 9.5 |
| 240 | + 8.0 |
| 255 | + 4.0 |
| 270 | — 1.5 |
| 285 | — 6.5 |
| 300 | —10.0 |
| 315 | —12.5 |
| 330 | —11.0 |
| 345 | — 6.0 |

*(h)* Replace the setscrew wrench.

*(i)* Install the compensator assembly into the loop assembly. Be sure that the coupling pin on the compensator enters the coupling slot in the adjustment plate.

*(j)* Replace the three mounting screws, and reconnect the four wires to their terminals.

*(k)* Replace the bottom cover plate. Be sure that the neoprene gasket is in place.

*(l)* Install loop in airplane (reverse removal procedure).

*(m)* The error in radio compass equipment should not be greater than plus or minus 2.5 degrees at each of the above points.

f. RECORDER (RF-80A-15 Airplanes only). — An RD-15/ANQ-1A recorder is installed in the nose section, controlled by a selector switch on the right cockpit shelf. The control switch allows the recorder to operate during voice radio transmission or separately, as desired. See figure 223B for camera equipment wiring diagram.

## 19. BOMBING EQUIPMENT.

*a.* GENERAL DESCRIPTION. — Bomb shackles installed in each wing-tip fitting assembly are capable of carrying 100- to 1000-pound bombs, or 165-gallon droppable fuel tanks. The shackles on early airplanes are type B-1; those on later airplanes type S-1 or type S-2.

**Note**

On winterized airplanes, replace type B-7 or B-10 bomb shackles with type B-11. The type B-11 bomb shackles are designed to operate without lubrication and must be kept free of dirt and oil. Clean with kerosene and thoroughly dry with an air hose before installation.

The S-1 shackle has chemical-release terminals wired to

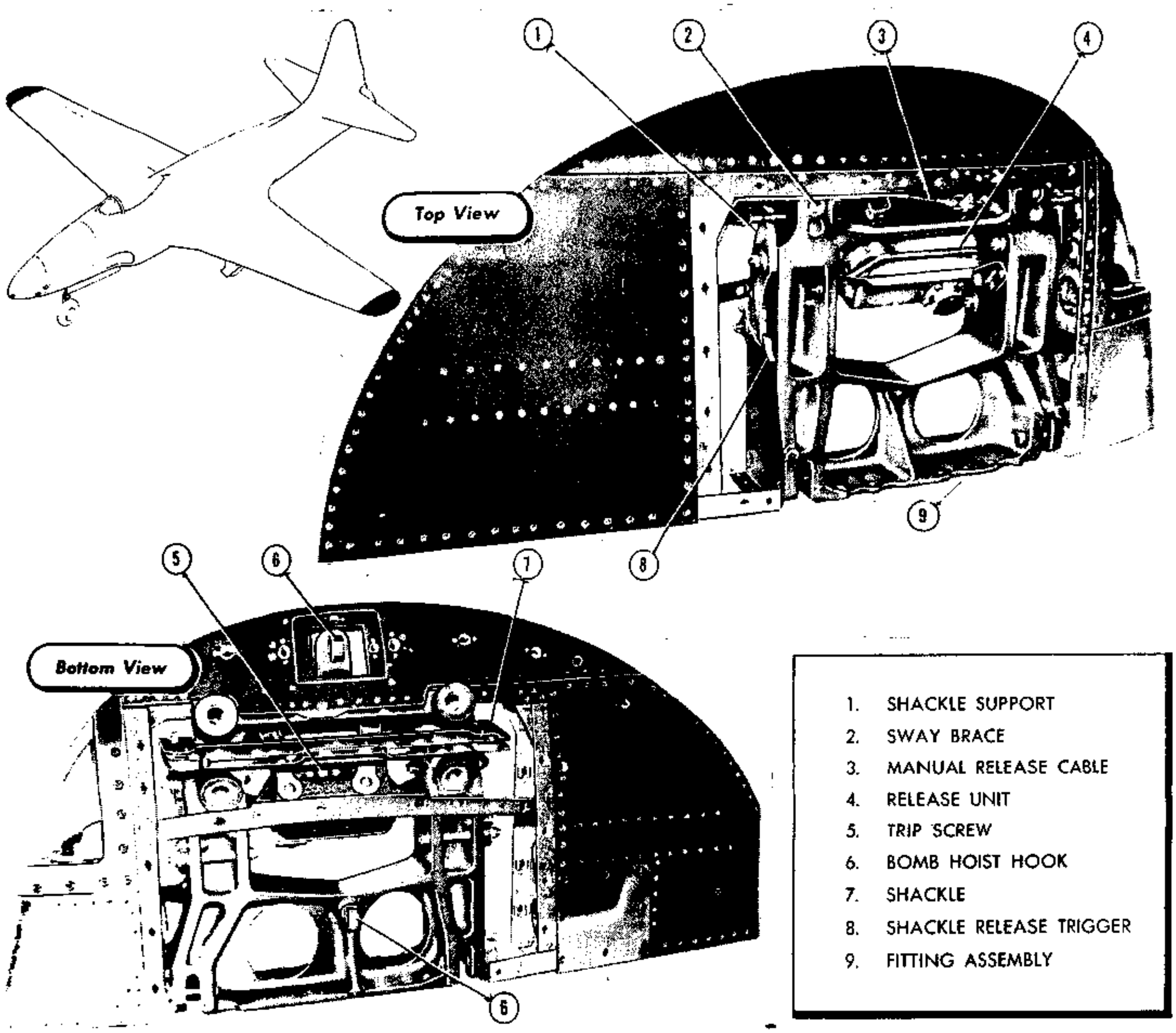



***Figure 232 — Bomb and Fuel Tank Carrying Equipment, Early Airplanes***

the nose arming circuit, so that M-10 or M-33 chemical tanks may be carried. Bombs or tanks are stabilized by automatically retracting sway braces in each wing-tip fitting. Bombs or tanks are released electrically by a button switch on the control stick or manually by emergency release handles.

On F-80A-10 and RF-80A-10 airplanes, a bomb deflector assembly may be installed in the wing tip. This assembly is stored in the armament compartment.

In those airplanes incorporating T.O. No. 1F-80-203 there are provisions for an S-1 or S-2 bomb rack to be carried in an under-the-wing pylon. Provision is also made for type R-3 fragmentation bomb racks. (Refer to figures 219B, 236D, and paragraph 19*d* (6).)

*b*. BOMB SHACKLES.

(1) B-10 BOMB SHACKLE. *(See figure 232.)*

*(a)* DESCRIPTION.—The B-10 bomb shackle is attached to the wing-tip fitting assembly by quick-release fittings. A type A-4 electrical bomb release unit is mounted adjacent to the shackle to operate it. The shackle is almost completely enclosed by a removable fairing on the bottom of the wing-tip. A slot in the fairing, covered by a split rubberized-fabric seal, makes it possible to remove the shackle without removing the fairing. This shackle is designed to operate without lubrication, and must be kept free from oil and dirt.

*(b)* REMOVAL.—Remove large access panel in top of wing tip and push shackle release triggers at end of shackle to release the shackle supports. Remove shackle through slot in fairing in bottom of wing tip.

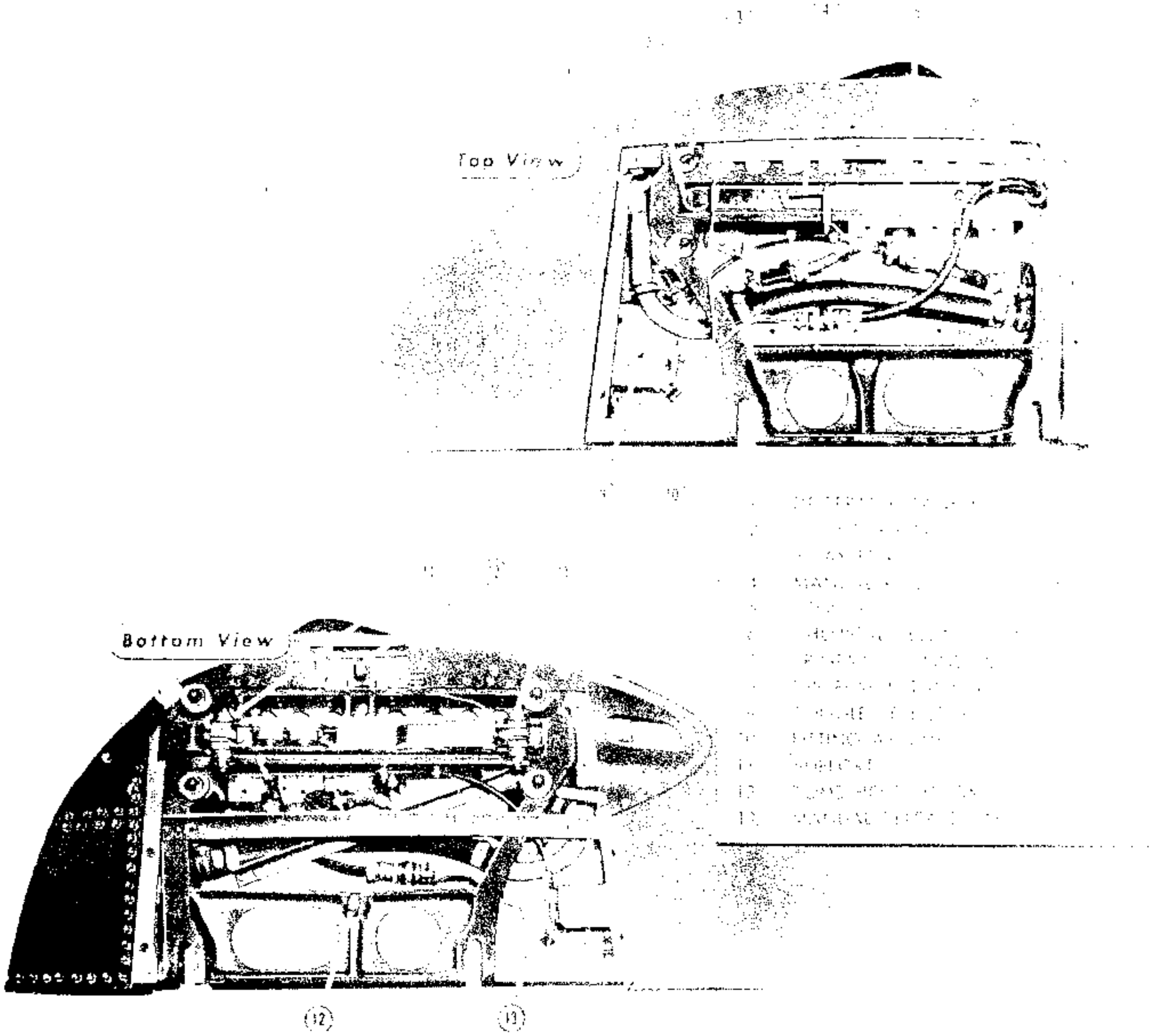



*Figure 233 — Bomb and Fuel Tank Carrying Equipment, Later Airplanes*

*(c)* INSTALLATION.

*1.* Remove large access panel in top of wing tip.

*2.* Cock electrical bomb release unit.

*3.* Cock the shackle.

*4.* With end of shackle marked "FRONT" toward wing leading edge, slip shackle through slot in fairing on bottom of wing tip, and engage shackle supports. Be sure that release and arming levers on shackle are properly engaged with arms on the electrical release unit.

*5.* Engage shackle supports with shackle release triggers.

*6.* Place manual release ring over release lever on shackle.

*7.* Replace large access panel in top of wing tip.

**Note**

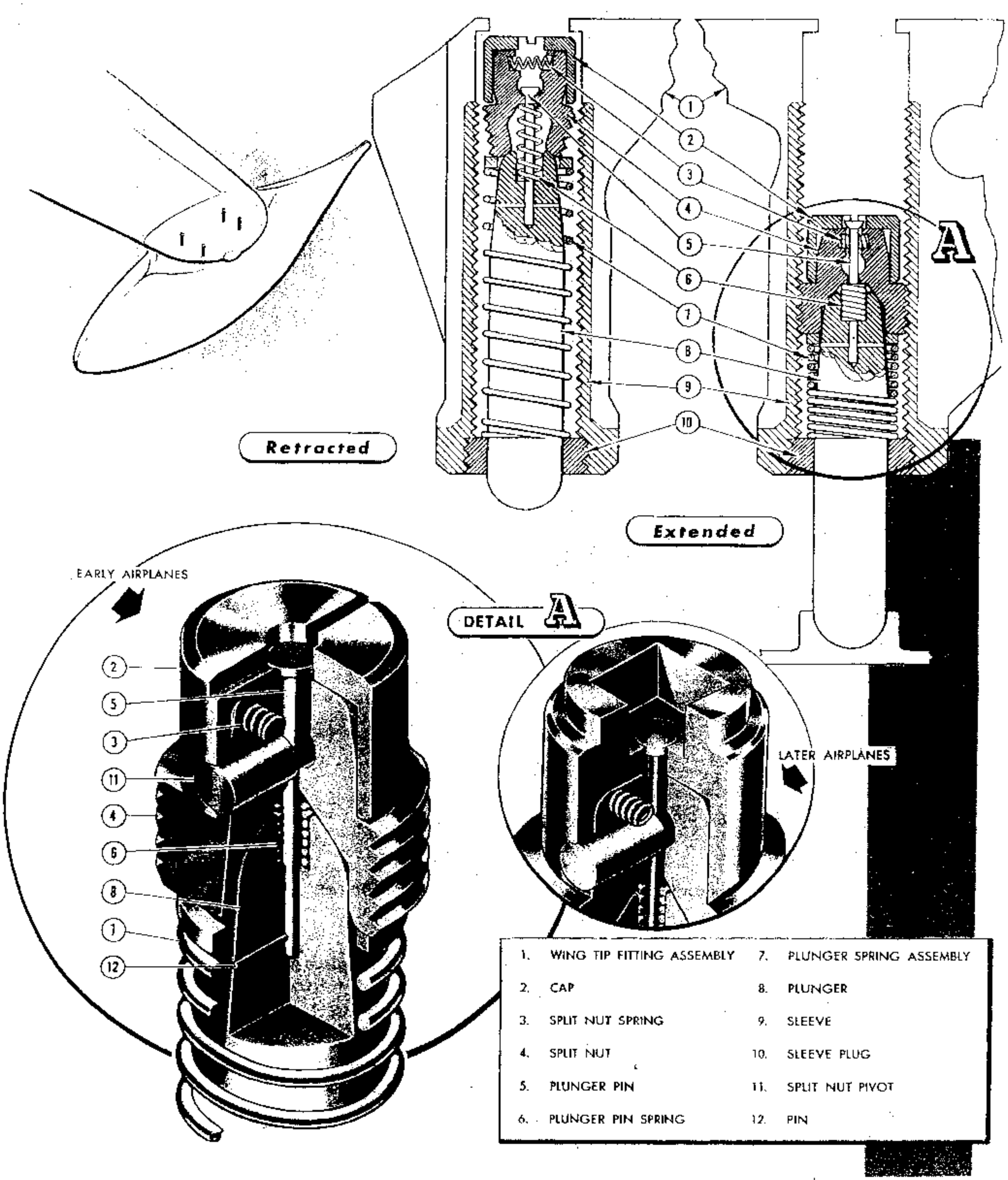
When installing a bomb or fuel tank, attach shackle before hoisting into position. Be sure end of shackle marked "FRONT" is toward nose of bomb or fuel tank.

*(d)* WINTERIZATION OF TYPE A-4 BOMB RELEASE.

*1.* Wipe unit clean with a DRY rag.

**CAUTION**

Do not use solvent to clean unit. Failure to comply may damage solenoids.




| | | | |
|---|---|---|---|
| 1. | WING TIP FITTING ASSEMBLY | 7. | PLUNGER SPRING ASSEMBLY |
| 2. | CAP | 8. | PLUNGER |
| 3. | SPLIT NUT SPRING | 9. | SLEEVE |
| 4. | SPLIT NUT | 10. | SLEEVE PLUG |
| 5. | PLUNGER PIN | 11. | SPLIT NUT PIVOT |
| 6. | PLUNGER PIN SPRING | 12. | PIN |

*Figure 234 — Sway Brace*

2. Check type of compound used for sealing release against entrance of dirt and moisture. If release units have been sealed with cement, general purpose, synthetic base, Specification No. MIL-C-4003, stock No. 7300-026500, (dark brown material), a visual inspection to determine if cover has been removed since sealing was accomplished is only requirement.

3. If seal has been broken, or if Glyptal (hard red material) has been used to seal units, the following resealing procedures must be followed:

a. Remove rear cover plate. If paper or fiber gasket is damaged, discard and complete sealing without gasket.

b. Remove excess cement from previous sealing.

c. Make visual inspection of internal parts to determine if any corrosion is present. If corrosion is evident, replace release unit.

d. If no corrosion is evident, thoroughly dry release unit and cover, preferably in an oven for two hours at 120°F.

e. Immediately after drying, apply a small ring of cement, general purpose, synthetic base, Specification No. MIL-C-4003, stock No. 7300-026500, on rear face of release housing around two 0.266-inch diameter mounting holes. Allow one to two minutes for partial drying, then replace cover plate and secure with four screws.

f. Apply cement approximately ⅛-inch wide and $\frac{1}{16}$-inch thick over entire joint between release housing and cover plate.

g. In a similar manner, seal joint between cover plate and collar of electrical connector.

h. In a similar manner, seal joint between phenolic insert and collar of electrical connector.

**CAUTION**

Care must be exercised to prevent application of cement to contact pins of connector. Short lengths of rubber or plastic tubing of suitable size may be placed over pins for protection while accomplishing step h above.

i. Allow cement to set before reinstalling release unit in airplane.

(2) S-1 BOMB SHACKLE. *(See figure 233.)*

*(a)* DESCRIPTION.—The S-1 bomb shackle is an all-electric self-contained unit and is installed in each wing-tip fitting assembly by two bolts passing through bushings at the bomb-carrying hook pivot points. The shackle is enclosed by a removable fairing on the bottom of the wing tip. Openings in the fairing permit the lugs on the bombs or fuel tanks to engage the bomb-carrying hooks.

**Note**

Shackle support bolts should be tightened finger tight, then safetied.

To load the shackle it is merely necessary to hoist the bomb into place. In most cases the bomb lugs will automatically cock the shackle as the bomb is hoisted into position. However, the use of the cocking ring will expedite the cocking of the shackle. The cocking ring is accessible by removing the large access panel in the top of the wing tip. No maintenance or adjustment of the shackle is necessary under normal use. The shackle is so designed that one side plate can be removed to accomplish cleaning or replacement of parts as necessary.

*(b)* REMOVAL.—Remove large access panel in top of wing tip. Disconnect link from shackle manual release lever. Disconnect "pigtail" connector cable at quick disconnect. Remove fairing from bottom of wing tip. Remove two bolts passing through bomb-carrying hook pivots, and remove shackle.

*c.* SWAY BRACES. *(See figure 234.)*

(1) DESCRIPTION.—Four automatically retractable sway braces are built into each wing-tip fitting assembly. When the bomb or tank is released, the braces retract into internally threaded sleeves in the fitting assembly.

Each brace assembly consists of a plunger attached by a plunger pin to a split nut assembly. In addition, a large spring assembly fits around the plunger. The plunger pin passes through the split nut assembly cap, a small spring, and is fastened into the body of the plunger by a small pin. The small spring around the plunger pin keeps the split nut assembly slightly separated from the plunger. The split nut pivots about two pins extending part way into the cap, which fits over one end of the split nut. Two springs inside the cap, between the two halves of the split nut, keep the threaded ends of the nut together so that the threads do not engage the threads of the sleeve when the brace is in the retracted position. The entire brace assembly is held into the sleeve by a plug.

When the sway brace is in place against a bomb or tank, the split nut assembly is forced down over the plunger, spreading the nut apart so that the threads engage the threads in the sleeve. When the bomb or tank is released, the small spring around the plunger pin separates the plunger from the split nut, and the small springs between the two halves of the split nut in the cap force the ends of the split nut together, disengaging the threads from the sleeve threads. The large spring assembly around the plunger then pushes the whole brace assembly into the sleeve until the split nut assembly cap bottoms at the end of the bore in the fitting assembly.

(2) OPERATION AND ADJUSTMENT.—On early airplanes the split-nut assembly cap is designed for use of a screw driver for adjustment. On later airplanes the design is changed to accommodate a standard ⅜-inch drive wrench extension. To engage the sway brace, insert the screw driver or wrench extension through the top of the bore in the wing-tip fitting assembly and push on the split-nut assembly cap. Continue pushing down on the cap until it bottoms. This is an indication that the split nut has engaged the threads of the sleeve. Turn the nut assembly with the tool until the brace is tight.

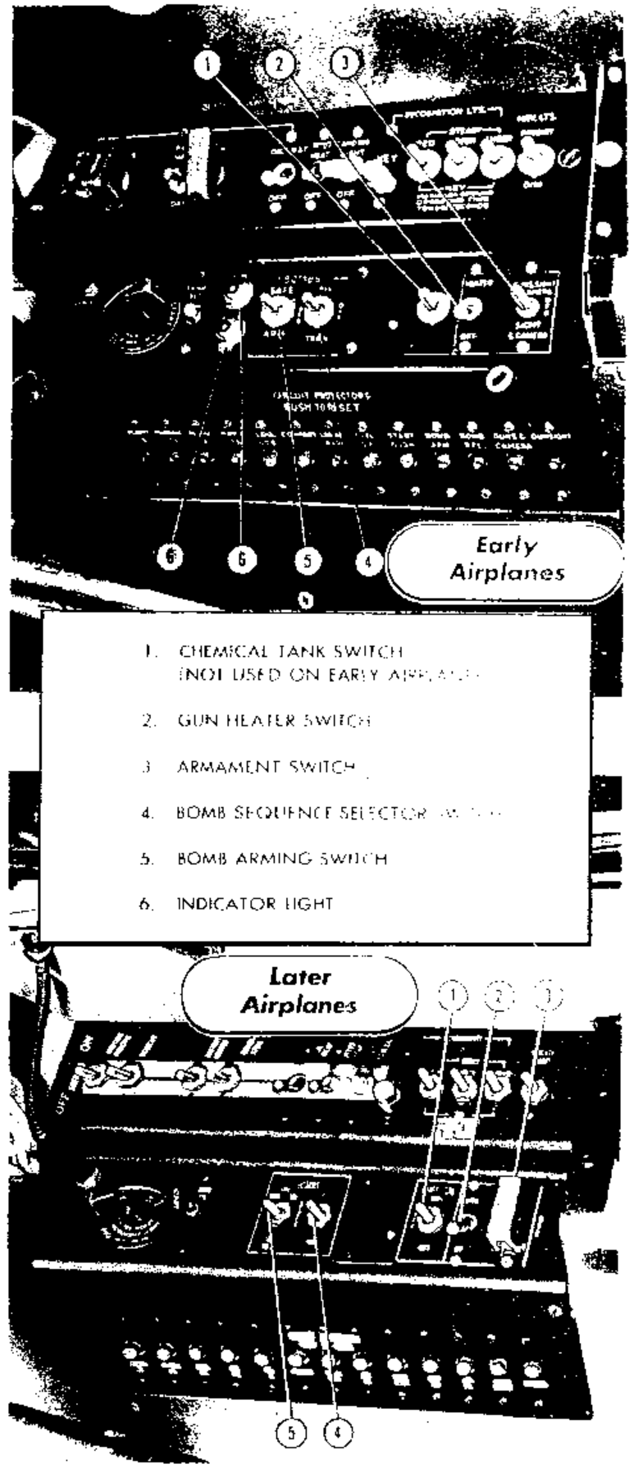



Figure 235 — Bomb Controls

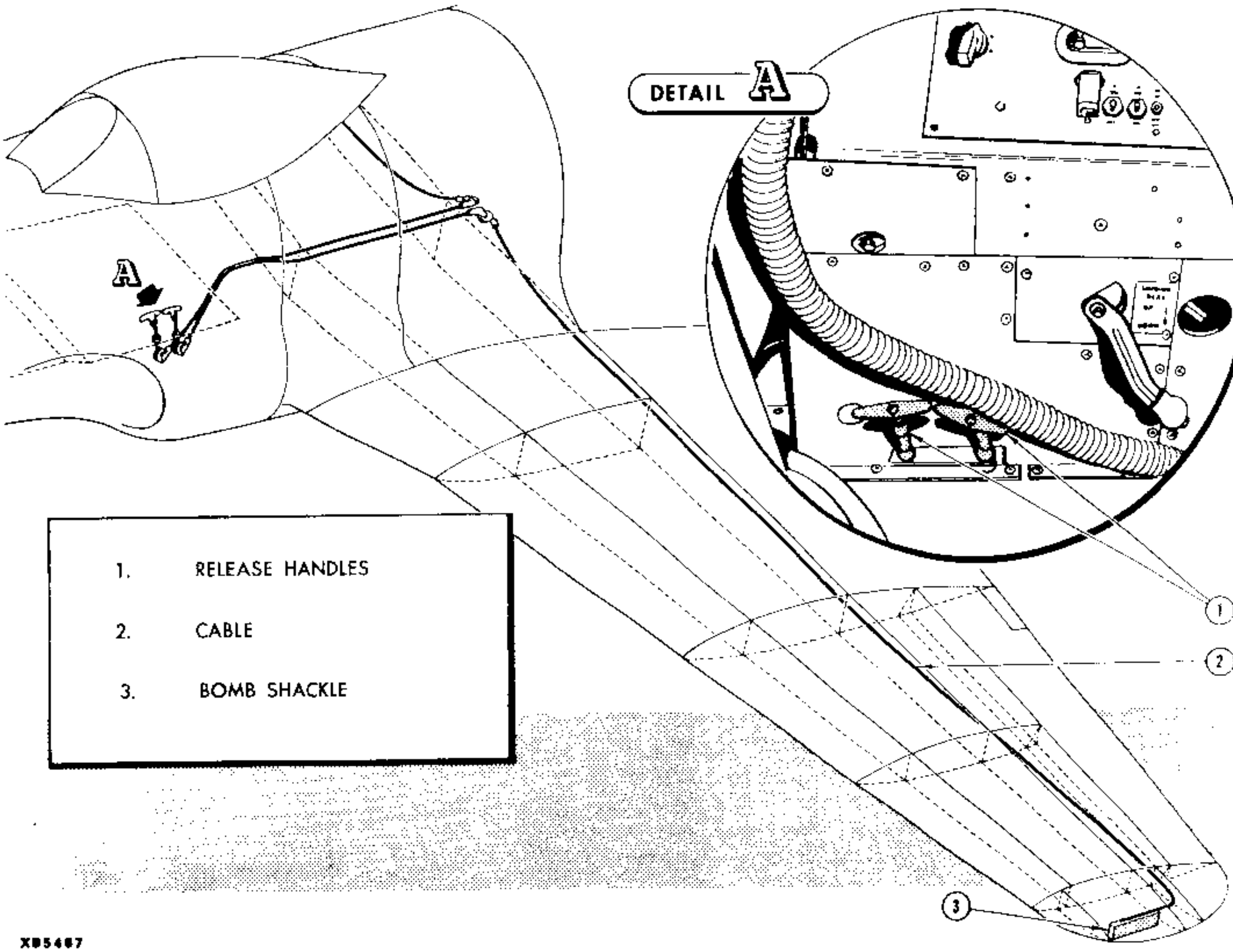



*Figure 236 — Manual Control, Droppable Tanks and Bombs*

*d.* BOMB RELEASE EQUIPMENT.
*(See figures 235 and 239.)*

(1) DESCRIPTION.—Release of bombs or tanks is controlled electrically by switches in the armament control panel on the right-hand cockpit shelf, on the control stick, and on the instrument sub-panel.

On early airplanes three switches control the type A-4 electrical bomb release units that operate the type B-10 bomb shackles. Two switches in the control panel have three positions each. The forward switch, or bomb arming switch, when in the "SAFE" position, permits the bombs to be dropped safe. The indicator lights glow, indicating that the bomb shackles are loaded and not armed. The lights go out as bombs or tanks are dropped. When this switch is in the "ARMED" position, bombs can be dropped armed. The indicator lights do not glow. In the "OFF" position, the bombs can be dropped armed. The aft switch, or bomb selector switch, when in the "ALL" position permits both bombs to be dropped together. When this switch is in the "TRAIN" position, the bombs can be dropped separately, the left bomb being dropped first. In the "OFF" position, the bombs cannot be dropped. The third switch, a button switch on the control stick, releases the bombs.

Later airplanes have three switches on the armament control panel and a button switch on the control stick to control the all-electric self-contained S-1 bomb shackle. The three switches on the control panel are the bomb arming, bomb selector, and the chemical tank switches. The arming switch is a three-position switch and bombs may be dropped "SAFE," "TAIL ARMED ONLY," or "NOSE & TAIL ARMED." The bomb selector switch operates the same as explained previously for early airplanes. The button switch on the control stick releases the bombs. A toggle switch in the wing tip is used in connection with the chemical tank switch on the control panel. When the chemical tanks are installed, the toggle switch in the wing tip is turned to "CHEMICAL." The chemical tanks may be selected by the chemical switch on the control panel. The arming switch is turned to "NOSE & TAIL ARMED." If the toggle switch in the wing tip is turned to "BOMBS," both chemical tanks can be operated together when the arming switch is turned to "NOSE & TAIL ARMED."

Emergency release handles on the floor of the cockpit to the left of the pilot operate the shackle release levers manually through a cable control.

For electrical information on the bomb and droppable tank circuit see paragraph 17*y*, this section.

(2) ELECTRICAL BOMB RELEASE.
*(See figure 232.)*

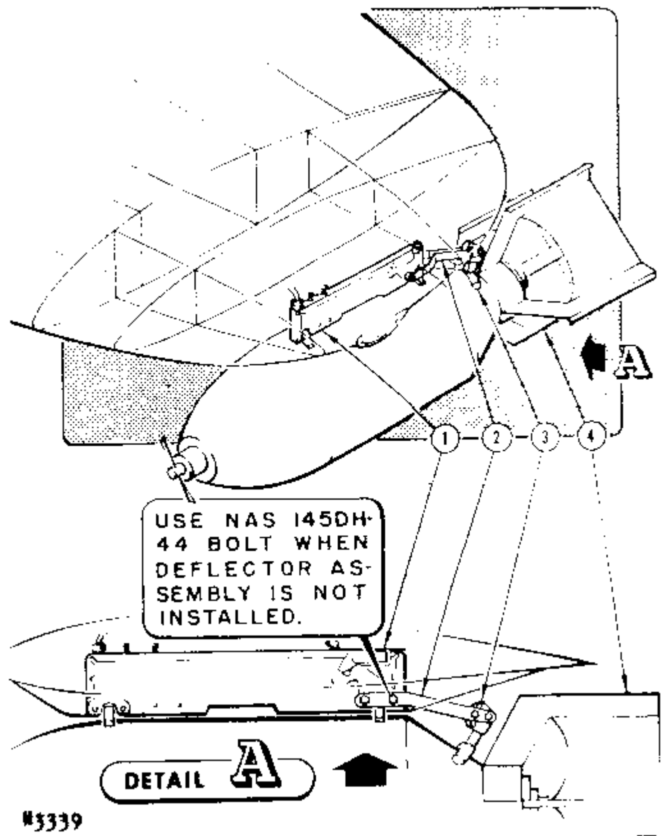
*(a)* DESCRIPTION.—On early airplanes the type A-4 electrical bomb release unit is mounted in each wing tip. Two arms on the release unit engage with the arming and release levers on the type B-10 bomb shackle. The operating arms of the release unit are cocked manually by rotating them away from each other. To release both levers, arming and releasing the bombs, both circuits in the release unit are energized. If the bomb is to be released unarmed, only one circuit is energized. The electrical release unit can be released mechanically by turning the trip screw on the face of the unit between the center lines of the two levers. If release is tripped manually, the trip screw should be returned to original position by a screw driver or other similar implement, or it will be impossible to cock the release.

*(b)* REMOVAL.—Remove fairing on bottom of wing tip. Remove frame strip for attaching fairing by removing four screws. Remove electrical disconnect plug. Remove two screws attaching unit to structure, and remove bomb release unit.

(3) MANUAL RELEASE MECHANISM.
*(See figure 236.)*

*(a)* DESCRIPTION.—Two handles located on the floor to the left of the pilot can be used to release the bombs or tanks in case of failure of the electrical release system. A cable fastened to each handle is routed to a bomb shackle in each wing tip or pylon where it is connected to the shackle manual release lever.

*(b)* ADJUSTMENT.—See that release handles are fully depressed. On early airplanes having the B-10 bomb shackle installed, cock shackle and see that the ring on the end of the wing-tip cable is over the shackle release lever. On later airplanes having the S-1 bomb shackle installed, cock shackle and see that the wing-tip cable and linkage are securely fastened to the shackle release lever. On later airplanes having the S-1 or S-2 bomb shackle installed, cock shackle and see that wing-tip or pylon cable and linkage are securely fastened to




| | | | |
|---|---|---|---|
| 1. | BOMB SHACKLE | 3. | DEFLECTOR |
| 2. | SUPPORT | 4. | BOMB |

*Figure 236A — Bomb Deflector*

shackle release lever. Allow a maximum of $\frac{1}{2}$ inch slack in cable through the wing, and tighten cable connector, which must be so located that shackle trips before connector contacts cable sheath. Be certain that shackle trip lever is in full cocked position when cable length is adjusted.

(4) BOMB DEFLECTOR ASSEMBLY.
*(See figure 236A.)*

*(a)* DESCRIPTION. — On F-80A-10 and RF-80A-10 airplanes, a bomb deflector assembly is supplied as part of loose equipment. The assembly consists of a support and deflector arm. When 500-pound or larger bombs are carried, only the support is installed. When 250-pound bombs are carried, the deflector arm is attached to the support. Neither piece is used with droppable fuel tanks.

*(b)* INSTALLATION.—Secure support to aft end of shackle and wing tip casting by two NAS145-DH-50 bolts, AN365-524 nuts, and AN960-516 washers.

Attach deflector arm to support by two AN4-15a bolts, AN365-428 nuts, and AN960-416 washers. When droppable fuel tanks are carried, use one NAS145-DH-44 bolt to secure aft end of shackle to wing-tip casting, in place of one NAS145-DH-50 bolt used with bomb deflector support.

(5) BOMB PYLONS. *(See figures 236B and 236C.)*—The bomb pylon installation applies only to those airplanes incorporating T.O. 01-75F-42.

*(a)* DESCRIPTION.—The change installs S-1 or S-2 bomb racks mounted at mid-wing with four angle brackets, and enclosed with fairings. This unit contains a bumper plate to protect the airplane from damage in event of pitching bombs or tanks. An electrical harness and manual control cable are routed into the pylon and connected to the bomb rack. There are also four adjustable sway bolts to be used as anti-sway braces.

*(b)* BOMB PYLON REMOVAL.—Remove pylon detachable fairings. Disconnect jettison cable and electrical connector and wires from bomb rack. Remove screws attaching pylon to wing. If necessary, the forming channels for the fairing may be removed by removing screws attaching them to the wing.

*(c)* BOMB RACK.—This is an all-electric self-contained unit incorporating provisions for carrying bombs and releasing them singly or in salvo, either tail armed only, or nose and tail armed, or safe. In addition to the electrical release mechanism, a cable-actuated jettison mechanism is also provided.

*(d)* BOMBING CONTROLS. Bomb arming and bomb selector switches on the armament control panel, and a push-button switch on the control stick, control the bomb racks. Bombs can be dropped "SAFE," "TAIL ARMED ONLY," or "NOSE AND TAIL ARMED." Bombs can be dropped singly or in salvo.

*(e)* BOMB AND DROPPABLE TANK MANUAL RELEASE MECHANISM.—Two handles on the floor to the left of the seat can be used to release the bombs and tanks in case of failure of the electrical release system. Cables fastened to the handles are routed to each bomb rack and wing tip where they are connected to the manual release lever.

*(f)* ADJUSTMENT OF MANUAL RELEASE MECHANISM.—Make sure that release handle is fully depressed. Cock rack, and see that the release cable and linkage are securely fastened to the rack release lever. Take up all but approximately ½ inch slack in the cable from the cockpit at the point where the cable joins the release lever, and tighten the cable connector. The cable connector must be located so that the rack will trip before the connector contacts the cable sheath.

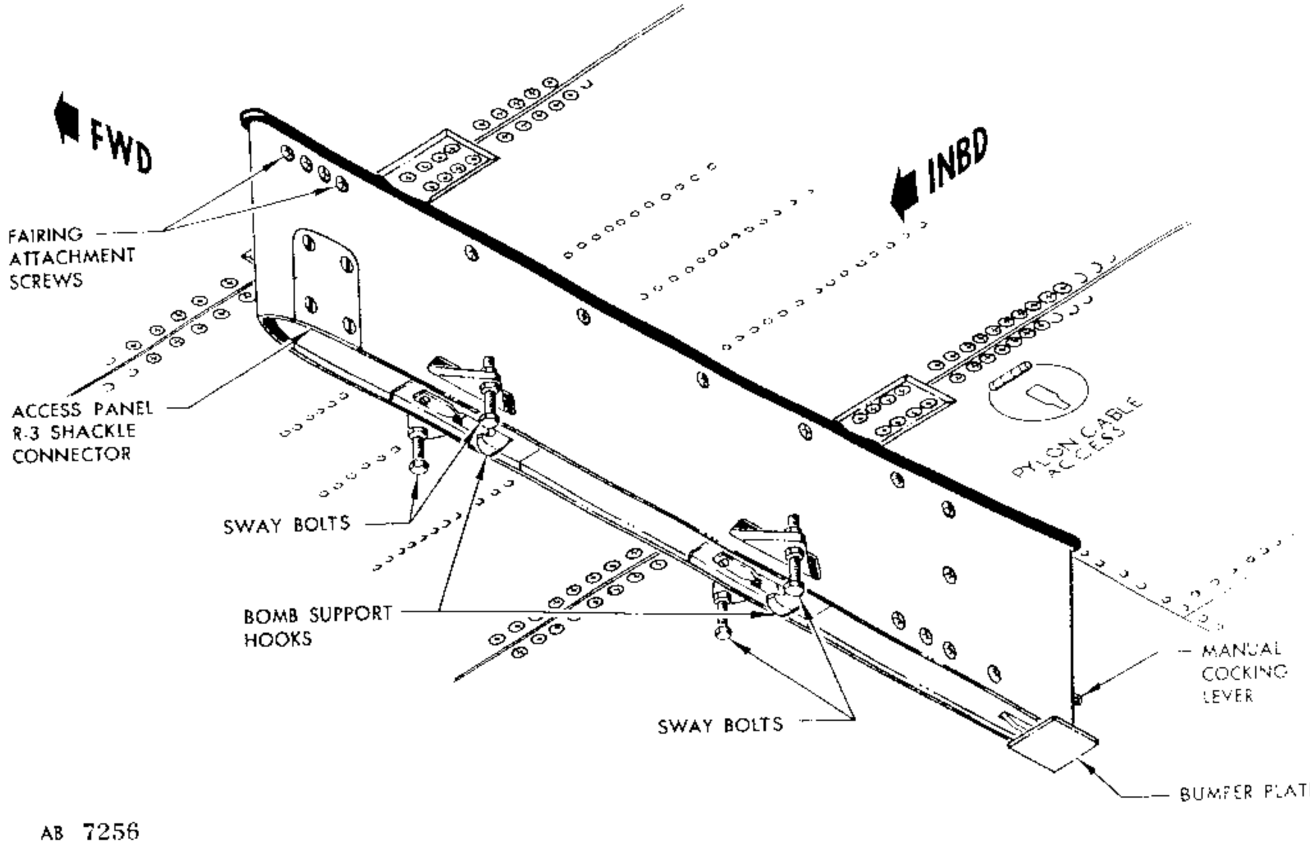



*Figure 236B — Bomb Pylon Installation (Airplanes Incorporating T.O. 01-75F-42)*

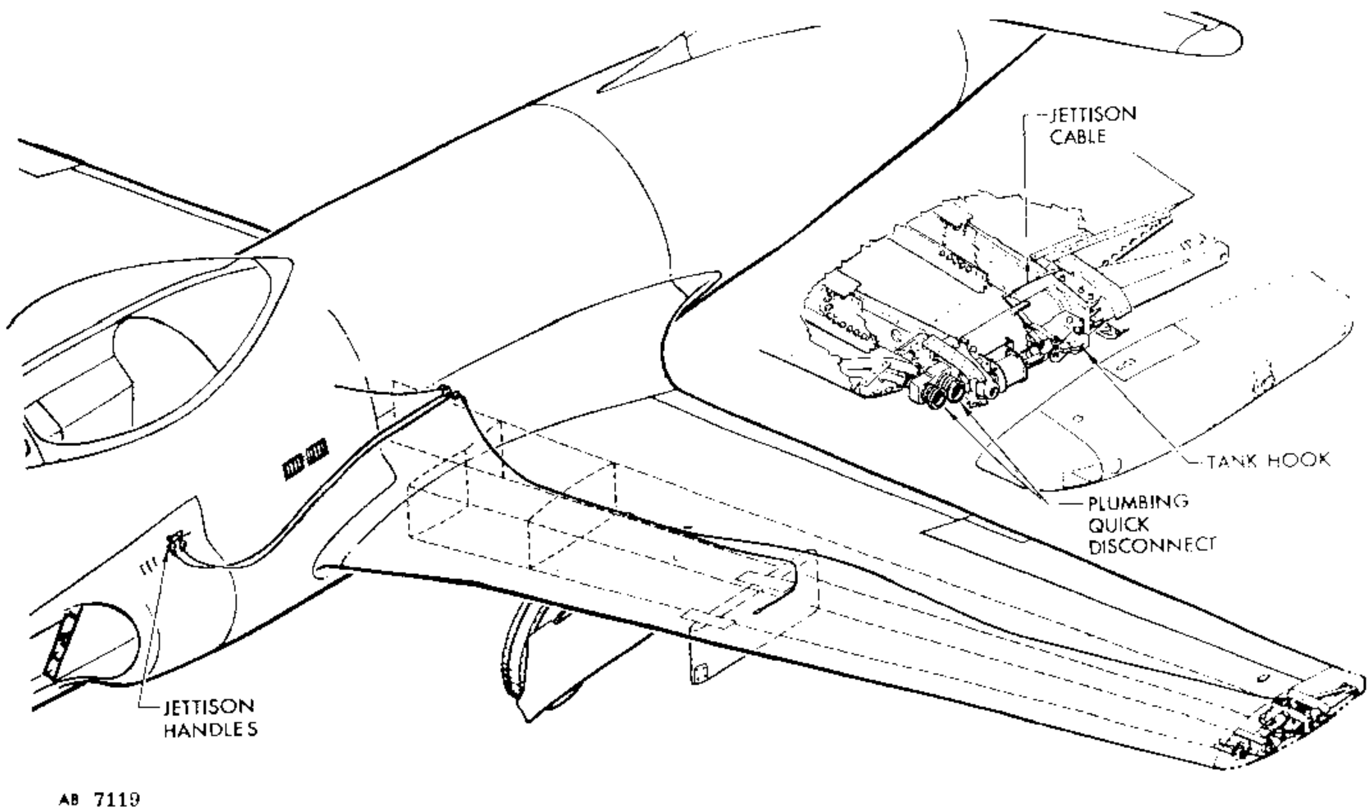



*Figure 236C — Manual Control, Droppable Tanks and Bombs (Airplanes Incorporating T.O. 01-75F-42)*

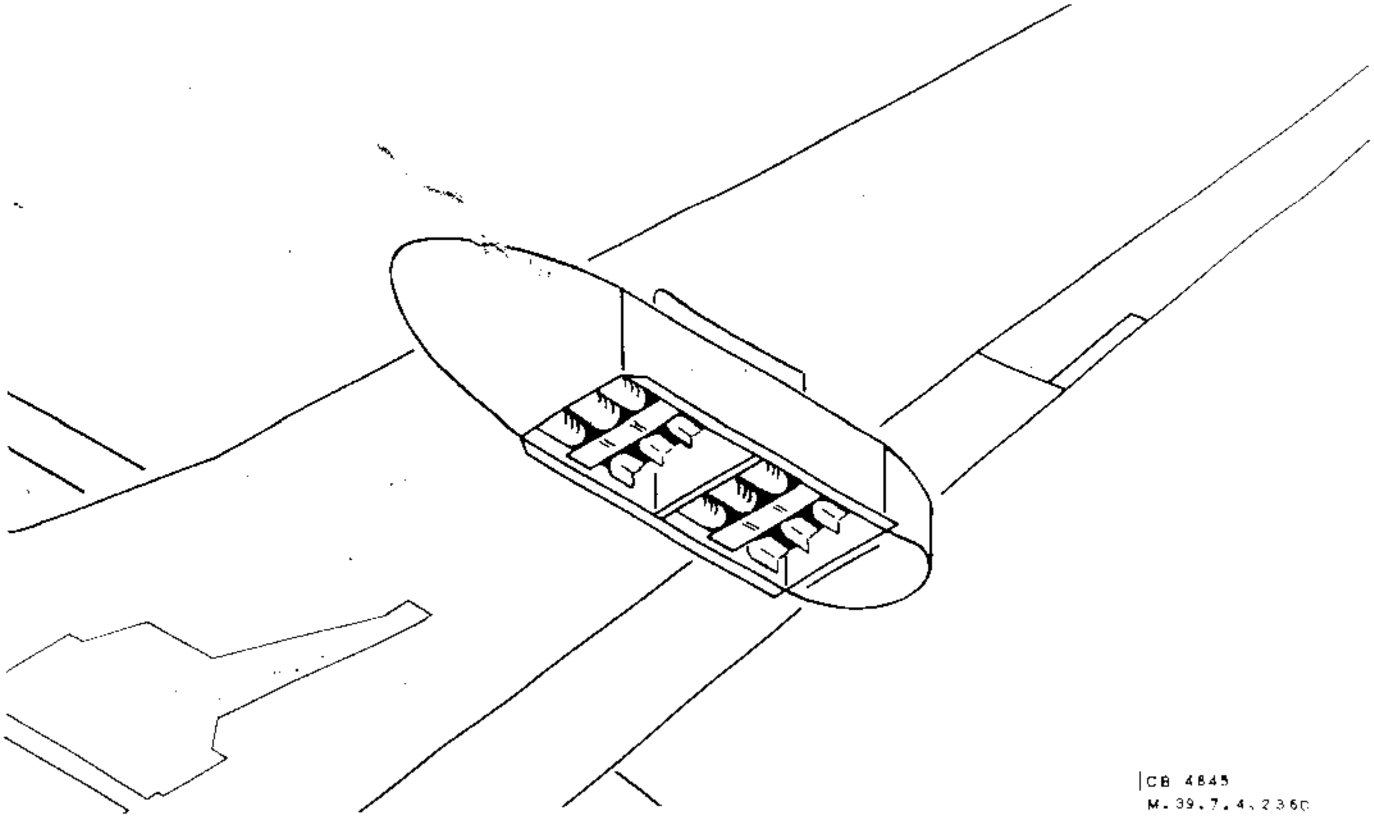



*Figure 236D — Fragmentation Bomb Rack Installation*

(6) FRAGMENTATION BOMB RACK.
*(Refer to figures 219B, 236D, and T.O. No. 11-5-76.)*

*(a)* DESCRIPTION.—The type R-3 fragmentation bomb rack is designed for carrying AN-M40 or M-72 parachute fragmentation bombs, or AN-M41 stabilized fragmentation bombs. The rack carries 18 bombs and may be mounted on the bomb pylon midway beneath each wing. (Refer to paragraph 19*a* (5).) Sway bracing is provided. Individual six bomb groups are stacked three deep in two tandem compartments.

*(b)* BOMB RELEASE.—The sequence of bomb release is as follows:

*1.* The tripping solenoid in the rear of the rack trips the rear bomb compartment retaining door and the three bombs in this section are released.

*2.* As the third bomb falls, a follower comes down and, through a mechanical linkage, trips the bomb retaining door in the forward bomb compartment.

*(3)* As the top bomb falls, the follower in this section actuates a switch which turns off the indicator light on the control box, and transfers current to the next section.

*4.* The rack complete with bombs may also be released to complete a safe salvo.

**Note**

Each section may be released separately or all three groups may be released in a train of 18 bombs.

*(c)* LOADING.—Refer to T.O. No. 11-5-76.

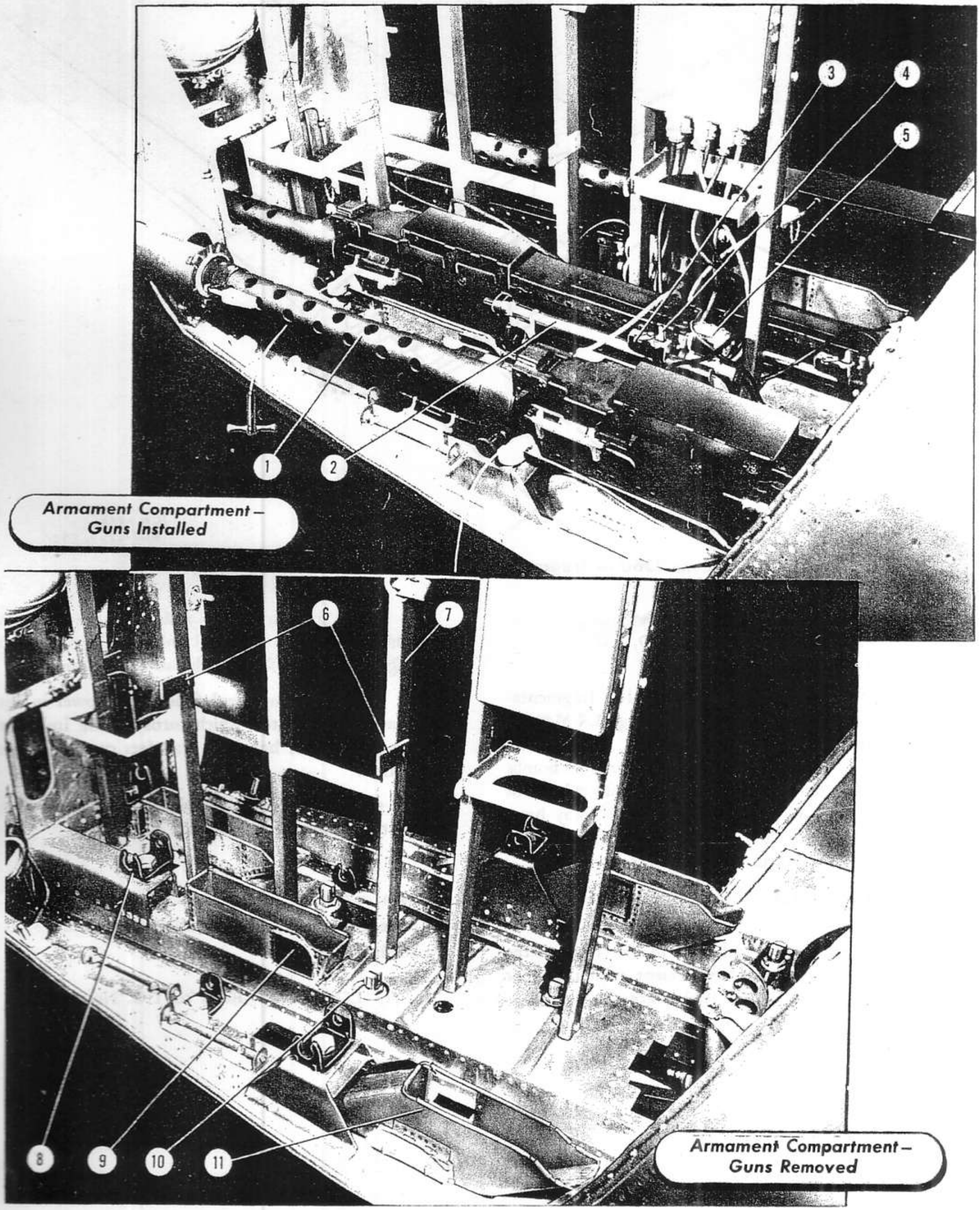
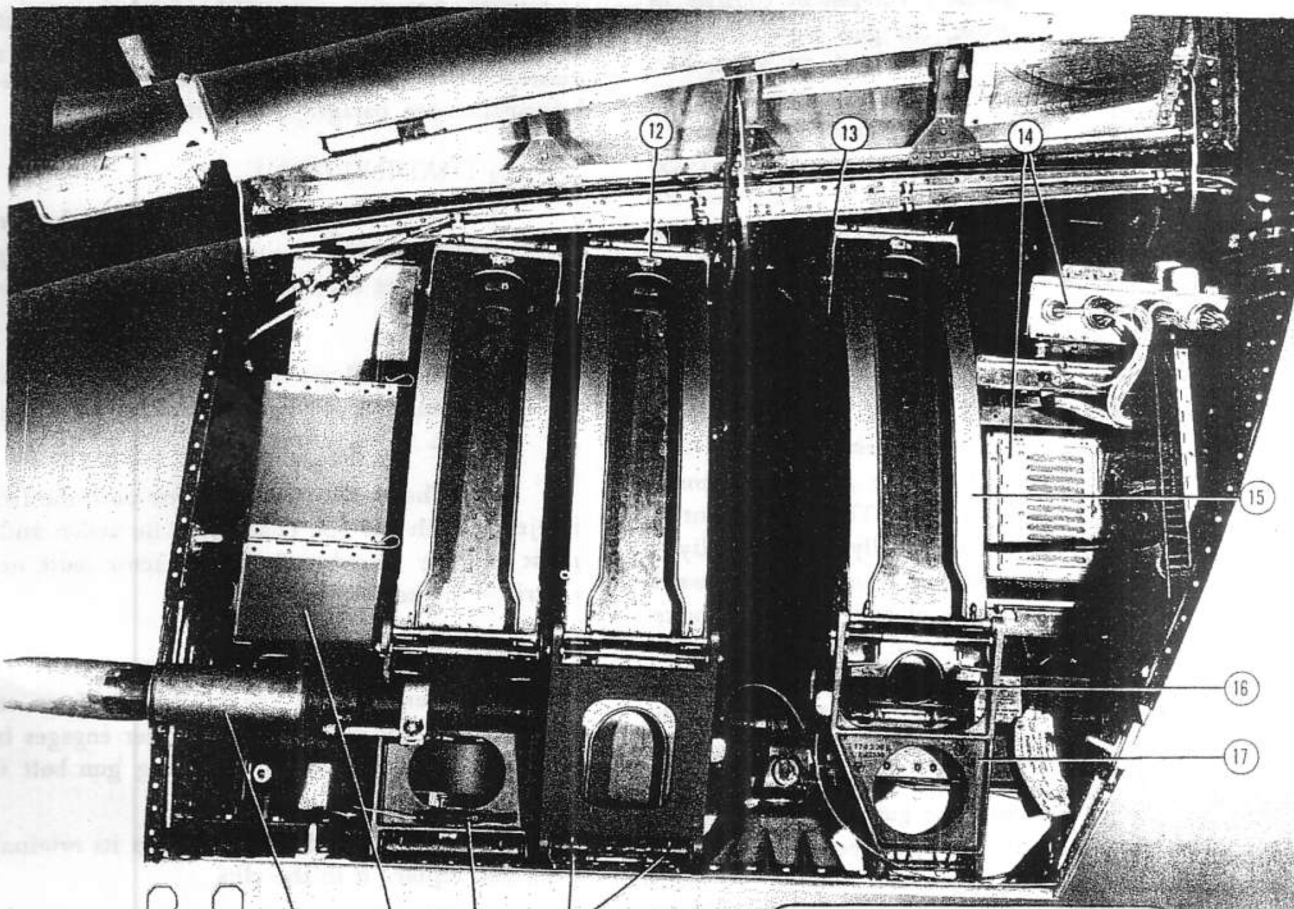
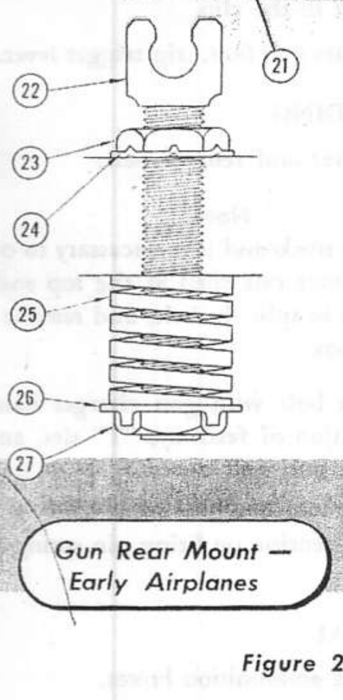



*Figure 237 — (Sheet 1 of 2 Sheets) — Machine Gun Installation*




*Armament Compartment — Complete Installation*




*Gun Rear Mount — Early Airplanes*

1. M-2 .50 CALIBER MACHINE GUN
2. GUN CHARGER OUTER SLIDE
3. TRIGGER LOCK
4. GUN CHARGER TRIGGER
5. GUN FIRING SOLENOID
6. GUN LEVELING LUGS
7. AMMUNITION BOX SUPPORT POST
8. GUN FRONT MOUNTING TRUNNION
9. HOLE FOR CLIP CHUTE
10. GUN REAR MOUNTING POST
11. CASE EJECTION CHUTE
12. AMMUNITION BELT STOP
13. AMMUNITION BOX HANDLE
14. COMMAND RADIO
15. AMMUNITION BOX
16. FEED CHUTE
17. FEED CHUTE SUPPORT
18. CHUTE RELEASE LEVERS
19. GUN CHARGER HANDLE
20. BALLAST BOX ★
21. BLAST TUBE
22. GUN POST
23. LOCK NUT
24. LOCK WASHER
25. SPRING
26. LOCK WASHER
27. NUT

★ ON LATER AIRPLANES, BALLAST BOX IS LOCATED ON RIGHT SIDE OPPOSITE NO. 2 AMMUNITION BOX.

**Figure 237 (Sheet 2 of 2 Sheets) — Machine Gun Installation**

## 20. GUNNERY EQUIPMENT.

a. GENERAL.—The gunnery equipment consists of the machine gun installation, the gun sight, the gun cameras, and the camera pods. Six fixed .50-caliber M-2 machine guns are mounted in a compartment in the fuselage nose section, with an ammunition box for each gun. A computing gun sight is installed in the cockpit directly behind the bullet-resistant windshield on the center line of the airplane. One gun camera is in the leading edge of the right air intake duct, and an additional camera is in each pod on the wing leading edges.

*b.* MACHINE GUN INSTALLATION. *(See figure 237.)*

(1) DESCRIPTION. — The six .50-caliber M-2 machine guns are mounted on the gun compartment structure by quick-release fittings. The rear mount of each gun can be adjusted horizontally and vertically to permit boresighting. A 300-round ammunition box is mounted above the feed chute of each gun. The boxes hook over fittings at the top and are fastened to the feed-chute supports at the bottom by quick-release fittings. The feed chutes and supports are fastened to the guns and to the structure by quick-release fittings. Expended links and cartridge cases are discharged through chutes into the space below the guns, from which they are discharged overboard through electrically operated doors in the skin. To alleviate overheating and to facilitate maintenance, the gun barrel jacket sleeve and clamp have been removed from the guns (T.O. 01-75F-25).

**CAUTION**

During gunfiring tests on the ground, pad the nose-gear torque arms with cloth or other suitable material. This will prevent a live shell (dropped from the ejection chute after a jam has been cleared or during initial injection of the belt) from being fired by striking unpadded torque arms.

Guns are charged manually by handles located in the gun compartment. Each gun is supplied with an electric heater controlled from the cockpit.

The guns and gun cameras are fired electrically by a trigger switch on the control stick. In order for the trigger switch to be operative, the master armament switch on the right-hand cockpit shelf must be turned to either the "GUNS," or "SIGHT AND CAMERA" position. Operation of the master armament switch to the "GUNS" position turns on the gun sight and operates the cockpit pressure regulator to reduce cockpit pressure to 1.5 psi. The shell ejection doors are opened by the trigger switch when the master armament switch is in the "GUNS" position. Operation of the switch to the "SIGHT AND CAMERA" position turns on the gun sight, energizes the gun camera circuit, and operates the cockpit pressure regulator. A switch adjacent to the master switch controls the gun heaters. For electrical information see paragraph 17*x*, this section.

(2) LOADING GUNS.

*(a)* Enter the double-looped end of the cartridge belt into the machine gun through the feed opening until the first cartridge is beyond the belt-holding pawl.

**Note**

If cartridge will not slip past belt-holding pawl, open gun cover sufficiently to allow cartridge to enter. Close cover.

*(b)* Charge the gun twice (or until the first link is ejected with the gun charger). The action and cover must be fully closed and the extractor must grip the cartridge in the feedway.

(3) CHARGING GUNS.

*(a)* Remove gun charger handle from stowage clip and pull out until charger trigger engages beveled shoulder on outer side, thus holding gun bolt in rear position.

*(b)* Allow handle to return to its original position, and replace it in the clip.

*(c)* To release gun bolt, trip trigger lever.

(4) UNLOADING.

*(a)* Lift cover and remove belt.

**Note**

In case belt is stuck and it is necessary to open the cover, remove one shell at the top end of the feed chute to split the belt, and remove the ammunition box.

*(b)* Retract bolt with gun charger handle and make visual inspection of feedway, "T" slot, and chamber to be sure that gun is unloaded.

*(c)* Release bolt and close the cover.

*(d)* Release tension on firing pin spring by pressing trigger lever.

(5) REMOVAL.

*(a)* Remove ammunition boxes.

*(b)* Remove electrical disconnect plug from gun solenoid and gun heater.

*(c)* Remove the link ejection and ammunition feed chutes by releasing the quick-release fittings attaching them to the gun.

(*d*) On early airplanes, turn spring-loaded pin in rear post 90°. On later airplanes, pull spring-loaded pin knob out approximately ¼ inch. Raise aft end of gun and release knob, leaving pin in the gun mounting flanges. (See figure 238.)

(*e*) Withdraw the spring-loaded pin in the front mounting trunnion about ¼ inch. Raise gun just clear of trunnion and release the pin.

(*f*) Lift gun slightly off its mountings. Any tendency for it to stick may be overcome by striking the gun sharply with the hand. Move the gun aft until the muzzle clears the blast tube. Remove gun from the airplane.

**CAUTION**

As each gun is removed, place ballast equal to the weight of the gun in the nose of the airplane.

(*g*) Remove the trunnion pin and spring from the gun by taking out the cotter pin.

**Note**

If the gun is to be left out of the airplane, remove the detachable parts of the trunnion and post, and reinstall them in the airplane.

(*h*) In case a gun rear post must be replaced, all rear posts except for the channel gun are accessible through the nose wheel well. The channel gun rear post is accessible through the shell ejection door. For detachment of door, see paragraph 17*x*, this section.

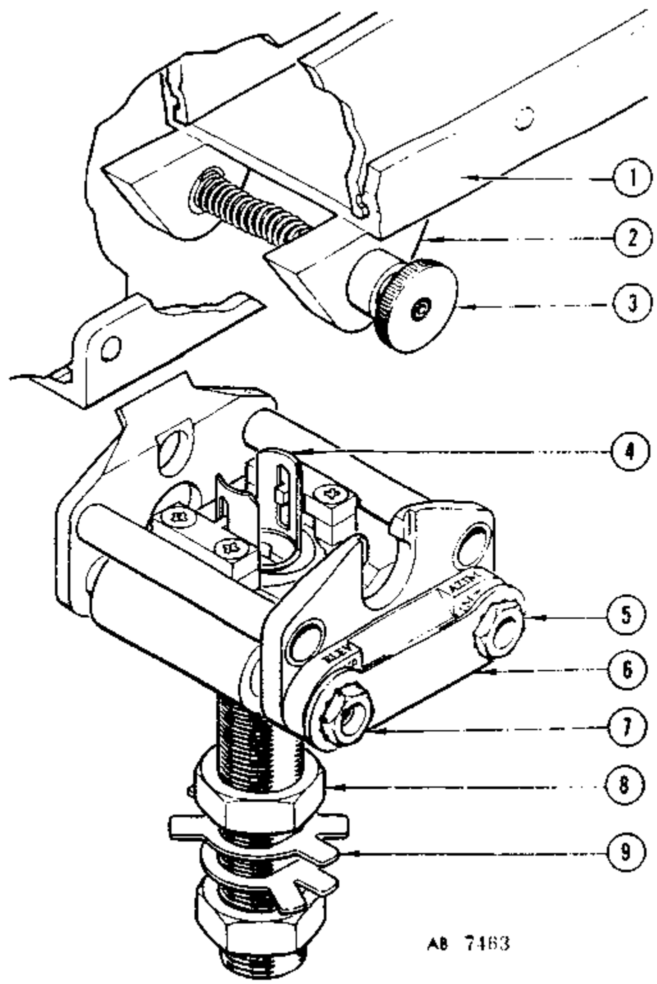
(6) MACHINE GUN BARREL REMOVAL WITH GUN INSTALLED. — To remove the barrel from a machine gun, remove the ammunition box and slip off the backplate of the gun. Use tool No. S-10802 to actuate the oil-buffer spring back. Remove the barrel.

(7) INSTALLATION OF GUNS. — Reverse removal procedure.

**CAUTION**

When installing guns, be sure both front and rear attachments are properly seated and locked, otherwise guns may jump mountings and cause serious damage.

(8) AMMUNITION BOXES, FEED CHUTES, AND EJECTION CHUTES. — Each gun is provided with a 300-round ammunition box located above the gun feedway. Ammunition boxes are easily removable, and are supported at the top rear by fittings which rest on hooks attached to vertical support posts. A feed chute is attached between each ammunition box and gun. When installed, the lip of the chute should be even with or slightly above the bottom surface of the gun feedway.




| | |
|---|---|
| 1. | MACHINE GUN |
| 2. | MOUNTING FLANGE |
| 3. | SPRING-LOADED PIN |
| 4. | GUN POST |
| 5. | AZIMUTH ADJUSTMENT |
| 6. | LOCKING PLATE |
| 7. | ELEVATION ADJUSTMENT |
| 8. | NUT |
| 9. | LOCKWASHER |

***Figure 238 — Gun Rear Mount, Later Airplanes***

A case ejection chute extends down from each gun breech and leads to the shell ejection doors in the fuselage skin. (For information on shell-ejection door mechanism, refer to paragraph 17*x*, this section.) The upper portion of each chute is fastened to the floor of the gun compartment by hinges. Link ejection chutes guide expended links into the case ejection chutes. Each chute slides into an opening on the side of a case chute or into an opening in the floor, and attaches to the gun by a link-chute adapter.

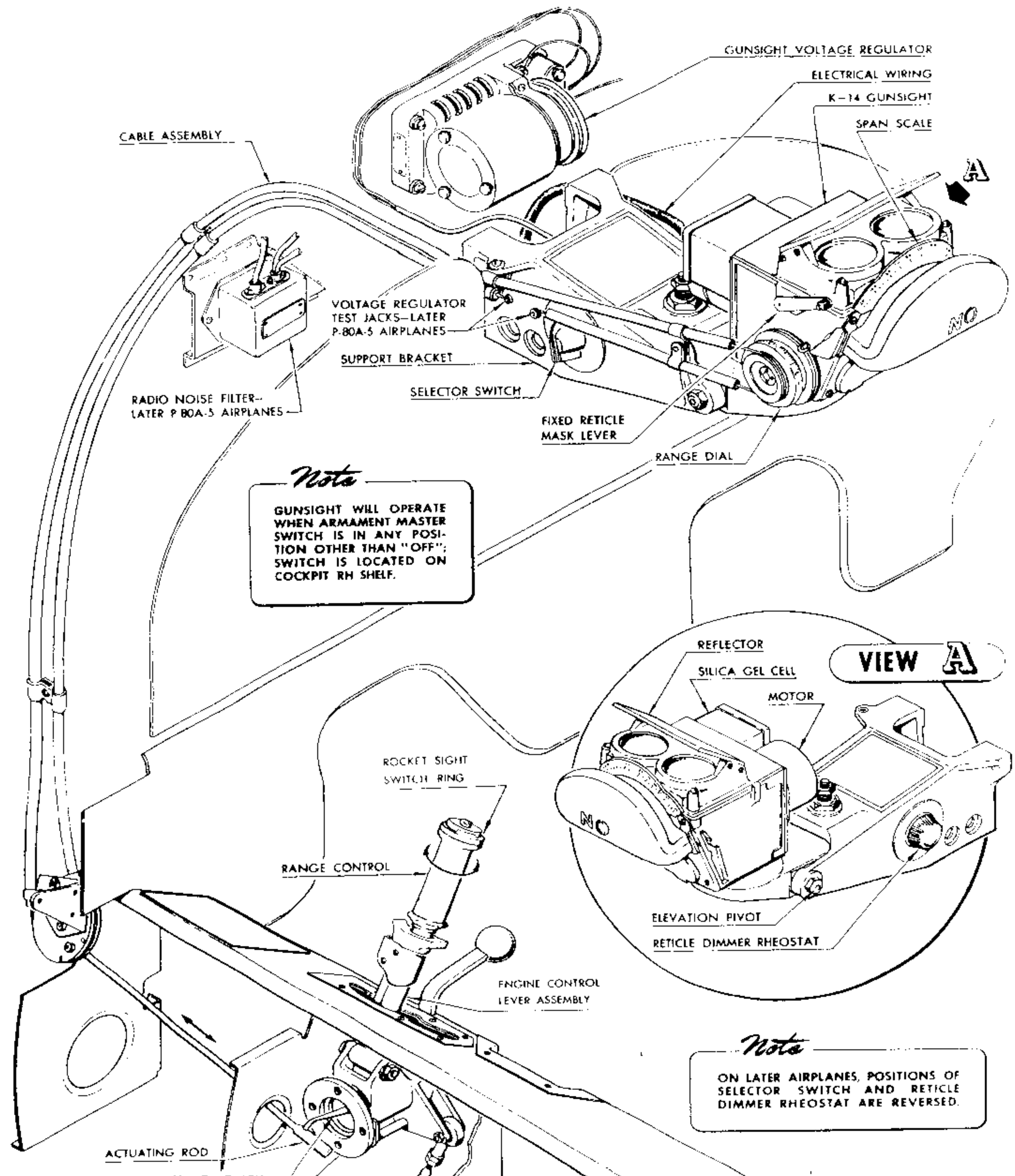



*Figure 239 — Gun Sight Installation*

*c.* GUN SIGHT. *(See figure 239.)*

(1) DESCRIPTION. — The airplane is equipped with a type K-14A or K-14B gun sight mounted on a casting aft of the windshield. The sight works on the gyroscopic principle, and is designed to provide the proper lead for fighter deflection gunnery. The sight is effective at all ranges between 200 and 800 yards, at any angle, as long as the target is tracked for not less than one second and the span lever has been set properly. The greatest effectiveness is obtained at ranges between 300 and 500 yards.

The gun sight installation consists of the following five operating parts:

*(a)* SIGHTING HEAD.—This is located just aft of the windshield, in the pilot's line of vision. It consists of two reflector sights mounted integrally side by side. The left sight is fixed and its line of sight is always parallel to the flight line of the airplane. The right sight is the gyro sight and contains the automatic computing mechanism. On the face of the sight just forward of the crash pad are the span lever and scale. A lever on the left side of the head operates a mask which blanks out part of the fixed-sight reticle pattern. An access door is provided on the face of the sight for replacing burned-out lamps.

*(b)* SELECTOR SWITCH AND RETICLE DIMMER RHEOSTAT. — The selector switch determines whether the fixed sight alone is to be used, the fixed and gyro sights together, or the gyro sight only. The rheostat increases or decreases the brightness of the sight reticle. These switches are on the left side of the instrument sub-panel.

*(c)* RADIO NOISE FILTER.—This item is included to reduce the level of the radio-frequency noise generated by the series-wound, direct-current motor in the sight.

*(d)* VOLTAGE REGULATOR.—This is a carbon pile regulator, and is included for maintaining the potential of 22 volts (± .5 volt) required by the sight for accurate calibration.

*(e)* RANGE CONTROL TWIST GRIP.—This is part of the throttle lever, and enables the pilot to keep the target framed continually in the ring formed by the inner points of the diamonds of the gyro-sight reticle, while flying the airplane.

*(f)* LUBRICATION.—Lubricate the upper bearing with oil, Spec AN-0-6A, through the hole and into the friction joint above the upper bearing. The top and bottom bearings will have clearances of 0.002 to 0.004 inches. When reassembling the control handle, lubricate the handle with oil, Spec AN-0-6A, and the bearings with grease, Spec MIL-G-3278.

(2) OPERATION.—The gun sight automatically compensates for range and deflection by making the pilot fly the airplane so the guns lead the target by the required distance. To operate the sight, turn the battery switch "ON" and turn the armament master switch either to "GUNS" or to "SIGHT AND CAMERA."

**CAUTION**

Keep gyro sight turned on during taxiing, take-off, and landing. This must be done to protect the gyro pivots from damage.

Turn selector switch to the desired sight: "FIXED," "FIXED AND GYRO," or "GYRO." Turn rheostat to give the desired illumination. Set the span lever to the proper index for the target. Range the target by turning the range control twist grip with a smooth continuous movement, keeping the target framed by the inner points of the diamonds. The target must be tracked in this manner for at least one second.

(3) OPERATIONAL CHECKS.

*(a)* GROUND CHECK.

*1.* Turn battery switch "ON."

*2.* Turn armament master switch to "GUNS."

*3.* Turn rheostat to "BRIGHT."

*4.* Turn sight selector switch to "FIXED AND GYRO."

*5.* See that both reticles light up.

*6.* Turn armament master switch to "SIGHT AND CAMERA." See that reticles light up again.

*7.* Move sight selector switch to "FIXED" and then to the "GYRO" positions and observe that each reticle lights properly.

*8.* Reset the selector at "FIXED AND GYRO" and dim the reticles as desired.

*9.* Test throttle twist grip for free operation without excessive stiffness, binding, or jumpiness from maximum to minimum range at various throttle positions. See that the gyro sight reticle movements correspond to the movements of the twist grip.

FIGURE 240 DELETED.

*(b)* FLIGHT CHECK.

*1.* Turn the sight on and allow it to warm up for 15 minutes.

*2.* Set selector switch at "FIXED AND GYRO," the fixed reticle mask lever up, and the range at 800 yards.

*3.* Cage the direction gyro at zero degrees.

*4.* Establish a steady turn at a rate which will deflect the dot of the gyro sight reticle to the circumference of the fixed reticle rings, that is, one rad or 35 mils deflection.

*5.* Hold this rate of turn constant and uncage the directional gyro when the second hand of the clock passes zero seconds.

*6.* Maintain the constant rate of turn by keeping the dot at the 35-mil deflection ring for 60 seconds.

*7.* Cage the gyro after exactly 60 seconds have elapsed, and read the number of degrees turn from the directional gyro.

*8.* Repeat the above procedure for a turn in the opposite direction.

*9.* The correct amount of turn should be 130 degrees (± 10 degrees).

*10.* There should not be more than 10 degrees difference between the right and left turn. A greater difference indicates misalignment of the reticle.

*11.* If the amount of turn is greater than 130 degrees (± 10 degrees) and the electrical circuit reveals no fault, the gyro pivot friction is probably too high, and the sight should be sent to a qualified depot for overhaul.

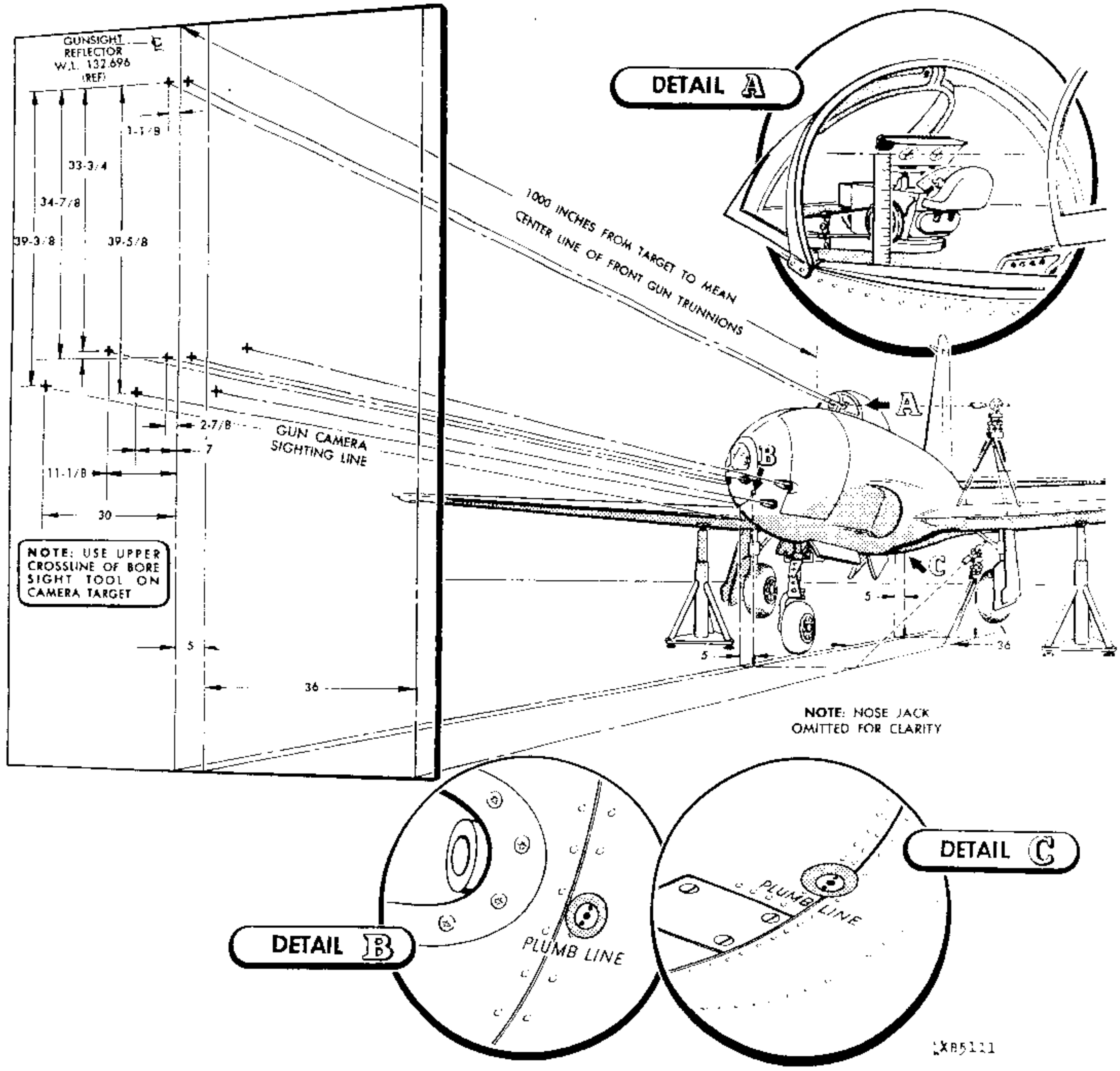



*Figure 240A — Boresight Target Alignment Diagram*

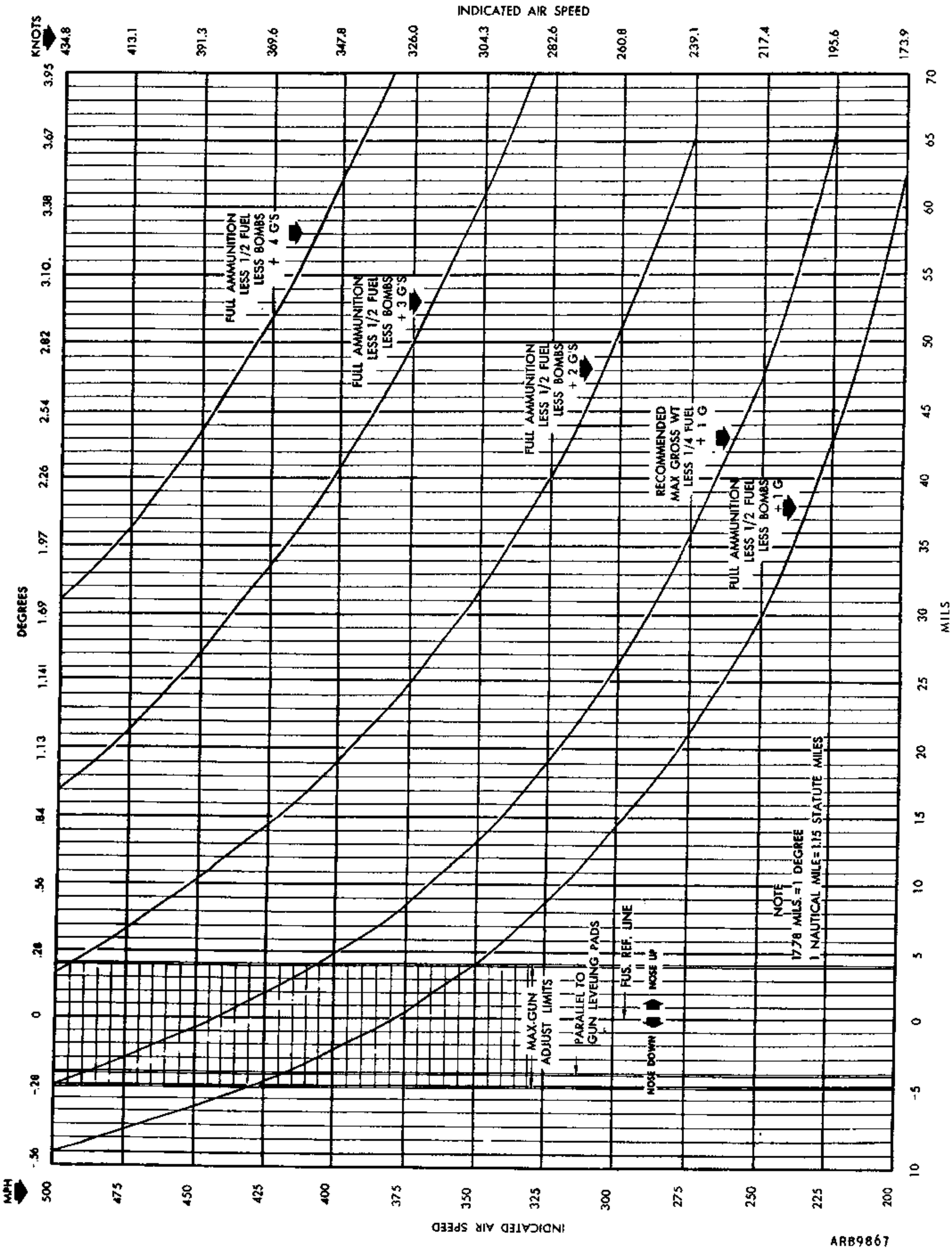



*Figure 240B — Gun and Sight Alignment Chart, F-80A-10 Airplanes*

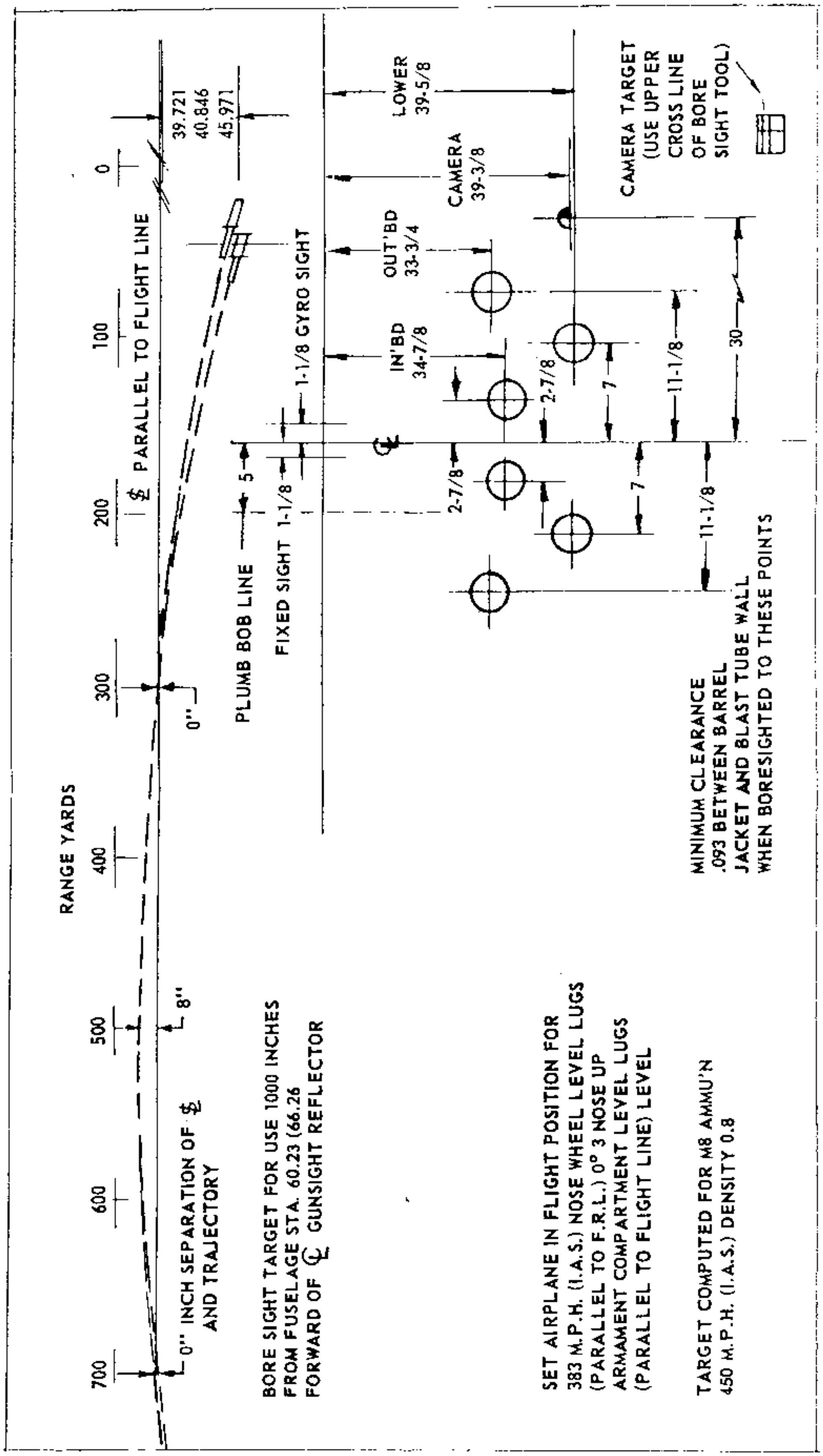



*Figure 240C—Target Harmonization, F-80A Airplanes*

*12.* If the amount of turn is less than 130 degrees (±10 degrees), check the electrical circuits to see that the proper resistances are in the range circuit. If no high-resistance connections, or no improper resistances are found, the sight should be sent to a qualified depot for overhaul.

*d.* BORESIGHTING.

(1) DESCRIPTION.—Boresighting is the process of aligning the gun sight and the guns with respect to the flight line of the airplane. The sight line must be set parallel to the flight line of the airplane. At different indicated air speeds the fuselage reference line varies from the flight line. The fuselage reference line and the flight line of this airplane are parallel at approximately 353 mph IAS, depending on the weight at which the airplane is operating. At speeds above 353 mph, the fuselage reference line angles downward from the flight line. That is, the airplane flies slightly "nose down" without losing altitude. At speeds less than 353 mph, the converse is true. After the line of sight has been adjusted parallel to the flight line for the desired air speed, the guns must be adjusted so their fire will intersect the sight line at the desired range.

(2) POSITIONING THE AIRPLANE.—Place the airplane on jacks as described in section III, paragraph 2*d*. (See figure 17.) Then put a spirit level across the lateral leveling pads (figure 18) and adjust one of the wing jacks until the spirit level shows the airplane to be level laterally. Next, place the spirit level on the gun leveling pads (figure 237) and adjust the nose jack until the airplane is level fore and aft.

**Note**

The airplane is now set in flight attitude. (See figure 241 for attitude in which to set the airplane for different air speeds, loading, and acceleration conditions.) At this setting, the fuselage reference line is 3.6 mils nose down from the flight line. This is because the gun leveling lugs are located, at the factory, 3.6 mils nose up. If the airplane is to be boresighted for a speed other than 380 mph, the longitudinal leveling pads in the nose wheel well must be used. (See figure 18.) If the airplane is to be sighted for a speed under 353 mph, place .018-inch shim, for each mil, between the aft leveling pad and the level. If the airplane is to be sighted for a speed greater than 353 mph, place the shim on the forward pad.

(3) POSITIONING THE BORESIGHTING TARGET.—Place a target, made in accordance with figure 240, 1000 inches (83 ft. 4 in.) in front of the reticle image on the sight reflector. The target must be mounted so that it can be moved both vertically and horizontally.

*(a)* HORIZONTAL LOCATION. *(See figure 240A.)*—Drop plumb lines from plumb-line points at the forward and aft ends of the airplane. Place the center of a surveyor's transit on eye level even with the aft plumb line and 36 inches to the left. Level the instrument. Put a scale on the ground with one end against the forward plumb bob and the other end extending to the left. Swing the instrument onto the scale and adjust until the vertical cross hair is on the scale and 36 inches to the left of the plumb bob. Then focus the telescope on the target. Move the target horizontally until the line which is 36 +5 or 41 inches to the left of the target center aligns with the cross hair of the instrument.

*(b)* VERTICAL LOCATION. *(See figure 240A.)*—Place a surveyor's transit or wye level on the left wing near the fuselage at a height of from 2 to 10 inches below the reticle image on the reflector. Level the instrument. Hold a steel scale against the side of the gun sight so that one end is at the same height as the recticle image on the reflector, and the other end extends downward. Focus the telescope of the instrument on the scale and read the distance the horizontal cross hair is below the reticle image. Then swing the telescope to the target. Raise the target until the sight mark on the target is the same distance above the cross hair as the recticle image.

**Note**

The target may also be positioned with relation to the airplane by using a type A-2 sight line level indicator.

(4) GUN ADJUSTMENT.—Adjust each gun to its individual mark on the boresight target. Adjustment for both elevation and azimuth is at the rear support of each gun. Use tools from either the type J-1 or type J-2 boresighting kit, and No. S-34102 and S-34103, or S-34105. (See figure 243.) Better results will be obtained by using the breech sight rather than the muzzle sight for the left inboard gun, as this gun is located so far back in its blast tube.

(5) SIGHT ADJUSTMENT.

*(a)* Turn sight on and wait approximately 15 minutes for gyro sight to warm up and become steady.

*(b)* Adjust gyro sight to align with right-hand sight mark on target by adjusting elevating screw in bracket just forward of sighting head. Adjust for azimuth by use of vernier coupling in sighting head attachment to bracket.

*(c)* Align fixed sight with the left-hand sight mark on the target by trial and error adjustment of the

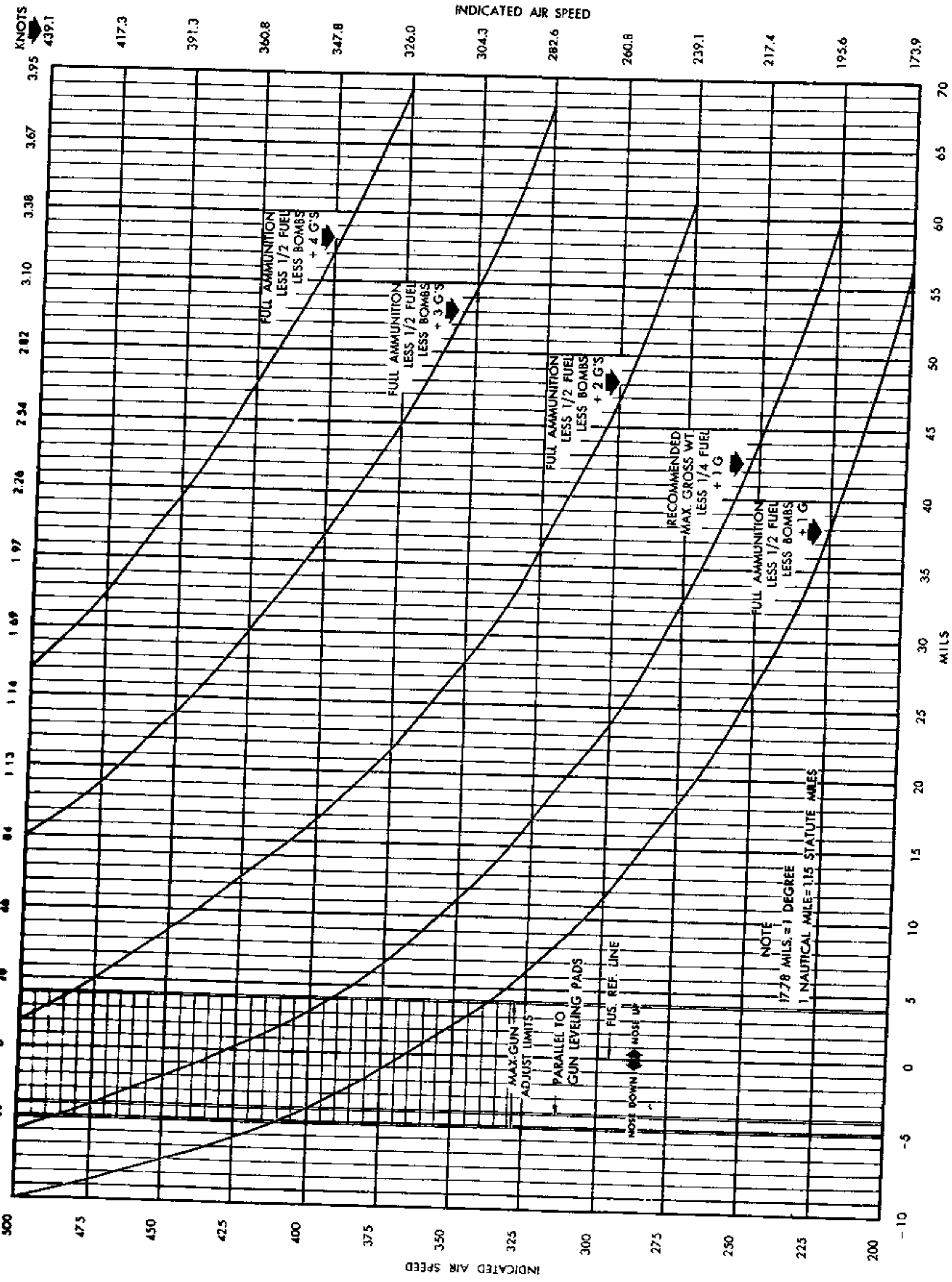
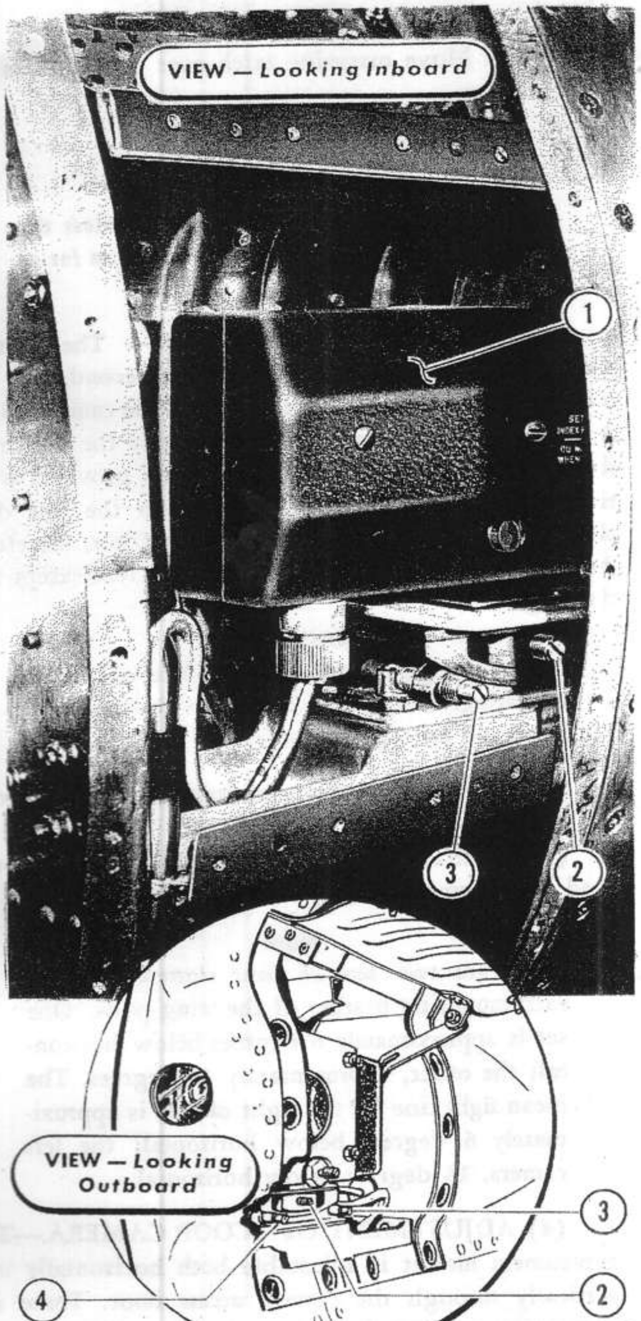



*Figure 241 — Gun and Sight Alignment Chart*




| | |
|---|---|
| 1. | GUN SIGHT AIMING POINT CAMERA |
| 2. | ELEVATION ADJUSTMENT LOCK SCREW |
| 3. | AZIMUTH ADJUSTMENT SCREW |
| 4. | ELEVATION ADJUSTMENT SCREW |

*Figure 242 — Gun Camera Installation*

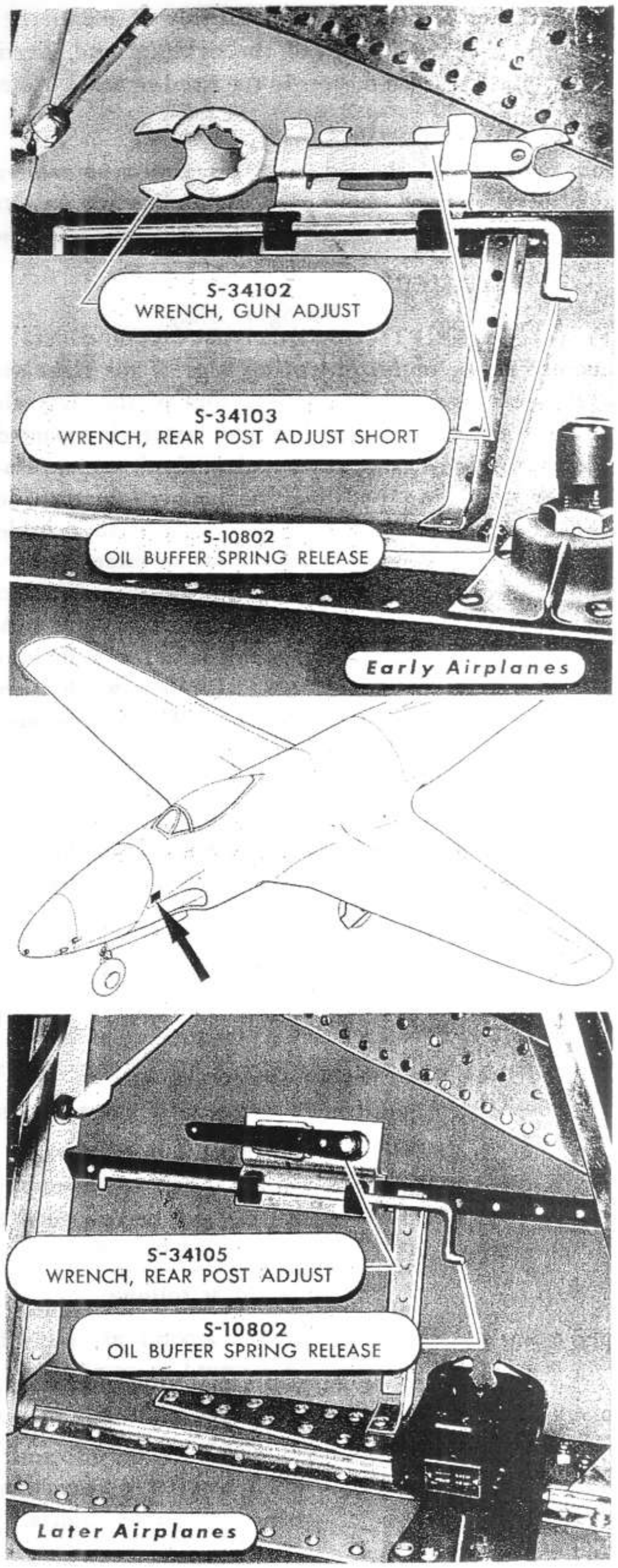



*Figure 243 — Armament Tools Installation*

two adjusting screws, one on each side of the electric motor, at the forward end of the sighting head. These screws adjust the two mirrors in the fixed sight.

(6) GUN CAMERA ADJUSTMENT. — Adjust gun camera with the aid of a magazine-type camera sight to align with the camera sighting mark on the target.

*e.* GUN CAMERA. *(See figure 242.)*

(1) DESCRIPTION.—One type N-6 gun camera is mounted in the outboard leading edge of the right air intake scoop, and one type N-6 gun camera is mounted in each wing pod. A hinged panel inside the scoop provides access to the camera and its adjustable mount. The nose of each wing pod must be removed to provide access to the cameras. Each camera has an internal overrun device, which allows the camera to operate for two seconds after the trigger switch has been released. A heater and a receptacle for a lens heater are built into each camera. When the armament master switch is in either "GUNS" or "SIGHT AND CAMERA" position, each wing pod camera can be operated.

**Note**

The wiring to the camera in the right air intake scoop is disconnected when the wing cameras are installed.

(2) OPERATION.

*(a)* CAMERA LOADING.

*1.* At right air intake scoop, proceed as follows:

a. Disconnect fasteners in camera access door. Raise door until brace engages its stop.

b. Loosen knurled bolt at bottom of mounting bracket, and remove camera with its mounting bracket. The adjustable mount need not be removed.

*2.* At wing pod, proceed as follows:

a. Loosen four screws around aft end of pod nose, and slide pod nose forward to remove.

b. Remove four nuts that attach camera to mounting bracket, and remove camera.

*3.* Open magazine cover at aft end of camera by pressing latch knobs toward lens-end of camera.

*4.* Move the magazine latch out of the way to allow for magazine loading. This also retracts the magazine driving spline.

*5.* Insert type A-6 film magazine into camera with aperture toward lens and footage indicator toward mount-side of camera. Note footage on magazine and set indicator in camera to agree.

*6.* Move magazine latch over magazine as far as it will go.

*7.* Close magazine cover.

**Note**

The magazine cover will not close unless the magazine latch has been moved down as far as it will go.

*(b)* SHUTTER AND LENS. — The shutter speeds are 16, 32, and 64 exposures per second, and are controlled by the shutter-speed knob on the camera body. A minus blue filter having approximately the transmission characteristics of Wratton No. 12 is provided with each lens assembly. The calibrations on the lens diaphragm are corrected for use with the filter, therefore the filter should not be removed from the lens except for cleaning.

**CAUTION**

Never change shutter speeds while camera is operating. Keep index marks on shutter-speed knob and on top cover aligned.

(3) REMOVAL.—See paragraph *e*(2)*(a)* preceding.

(3A) INSTALLATION.—Reverse procedure outlined in paragraph *e*(2)*(a)*.

**Note**

There are two sets of four slotted holes in each mounting bracket of the wing pods. One set is approximately 6 degrees below horizontal; the other, approximately 15 degrees. The mean sight line for the right camera is approximately 6 degrees below horizontal; the left camera, 15 degrees below horizontal.

(4) ADJUSTMENT OF SCOOP CAMERA.—The gun-camera mount is adjustable both horizontally and vertically through the camera access door. Three adjustment screws are located at the base of the mount. The forward screw adjusts the camera vertically, the center screw locks the mount in position, and the aft screw adjusts the mount horizontally.

**Note**

The gun camera must be re-aligned whenever the gun sight is changed or resighted, or if the camera becomes loose in its mount.

(5) ADJUSTMENT OF POD GUN CAMERA.—These cameras are adjustable in elevation through a range of five degrees. Loosen the camera mounting stud nuts. Place a gunner's quadrant on the front of the camera, and move the camera in elevation until the gunner's quadrant registers the correct angle. Tighten camera mounting stud nuts.

## 20A. ROCKET INSTALLATION.

*(See figure 243A.)*

Structural and electrical provisions are contained in each wing for the installation of four 5-inch rockets. Electrical arming, jettisoning, and launching control switches are in the cockpit. A ring-type switch on the engine control lever adjusts the gun sight reticle for rocket firing.

Each wing contains provisions for carrying four rockets. These consist of two forward launching posts and four aft launching posts, all hinged to fit flush with the under surface of the wing when rockets are not being carried. Two jettisoning solenoids, and four arming solenoids are mounted inside each wing, approximately above the two launching stations.

Two rockets are carried at each rocket station. The upper rocket is suspended from one forward and two aft posts; the lower rocket is suspended from a forward post on the upper rocket, with the tail fins engaged with the tail fins of the upper rocket.

*a.* FORWARD LAUNCHING POSTS.—Each forward post contains a pair of hooks which are located in the closed position by means of a wedge. The forward hook of the upper rocket is secured in the opening of the hooks by 0.102 brass shear wire. Energizing the jettison solenoid permits the locking wedge to be withdrawn by a spring, dropping the rockets. The forward post is locked in the forward position by pulling down on a serrated tab on the side of the post.

*b.* AFT LAUNCHING POSTS. — Each post incorporates a support pin which is drilled longitudinally to contain the igniter wire. The igniter wire is enclosed in an insulating sleeve, and is connected to a special screw which forms the head of the pin. The aft post is locked in extended position by pulling forward on a shorter pin just above the support pin.

## 21. OXYGEN SYSTEM.

### WARNING

Take every precaution when working with oxygen to see that all clothing, lines, fittings, and equipment are free from oil and grease. Fire or explosion may result when slight traces of oil or grease come in contact with oxygen under pressure. Do not open valves where there is an open flame or an electric arc.


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*Figure 243A — Rocket Installation*

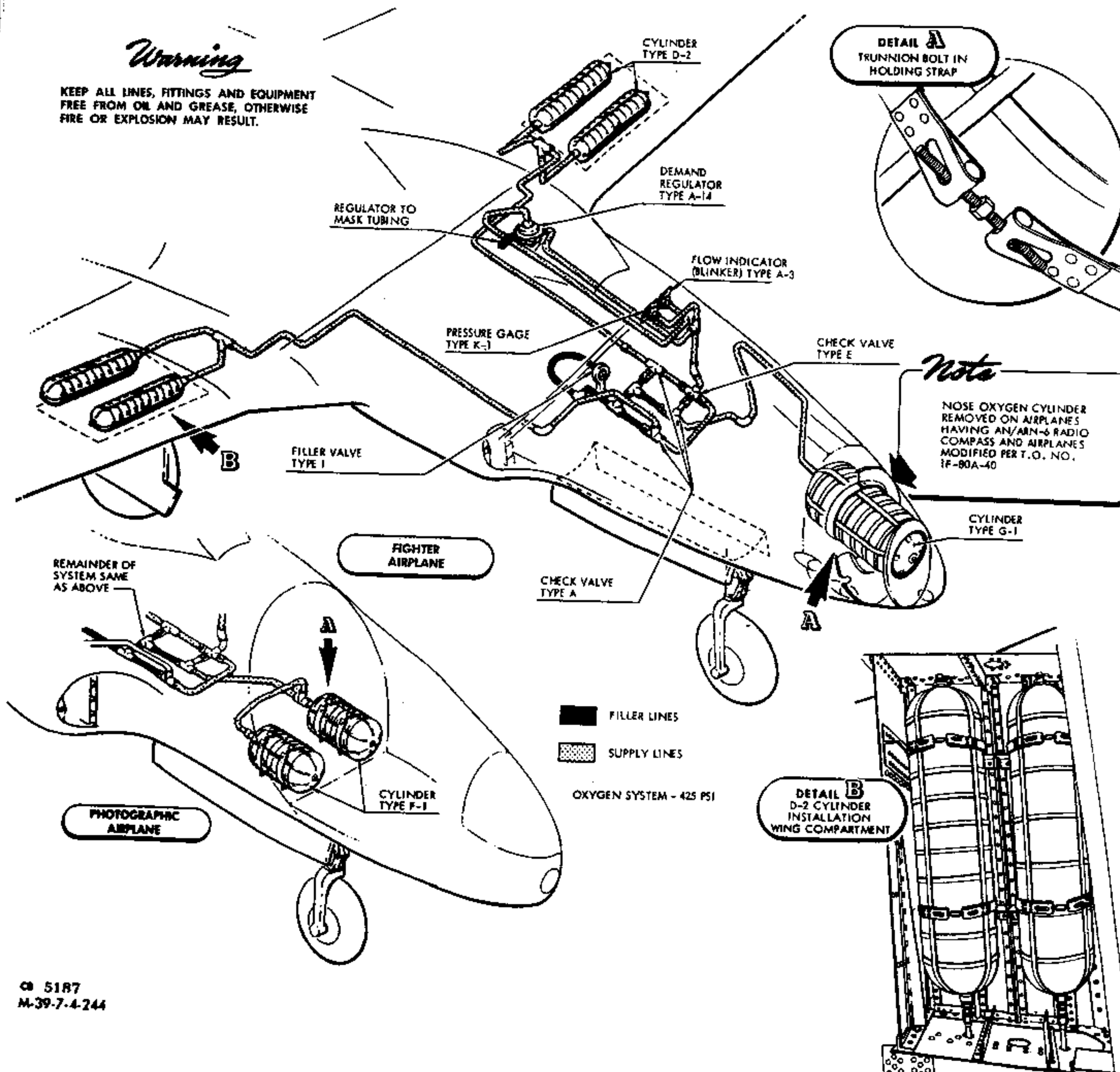



*Figure 244 — Oxygen System*

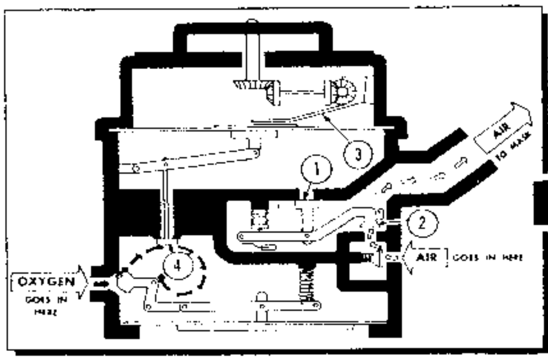
tion to the exhaling valve to see that no accumulation is permitted to form on either the valve seat or the valve flap.

Do not pack an oxygen mask in a duffle bag, or leave it in the airplane where it will be exposed to the sun or weather. Keep mask in the box in which it was originally packed. Do not permit oil or grease to come in contact with any portion of the mask or tubing.

*f.* DEMAND REGULATOR.

*(See figures 244 and 245.).*

(1) DESCRIPTION. — The type A-14 diluter-demand oxygen regulator, mounted on the left shelf of the cockpit, has been developed for use in high-altitude flying. It is essentially a diaphragm-operated flow valve which opens when the pilot inhales and shuts off when

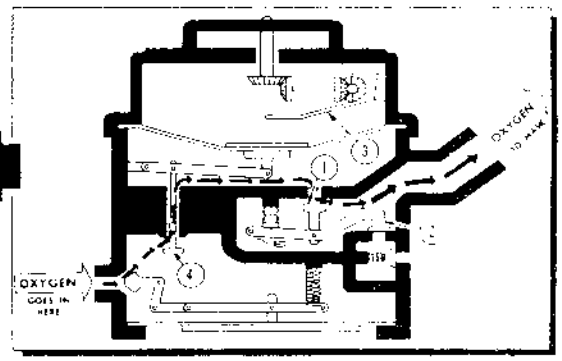


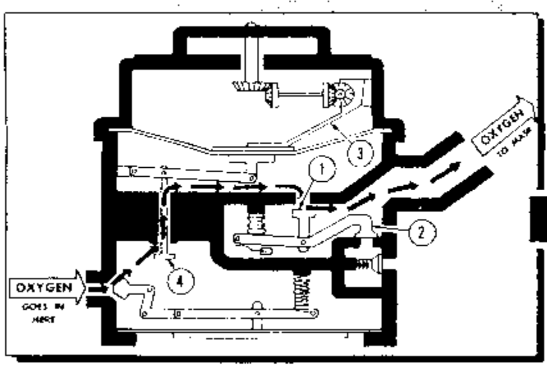

**A**

A-14 REGULATOR OPERATION DURING INHALATION AT SEA LEVEL. OXYGEN DILUTER VALVE (1) IS CLOSED; AIR DILUTER VALVE (2) IS OPEN, AND YOU BREATH AIR ONLY

**B**

REGULATOR OPERATION DURING INHALATION AT 30,000 FEET. AIR DILUTER VALVE (2) IS CLOSED; OXYGEN DILUTER VALVE (1) IS OPEN, AND YOU BREATH 100 PERCENT OXYGEN.




**C**

REGULATOR OPERATION DURING INHALATION WITH PRESSURE BREATHING. SPRING (3) PRESSES DOWN ON DIAPHRAGM OPENING DEMAND VALVE (4) AND FORCING OXYGEN INTO THE MASK UNDER PRESSURE.

**D**

REGULATOR OPERATION DURING EXHALATION WITH PRESSURE BREATHING. AS YOU EXHALE YOU MOMENTARILY RAISE THE PRESSURE IN THE MASK ABOVE THE OXYGEN SUPPLY PRESSURE, FORCING THE DIAPHRAGM UP AGAINST THE SPRING TENSION. THE DEMAND VALVE (4) CLOSES AND NO OXYGEN FLOWS.

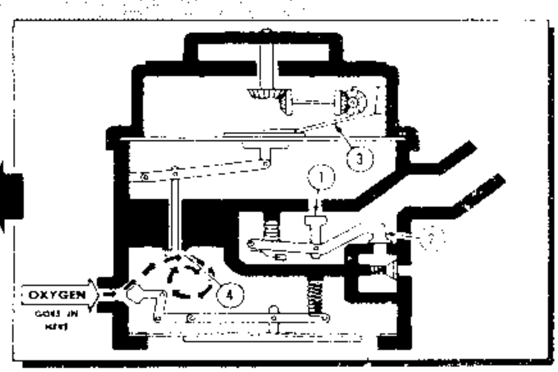



**Figure 245 — Oxygen Regulator Operation**

he exales. The unit is completely automatic in normal operation for all altitudes up to 30,000 feet. As altitude increases above 30,000 feet, the dial control on the front of the regulator must be manually set to be equal to or greater than the reading of the cabin altimeter.

(2) OPERATION. *(See figure 245.)*—Each time the pilot inhales, a small amount of suction is applied to the regulator. This suction is sufficient to deflect the diaphragm which is connected to a valve thus causing the valve to open and oxygen to flow to the mask. As soon as inhalation stops and suction is no longer applied, a spring returns the diaphragm to its original position and the valve is closed.

When the diluter control handle is in the "NORMAL" position the regulator automatically mixes the required amount of oxygen with air at all altitudes up to 30,000 feet. This is accomplished by an aneroid within the regulator which controls an oxygen port and an air port. As altitude increases, the aneroid expands, gradually closing the air port while opening the oxygen port, so that at approximately 30,000 feet the air port is completely closed and the oxygen port is wide open.

When the diluter control handle is turned to "100% OXYGEN" position, the regulator still functions as a demand regulator, but the air port is closed and 100% pure oxygen is supplied at all altitudes.

The dial control on the front of the regulator is marked for critical settings, and as altitude is increased above 30,000 feet, the dial must be turned to the successive positions. These markings indicate oxygen pressures for minimum requirements at the various altitudes, so that the dial setting at any time must be equal to or greater than the reading of the cabin altimeter.

The control dial should be set to "SAFETY" at altitudes between 30,000 and 40,000 feet. The regulator will then supply oxygen to the mask at a pressure very slightly above that of the outside air.

(3) REMOVAL.

*(a)* Discharge oxygen system pressure slowly by turning regulator control dial to "SAFETY."

*(b)* Remove regulator-to-mask tubing and plug regulator outlet.

*(c)* Remove cockpit trim panel below the regulator. (See figure 248.)

*(d)* Working through trim panel opening, disconnect supply line and line to the flow indicator.

*(e)* Remove mounting screws and lift regulator from shelf. Plug remaining openings.

(4) REPAIRS AND ADJUSTMENTS.—Return defective regulator to instrument repair department of control depot.

(5) INSTALLATION (Replacement Regulator).

*(a)* Remove shipping plug from oxygen inlet fitting.

*(b)* Remove plastic dust plug from outlet elbow.

**Note**

When replacing oxygen regulators be sure to use outlet elbow supplied with new regulator. Bendix design A-12 and AN6004-1 regulators have a screen type baffle installed inside outlet elbow which prevents oxygen syphoning. The elbow with baffle installed must not be used with any other type or design regulator as it will restrict oxygen flow of these regulators.

*(c)* Apply oxygen-fitting thread compound. Specification AN-C-86, to inlet nipple. Do not allow compound to run over end of nipple.

## WARNING

Do not use oil, or any material containing oil, on threads, since fire or explosion might occur when such material contacts oxygen under pressure.

*(d)* Set regulator in position on cockpit shelf, and attach 5/16-inch aluminum alloy tubing from oxygen source to nipple. Be sure tubing is free of obstructions, and that it is attached securely and in such a manner as to protect against breakage.

*(e)* Remove brass plug from flow-indicator connection.

*(f)* Apply approved oxygen-fitting thread compound, Specification AN-C-86, to flow-indicator line nipple and insert nipple into regulator boss. Do not allow thread compound to run over end of nipple. Tighten nipple carefully; do not exceed torque of approximately 50 inch-pounds.

*(g)* Attach 5/16-inch aluminum alloy tubing from flow indicator to the nipple. Hold nipple securely with a wrench.

*(h)* Attach regulator to cockpit shelf with its mounting bolts.

*(i)* Attach mask-to-regulator tubing, Specification AN-T-23A, type AN6003, to the oxygen-air outlet with hose clamp supplied with the tubing.

**Note**

The outlet elbow is serrated, and mates with serrations in the regulator body. If it is necessary to change the position of the outlet elbow, remove outlet gland nut from outlet of regulator and remove elbow from regulator. Select desired position of elbow and reinsert serrations into mating serrations of regulator outlet, being sure rubber sealing gasket is in place. Tighten outlet gland nut securely.

(6) TEST AFTER INSTALLATION.

*(a)* Charge oxygen system to a pressure of 425 psi ($\pm$25 psi).

*(b)* Place diluter control in "100% OXYGEN" position.

*(c)* Open trap-door dust cover of the mask-to-regulator tubing on end opposite to that connected to regulator. Place mouth over tube opening and inhale through the tube. A good flow of oxygen should pass through tubing with negligible resistance.

*(d)* Place dial control in "SAFETY" setting. A steady flow of oxygen through regulator-to-mask tubing indicates correct operation of emergency control.

*(e)* Turn dial control to "NORMAL" position and check all line connections for leakage by applying a small amount of NEUTRAL soap solution.

*(f)* Apply a small amount of NEUTRAL soap solution to regulator case at seams and around connections.

**Note**

If a line leak is indicated, make necessary adjustments, but do not tamper with the regulator.

*(g)* Disconnect regulator-to-mask tubing and place a soap film across elbow opening. There must be no swelling of the soap film.

*(h)* Wipe regulator and connections clean of soap solution after tests are complete.

*(i)* With pressure control knob set at "NORMAL" and diluter lever set at "100% OXYGEN", place open end of mask-to-regulator against mouth and blow gently. Any escape of air will indicate a leaky diaphragm, faulty relief valve, faulty air inlet valve,

or leak in mask-to-regulator tubing. If leakage exists, replace faulty components.

**Note**

Blow gently; hard blowing into regulator will unseat second stage relief valve and give false indication of leakage.

*(j)* Install oxygen mask to regulator hose and water manometer to bail-out connection. With mask held tightly against face to prevent leakage of oxygen, set diluter lever at "NORMAL OXYGEN" and take deep breath. While holding breath, turn pressure control knob to each position and note manometer readings. Minimum allowable pressure reading at each setting is listed below. Maximum allowage pressure is 17 inches of water.

| *DIAL SETTING* | *PRESSURE DELIVERED (INCHES OF WATER)* |
|---|---|
| Normal | Same as ambient |
| Safety | 1.25 |
| 41M | 3.5 |
| 43M | 5.5 |
| 45M | 7.5 |
| Above 45M | 11.5 |

*g.* FLOW INDICATOR.

(1) DESCRIPTION. — The A-3 flow indicator blinks open and shut with each breathing cycle of the user, and thus gives visual indication that oxygen is flowing from the regulator when the dial control is set in "NORMAL" position. However, it does not indicate that sufficient oxygen is flowing. Should the blinker fail to move while the system is in normal operation at altitude, it may be an indication of failure in the demand mechanism of the regulator, and the control of the regulator should be turned to "SAFETY" position immediately.

The flow indicator is mounted at the left end of the instrument sub-panel.

(2) REMOVAL.

*(a)* Discharge oxygen system pressure slowly by turning regulator control dial to "SAFETY."

*(b)* Disconnect and plug tubing connections.

*(c)* Remove four mounting bolts and remove indicator.

(3) INSTALLATION. — Reverse removal procedure.

**Note**

If tape was used for sealing tubing, clean all adhesive from surfaces.

*h.* PRESSURE GAGE.

(1) DESCRIPTION. — The oxygen pressure gage indicates the pressure in pounds per square inch of oxygen in the supply cylinders. This gage is mounted adjacent to the flow indicator.

(2) REMOVAL.

*(a)* Discharge oxygen system pressure slowly by turning regulator control dial to "SAFETY."

*(b)* Disconnect and plug tubing.

*(c)* Remove mounitng bolts and lift gage from bracket.

(3) INSTALLATION. — Reverse removal procedure.

## WARNING

Be sure all parts of the gage and all tubing are free from oil, grease, or other foreign matter.

*i.* CYLINDERS. *(See figure 244.)*

(1) DESCRIPTION.—The oxygen supply is contained in shatter-proof cylinders. One type G-1 cylinder is mounted in the nose of the fighter airplanes forward of the ammunition trays, or two type F-1 cylinders are mounted under the radio rack in the camera compartment of photographic airplanes. Airplanes modified per T. O. No. 1F-80A-40 and fighter airplanes having the AN/ARN-7 radio compass loop installed do not have a nose cylinder. Four type D-2 cylinders are mounted in the wing (both types of airplanes), two on each side of the airplane between wing stations 34 and 63. The G-1 cylinder has an internal volume of 2100 cubic inches; the D-2 cylinder has an internal volume of 500 cubic inches; and the F-1 cylinder has an internal volume of 1000 cubic inches. Access to the G-1 cylinders is through the armament compartment; to the D-2 cylinders is through removable panel No. 6 (figure 7); to the F-1 cylinder through the camera compartment.

(2) REMOVAL.—Do not remove cylinders unless they are damaged or contaminated.

*(a)* GENERAL.

*1.* Discharge oxygen system pressure slowly by turning regulator control dial to "SAFETY."

*2.* Disconnect and plug lines at tube fittings.

*3.* Install pipe plugs in cylinder fittings to prevent entrance of dust, moisture, or other foreign matter.

(b) NOSE CYLINDER.

1. EARLY FIGHTER AIRPLANES.

a. Prop armament compartment doors open by means other than rods provided in the airplane. This is necessary because clips for holding armament doors open will come out with the vertical support posts to be removed in step c following.

b. Remove ammunition boxes.

c. Remove four forward ammunition box support posts. Each post is held in place by two bolts, one at the top and one at the bottom.

d. Disconnect static pressure tubing at "T" fitting, and swing tubing out of the way.

e. Loosen cylinder support strap by unscrewing trunnion bolt, and remove cylinder from bracket. Cylinder weighs approximately 19 pounds.

2. PHOTOGRAPHIC AIRPLANES.

a. Open the camera compartment hood.

b. Remove the radio junction boxes and the radio rack.

c. Break the safety wire and disconnect the straps holding the cylinders in place. Remove cylinders.

*(c)* WING CYLINDERS.—Remove access panel No. 6 (figure 7). Loosen cylinder support straps by unscrewing trunnion bolts, and remove cylinders.

(3) MAINTENANCE.

*(a)* Maintain at least 50 psi oxygen pressure in the cylinders at all times to prevent accumulation of moisture due to "breathing" of cylinders.

*(b)* Keep cylinders clean and dry, inside and outside.

*(c)* Paint outside surface with zinc chromate primer, Specification AN-TT-P-656, as a protection against corrosion.

*(d)* See paragraph *d* preceding for filling procedure.

*(e)* For maintenance repairs requiring disassembly, return cylinders to repair depot.

(4) INSTALLATION.—Reverse removal procedure.

**WARNING**

Use only approved sealing compound, Specification AN-C-86, for sealing threads at connections. Do not use red lead oxide or paint.

*j.* FILLER VALVE AND BRITISH ADAPTER.—A filler valve is provided which will fit all cylinders and all filler hose on U. S. Army Air Forces oxygen-supply equipment. Early airplanes have a British adapter attached by a chain to the filler box, which allows quick adaptation of British oxygen equipment. A plug with a rubber washer fits into the filler valve to keep it clean when not in use.

The filler valve is located on the left side of the airplane, in the forward part of the sub-cockpit area. Access to the valve is through the nose-gear wheel well.

*k.* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Loss of system pressure. | Leak in system. (See note following.) | Check tubing, fittings, and connections. |
| | Leaking or damaged cylinder. | Replace cylinder. |
| | Check valves not closing or are installed backward. | Inspect check valves and reverse or replace. |
| Oxygen duration too short. | Leak in system. | Check system tubing. |
| | Faulty check valve. | Replace valve. |
| | Faulty cylinder. | Replace cylinder. |
| | Check valve sticking or installed backward preventing filling a cylinder (cylinder does not heat during filling). | Inspect filler lines and check valves. Reverse or replace check valve. |
| | Check valve sticking or installed backward preventing flow to regulator. | Inspect supply lines and valve; reverse or replace valve. |
| Pilot receives insufficient oxygen at high altitudes. | Regulator functioning improperly. | Replace regulator. |
| | Mask does not fit. | Refit or replace mask. |
| | Flapper valve in mask not operating properly. | Check mask exhaust valve. |
| | Flexible tubing to mask crushed or kinked. | Replace tubing if necessary. |

NOTE

When airplane ascends from warm temperatures of ground level to low temperatures of high altitudes, the gage will show a drop in cylinder pressure. This does not indicate a loss of oxygen but only that drop in temperature has caused volume of gas to decrease in pressure.

*l.* LEAKAGE TEST OF OXYGEN SYSTEM.

(1) Inspect filler line check valves for leakage by charging oxygen system to at least 50 psi; then seat check valves in manifold by inserting AN6027-1 filler valve adapter into filler valve. Allow sufficient time for filler line to drain. Draw film of pure soap solution over open end of adapter. If film is broken within 10 seconds, a leaky check is indicated; isolate and replace faulty check valve.

(2) Charge the oxygen system to a pressure between 425 and 450 psi and allow it to cool for one hour.

(3) Record the oxygen gage pressure and the air temperature. After a 12-hour period, record the air temperature again. If the temperature has changed, note the change in degrees and whether it has increased or decreased. Refer to the following table and convert this temperature change into a pressure correction.

(4) Correct the first pressure reading by adding the correction if the temperature has risen, or subtracting the correction if the temperature has fallen. This will give the correct pressure.

(5) Compare the corrected pressure with the actual pressure reading taken 12 hours after the first. If the actual pressure has dropped 25 or more psi below the corrected pressure, a dangerous leakage is indicated, and until the leakage has been corrected, flights above 10,000 feet are permissible only with the approval of the Personal Equipment Officer.

(6) If the system leakage test shows leakage is within limits, the system should be charged to 425 psi.

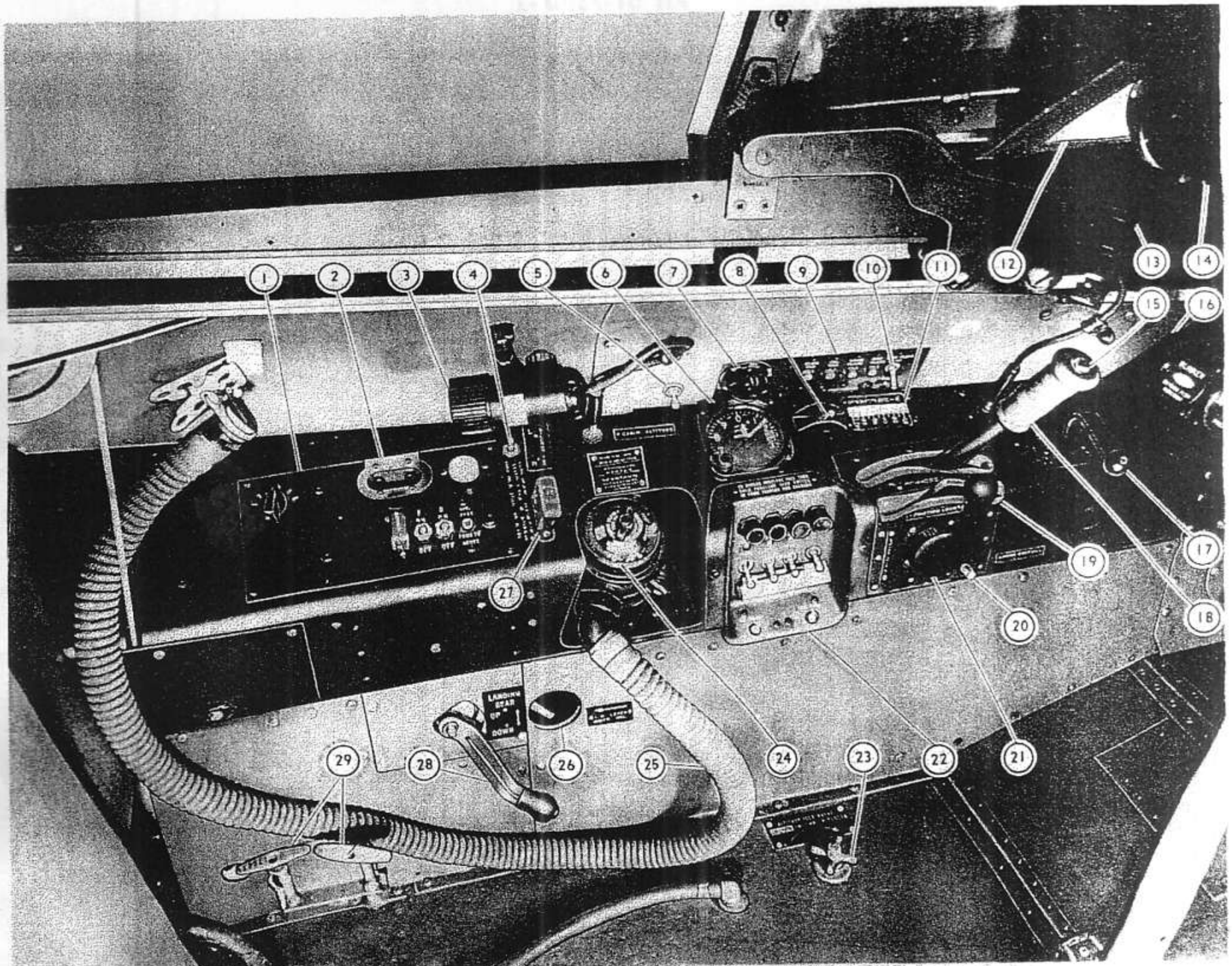
Table for Correction of Pressure During Leak Test.

| *Change in Temperature* | *Pressure Correction* | *Change in Temperature* | *Pressure Correction* |
|---|---|---|---|
| 5°F | 4 psi | 30°F | 24 psi |
| 10°F | 8 psi | 35°F | 28 psi |
| 15°F | 12 psi | 40°F | 32 psi |
| 20°F | 16 psi | 45°F | 36 psi |
| 25°F | 20 psi | 50°F | 40 psi |

**Note**

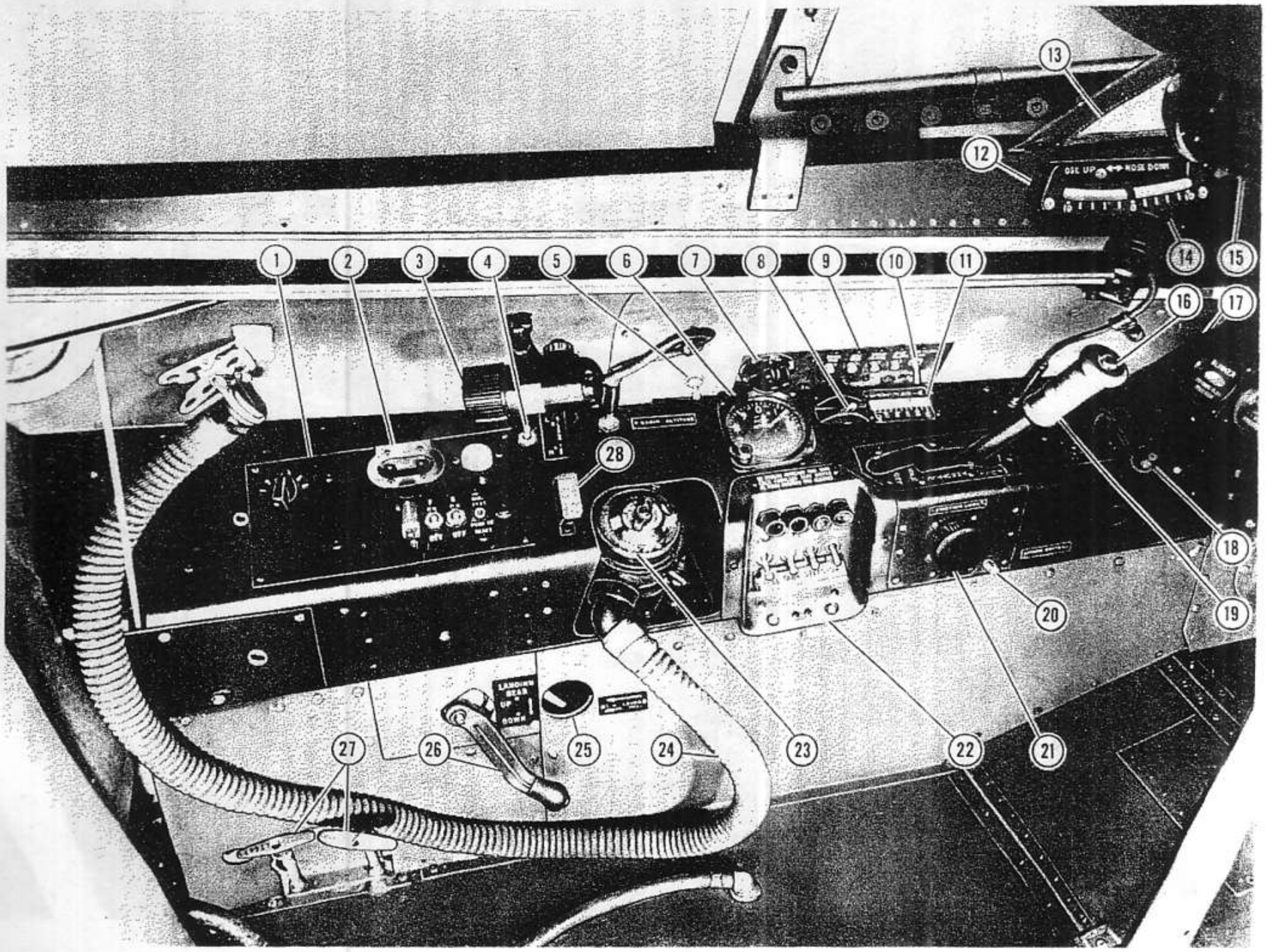
If the temperature has risen, the pressure correction will be plus (added). If the temperature has dropped, the pressure correction will be minus (subtracted).

*m.* PURGING OXYGEN SYSTEM. Purge oxygen system by filling and depleting at least three times. It will be necessary to purge system should foreign matter or moisture enter. This may occur if lines and fittings are not plugged and capped when disconnected.



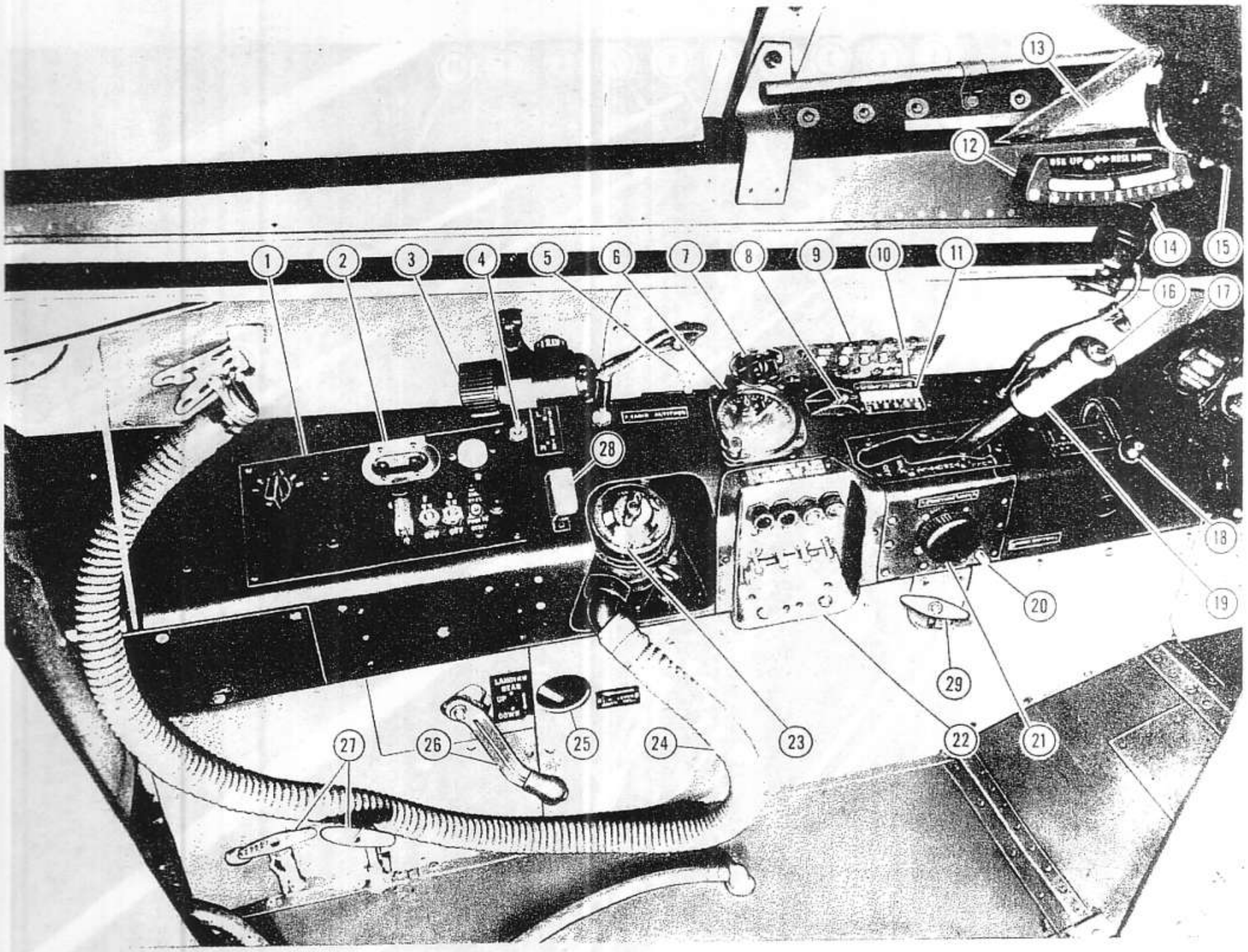

| | | | |
|---|---|---|---|
| 1. | IDENTIFICATION RADIO CONTROL PANEL | 16. | INSTRUMENT SUB-PANEL |
| 2. | DESTRUCTOR SWITCH | 17. | AIR CONDITIONING CONTROL LEVER |
| 3. | COCKPIT LIGHT | 18. | ENGINE CONTROL LEVER (THROTTLE) |
| 4. | AILERON TAB SWITCH | 19. | ENGINE CONTROL LEVER (STOPCOCK) |
| 5. | EMERGENCY FUEL PUMP SWITCH | 20. | WARNING HORN SWITCH |
| 6. | CABIN ALTIMETER | 21. | CONTROL LEVER FRICTION LOCK |
| 7. | FLUORESCENT LIGHT CONTROL | 22. | FUEL TANK SELECTOR PANEL |
| 8. | WING FLAPS CONTROL SWITCH | 23. | ALTITUDE IDLE VALVE |
| 9. | CIRCUIT PROTECTORS PANEL | 24. | OXYGEN REGULATOR |
| 10. | DIVE FLAPS OPERATING SWITCH | 25. | REGULATOR-TO-MASK TUBING |
| 11. | WING FLAPS POSITION INDICATOR | 26. | ALIGHTING GEAR EMERGENCY RELEASE LEVER |
| 12. | INSTRUMENT GLARE SHIELD | 27. | FUEL BYPASS SWITCH |
| 13. | FLUORESCENT LIGHT | 28. | ALIGHTING GEAR CONTROL LEVER |
| 14. | GUN SIGHT | 29. | EMERGENCY BOMB RELEASE HANDLES |
| 15. | MICROPHONE SWITCH | | |

LEFT SIDE, P-80A-1 AIRPLANES
***Figure 246 (Sheet 1 of 4 Sheets) — Cockpit Interior***




| | | | |
|---|---|---|---|
| 1. | IDENTIFICATION RADIO CONTROL PANEL | 15. | GUN SIGHT (FIGHTER AIRPLANES ONLY) |
| 2 | DESTRUCTOR SWITCH | 16. | MICROPHONE SWITCH |
| 3. | COCKPIT LIGHT | 17. | INSTRUMENT SUB-PANEL |
| 4. | AILERON TAB SWITCH | 18. | AIR CONDITIONING CONTROL LEVER |
| 5. | EMERGENCY FUEL PUMP SWITCH | 19. | ENGINE CONTROL LEVER (THROTTLE) |
| 6. | CABIN ALTIMETER | 20. | WARNING HORN SWITCH |
| 7. | FLUORESCENT LIGHT CONTROL | 21. | CONTROL LEVER FRICTION LOCK |
| 8. | WING FLAPS CONTROL SWITCH | 22. | FUEL TANK SELECTOR PANEL |
| 9. | CIRCUIT PROTECTORS PANEL | 23. | OXYGEN REGULATOR |
| 10. | DIVE FLAPS OPERATING SWITCH | 24. | REGULATOR-TO-MASK TUBING |
| 11. | WING FLAPS POSITION INDICATOR | 25. | ALIGHTING GEAR EMERGENCY RELEASE LEVER |
| 12. | INCLINOMETER (PHOTOGRAPHIC AIRPLANES ONLY) | 26. | ALIGHTING GEAR CONTROL LEVER |
| 13. | INSTRUMENT GLARE SHIELD | 27. | EMERGENCY BOMB RELEASE HANDLES |
| 14. | FLUORESCENT LIGHT | 28. | FUEL BYPASS SWITCH. |

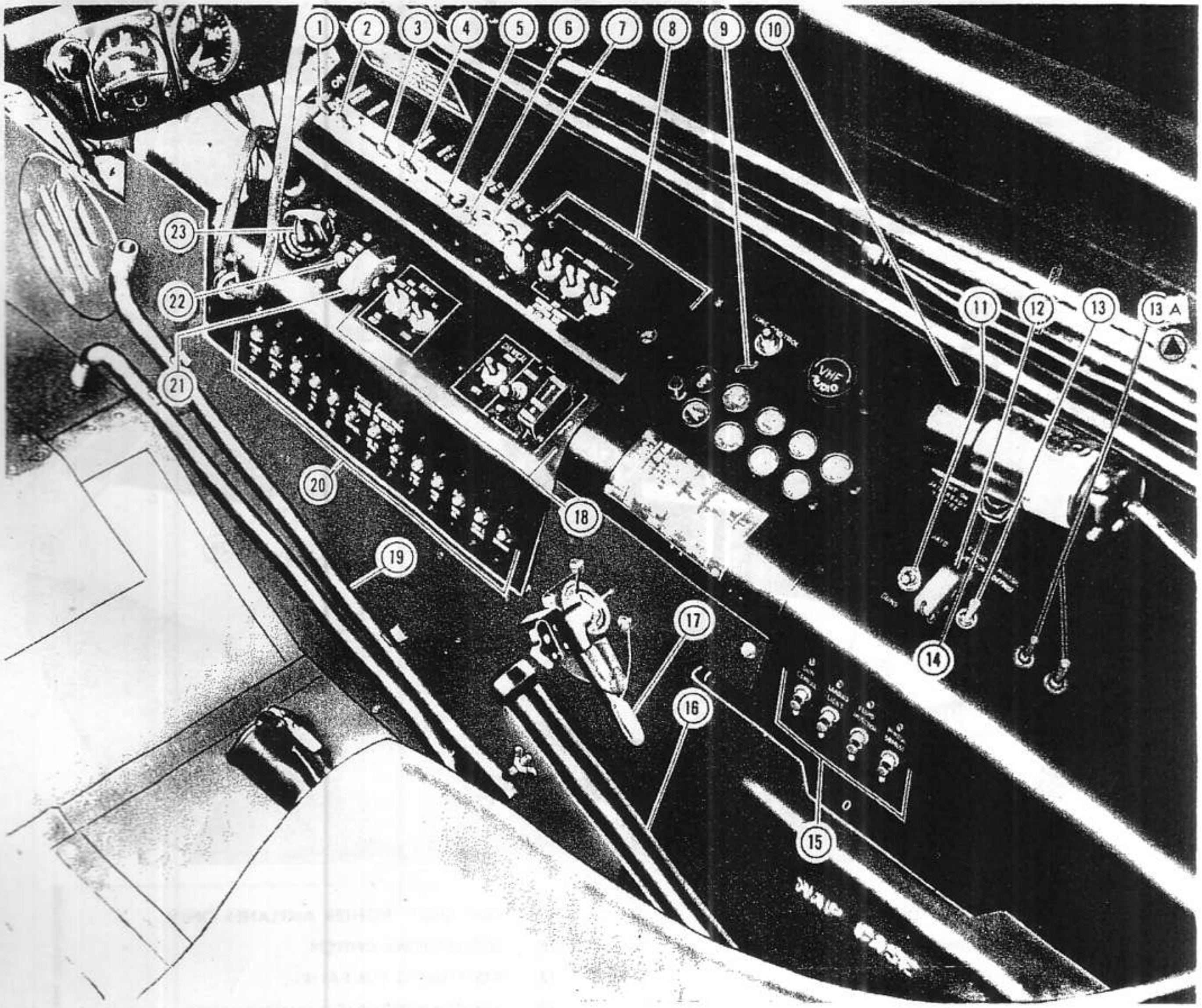
LEFT SIDE, P-80A-5 AND FP-80A-5 AIRPLANES
*Figure 246 (Sheet 2 of 4 Sheets) — Cockpit Interior*




1. IDENTIFICATION RADIO CONTROL PANEL
2. DESTRUCTOR SWITCH
3. COCKPIT LIGHT
4. AILERON TAB SWITCH
5. EMERGENCY FUEL PUMP SWITCH
6. CABIN ALTIMETER
7. FLUORESCENT LIGHT CONTROL
8. WING FLAPS CONTROL SWITCH
9. CIRCUIT PROTECTORS PANEL
10. DIVE FLAPS OPERATING SWITCH
11. WING FLAPS POSITION INDICATOR
12. INCLINOMETER (PHOTOGRAPHIC AIRPLANES ONLY)
13. INSTRUMENT GLARE SHIELD
14. FLUORESCENT LIGHT
15. GUN SIGHT (FIGHTER AIRPLANES ONLY)
16. MICROPHONE SWITCH
17. INSTRUMENT SUB PANEL
18. AIR CONDITIONING CONTROL LEVER
19. ENGINE CONTROL LEVER (THROTTLE)
20. WARNING HORN SWITCH
21. CONTROL LEVER FRICTION LOCK
22. FUEL TANK SELECTOR PANEL
23. OXYGEN REGULATOR
24. REGULATOR TO MASK TUBING
25. ALIGHTING GEAR EMERGENCY RELEASE LEVER
26. ALIGHTING GEAR CONTROL LEVER
27. EMERGENCY BOMB RELEASE HANDLES
28. FUEL BYPASS SWITCH
29. JATO JETTISON LEVER

**LEFT SIDE, P-80A-10 AND FP-80A-10 AIRPLANES**

***Figure 246 (Sheet 2A of 4 Sheets) — Cockpit Interior***

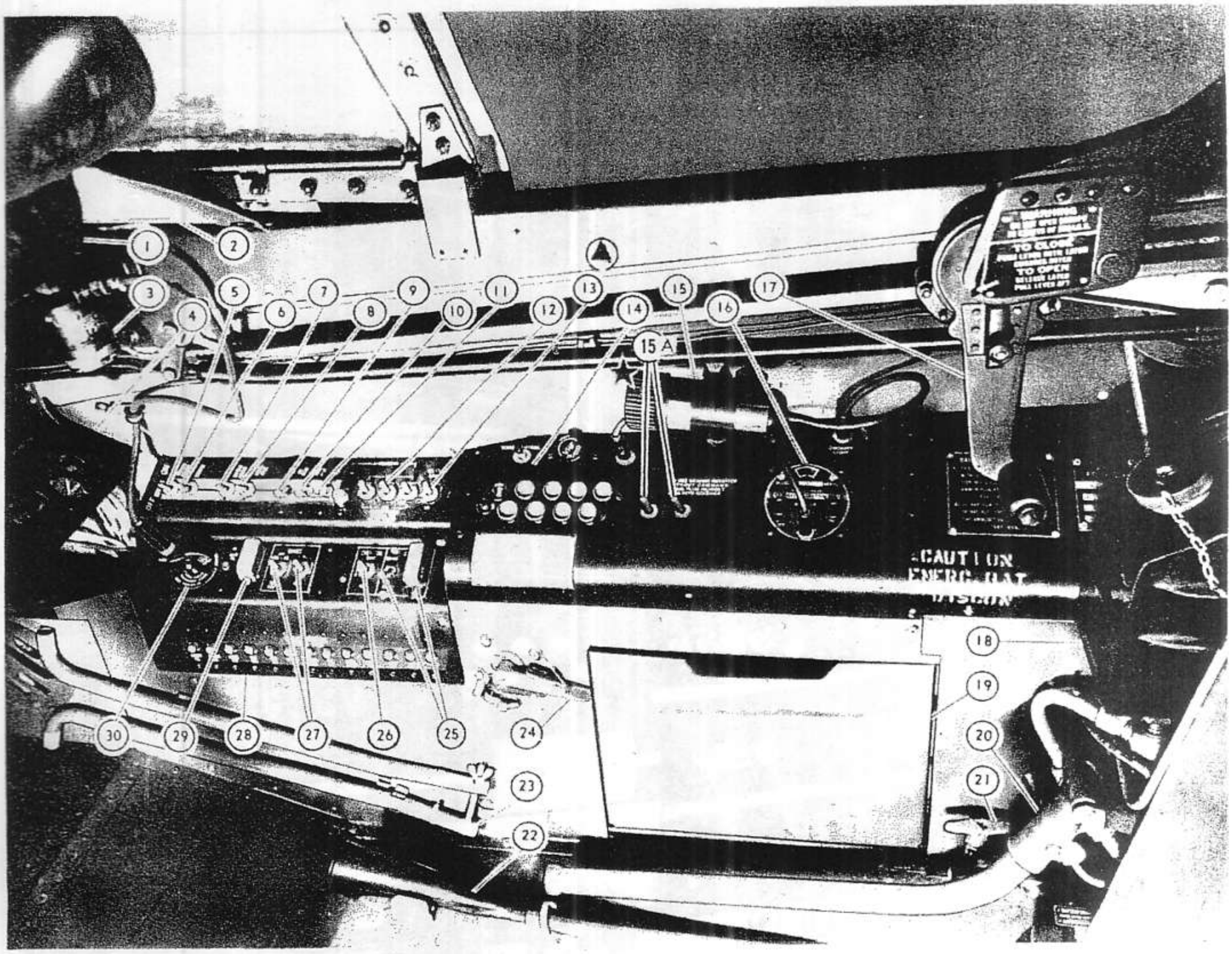



1. IGNITION BOOSTER SWITCH
2. STARTER SWITCH
3. BATTERY MASTER SWITCH
4. GENERATOR SWITCH
5. OIL HEATER SWITCH
6. PITOT HEATER SWITCH
7. LANDING LIGHT SWITCH
8. RECOGNITION AND NAVIGATION LIGHT SWITCHES
9. COMMAND RADIO CONTROLS
10. COCKPIT LIGHT
11. JATO-GUNS SWITCH
12. FLUID INJECTION SWITCH
13. WINDSHIELD DEFROSTER SWITCH
▲ 13A. NAVIGATION AND POSITION LIGHTS SWITCHES
14. JATO CIRCUIT WARNING LIGHT
15. CIRCUIT PROTECTORS
16. EMERGENCY HYDRAULIC SYSTEM HAND PUMP
17. ALIGHTING GEAR EMERGENCY SELECTOR VALVE
18. ARMAMENT SWITCHES
19. SURFACE CONTROLS LOCK (STOWED)
20. CIRCUIT PROTECTORS PANEL
21. AILERON BOOSTER SWITCH
22. RANGE RECEIVER CIRCUIT PROTECTOR
23. FLUORESCENT LIGHT CONTROL

▲ ADDED (AF DWG 50H7883)

RIGHT SIDE, F-80A-10 AND RF-80A-10 AIRPLANES

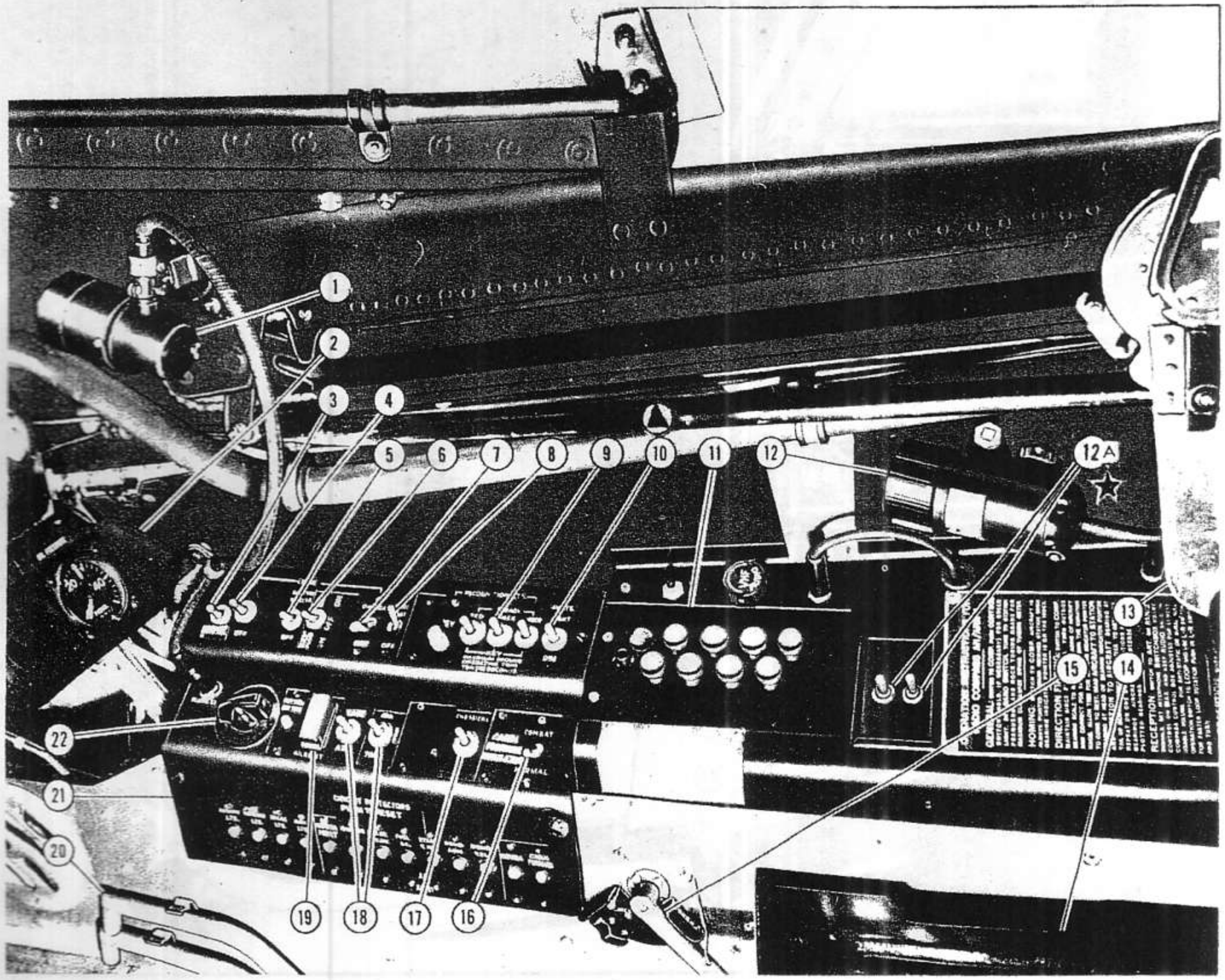
*Figure 246 (Sheet 2B of 4 Sheets) — Cockpit Interior*




| | |
|---|---|
| 1. GUN SIGHT | ★ 15A. NAVIGATION AND POSITION LIGHTS SWITCHES |
| 2. GLARE SHIELD | 16. BEACON RECEIVER CONTROL (P-80A-1 AND EARLY P-80A-5 AIRPLANES) |
| 3. FLUORESCENT LIGHT | 17. CANOPY INSIDE OPERATING HANDLE |
| 4. INSTRUMENT SUB-PANEL | 18. EMERGENCY HYDRAULIC SYSTEM RESERVOIR |
| 5. IGNITION BOOSTER SWITCH | 19. MAP CASE |
| 6. STARTER SWITCH | 20. EMERGENCY HYDRAULIC SYSTEM HAND PUMP |
| 7. BATTERY MASTER SWITCH | 21. EMERGENCY BATTERY DISCONNECT |
| 8. GENERATOR SWITCH | 22. PILOT'S RELIEF TUBE |
| 9. OIL HEATER SWITCH | 23. SURFACE CONTROLS LOCK (STOWED) |
| 10. PITOT HEATER SWITCH | 24. ALIGHTING GEAR EMERGENCY SELECTOR VALVE |
| 11. LANDING LIGHT SWITCH | 25. GUNNERY CONTROL SWITCHES |
| 12. RECOGNITION LIGHT SWITCHES | 26. CHEMICAL TANK SELECTOR SWITCH |
| ▲13. NAVIGATION LIGHTS SWITCH | 27. BOMB CONTROL SWITCHES |
| 14. COMMAND RADIO CONTROLS | 28. CIRCUIT PROTECTORS PANEL |
| 15. COCKPIT LIGHT | 29. AILERON BOOSTER SWITCH (P-80A-5 AIRPLANES ONLY) |
| ▲ DELETED (AF DWG 50H7883) | 30. FLUORESCENT LIGHT CONTROL |
| ★ ADDED (AF DWG 50H7883) | |

RIGHT SIDE, F-80A-1 AND F-80A-5 AIRPLANES

*Figure 246 (Sheet 3 of 4 Sheets) — Cockpit Interior*




1. FLUORESCENT LIGHT
2. INSTRUMENT SUB-PANEL
3. IGNITION BOOSTER SWITCH
4. STARTER SWITCH
5. BATTERY MASTER SWITCH
6. GENERATOR SWITCH
7. OIL HEATER SWITCH
8. PITOT HEATER SWITCH
9. RECOGNITION LIGHT SWITCHES
▲10. NAVIGATION LIGHTS SWITCH
11. COMMAND RADIO CONTROLS
12. COCKPIT LIGHT
★ 12A. NAVIGATION AND POSITION LIGHTS SWITCHES
13. CANOPY INSIDE OPERATING HANDLE
14. MAP CASE
15. ALIGHTING GEAR EMERGENCY SELECTOR VALVE
16. CABIN PRESSURE REGULATOR SWITCH
17. CHEMICAL TANK SELECTOR SWITCH
18. BOMB CONTROL SWITCHES
19. AILERON BOOSTER SWITCH
20. SURFACE CONTROLS LOCK (STOWED)
21. CIRCUIT PROTECTORS PANEL
22. FLUORESCENT LIGHT CONTROL

▲ DELETED (AF DWG 50H7883)
★ ADDED (AF DWG 50H7883)

RIGHT SIDE, RF-80A-5 AIRPLANES

*Figure 246 (Sheet 4 of 4 Sheets) — Cockpit Interior*

## 22. FURNISHINGS AND MISCELLANEOUS EQUIPMENT.

*(See figure 246.)*

*a.* PILOT'S SEAT.

(1) DESCRIPTION.—The pilot's seat type AN-7505, is formed from magnesium sheet and is mounted on a tubular frame. The seat assembly is mounted to the aft armor plate. A handle located on the right side of the seat is provided for height adjustment, and a release for the shoulder harness is on the lower left side. A shoulder harness, type B-15, and a safety belt, type B-14, are included with the seat assembly. On later airplanes an inertia lock is provided in connection with the shoulder harness. A cable, reel, and ratchet assembly is attached to the back of the seat, near the floor. The cable is fastened to the shoulder harness and reels in or out as the pilot moves forward or backward. When the airplane is pulling out of a dive with a minimum of 2½ "Gs," the ratchet engages, stopping further release of the cable and preventing forward movement of the pilot. When the pull of gravity stops, a handle to the left of the pilot's seat permits the pilot to unlock the ratchet mechanism.

On early airplanes a "G" suit valve is attached to the left side of the seat. Later airplanes have the "G" valve mounted aft of the pilot's seat armor plate with a tube extending from the valve to a bracket on the left side of the seat. The seat is adjustable in both fore-and-aft and vertical directions.

(2) REMOVAL.

*(a)* Disconnect plumbing lines for "G" valve and for relief tube.

*(b)* Withdraw two quickly removable pins from brackets at either side at the top of the seat back.

*(c)* Lift seat from the airplane.

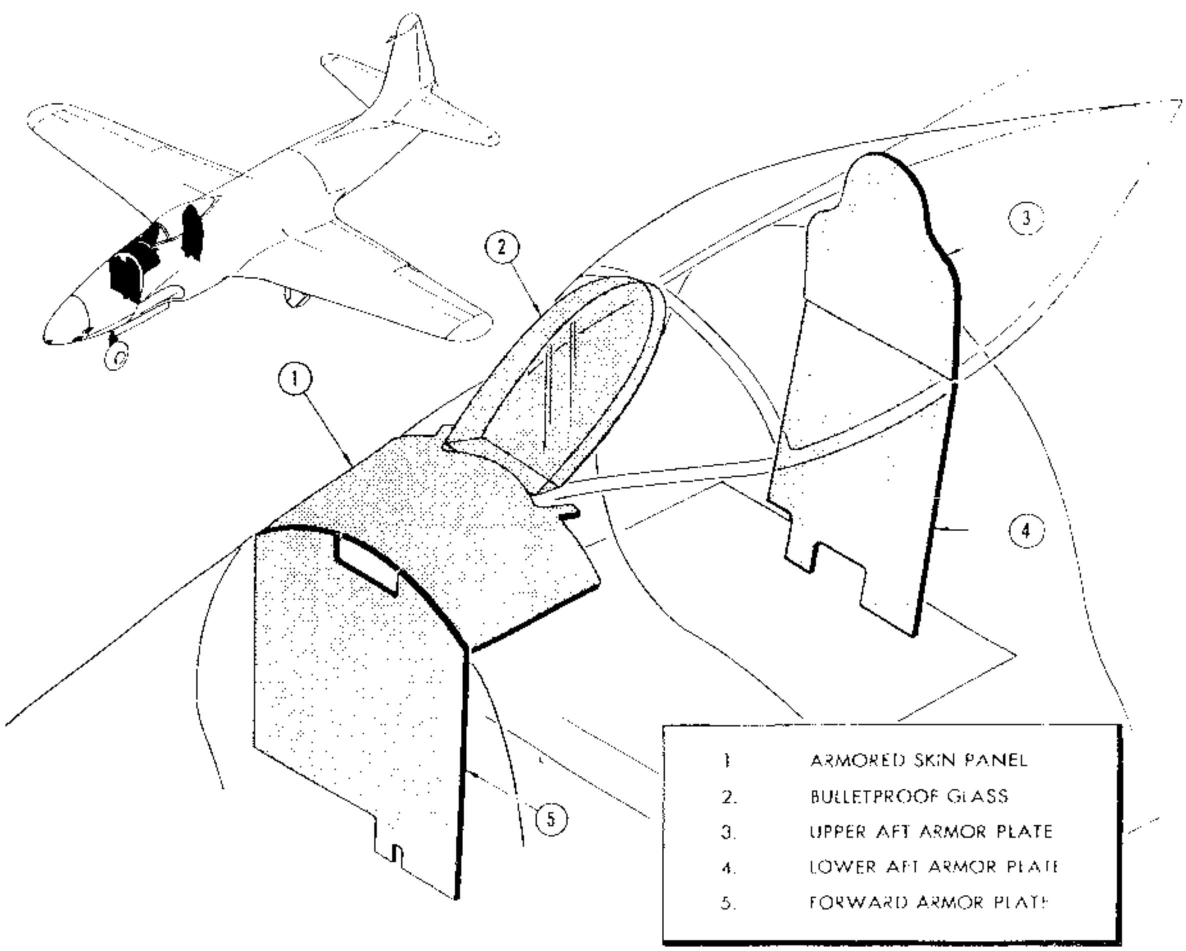



*Figure 247 — Armor Plate*

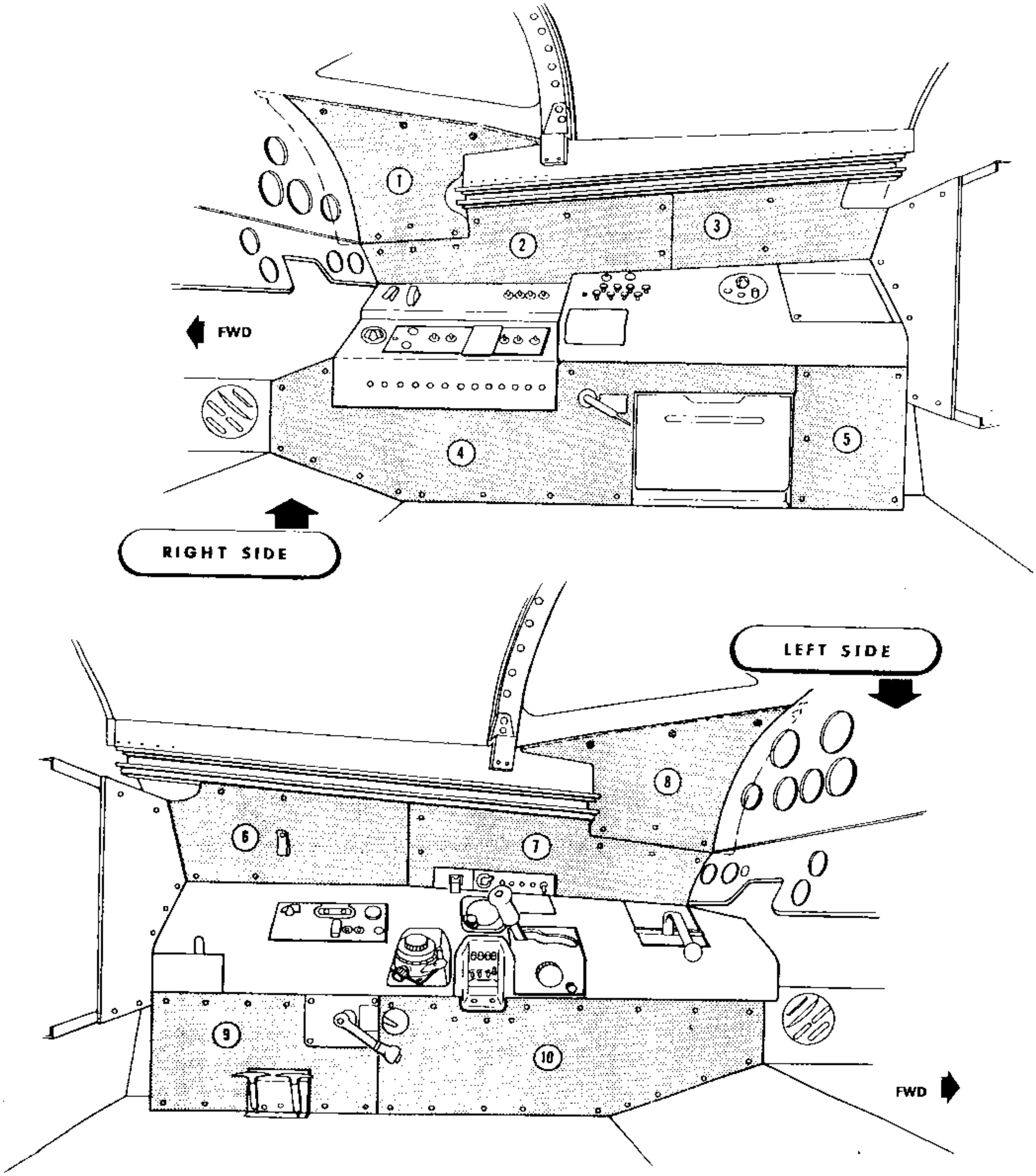



*Figure 248 — Cockpit Trim Panels*

*b.* ARMOR PLATE. *(See figure 247.)*—The pilot is protected from gun fire by armor plate and bulletproof glass. For information on the removal of the bulletproof glass, see paragraph 3*c*(4), this section.

Front armor protection consists of a skin panel of 1/4-inch hard clad aluminum alloy on the top of the fuselage mid section immediately forward of the windshield, and a sheet of armor plate mounted on the front of the bulkhead at station 103. The armor plate is 1/4-inch face-hardened steel, Ordnance Department Specification AN-OS-2.

Rear armor protection is a welded assembly fabricated from two pieces of steel plate. The upper plate extends from behind the pilot's head down approximately 19 inches to the weld. This plate is 3/8-inch face-hardened steel, Ordnance Department Specification AN-OS-2. From the weld to the bottom of the seat, the material is 1/4-inch homogeneous steel, Ordnance Department Specification AN-OS-1.

In order to remove the front armor plate, the command radio, radio rack, and the two brake reservoirs must be removed. The seat must be removed to permit removal of the aft armor plate.

*c.* RELIEF TUBE.—A specially designed horn is held in a bracket under the right front corner of the pilot's seat. A manually controlled valve in the horn prevents loss of cockpit pressure when the equipment is not in use. Rubber tubing extends under the seat, through the cockpit floor, and connects to an aluminum alloy tube which vents overboard.

*d.* MAP CASE.—A case for stowage of maps and flight report holder is built into the shelf on the right side of the cockpit.

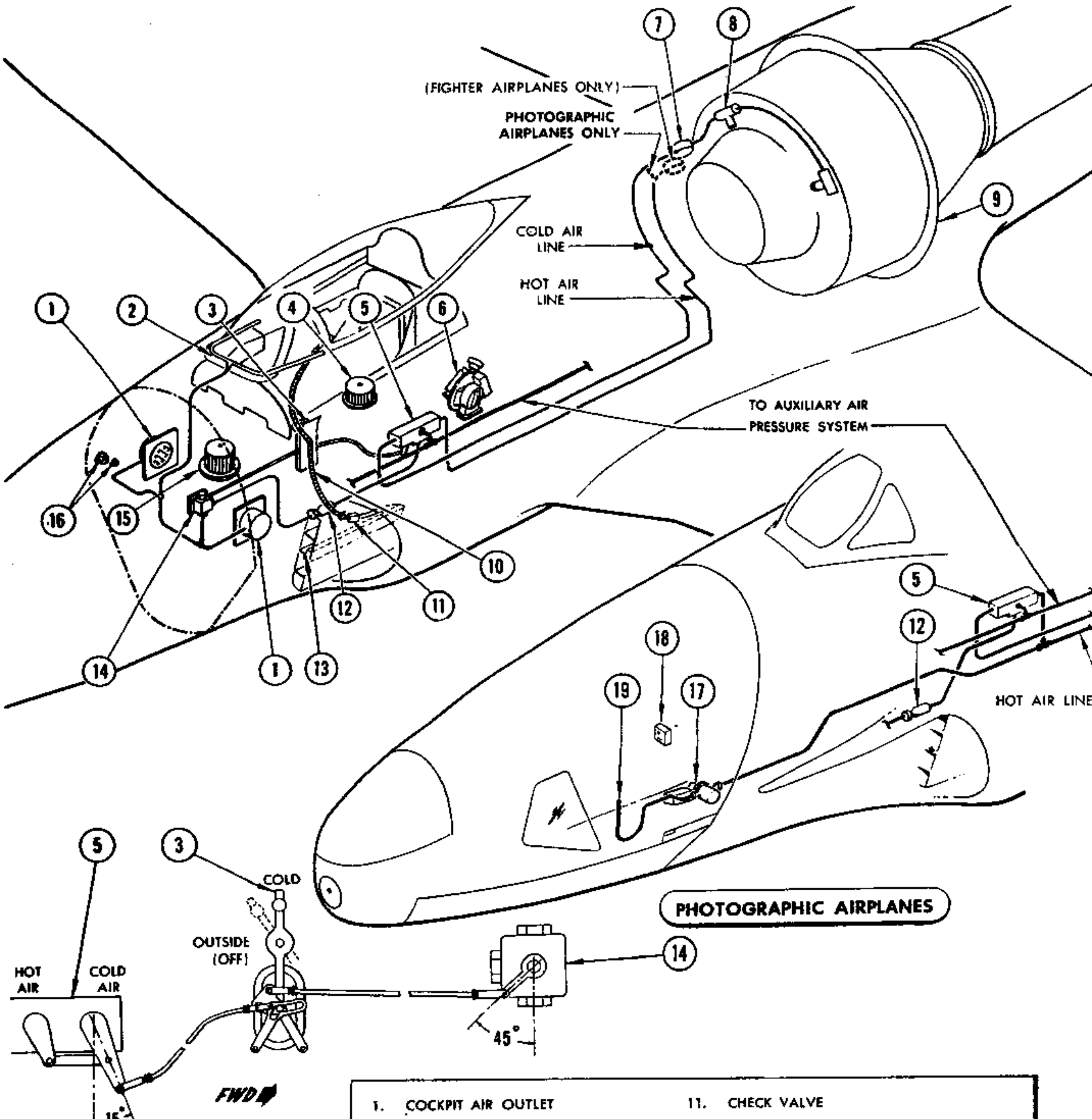
*e.* DATA CASE.—On fighter airplanes, technical orders are stowed in a case installed in the right side of the armament compartment. The case is fastened to the airplane structure above the armorer's tool kit. On photographic airplanes, the data case is in the forward section of the camera compartment hood.

*f.* COCKPIT TRIM PANELS. *(See figure 248.)*—The trim panels are fastened to the airplane structure with screws. The two panels which fair into the ends of the instrument panel are .020 24S-T Alclad sheet. The remaining panels above and below the cockpit side shelves are 1/32-inch dark green phenolic resin sheet, Specification HH-P-256.

Removal of the cockpit trim panels gives access to plumbing lines and electrical wiring which are routed along the sides of the cockpit.

*g.* INSTRUMENT GLARE SHIELD.—For night flying, a shield of waterproof duck, dyed black, is provided for glare protection on the instrument panel. The shield is installed directly over the gun-sight mounting bracket forward of the gun sight, and attaches to the main instrument panel at two points, and to three points on each side of the fuselage directly below the windshield defroster tube.

*h.* REAR VIEW MIRROR.—A curved glass mirror enclosed in a metal case is mounted to the windshield frame, and is adjustable in a vertical direction.




| | | | |
|---|---|---|---|
| 1. | COCKPIT AIR OUTLET | 11. | CHECK VALVE |
| 2. | DEFROSTER OUTLET | 12. | FLOW CONTROL VALVE (EARLY AIRPLANES) |
| 3. | AIR CONDITIONING CONTROL | 13. | OUTSIDE AIR SCOOP |
| 4. | VACUUM RELIEF VALVE | 14. | AIR SELECTOR VALVE |
| 5. | HEAT CONTROL VALVE | 15. | PRESSURE RELIEF VALVE |
| 6. | CABIN PRESSURE REGULATOR | 16. | GROUND TEST FITTINGS |
| 7. | QUICK DISCONNECT FITTINGS | 17. | CAMERA COMPT HEAT CONTROL VALVE |
| 8. | COMPRESSED AIR OUTLETS | 18. | THERMOSTAT |
| 9. | ENGINE | 19. | HOT AIR OUTLET |
| 10. | COLD AIR BLAST TUBE | | |

*Figure 249 — Heating, Cooling and Pressurization System, P-80A-1, P-80A-5, and FP-80A-5 Airplanes Only*

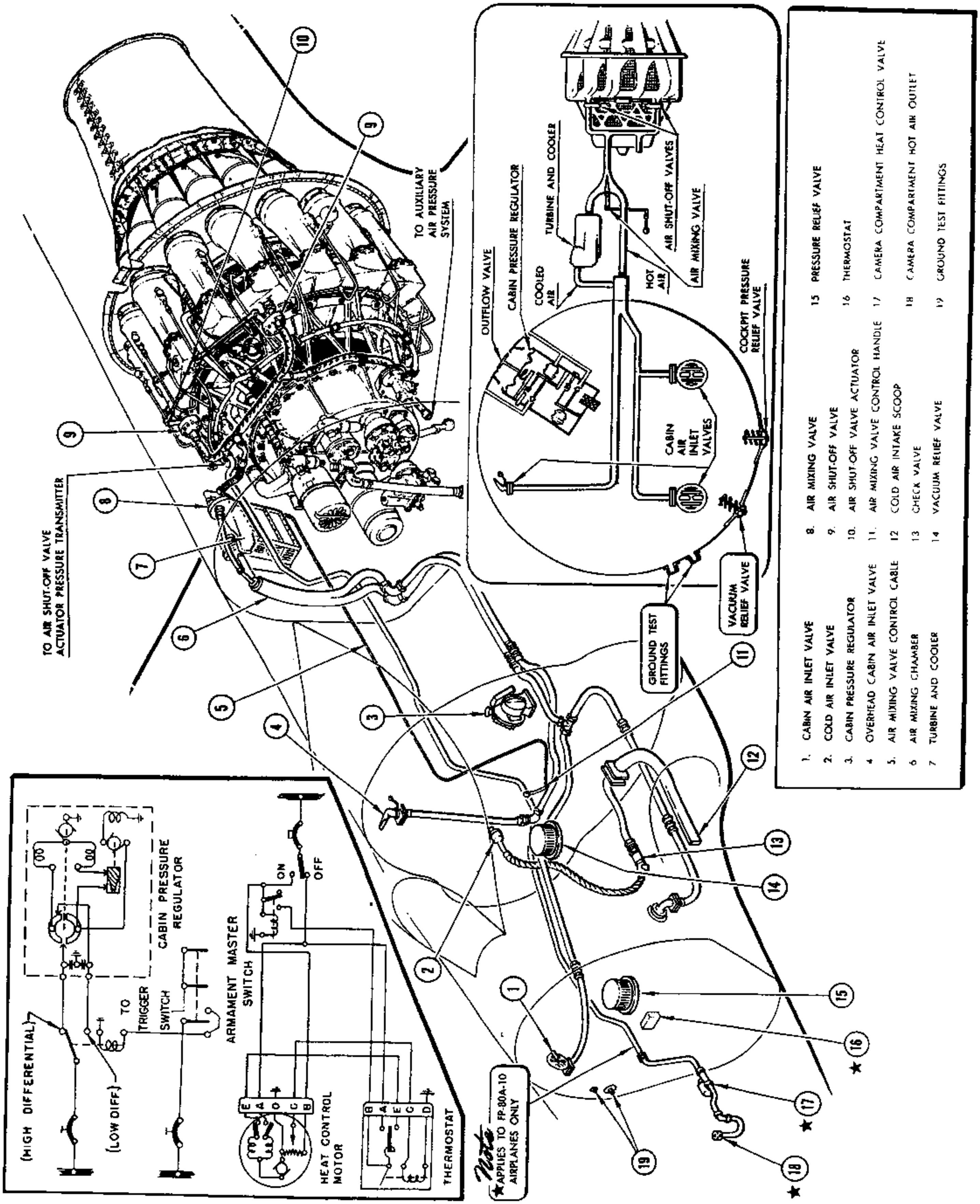



*Figure 249A — Heating, Cooling, and Pressurization System, P-80A-10 and FP-80A-10 Airplanes Only*

## 23. HEATING, COOLING, AND PRESSURIZATION SYSTEM.

*(See figures 249, 249A, and 250.)*

*a.* DESCRIPTION.—The air conditioning system includes equipment for pressurizing the cockpit and for providing the pilot with air at a controllable temperature. A single control handle on the air conditioning control assembly at the left side of the cockpit controls the air flow to the cockpit.

On F-80A-1, F-80A-5, and RF-80A-5 airplanes, the control handle operates two valves, an air selector valve and a heat control valve. The air selector valve selects either pressurized or unpressurized air. For unpressurized operation the selector valve shuts off the air from the engine compressor. For pressurized operation the selector valve connects the cockpit air outlets to the mixed-air port of the heat control valve. The cold-air port of the heat control valve is connected directly to the engine compressor; the hot-air port is not connected on fighter airplanes, but is connected into the cold-air line on photographic airplanes.

When the control lever is in the "OUTSIDE AIR" position, the selector valve shuts off the supply of air from the compressor. When the control lever is moved to the "COLD AIR" position, the air selector valve connects the cockpit air outlets to the mixed-air port of the heat control valve. Thus air from the compressor is delivered to the cockpit.

On F-80A-1 airplanes, a flow control valve in the line between the heat control and air selector valves maintains the proper rate of flow from the compressor, regradless of cockpit or compressor pressure. Air leaves the cockpit through a pressure regulator valve in the cockpit to the left of the pilot.

On F-80A-10 and RF-80A-10 airplanes, two air shut-off valves on the engine compressor casing shut off the flow of air to the cockpit when the fluid injection system is in operation. All air passing to the cockpit must pass through the air mixing valve which modulates the hot and cold air. The air turbine and cooler assembly cools a portion of the air prior to its entering the mixing chamber. Three control handles in the cockpit govern the flow of warm air. One valve is located behind the pilot's right shoulder and admits hot air to be blasted on the canopy. Two other hot-air valves are located, one on each side of the cockpit, approximately even with the rudder pedals. The major portion of the air lines is lagged with ½-inch fiberglas tape.

On all F-80A airplanes, a cold-air blast tube, connected through a check valve to the outside air scoop, provides an additional source of cold air for the cockpit. The flexible blast tube contains a butterfly valve and swivel joint in the discharge end.

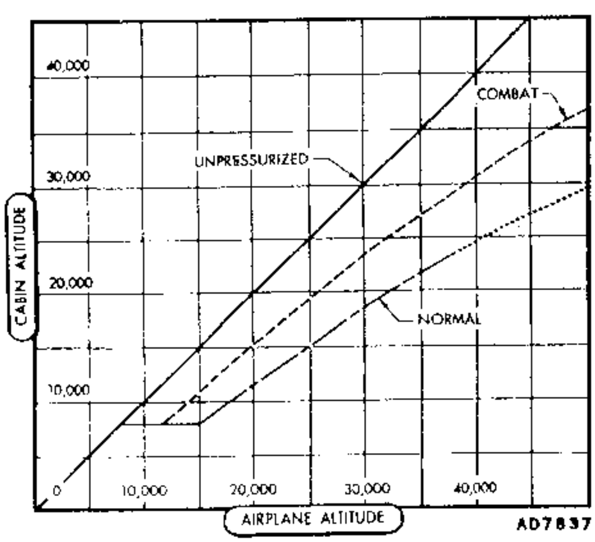
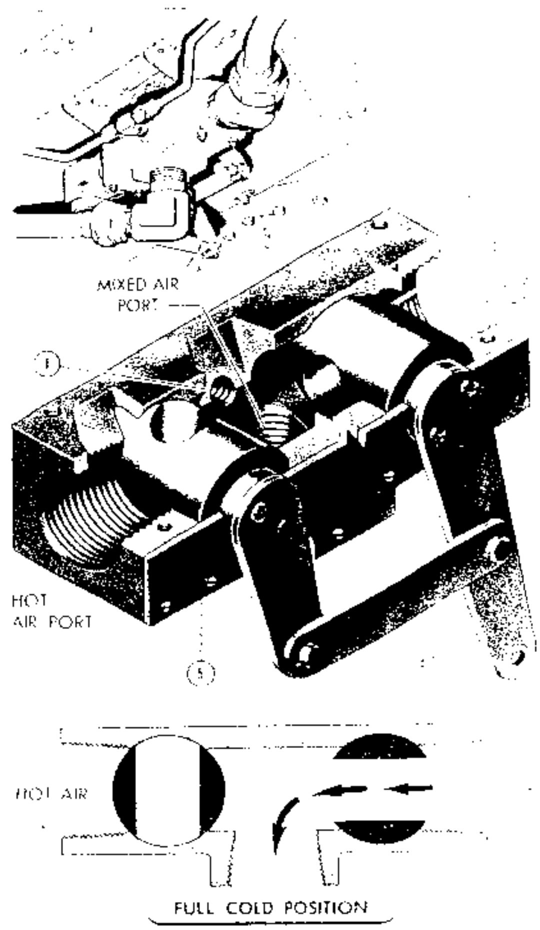



*Figure 250 — Cockpit Altitude vs. Airplane Altitude*




1. AUXILIARY AIR PORT
2. VALVE BODY
3. PLUG
4. VALVE ACTUATING LEVER
5. COVER

*Figure 251 — Heat Control Valve*

A pressure relief valve, on all F-80A airplanes, protects the cockpit from excessive pressures in case of valve failure in the pressure regulator, and a vacuum relief valve prevents cockpit pressure from being less than atmospheric pressure.

*b.* CAMERA COMPARTMENT HEATING (RF-80A-5 and RF-80A-10 Airplanes Only).—Heat for the camera compartment is obtained from the hot-air line from the engine compressor. A thermostatically controlled electrically operated valve in the camera compartment is set before flight to maintain the desired temperature. The hot air outlet is on the right side of the aft camera bay. See paragraph 17*bb*(5), this section, for information on the thermostatic control valve.

*bA*. CAMERA COMPARTMENT HEATING (RF-80A-15 Airplanes only).—The automatic temperature control system for camera compartment heating has been replaced by a manually controlled electrically operated heat control valve. See paragraph 17*bb*(5A) for information on the camera heat control circuit.

*c*. AIR SELECTOR VALVE (F-80A-1, F-80A-5, and RF-80A-5 Airplanes only).—The air selector valve is a three-way plug valve on the left side of the cockpit forward of the instrument panel. The valve operating lever is connected by a push-pull rod to a cam in the air conditioning control assembly.

*d*. HEAT CONTROL VALVE (F-80A-1, F-80A-5, and RF-80A-5 Airplanes only). *(See figure 251.)*

(1) DESCRIPTION.—The heat control valve contains two plug valves in one body, both operated by one lever. The valve is located in the hydraulic compartment below the fuselage fuel tank. The operating lever of the valve is connected by a flexible control assembly to a cam in the air conditioning control assembly.

An outlet interconnected with the mixed-air port of the valve supplies air to the auxiliary air pressure system. (See paragraph 24*a*, this section.)

(2) DISASSEMBLY.

*(a)* Remove operating levers from plugs.

*(b)* Remove screws attaching cover to body.

*(c)* Remove plugs from body.

(3) ASSEMBLY.

*(a)* Assemble plugs in body.

*(b)* Bolt the cover and gasket to valve body. Be sure that plugs do not bind after cover is installed.

*(c)* Attach operating levers and link to valve plungers.

*(d)* Check the valve for proper operation. When control lever is 15 degrees toward cold-air port, cold-air port should be wide open and hot-air port should be completely closed.

*e*. HEATING, COOLING, AND PRESSURIZATION CONTROL ASSEMBLY (F-80A-1, F-80A-5, and RF-80A-5 Airplanes only).

(1) DESCRIPTION.—The air selector and the heat control valves are operated by a single control handle through a control assembly located on the left side of the cockpit, immediately forward of the throttle control. The control handle, which is pivoted at the middle, contains a roller at the end opposite the operating knob. The roller engages the curved slots in the two valve-operating levers. A push rod connects one lever to the selector valve, and a flexible control assembly connects the other lever to the heat control valve.

(2) ADJUSTMENT.

*(a)* Set the control handle in the middle or "COLD AIR" position.

*(b)* Check location of lever on air selector valve. When lever is 45 degrees to the rear of the valve vertical center line (below valve horizontal line) the valve should connect center and lower ports.

*(c)* Adjust rod ends on push rod to air selector valve so that when control handle is in "COLD AIR" position, operating lever on valve is 45 degrees to the rear of the valve vertical center line.

*(d)* With control handle in "COLD" position, adjust rod ends on flexbile control assembly so that the heat control valve is in full cold position.

**Note**

Valve is in full cold position when center line of lever on cold air plug is 15 degrees from perpendicular to hot- and cold-air ports, toward the cold air port.

*f*. FLOW CONTROL VALVE (F-80A-1 Airplanes only). *(See figure 252.)*

(1) DESCRIPTION. — The flow control valve maintains sufficient air flow from the engine compressor to take care of cockpit leakage and to provide the proper amount of air for the pilot. The air flow is maintained at the proper amount regardless of supply pressure or cockpit pressure. The valve is located in the sub-cockpit compartment and is connected in the line between the cockpit or mixed air port of the heat control valve and the air selector valve.

(2) MAINTENANCE REPAIRS.—The flow control valve is preset at the factory to give the proper flow and is non-adjustable. If a flow control valve is found to be defective, replace it with a new or reconditioned valve. If no replacement valve is obtainable, it may be possible to correct the defective valve by cleaning the bore and plunger at the end of the valve with unleaded gasoline. Be sure that all oil and dirt are removed from the valve and that the plunger can move freely in the bore. When installing the valve, be sure that no leaks occur at connections.

*g*. COCKPIT PRESSURE REGULATOR VALVE (All F-80A Airplanes). *(See figures 253 and 253A.)*

(1) DESCRIPTION.—The pressure regulator valve located on the left side of the cockpit, regulates cockpit pressure by controlling the air flow from the cockpit. The valve is automatic and non-adjustable, and is set at the factory to give the following conditions: from zero to 8000 feet no pressurization is provided; from

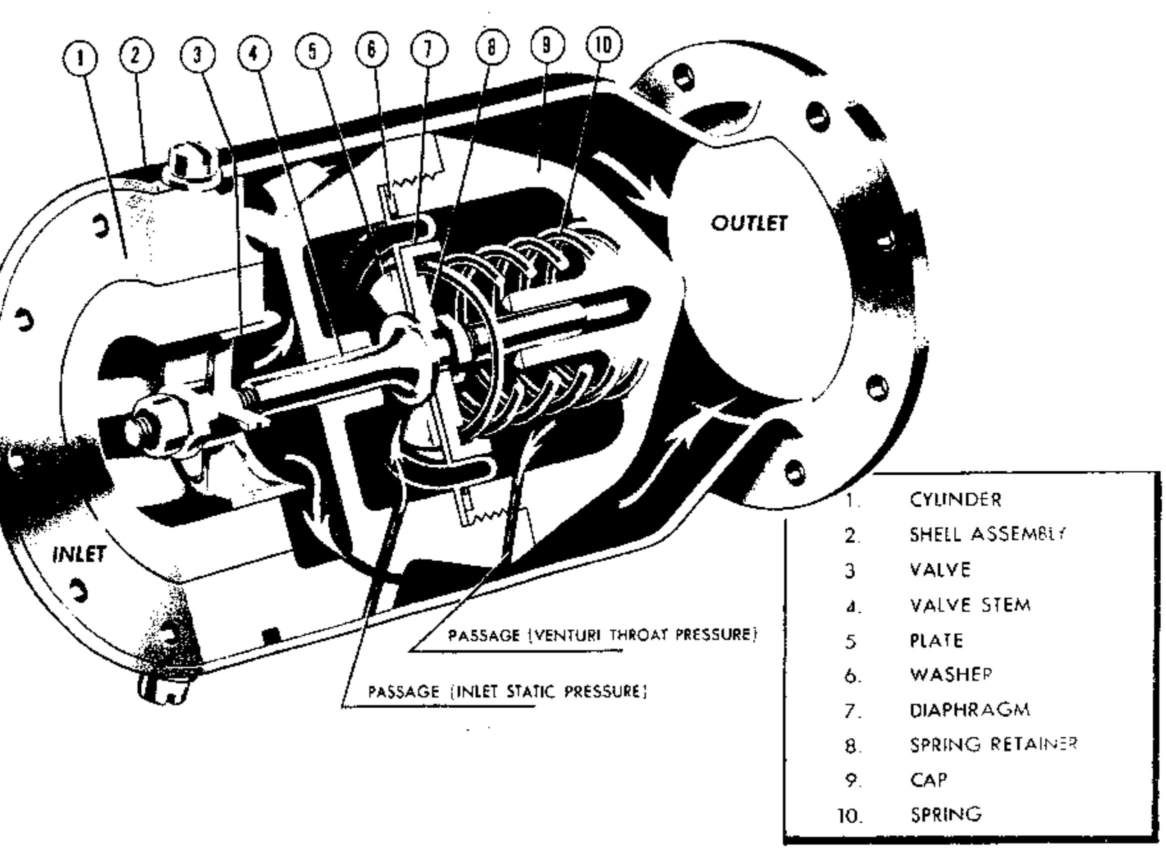



*Figure 252 — Flow Control Valve, P-80A-1 Airplanes*

8000 to 15,000 feet the cockpit pressure is maintained at an equivalent of 8000 feet altitude; and above 15,000 feet the cockpit pressure is maintained at 2.75 psi above atmospheric pressure. An electrically controlled valve in the pressure regulator valve makes it possible to reduce the pressure differential to 1.5 psi if desired. (See figure 250.) The pressure is reduced by operating the armament master switch to either the "GUNS" or "SIGHT AND CAMERA" position on fighter airplanes, or by moving the pressure regulator switch on photographic airplanes to "COMBAT."

On early fighter airplanes only, this change in pressure differential is accomplished by a poppet valve which is actuated by a bimetal leaf. When the armament master switch is operated to "GUNS" or "SIGHT AND CAMERA," a heating element within the pressure regulator valve actuates the bimetal leaf to open the low-differential poppet valve. When the switch is turned off, a spring closes the low-differential valve.

On later airplanes the mechanism for changing to the low-differential pressure is an electric motor-driven gear box. The gear box actuates a differential-pressure spring to establish the low and high differential pressures.

When the armament master switch is operated to "GUNS" or "SIGHT AND CAMERA," or the pressure regulator switch is moved to "COMBAT," the motor runs at full speed to actuate the differential-pressure spring to the low-differential condition. This operation requires approximately 20 seconds.

When returning to high-differential after the armament master switch is turned off, or the pressure regulator switch is moved back to "NORMAL," the electric motor reverses the action. However, this reverse action takes approximately $2\frac{1}{2}$ minutes. An interrupter assembly integral with the pressure control valve controls the time required to change from the low to the high-differential condition.

A shut-off valve is provided on some units which may be used to make the entire pressure regulator valve inoperative. The shut-off valve is normally safety-wired in the open position, but it may be closed to shut off the air flow from the cockpit when pressure testing the cockpit.

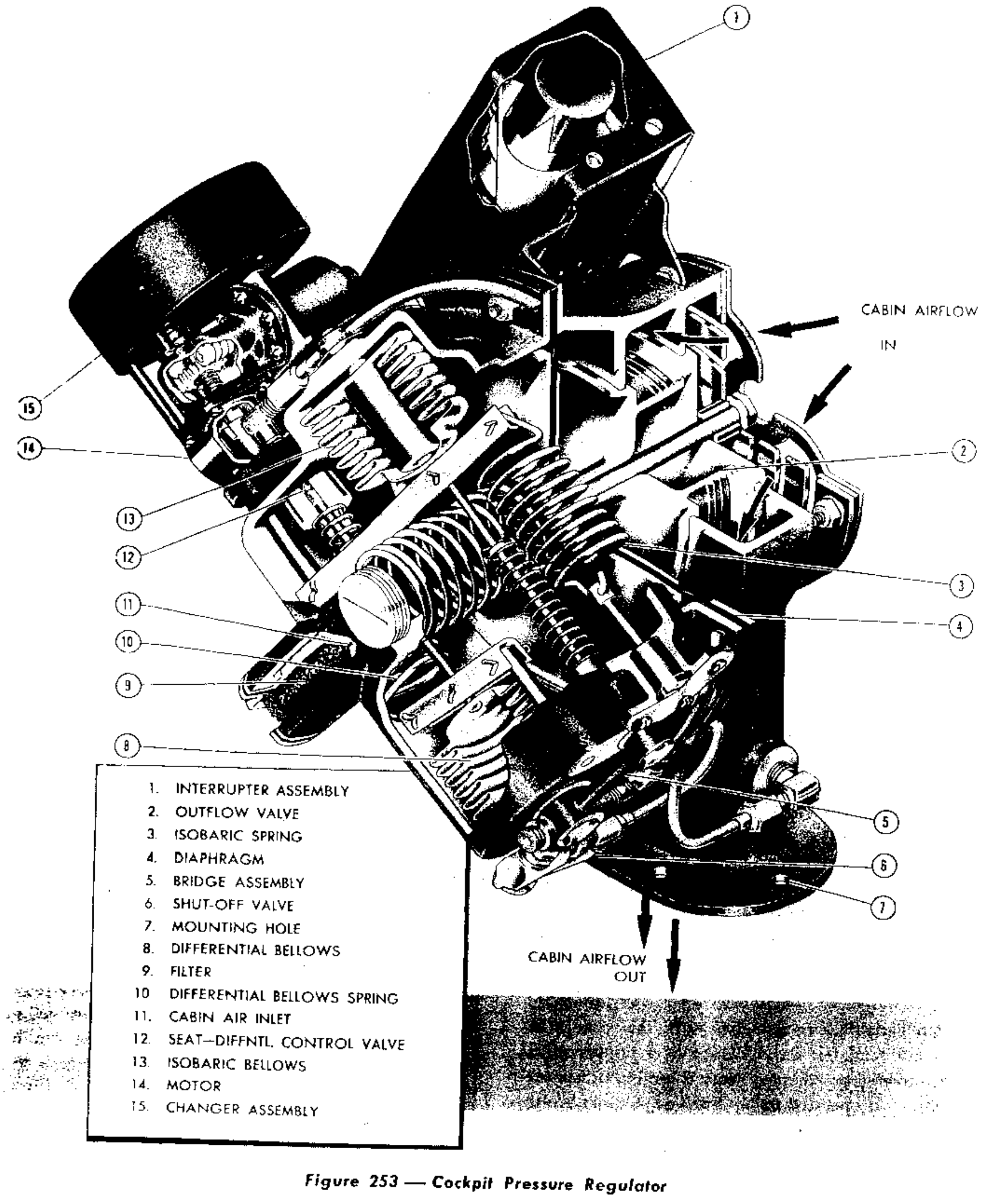
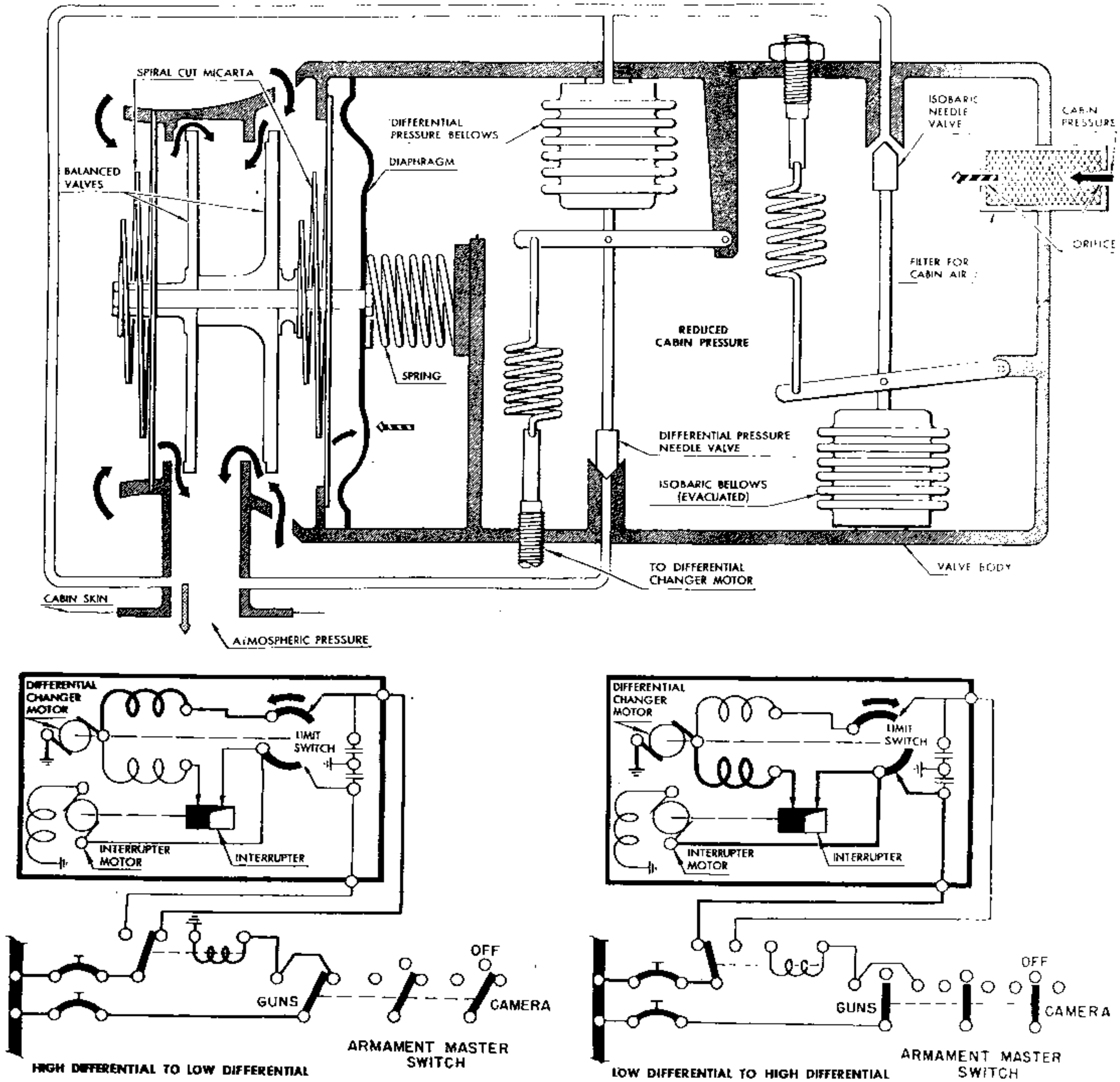



*Figure 253 — Cockpit Pressure Regulator*




*Code*

CABIN PRESSURE

REDUCED CABIN PRESSURE

ATMOSPHERIC PRESSURE

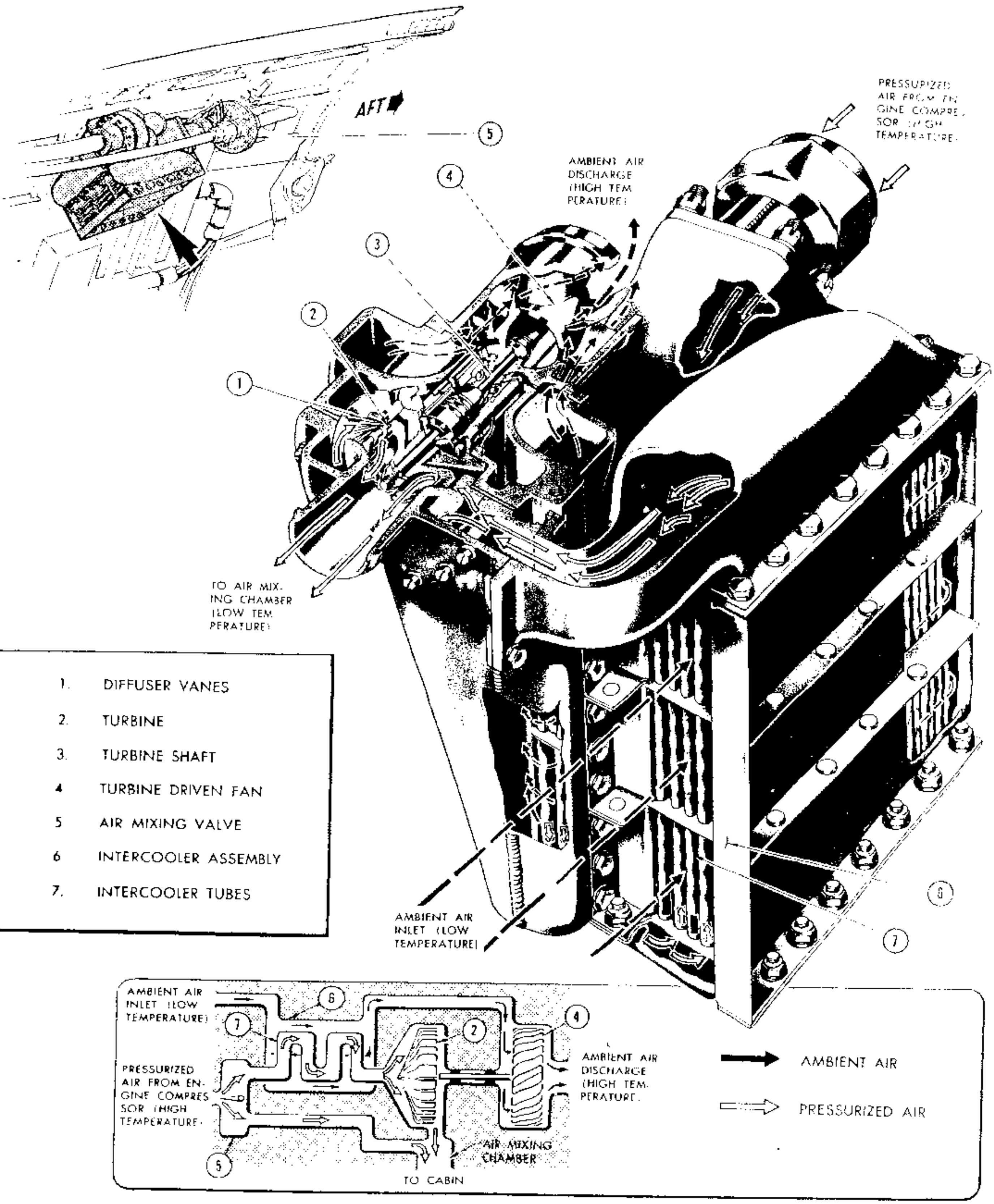
AS AIRPLANE ASCENDS, ISOBARIC BELLOWS EXPANDS CLOSING ISOBARIC NEEDLE VALVE THROUGH WHICH INTERIOR OF REGULATOR IS CONNECTED TO ATMOSPHERE. INCREASED REGULATOR PRESSURE MOVES DIAPHRAGM OUT, CLOSING CABIN OUTFLOW VALVE.

WHEN COCKPIT PRESSURE EXCEEDS 2.75 PSI ABOVE ATMOSPHERIC, DIFFERENTIAL PRESSURE BELLOWS (CONNECTED TO ATMOSPHERE) OPENS DIFFERENTIAL NEEDLE VALVE, VENTING INTERIOR OF REGULATOR TO ATMOSPHERIC PRESSURE. REGULATOR PRESSURE DROPS, DIAPHRAGM MOVES IN, CABIN OUTFLOW VALVE OPENS, LOWERING PRESSURE TO 2.75 PSI ABOVE ATMOSPHERIC PRIOR TO CABIN OUTFLOW VALVE CLOSING. CYCLE IS CONTINUOUS AND AUTOMATIC.

WHEN ARMAMENT MASTER SWITCH IS PLACED IN "GUNS" OR "CAMERA" POSITION, (LEFT WIRING DIAGRAM) DIFFERENTIAL CHANGER MOTOR REDUCES LOAD ON DIFFERENTIAL PRESSURE BELLOWS AND OPENS DIFFERENTIAL NEEDLE VALVE, CAUSING CABIN OUTFLOW VALVE TO REDUCE PRESSURE TO 1.5 PSI ABOVE ATMOSPHERIC.

WHEN THE ARMAMENT MASTER SWITCH IS PLACED IN "OFF" POSITION, (RIGHT WIRING DIAGRAM) DIFFERENTIAL CHANGER MOTOR INCREASES LOAD ON SPRING AND CLOSES DIFFERENTIAL NEEDLE VALVE, CAUSING CABIN OUTFLOW VALVE TO RETURN PRESSURE TO 2.75 PSI ABOVE ATMOSPHERIC.

*Figure 253A — Cockpit Pressure Regulator Electric and Schematic Diagram*




1. DIFFUSER VANES
2. TURBINE
3. TURBINE SHAFT
4. TURBINE DRIVEN FAN
5. AIR MIXING VALVE
6. INTERCOOLER ASSEMBLY
7. INTERCOOLER TUBES

*Figure 253B — Air Turbine and Cooler Assembly, P-80A-10 and FP-80A-10 Airplanes Only*

(2) MAINTENANCE REPAIRS.—The pressure regulator valve has been adjusted and tested at the factory, and the valve should not be disassembled or adjusted. If the valve is found to be defective, it should be replaced by a new or reconditioned valve. When installing the valve, be sure that all connections are tight, and that the valve mounting gasket is in serviceable condition.

(3) REPLACEMENTS.—Replace control-chamber filter screen at each 100-hour inspection period.

*h.* PRESSURE RELIEF VALVE (All F-80A Airplanes). *(See figure 254.)*

(1) DESCRIPTION.—The pressure relief valve operates only upon failure of the cockpit pressure regulating valve. The valve contains a spring-loaded disc, and is set to start relieving at 3 psi above atmospheric pressure. Flow through the valve is sufficient to prevent cockpit pressure from exceeding atmospheric by more than 3.2 psi. The valve is mounted on the cockpit floor between the rudder pedals.

(2) MAINTENANCE REPAIRS.—The pressure relief valve has been adjusted and tested at the factory and should not be disassembled. If the valve leaks or operates erratically, it should be cleaned without disassembling. Be sure all oil and dirt are removed from between disc and seat. Operate disc by hand to be sure that disc is seating properly. When installing the valve, be sure there are no leaks around the valve mounting flange.

*i.* VACUUM RELIEF VALVE (All F-80A Airplanes).

(1) DESCRIPTION.—The vacuum relief valve is a spring-loaded disc check valve used to prevent atmospheric pressure from exceeding the cockpit pressure by any appreciable amount. The valve is located on the cockpit floor to the right and to the rear of the pilot's seat.

(2) MAINTENANCE REPAIRS.—If leakage occurs through the check valve, the seat and disc should be cleaned with solvent. Operate disc by hand to see that it seats properly. When installing the valve, be sure that no leakage can occur around the mounting flange.

*j.* COCKPIT PRESSURE TESTING (F-80A-1, F-80A-5, and RF-80A-5 Airplanes Only). *(See figure 249.)*

(1) Disconnect tube assembly directly ahead of airflow control valve, and connect a gig to airplane heating, cooling, and pressurization system at this point. On F-80A-5 and RF-80A-5 airplanes, use ground test fitting in cockpit forward bulkhead.

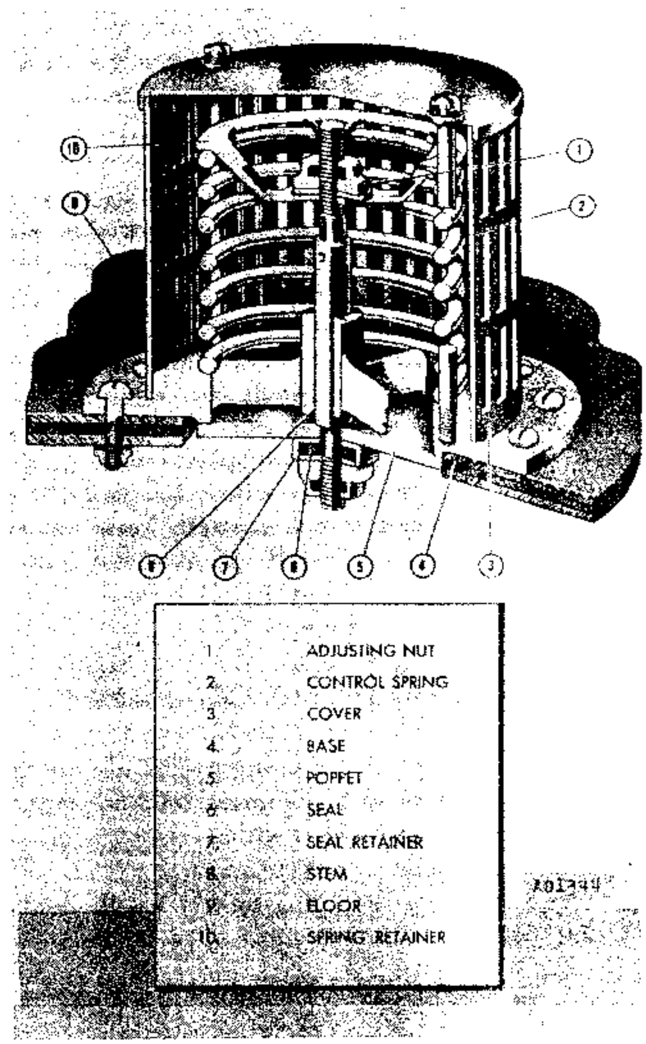



*Figure 254 — Cockpit Pressure Relief Valve*

(2) Connect air pressure line from gig to instrument air system at the "G" suit valve "I" in the sub-cockpit area. (See figure 255.)

(3) Cap off the ¾-inch "G" suit line after disconnecting it from the side outlet of the instrument air system "I" in the sub-cockpit area.

(4) Seal off the static and pitot lines, or plumb them to the instrument panel. Cockpit pressure must not leak into the static system.

**CAUTION**

Static side of instruments will not withstand cockpit pressure.

(5) On F-80A-1 airplanes, break the connection on the hydraulic-tank air supply line in the right-hand main wheel well. Connect a manometer line to the end of the break coming through the sub-cockpit area. On F-80A-5 and RF-80A-5 airplanes, use the ground test fitting on the cockpit forward bulkhead.

(6) Cap off all open plumbing into the cockpit except the pressurizing line to the hydraulic reservoir ("goose-neck" line in right rear corner of cockpit on F-80A-1 airplanes only).

(7) On F-80A-1 airplanes, before starting pressure test, attach a rubber hose to the "goose-neck" line and blow through it gently. Observe manometer for satisfactory operation.

(8) Cut safety wire from valve handle on the cockpit pressure regulator. Turn handle 90°. This closes off outside air to the regulator and opens the interior to cockpit pressure. This shuts off leakage through the regulator. Pressure regulators installed on some F-80A-1 airplanes do not have a manual shut-off. These regulators should be removed, or sealed off to outside air.

**Note**

After pressure check, be sure that valve handle is returned to original position and re-safetied.

(9) If emergency cockpit-pressure relief valve leaks, replace it with a new valve. Do not make any adjustments or changes in the pressure setting.

(10) Place air conditioning control handle in the "COLD" position.

(11) Close and lock the canopy, and fasten the safety straps of canvas webbing around the fuselage.

## WARNING

Make sure the safety straps are used to prevent the canopy from causing injury in event the canopy mechanism should fail.

(12) Open the valve on the gig and apply 30 psi to the instrument air line. Air pressure gage on the instrument panel should read 4.4 ($\pm$ 0.5) in. Hg.

(13) Apply air pressure to cockpit gradually, by slowly cracking the valve on the test gig. Watch manometer closely, and when pressure indicated reaches 2.75 (+ 0.00 — 0.02) psi, volume of air input shown on flowmeter shall not exceed 25.0 cubic feet per minute (i.e., 25 cubic feet per minute of free air at 2.75 pounds pressure over atmospheric).

Allow an additional 3 cubic feet per minute leakage to compensate for loss of pressure through the cockpit pressure regulator (manual shut-off type) if installed.

*k.* AIR SHUT-OFF VALVE ACTUATOR (F-80A-10 and RF-80A-10 Airplanes Only).—Refer to figure 123F and paragraph 13A*k*, this section.

*l.* AIR SHUT-OFF VALVE (F-80A-10 and RF-80A-10 Airplanes Only).

(1) DESCRIPTION.—The air shut-off valve is a sliding-leaf type valve. Upon being actuated, the leaf in the valve shuts off all air flow from the engine compressor to the heating, cooling, pressurizing, and auxiliary air systems. The two shut-off valves are located on the upper portion of the engine compressor casing.

(2) REMOVAL.

*(a)* Disconnect air outlet line.

*(b)* Loosen and remove valve actuating arm from valve stem.

*(c)* Loosen jam nut on valve adapter.

*(d)* Remove air shut-off valve and adapter from engine compressor as a unit.

(3) INSTALLATION.—Reverse removal procedure.

**Note**

Screw adapter into the compressor casing with "O" ring installed, applying anti-seize compound, Specification AN-C-147, to the threads of the adapter and to compressor casing threads. Tighten adapter, applying torque of 18 to 30 foot-pounds.

m. AIR MIXING VALVE (F-80A-10 and RF-80A-10 Airplanes Only).

(1) DESCRIPTION.—The air mixing valve is located on the right side of the fuselage just aft of the turbine and cooler assembly. The mixing valve controls the amount of hot and cold air which enters the mixing chamber. Complete shut-off of the air supply by this valve is prevented by a small hole drilled in the valve leaf covering the air passage to the turbine and cooler assembly. This opening is needed to keep the cooler turbine rotating. The operating handle is on the left shelf just forward of the engine control lever.

(2) REMOVAL.

*(a)* Remove "U" fitting from aft side of valve.

*(b)* Disconnect line leading from mixing chamber to mixing valve.

*(c)* Disconnect valve handle from push-pull rod.

*(d)* Disconnect mixing valve from turbine and cooler assembly.

*n.* TURBINE AND COOLER ASSEMBLY (F-80A-10 and RF-80A-10 Airplanes Only). *(See figure 253B.)*

(1) DESCRIPTION.—The turbine and cooler assembly is located on the right side of the fuselage between stations 238 and 252. The assembly is installed in the aircraft with the ambient air intake open to the intake ducts which supply air to the engine compressor. Cooling air is thus obtained for circulation through the cooler assembly and to provide a means for absorbing power developed in the turbine and cooler assembly.

The assembly consists of a cross-flow heat exchanger, or cooler, and a radial type expansion turbine. The necessary ducts are provided to ensure proper flow of compressed and ambient air through the unit.

(2) OPERATION. *(See figure 253B.)*—The cooler is divided into two equal sections by baffle plates, each section having 242 tubes extending vertically through the assembly. Hot pressurized air from the engine compressor enters through the tubes in one section of the cooler assembly (white arrows). The pressurized air then reverses direction to flow up through the tubes in the other section and into the duct passage mounted on top of the assembly. After flowing through the cooler assembly, the pressurized air is directed through the duct passage into a chamber of the turbine assembly containing a ring of restricted passages or nozzles. The air forces its way through these passages at high velocity and impinges upon the blades of a turbine wheel mounted on a shaft running through the turbine assembly, causing the turbine wheel to rotate at 90,000 rpm.

Cooling air from the atmosphere (broken black arrows), enters the cooler through the ambient air intake and flows around the tubes in the ambient air intake section, reversing the direction of flow around the tubes in the other section and into the vertical duct at the end of the assembly. The air is then drawn into the fan section of the turbine, and passes through the ambient air outlet to atmosphere. Heat is transferred from the pressurized air flowing through the tubes of the cooler to the ambient air flowing across the tubes. Heat contained in the pressurized air is thus removed with little loss in pressure. Rotation of the fan is utilized to draw ambient air through the cooler assembly. This permits installation of the unit out of the slipstream. It further assures efficient operation of the heating, cooling, and pressurization system when the aircraft is on the ground and no "ram" air pressure exists to supply the cooling flow.

(3) REMOVAL.—Disconnect mixing valve from turbine and cooler. Unclip electric lines from turbine and cooler assembly at three places. Remove four bolts holding assembly to shock mountings. Move unit inboard and aft to remove it from the airplane.

**CAUTION**

When removing the assembly, do not tear rubber tube connecting turbine and cooler assembly with mixing chamber.

(4) INSTALLATION.—New turbine units are not filled with oil at the factory and must be filled with recommended oil prior to installation. Because bearings and wicks may become dried out in storage, it is imperative to comply with following instructions prior to installation of turbine.

*(a)* Set unit in normal operational attitude (installed position) and fill sump about half full of oil, Specification MIL-O-6081A.

*(b)* Invert unit 180 degrees and rock vigorously for 10 seconds. This will allow oil to lubricate bearings and saturate wick.

*(c)* Return unit to normal operational attitude and install in airplane by reversing removal procedure. Fill unit to level of filler plug with oil, Specification MIL-O-6081A.

**CAUTION**

Make sure ambient air inlet is pointing forward.

*o.* CABIN AIR INLET VALVE (F-80A-10 and RF-80A-10 Airplanes Only).

(1) DESCRIPTION.—Two cabin air inlet valves are located, one on each side of the cockpit, at a level approximately even with the rudder pedals. These valves serve to deliver warm air in quantity desired by pilot, or to shut off air supply completely, if desired.

(2) REMOVAL.

*(a)* Remove valve-handle retaining nut, and valve handle.

*(b)* Remove four screws and nuts holding lower plate, handle stops, and valve in position.

*(c)* Remove four screws fastening valve to air pressure line.

*(d)* Remove unit from behind mounting panel.

*p.* OVERHEAD CABIN AIR INLET VALVE (F-80A-10 and RF-80A-10 Airplanes Only).

(1) DESCRIPTION.—The overhead cabin air inlet valve is on the end of a tube projecting from the floor to the right and behind the pilot's seat. This unit, in addition to assisting in the provision of warm air for heating the cockpit, also aids in defrosting the canopy, due to the angle at which the valve is set.

(2) REMOVAL. — Remove four screws and nuts which hold the valve to hot air tube.

*q.* COCKPIT PRESSURE TESTING (F-80A-10 and RF-80A-10 Airplanes Only). *(See figure 249A.)*

(1) Fill turbine and cooler sump with AN-O-9, Grade 1010 oil.

(2) Cut safety wire from shut-off valve handle on cockpit pressure regulator. Turn handle 90 degrees. This closes off outside air to regulator, opens the interior to cockpit pressure, and shuts off leakage through regulator.

**Note**

After pressure check, be sure to return handle to its original position, and re-safety it.

(3) Connect an air pressure line from a gig to instrument air system at "G" suit valve "T" in sub-cockpit area. (See figure 255A.)

(4) Cap off ¾-inch "G" suit line after disconnecting it from side outlet of instrument air system "T" in sub-cockpit area.

(5) Seal off static and pitot lines, or plumb them to instrument panel. Cockpit pressure must not leak into static system. Remove or cap altimeter on cockpit right shelf.

**CAUTION**

Static side of instruments will not withstand cockpit pressure.

(6) Close windshield defroster valve.

(7) Turn off auxiliary air shut-off valve (drop tank).

(8) Disconnect canopy seal pressure breaker, and plumb a 30-pound gage into seal line for checking seal line pressure.

(9) Attach a flowmeter line to air inlet at air mixing valve manifold.

(10) Attach test equipment capable of producing approximately 30 psi to auxiliary air line on aft side of main beam.

(11) Attach a test gig to larger ground test fitting of heating, cooling, and pressurization system on cockpit forward bulkhead. Attach a manometer to smaller fitting.

(12) Cap off drain hole in air line in left wheel well.

(13) Place air mixing valve in "HOT" position to prevent air pressure from operating turbine and cooler.

(14) Open cabin air inlet valves on cockpit floor near rudder pedals.

(15) Close overhead cabin air inlet valve on right side aft of pilot's seat.

(16) Close and lock canopy. Fasten safety straps of canvas webbing around the fuselage and over the canopy.

**WARNING**

Be sure safety straps are used to prevent the canopy from causing injury in event canopy mechanism should fail.

(17) Apply approximately 19 psi pressure to canopy pressure seal.

(18) Open valve on gig, and apply 30 psi pressure to instrument air line. Air pressure gage on instrument panel should read 4.4 (±0.5) inches Hg.

(19) Apply air pressure to cabin gradually, by slowly cracking valve on test gig. Watch manometer closely, and when pressure indicated reaches 2.75 (+0.00, —0.02) psi, volume of air input shown on flowmeter shall not exceed 37.0 cubic feet per minute (i.e., 37 cubic feet per minute of free air at 2.75 psi pressure over atmospheric).

(20) After leakage requirements have been met, move air mixing valve handle toward "COLD" to check air cooler turbine operation. Shut off air mixing valve as soon as possible.

(21) Close off cockpit at flowmeter, and with seal pressure still on, determine that canopy can be rolled back with reasonable force on operating crank.

*r.* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Insufficient cockpit pressure. | Excessive cockpit leakage. | See paragraph *3c(2)(b)*, this section for cockpit sealing. |
| | Supply pressure too low. | Check engine compressor pressure. It should be 6 psi minimum. |
| | Defective flow control valve. | Clean or replace if necessary. |
| | Defective pressure or vacuum relief valve. | Clean or replace valve. |
| | Defective pressure regulator valve. | Clean or replace valve. |
| | Leaky air selector valve. | Replace valve. |
| Cockpit pressure too high. | Defective pressure regulator valve. | Clean or replace valve. |
| | Pressure regulator valve inoperative. | Check the shutoff valve. |
| | Defective flow control valve. | Clean or replace valve. |
| Erratic cockpit pressure. | Defective pressure regulator or flow control valve. | Clean or replace valve. |

## 24. AUXILIARY AIR PRESSURE SYSTEM.

*(See figures 255 and 255A.)*

*a.* GENERAL DESCRIPTION. — The auxiliary air pressure system supplies air for the gyro instruments, the pressurized droppable fuel tanks, the canopy seal tubes, the pressurized hydraulic fluid reservoir, and the pressurized-suit valve. Air is obtained from the engine compressor; pressure control valves reduce the compressor pressure to the amounts required for the various units of the system.

*b.* INSTRUMENT AIR SYSTEM.

(1) DESCRIPTION. — A pressure control valve connected to the cockpit port of the heat-control valve is set to supply 2.2 psi (4.4 in. Hg) air pressure to the gyro instruments. The pressure control valve is located in the cockpit, to the right and rear of the pilot's seat. An instrument-air filter in the cockpit adjacent to the pressure control valve is connected in the pressure line. A gage on the instrument panel indicates air pressure in inches of mercury. An adjustable needle valve controls the gyro speed of the turn and bank indicator.

(2) PRESSURE CONTROL VALVE.

*(a)* DESCRIPTION. *(See figure 256.)* The pressure control valve obtains air from the engine at pressures varying from 6 to 85 psi, and reduces the pressure to 2.2 psi above cockpit pressure. The outlet pressure of the control valve remains constant at 2.2 psi above cockpit pressure regardless of inlet pressure.

Air from the pressure supply enters the valve body through two ball valves which are connected by a rocker arm. The supply pressure tends to close one valve and open the other, thus balancing the valve against supply pressure. An adjusting screw on the rocker arm is used to insure both balls closing at the same time. The ball valves are operated by a spring-loaded diaphragm which has control-valve outlet (instrument) pressure on

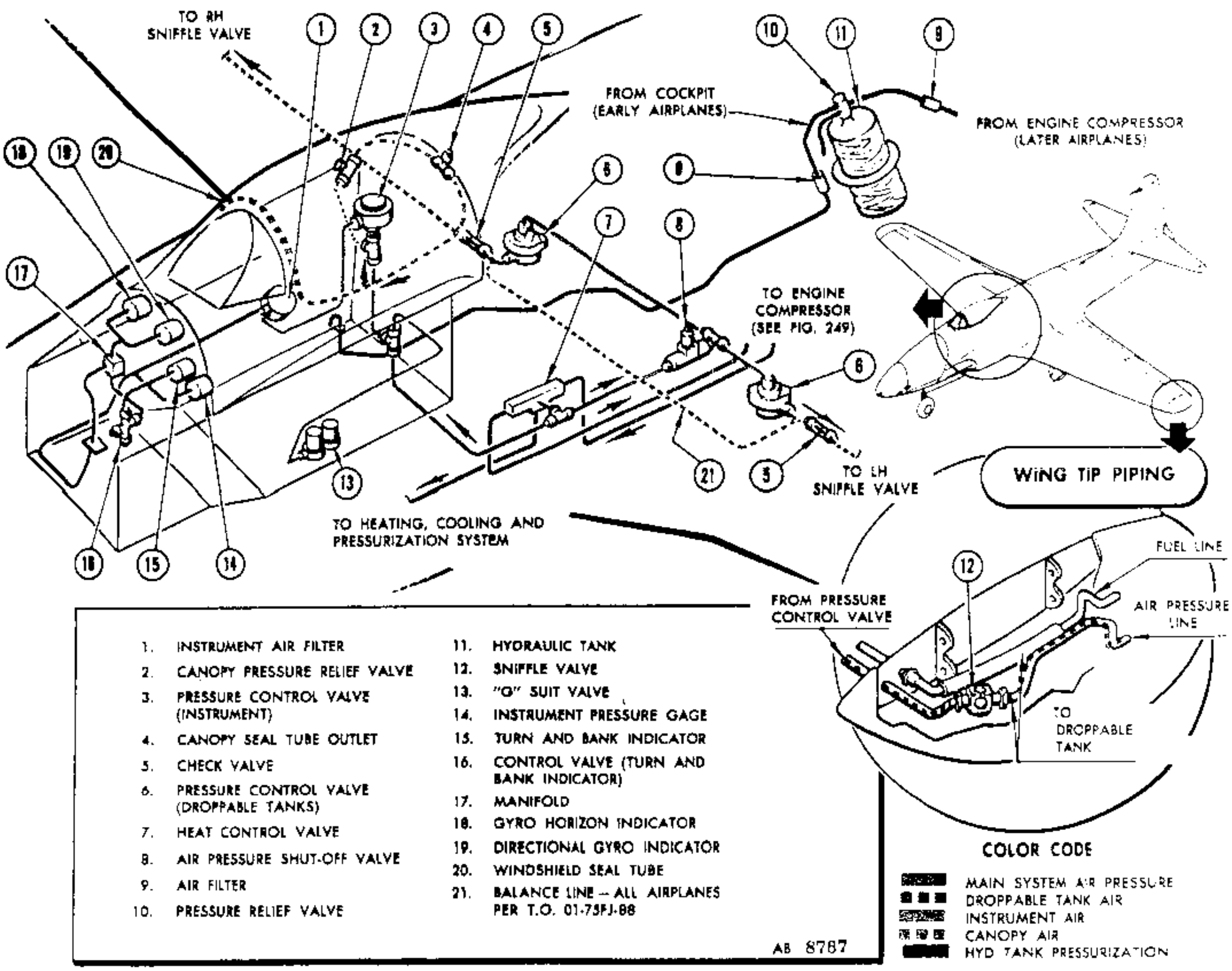



*Figure 255 — Auxiliary Air Pressure System, F-80A-1, F-80A-5, and RF-80A-5 Airplanes Only*

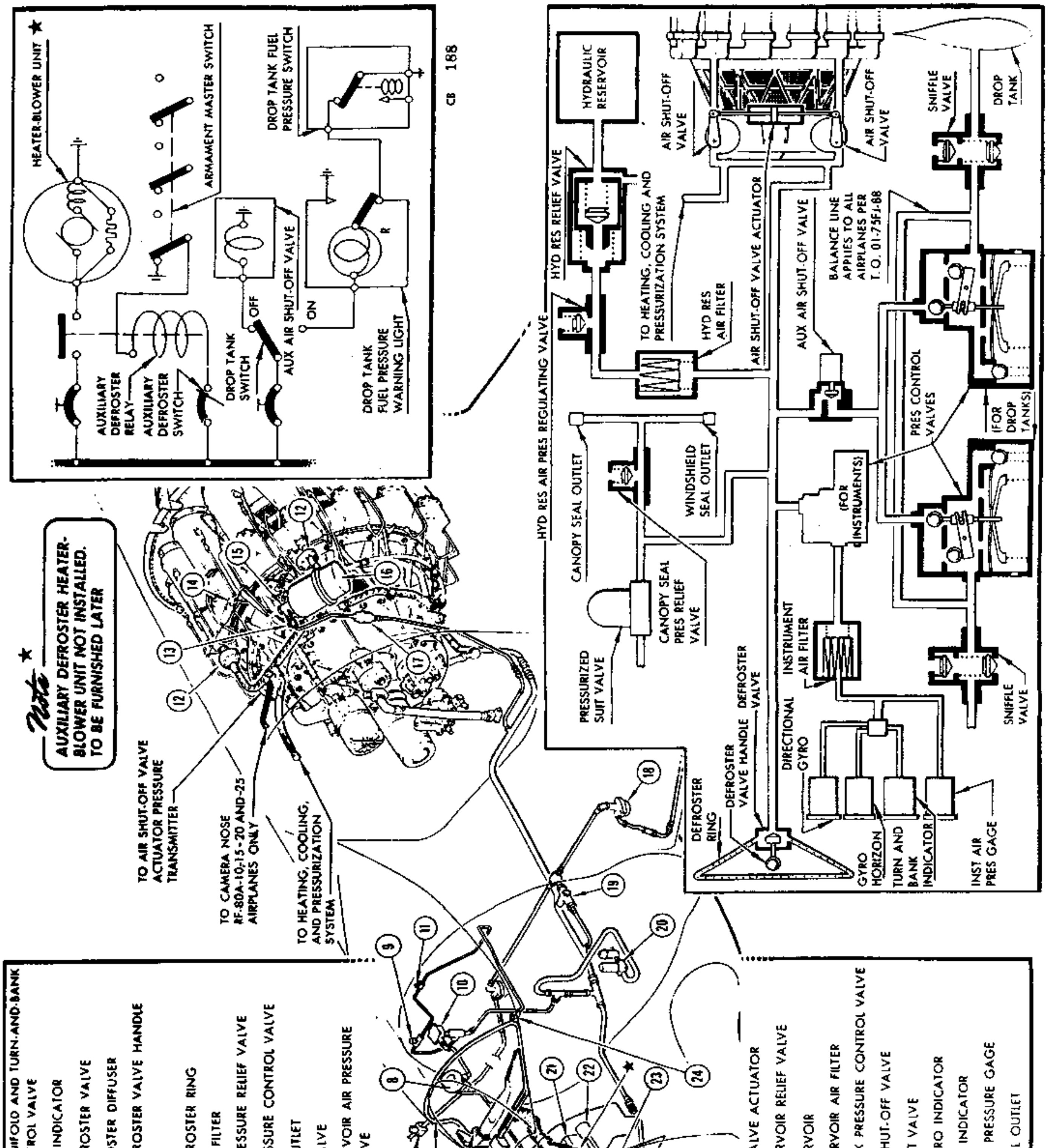



***Figure 255A — Auxiliary Air Pressure System, F-80A-10, RF-80A-10, RF-80A-15, RF-80A-20 and RF-80A-25 Airplanes***

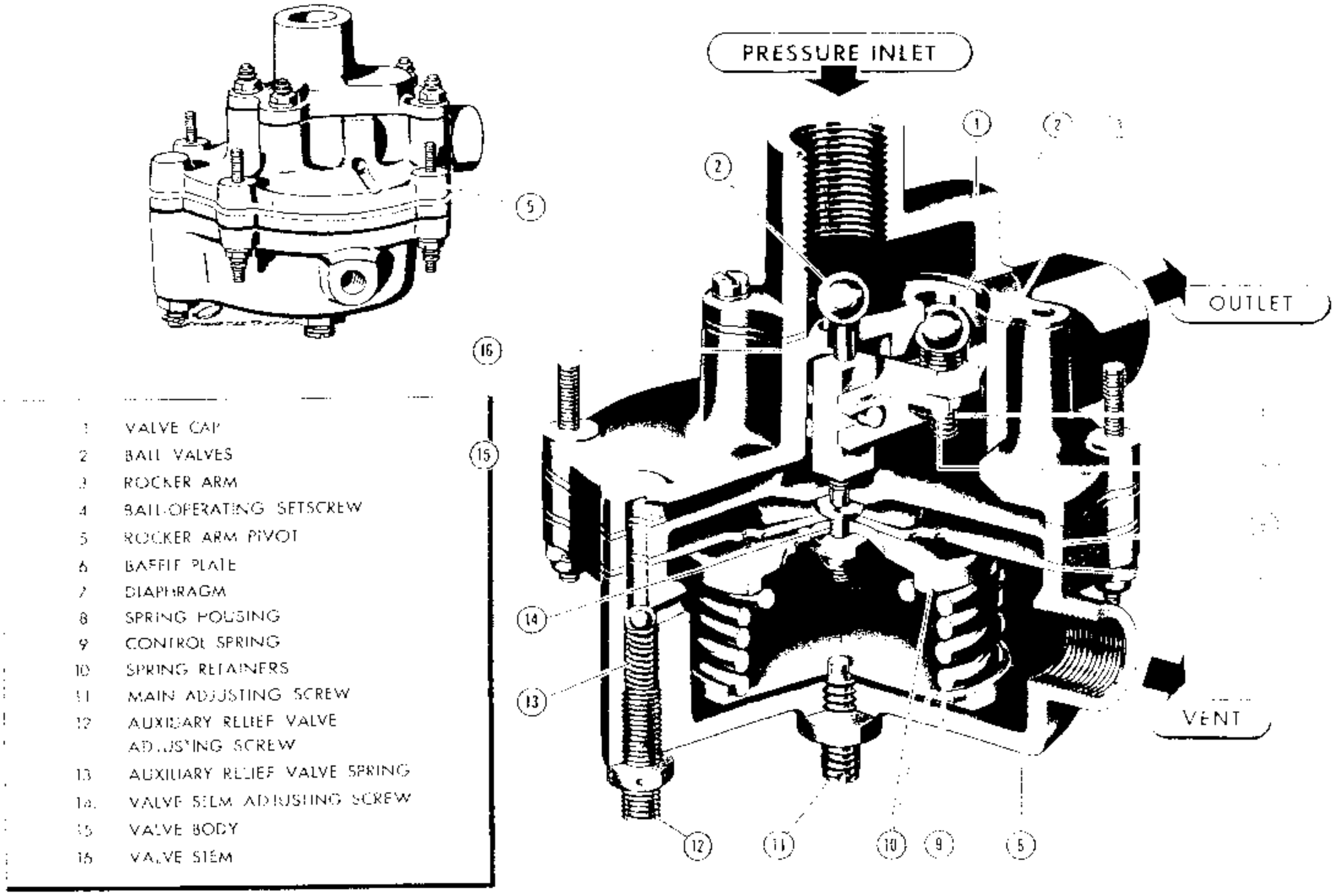



***Figure 256 — Air Pressure Control Valve***

one side and vent (cockpit) pressure on the other side. When pressure in the system drops below the control-valve setting, the control spring opens the ball valves and admits air from the supply to increase the system pressure. When the outlet pressure increases to the control-valve setting, air pressure on the diaphragm closes the ball valves.

A small auxiliary ball relief valve built into the spring housing is set at, or slightly below, the main control-valve setting. This takes care of air leakage past the balanced ball valves when the outlet port is blocked and the two ball valves are seated. This small auxiliary relief valve discharges into the spring housing and from there into the cockpit.

*(aA)* REMOVAL.

*1.* Remove pilot's seat and aft armor plate.

*2.* Disconnect instrument air lines, and all lines marked "access."

*3.* Remove two nuts holding unit to mounting bracket, and lift unit free.

*(b)* DISASSEMBLY.

**Note**

If possible, replace a defective pressure-control valve by a new or reconditioned valve, and return the defective valve to a base properly equipped to make repairs. If it is necessary to make repairs on a valve, all work must be done in a room free from dust, dirt, and oil.

*1.* Remove the four nuts attaching the spring housing to the valve body, and remove spring housing, spring retainer, and control spring.

**CAUTION**

Do not tear diaphragm when removing spring housing.

*2.* Remove valve cap from valve body by removing four attaching screws. Unscrew lock nut from valve adjusting screw and remove spring retainer, diaphragm, and washer.

*3.* Unscrew valve-stem adjusting screw and remove baffle and gasket.

*4.* Unscrew ball from valve stem, and remove pivot pin from rocker arm by unscrewing pivot pin on side of valve body. (Ball is screwed and swaged to valve stem and should not be removed unless necessary.)

*5.* Unscrew adjusting screw in bottom of spring housing, and remove auxiliary relief-valve ball and spring.

*(c)* MAINTENANCE.

*1.* Be sure that valve seats are not worn, and that they are free of corrosion and nicks.

*2.* See that pivot pins in valve linkage are not worn or bent, and that they are not binding.

*3.* Check springs for corrosion.

*4.* See that diaphragm and gasket are not torn or otherwise damaged.

*(d)* ASSEMBLY.

*1.* Clean all parts in solvent and dry with blast of air. Do not wipe parts with rags as the lint may cause malfunctioning of valve.

*2.* Assemble valve stem and rocker arm in valve body and screw the ball on the shaft. Insert pivot pin through body and rocker arm, and install cap and gasket.

*3.* Connect inlet port of valve to air supply of 6 psi. Push ball on valve stem against seat, and adjust setscrew on rocker arm until there is no flow. Tighten lock nut on setscrew. Test for no flow at 85 psi.

*4.* Assemble gasket and baffle plate to valve body, and tighten valve-stem adjusting screw snugly.

*5.* Insert washer, diaphragm, spring retainer, and lock nut on adjusting screw. Adjust valve-stem adjusting screw by unscrewing 1¾ turns. Tighten lock nut.

*6.* Insert control spring and spring retainer in spring housing.

*7.* Assemble spring housing to valve body and tighten four retaining nuts equally.

**CAUTION**

Be sure that diaphragm and gasket are seated properly so no air leakage can occur.

*(e)* ADJUSTMENT AND TESTING.—Provide a test bench consisting of a mercury manometer, air flowmeter, pressure gage, flow control valve, and an air pressure source of at least 85 psi.

*1.* Close off auxiliary relief valve by tightening adjusting screw.

*2.* Apply 85 psi air pressure to inlet port of control valve. Regulate flow-control valve so that flow through pressure-control valve is 260 cu ft/hr.

*3.* Adjust main adjusting screw so that outlet pressure is 4.4 ($\pm$0.5) in. Hg (2.2 psi).

*4.* Check flowmeter and readjust for flow of 260 cu ft/hr if necessary.

*5.* Reduce inlet pressure to 6 psi and adjust flow-control valve for flow of 175 cu ft/hr. Pressure at outlet port should be 4.4 ($\pm$0.5) in. Hg (2.2 psi).

*6.* Apply 85 psi air pressure to inlet port, and close outlet port. Unscrew auxiliary relief-valve adjusting screw until pressure gage just begins to drop below setting of the main valve. Safety both adjusting screws.

*(f)* TROUBLE SHOOTING.

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| Outlet pressure too low. | Supply pressure too low. | Check supply pressure. It must be between 6 and 85 psi. |
| | Leaks in piping or in valve. | Eliminate leaks. |
| | Improper setting of auxiliary relief valve or broken spring in auxiliary relief valve causing excessive leakage from vent line. | Replace spring if necessary, and readjust valve. |
| | Improper setting of valve, or broken main spring. | Replace main spring and readjust valve. |
| Pressure too high. | Improper setting of valve. | Readjust valve. |
| | Excessive leakage past ball valves as evidenced by large flow of air from vent line. | Clean valve and readjust valve linkage. |
| | Leaky diaphragm. Sticking of ball valve linkage. | Replace diaphragm. Clean valve to eliminate sticking. |
| Fluctuating pressure. | Improper setting of auxiliary relief valve. | Readjust valve. |
| | Sticking in valve linkage. | Clean valve to eliminate sticking. |
| | Ball valve not seating. | Adjust spring tension on ball spring. |

(3) FILTER.—An instrument air filter is connected in the instrument pressure line. The filter is located in the cockpit to the right and rear of the pilot's seat.

Replace filter element every 100 hours.

(4) TURN AND BANK INDICATOR CONTROL VALVE.

*(a)* DESCRIPTION.—A needle valve is installed in the line to the turn and bank indicator in order to control the gyro speed. The valve is mounted at the rear of the instrument panel, and the adjusting screw extends below the edge of the panel.

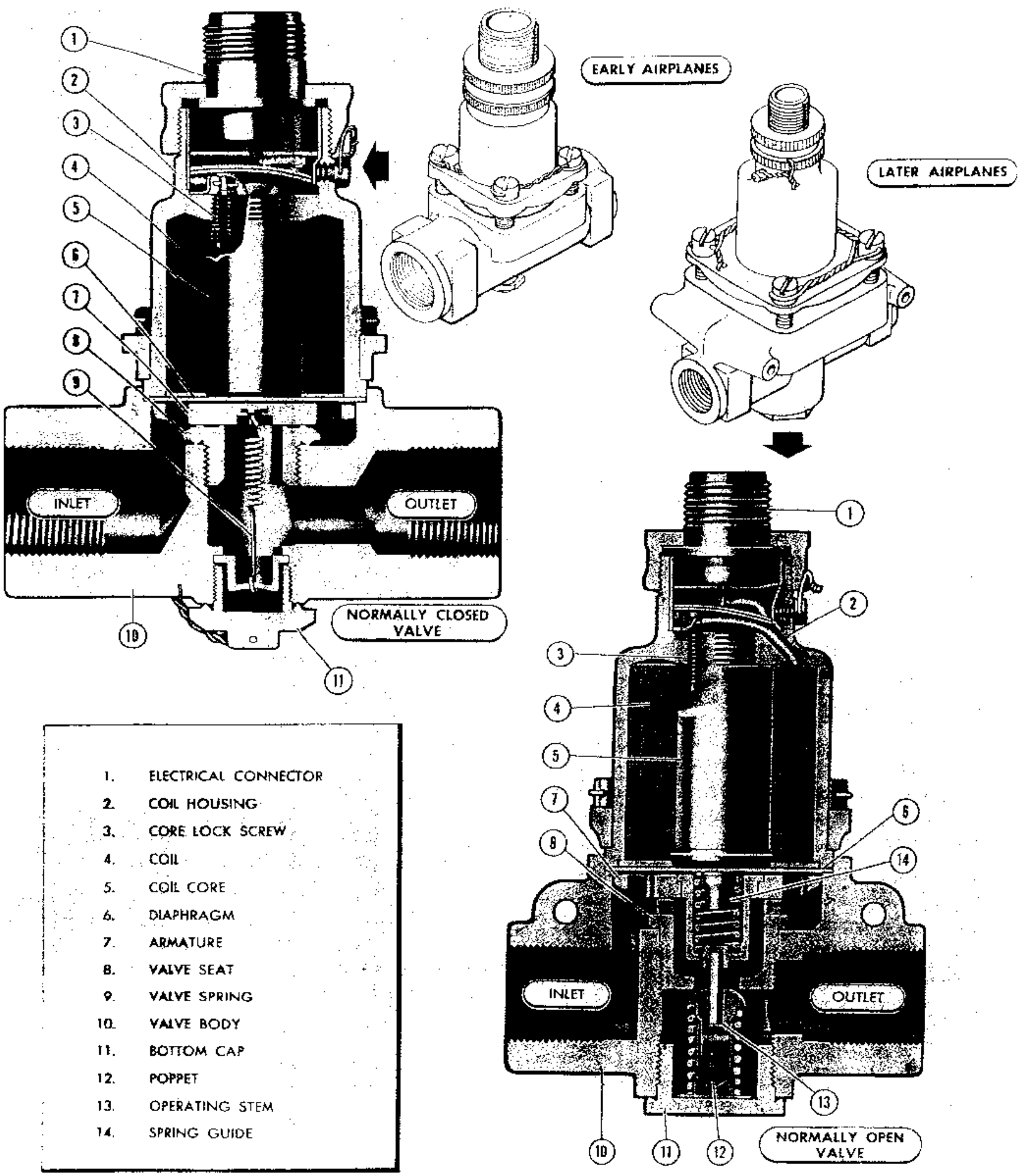
*(b)* ADJUSTMENT.

*1.* Install a gage in the line between the control valve and the turn and bank indicator.

*2.* Adjust the control valve to give 2 in. Hg (1 psi) pressure on the gage.

**Note**

Adjustments should be made when the gyro has reached its operating speed.




1. ELECTRICAL CONNECTOR
2. COIL HOUSING
3. CORE LOCK SCREW
4. COIL
5. COIL CORE
6. DIAPHRAGM
7. ARMATURE
8. VALVE SEAT
9. VALVE SPRING
10. VALVE BODY
11. BOTTOM CAP
12. POPPET
13. OPERATING STEM
14. SPRING GUIDE

*Figure 257 — Air Shut-off Valve*

*c.* DROPPABLE FUEL TANK PRESSURIZATION SYSTEM. *(See figure 255.)*

(1) DESCRIPTION. — Fuel is transferred from the droppable tanks to the fuselage tank by applying air pressure to the droppable tanks. Air from the cockpit port of the heat-control valve is applied to the tanks through an electrically operated shut-off valve, a pressure control valve, and a combination check and relief valve.

(2) SHUT-OFF VALVE. *(See figure 257.)*—The electrically operated air shut-off valve is located in the hydraulic compartment below the fuselage fuel tank. A single valve controls the air flow to both droppable tanks. The valve is controlled by the drop tank switch on the fuel-tank selector panel.

For further information on this valve, see paragraph 17*f*(4), this section.

(3) PRESSURE CONTROL VALVE.

*(a)* DESCRIPTION.—Two interconnected pressure control valves are located in the hydraulic compartment, one at each side of the compartment. The valves are identical to the pressure control valve used in the instrument air system except for the control spring and the pressure setting of the valve. The droppable-tank pressure control valves are set to deliver air at 5.25 psi above atmospheric pressure and are vented to the atmosphere. For further information on valves see paragraph *b*(2)*(a)* preceding.

*(b)* REMOVAL.

*1.* Disconnect dive flaps from actuating cylinders.

*2.* Disconnect and cap lines leading to valve.

*3.* Remove four bolts holding valve to support bracket.

*4.* Slide valve forward to remove it.

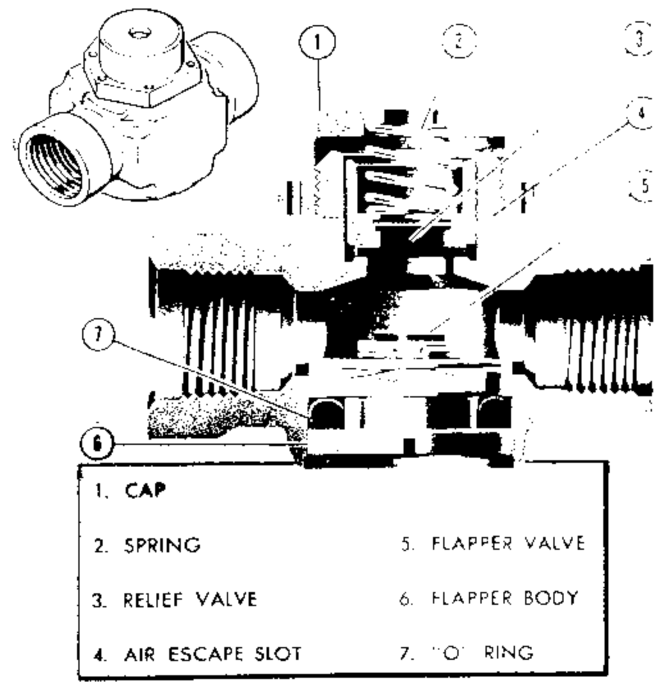



**Figure 258 — Sniffle Valve**

(4) SNIFFLE VALVE. *(See figure 258.)*

*(a)* GENERAL.—A double acting valve, located in the wing tip, is installed in each droppable tank air line to prevent excessive air pressure or the formation of a vacuum in the droppable tanks.

**CAUTION**

This suction relief portion of the valve is a simple flapper type valve and is held closed by gravity. When installing the valve, be sure that the pressure relief adjustment is up (toward the top surface of the wing tip). Make certain that neither the pressure relief nor vacuum relief openings of the sniffle valve are restricted in any manner during the installation.

*(b)* REMOVAL.

*1.* Remove wing tip access panels Nos. 2 and 80.

*2.* Disconnect lines from inlet and outlet ports.

*3.* Remove valve retaining clip, and remove unit.

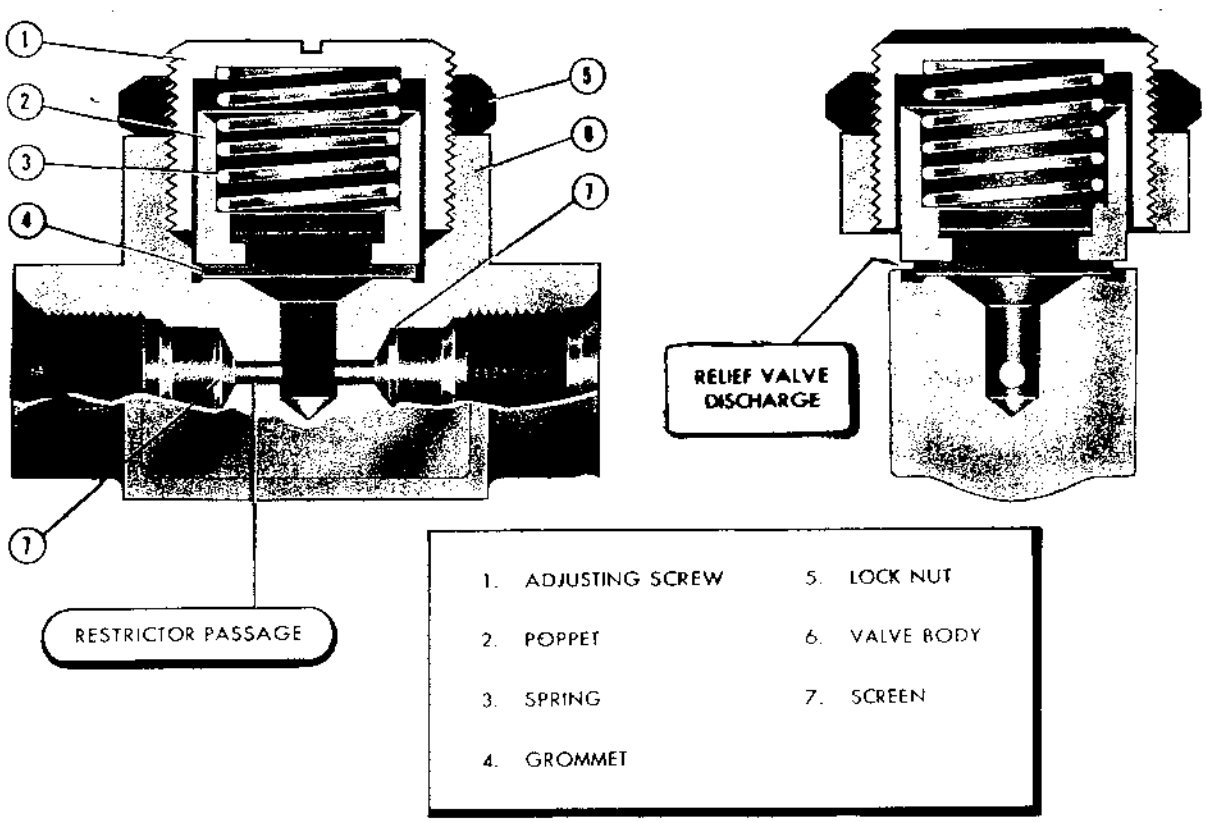



*Figure 259 — Canopy Pressure Relief Valve*

*d.* CANOPY SEAL AND WINDSHIELD SEAL SYSTEM.

(1) DESCRIPTION.—The canopy seal tube and the windshield seal are pressurized from the auxiliary air pressure system. Air is piped from the cockpit port of the heat-control valve to a relief valve located forward of the cockpit aft bulkhead. The relief valve is piped to a fitting which mates with an air chuck on the canopy. This supplies air pressure to the canopy seal tube when the canopy is locked in place. The relief valve limits the pressure applied to the seal tube and to the windshield seal. A line downstream of the relief valve supplies air pressure to the windshield seal. Both seals are inflated when the engine is running, but the windshield seal does not depend on the position of the canopy for operation.

(2) PRESSURE RELIEF VALVE.

*(a)* DESCRIPTION. *(See figure 259.)* — The pressure relief valve is located forward of the cockpit aft bulkhead, behind the right-hand shelf. It is accessible for servicing through a cockpit trim panel (3, figure 248). The valve is adjustable and is set to open at from 15 to 19 psi.

The valve incorporates a restrictor feature which limits the air flow to 0.4 cubic feet per minute at a pressure of 60 psi applied at either port.

*(b)* REMOVAL.—Remove pilot's seat and aft armor plate. Disconnect both ends of valve from air line, and remove unit.

(3) CANOPY SEAL BYPASS VALVE.

*(a)* DESCRIPTION. — A normally closed solenoid operated bypass valve is installed in the canopy and windshield seal line to deflate the seals when the canopy is being opened or closed on all airplanes having an electrically operated canopy. The valve is operated by the canopy actuator switches, and is mounted on the aft armor plate support structure to the right of the airplane center line.

*(b)* REMOVAL.

*1.* Remove pilot's seat. (See paragraph 22*a*(2).)

*2.* Remove armor plate.

*3.* Remove two screws holding valve to armor plate support structure.

*4.* Disconnect electrical lead from valve.

*5.* Disconnect valve from air-line tee.

*e.* HYDRAULIC FLUID RESERVOIR PRESSURIZATION SYSTEM.

(1) DESCRIPTION.—The hydraulic fluid reservoir is pressurized by cockpit pressure. Air is piped from the cockpit through an air filter to the reservoir relief valve. The relief valve, mounted on the reservoir, maintains a predetermined pressure within the reservoir, and is vented overboard. The inlet port of the pressure line is at the aft right corner of the cockpit floor.

The hydraulic fluid reservoir of later airplanes is pressurized by air bled from the cockpit-pressurization cold-air supply. The air is piped from the right wheel well through an air filter to a pressure regulating valve.

(2) FILTER.

*(a)* DESCRIPTION.—A filter is installed in the hydraulic reservoir pressurizing system upstream of the pressure relief valve, adjacent to the reservoir. The capacity of the filter is 3 cubic feet of air per minute at a pressure of 4 inches of water. The filter unit has a replaceable element which should be changed periodically.

*(b)* REMOVAL.—Remove retaining clip holding filter in place. Disconnect air pressure lines from unit, and remove filter.

(3) PRESSURE REGULATING VALVE.

*(a)* DESCRIPTION.—The valve is mounted adjacent to the reservoir, and delivers air at 2.8 to 5.5 psi.

*(b)* REMOVAL.—Disconnect lines from either end of valve, and remove valve.

*f.* PRESSURIZED-SUIT AIR SYSTEM.

(1) DESCRIPTION. — An air pressure system is installed to provide for inflation of the pilot's pressurized suit.

(2) PRESSURIZED SUIT VALVE.

*(a)* DESCRIPTION. — The type M-4 "G" suit valve receives air under pressure from the engine compressor, and meters it to the pilot's pneumatic suit during positive G accelerations. At the high setting, suit pressurization begins at 1.5 G's and increases at a rate of 1.4 psi per G. At the low setting, suit pressurization begins at 1.7 to 1.9 G's and increases at the rate of 1 psi per G.

*(b)* REMOVAL.—Disconnect air inlet line in cockpit. Remove three nuts and bolts holding "G" valve to mounting bracket.

*g.* WINDSHIELD DEFROSTER (F-80A-10 and RF-80A-10 Airplanes Only).

(1) DESCRIPTION.—The defroster ring is located around the edge of the windshield, inside the cockpit. The ring is perforated to blast air on the windshield. A valve at the forward end of the ring controls the air flow.

(2) REMOVAL.—Remove instrument panel. Disconnect defroster ring from air pressure line on right side of the gun sight mount. Remove defroster ring retaining clips and remove defroster.

*h.* AUXILIARY DEFROSTER DIFFUSER (F-80A-10 and RF-80A-10 Airplanes Only).

(1) DESCRIPTION.—An aluminum alloy diffuser is installed just inside the forward edge of the windshield to distribute air from the heater-blower unit over the windshield. The heater-blower unit is not installed but will be supplied at a later date.

(2) REMOVAL. — Remove windshield defroster ring. (See paragraph 24*g*(2).) Loosen clamping nut on diffuser, and remove diffuser.

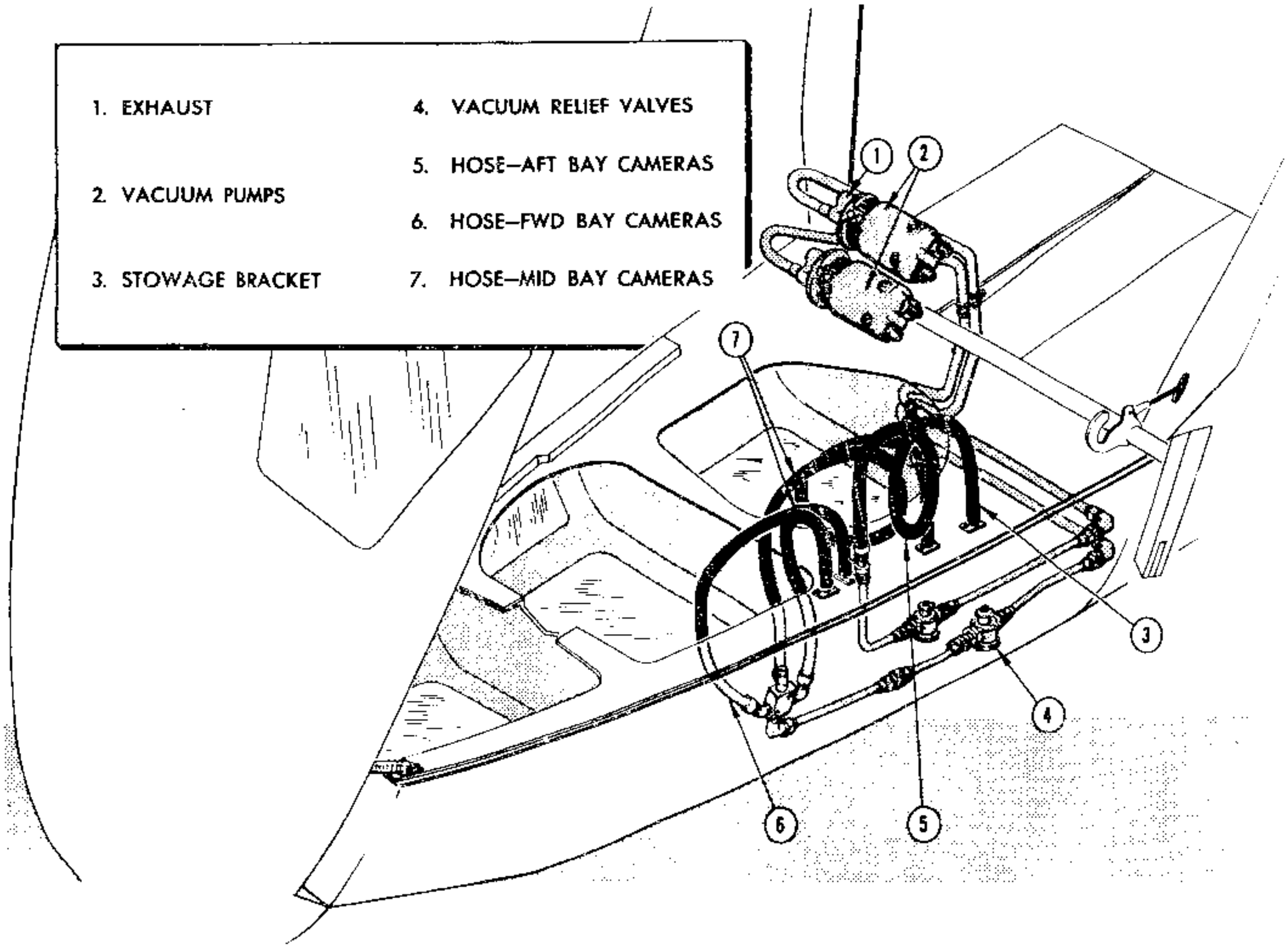



*Figure 260 — Vacuum System, RF-80A-5, RF-80A-10, and RF-80A-20 Airplanes*

## 25. VACUUM SYSTEM.

(Photographic Airplanes Only.)

*(See figure 260.)*

*a*. GENERAL.—The vacuum system consists of two vacuum pumps and two vacuum relief valves installed in the fuselage nose camera compartment, and the necessary tubing and hose. One of the pumps serves the aft bay camera; the other serves the middle and forward bay cameras. Flexible rubber hoses are provided for connection between the metal vacuum lines and the cameras. Fittings are provided for stowage of the vacuum hoses when the cameras are not installed.

*b*. OPERATION.—The vacuum pumps are driven by an integral electric motor which is energized when the camera master switch is turned on. These pumps supply suction to hold the film flat in the focal plane during exposure. A valve in the camera mechanism automatically relieves the vacuum while the film is wound between exposures.

*c*. VACUUM PUMPS.—The pumps are of the dry air type consisting of an eccentric rotor and a rotor housing containing a spring-loaded carbon vane. An end plate containing two integral ports is attached to the housing. A flapper valve in the exhaust port prevents any return flow of exhaust air. For electrical information, see paragraph 17*bb*(4), this section.

**Note**

On RF-80A-15 Airplanes, the electrically operated pumps for camera vacuum have been deleted. Vacuum is supplied by an air ejector pump located on the right side of the nose wheel well, fed by an air pressure line tapping the cabin air source at the engine.

## 26. PHOTOGRAPHIC EQUIPMENT.

*a.* GENERAL.—The FP-80A-5 photographic airplane is a modification of the standard P-80A-5 airplane. The nose section has been redesigned to accommodate various arrangements of cameras in place of armament. Three bays with camera supporting structure provide for vertical, split, and oblique camera installations. In addition, with the loop antenna removed, a forward shooting camera may be installed in the forward bay area. Cameras used are K-18 with 24-inch lens cone, K-17 with 6-, 12-, or 24-inch lens cone, and K-22 with 6-, 12-, 24-, or 40-inch lens cone. The cameras may be used in a number of combinations. They are controlled from the cockpit where control units are incorporated in the instrument and shelf panels.

For information regarding connection of vacuum lines, refer to paragraph 25, this section. For electrical information on photographic equipment, refer to paragraph 17*bb*, this section.

*b.* CAMERA INSTALLATIONS. — Provisions to accommodate the following cameras are installed in the photographic airplanes. In some installations, the K-22 cameras require modification to relocate the power and intervalometer receptacles, Refer to paragraph *c* following.

Camera magazines, type A-5A (unmodified) and type A-7, must be reworked to incorporate blinker light switches. Other magazines do not require change. Refer to paragraph *d* following.

Position of the camera supporting structure for each of the various cameras is indicated on the structure by camera numbers and arrows.

To set the cameras at the proper angles, place a bubble protractor on the floor of the camera compartment and determine the angle at which the airplane is resting. Then either add this angle to, or subtract it from, the angle obtained by placing the bubble protractor on the back of the camera, and adjust the camera accordingly.

For typical camera installation see figure 264.

(1) FORWARD BAY. *(See figure 261, sheet 1.)*

*(a)* One vertical K-17-6 with an A-9 magazine. (Rotate camera 180 degrees from normal fore-and-aft position. Remove manual winding lever from camera.)

*(b)* One forward aiming K-22-12 with an A-9 magazine. This camera aims at an angle of 12 degrees below horizontal. The radio loop antenna and data case must be removed.

(2) MID BAY. *(See figure 261, sheet 2.)*

*(a)* One left oblique K-17-6 with an A-5 or an A-5A magazine, and one right oblique K-17-6 with an A-5 or an A-5A magazine. (Rotate camera 180 degrees from normal fore-and-aft position. Remove manual winding lever from camera.)

*(b)* One left oblique K-17-6 with an A-5 or an A-5A magazine, and one vertical K-17-6 with an A-5 or an A-5A magazine . (Rotate camera 180 degrees from normal fore-and-aft position.)

*(c)* One vertical K-17-12 or K-17-24 with an A-9 magazine.

*(d)* One vertical K-22-6, K-22-12, K-22-24, or K-22-40 with an A-9 magazine. (Remove sun shade from K-22-40 lens cone.)

(e) One split K-22-24 or K-22-40 with an A-9 magazine. (Adjust split K-22-24 approximately 20 degrees to the right side of the airplane. Rotate K-22-40 camera 180 degrees from normal fore-and-aft position when an f5 lens is installed. Remove sun shade from K-22-40 lens cone.)

*(f)* One split K-17-24 with an A-9 magazine. (Rotate camera 180 degrees from normal fore-and-aft position.)

(3) AFT BAY. *(See figure 261, sheet 3.)*

*(a)* One vertical K-17-12 or K-17-24 with an A-9 magazine.

*(b)* One vertical K-22-12, K-22-24, or K-22-40 with an A-9 magazine. (Remove sun shade from K-22-40 lens cone.)

(c) One split K-17-24 with A-9 magazine. (Rotate camera 180 degrees from normal fore-and-aft position.)

*(d)* One split K-22-24 or K-22-40 with an A-9 magazine. (Rotate K-22-40 camera 180 degrees when an f5 lens is installed. Remove sun shade from K-22-40 lens cone.)

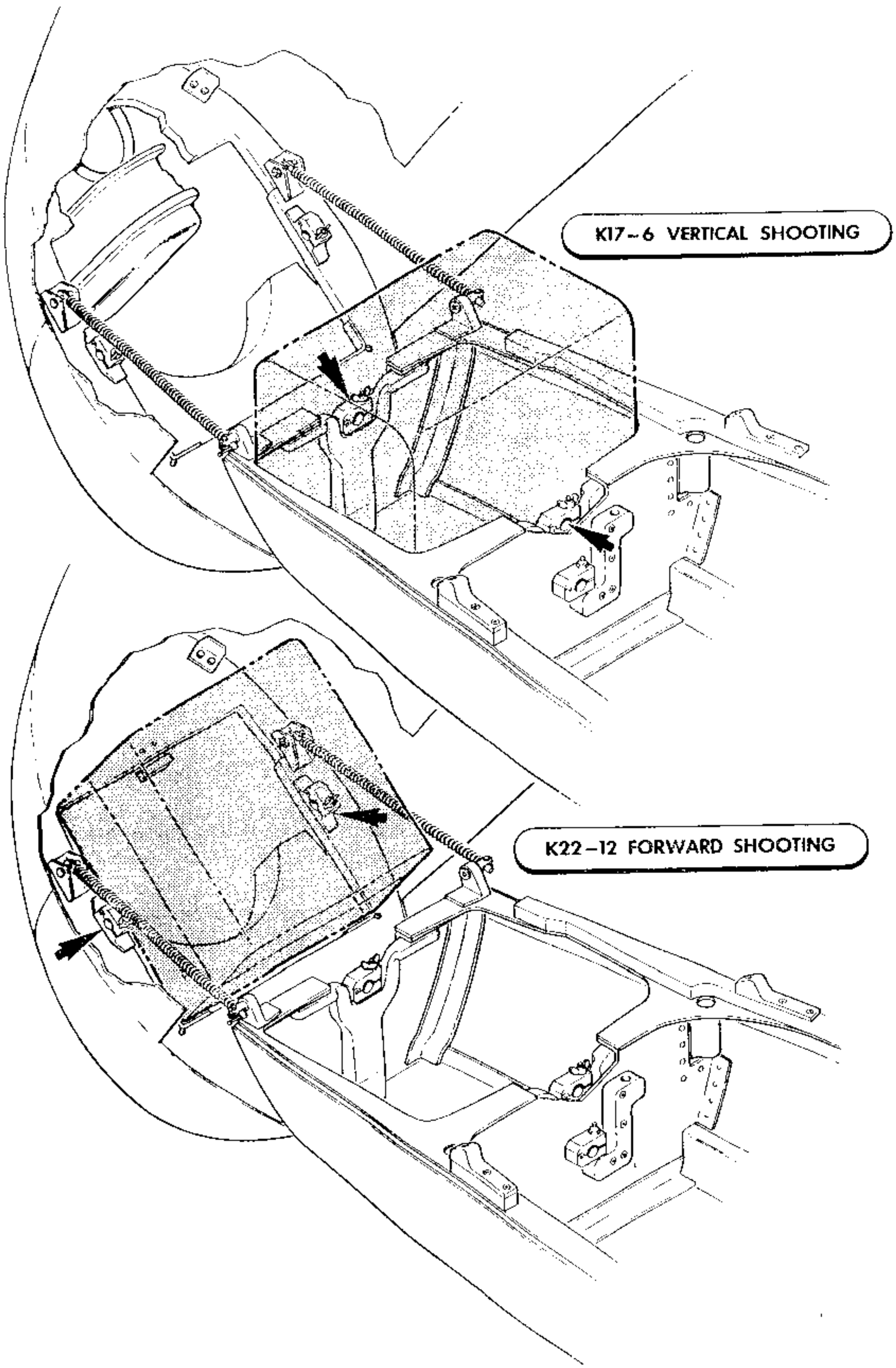
*(e)* One vertical K-18 with an A-8 magazine.

*(f)* One vertical K38-36 with an A-8B magazine.

*(g)* One vertical K38-24 with an A-8B magazine.

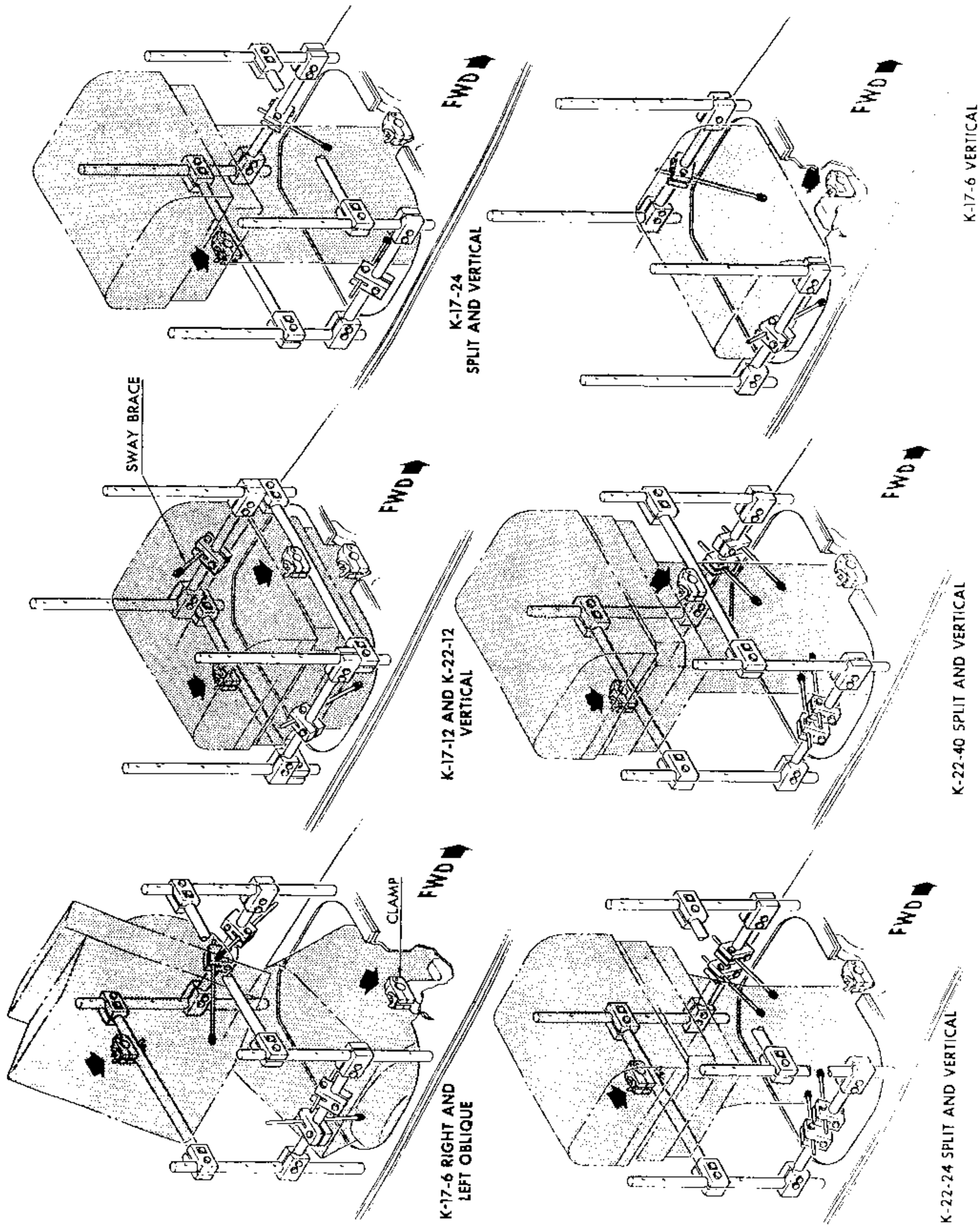
*c.* MODIFICATION OF K-22 CAMERA. *(See figure 262.)*—When used in the mid and aft bays, the K-22 cameras must have power and intervalometer receptacles removed from the side of the cameras and installed near the base of the lens cone. When used in the forward bay, aiming forward, the K-22 cameras must have power and intervalometer receptacles removed from the camera body, and replaced by a cable and receptacle box.

For modification of K-22 cameras for use in mid and aft bay installations, see figure 262, sheet 1. For modification of K-22 cameras for use in the forward bay, aiming forward, see figure 262, sheet 2.



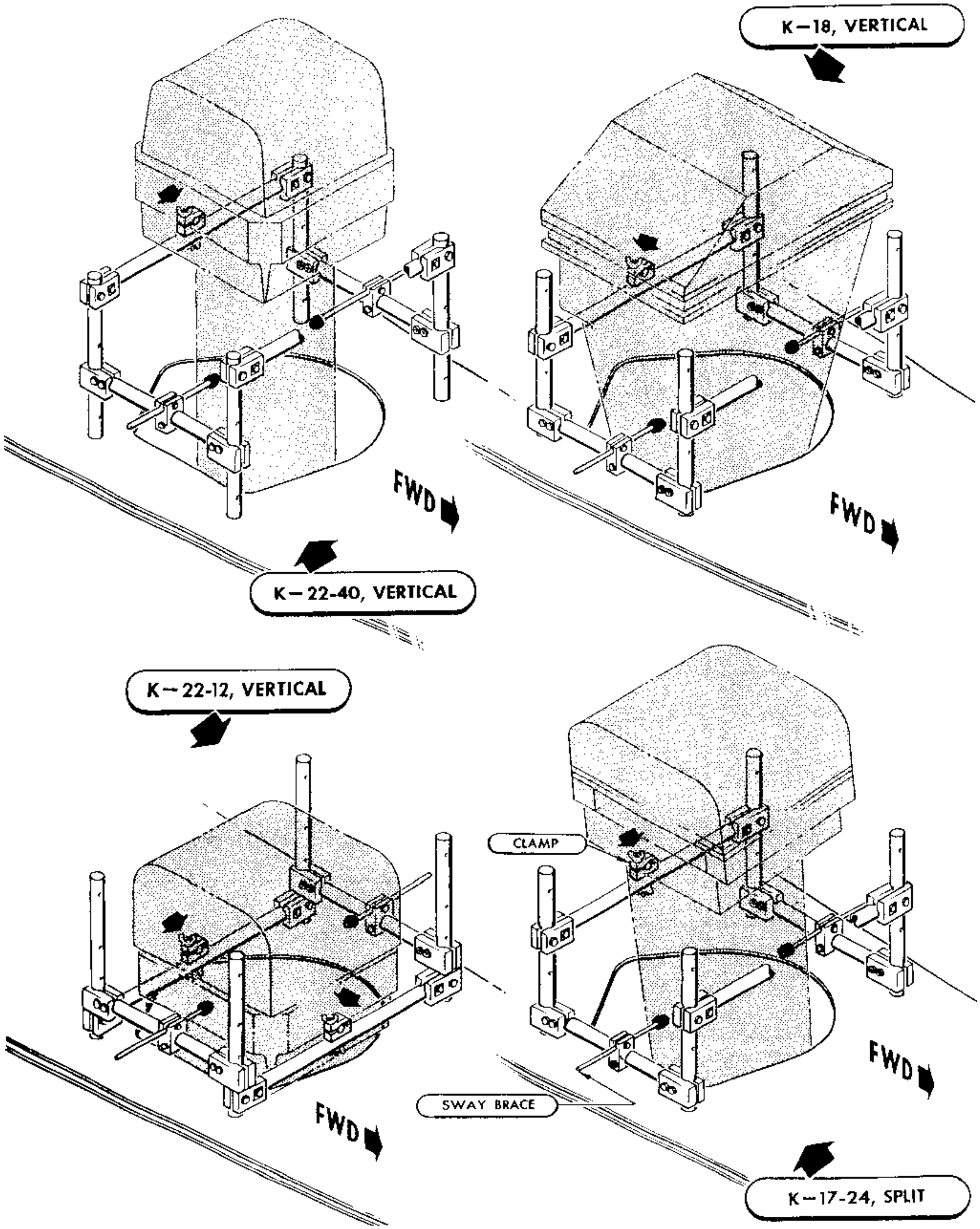

FORWARD BAY

*Figure 261 (Sheet 1 of 3 Sheets) — Camera Installation*



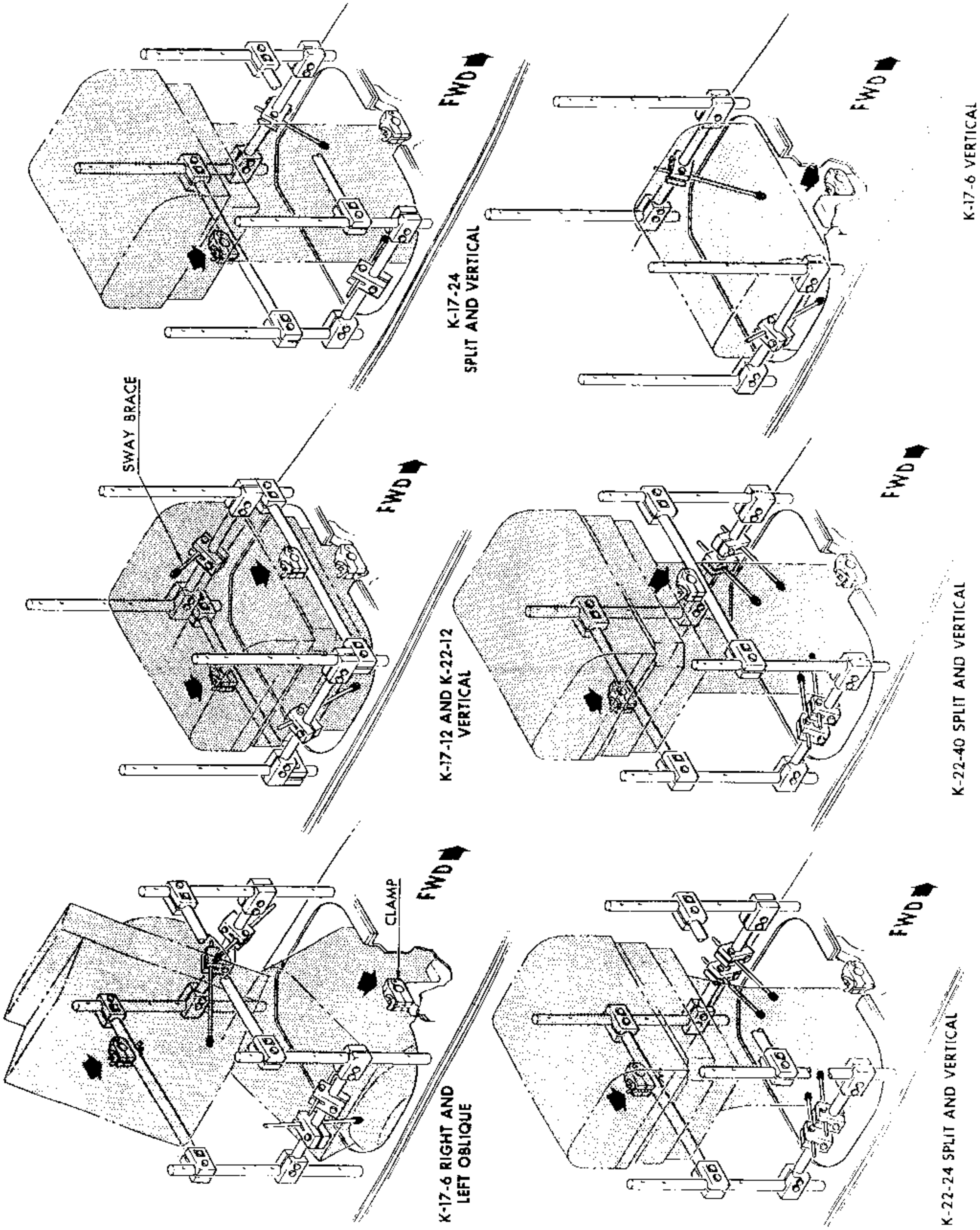

MID BAY

*Figure 261 (Sheet 2 of 3 Sheets) — Camera Installation*



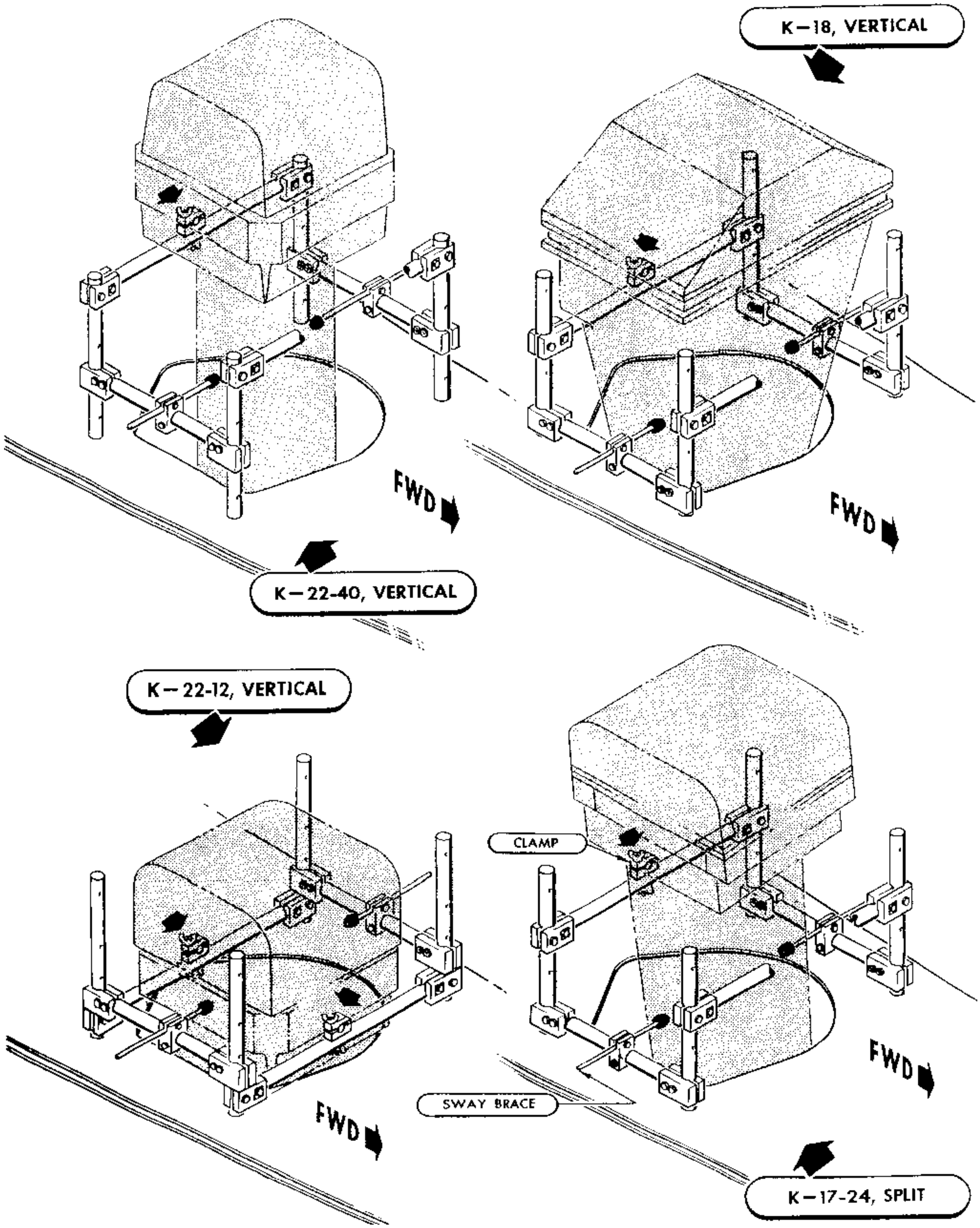

AFT BAY

*Figure 261 (Sheet 3 of 3 Sheets)—Camera Installation*



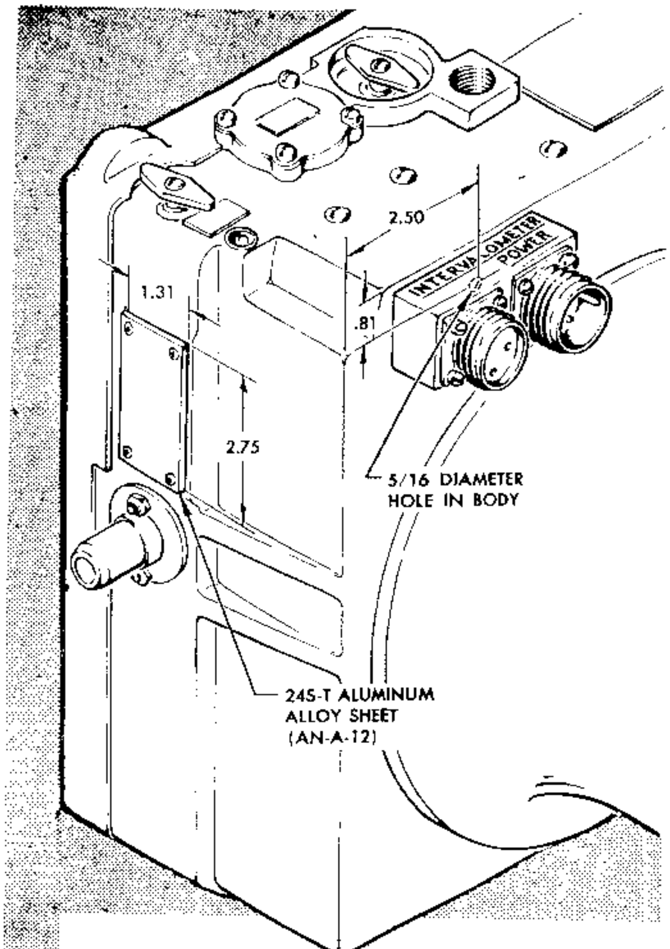

MID BAY

*Figure 261 (Sheet 2 of 3 Sheets) — Camera Installation*




AFT BAY

*Figure 261 (Sheet 3 of 3 Sheets)—Camera Installation*




1. Remove the eight screws holding the power and intervalometer connectors (part numbers AN3102H-16-11P and AN3102H-16S-6S) to the camera body.

2. Unsolder the electrical leads to both connectors, and remove the spacer and gaskets.

3. If an AN connector angle block, Fairchild part number C360-1247, is installed, remove it by extracting the four screws from inside the body.

4. From the inside of the body, remove the drive motor and drill a hole in the bottom of the camera body casting, approximately 5/16 inch in diameter. This hole need be only large enough to allow entry of all the wires, and should not be large enough to weaken the casting.

5. Drill and tap four holes in the bottom of the camera body casting around the previously-drilled hole. The four holes must match the holes in the spacer. Use a drill size 43 (.089) and tap size 4-40 threads per inch.

**Note**

If angle block was originally used, it must be replaced by a spacer, Fairchild part number C360-455, when connectors are relocated.

6. Bring the electrical leads through the 5/16-inch hole in the bottom of the camera body casting, and solder them to the proper terminals.

7. Assemble the receptacle, gaskets, and spacer, using the four 1¼ x 4-40 screws to hold the unit in place on the body. Use a metal-to-metal cement, if available.

8. From 3/16-inch aluminum plate, cut a rectangle 1 5/16 x 2¾ inches. Drill and tap four holes to match the holes in the camera body casting where the connectors were originally located. Use a drill size 43 (.089) and tap size 4-40 threads per inch.

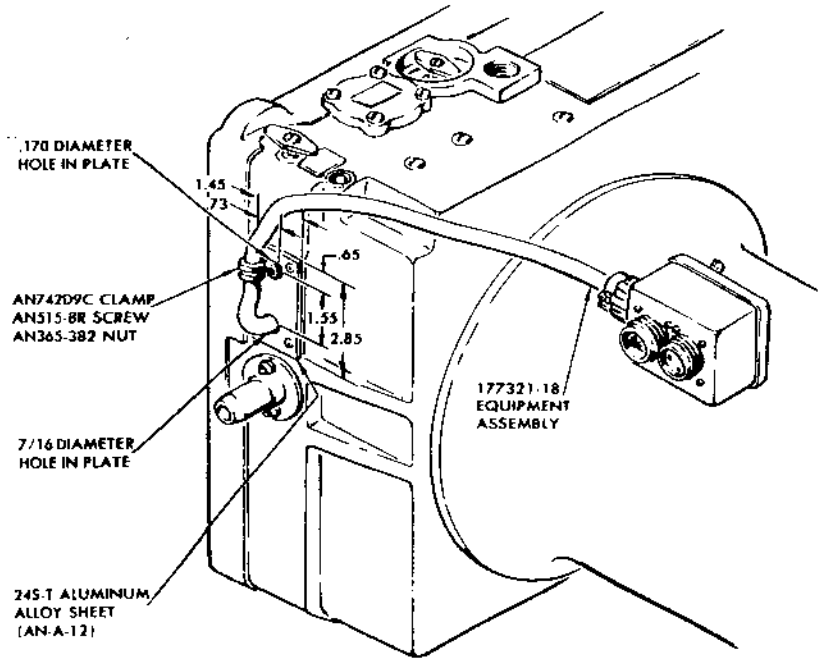
9. If the angle block, Fairchild part number C360-1247, was not installed on the camera, it will be necessary to furnish four No. 4-40 screws, 5/16 inch long. The screws must not bottom when the cover plate is in place.

10. Paint the cover plate black, front and back.

11. Attach the cover plate with the four No. 4-40 5/16-inch screws. If the spacer, Fairchild number C360-455 was originally installed, the four tapped holes in the camera body will have to be reamed out to permit passage of the screws.

12. Replace the drive motor.

*Figure 262 (Sheet 1 of 2 Sheets) — K-22 Camera Modification, Mid & Aft Bay*




1. Remove the eight screws holding the power and intervalometer connectors (part numbers AN3102-16-11P and AN3102H-16S-6S) to the camera body.

2. Unsolder the electrical leads to both connectors, and remove the spacer and gaskets.

3. If an AN connector angle block, Fairchild part number C360-1247, is installed, remove it by extracting the four screws from inside the body.

4. From 3/16-inch aluminum plate, cut a rectangle 1.45 by 2.85 inches. Drill and tap four holes to match the holes in the camera body casting where the connectors were originally located. Use a drill size 43 (.089), and a tap, size 4-40 threads per inch.

5. Drill a hole .170 inch in diameter and a hole 7/16-inch in diameter, located as shown. Chamfer both edges of the 7/16-inch hole.

6. Paint the cover plate black, front and back.

7. Insert cable of 177321-18 equipment assembly through 7/16-inch hole. Splice wires of cable of -18 assembly to respective wires that were removed from connectors in step 2, preceding. Cover splices with tape or plastic tubing.

8. Clamp cable to cover plate, using AN742-D9C clamp, AN515-8R screw, and AN365-832 nut.

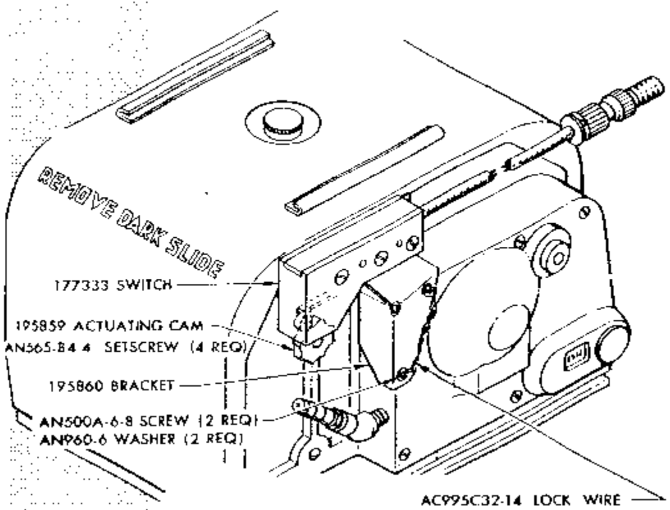
9. If the angle block, Fairchild part number C360-1247, was not installed on the camera, it will be necessary to furnish four number 4-40 screws, 5/16-inch long. The screws must not bottom when the cover plate is in place.

10. Attach the cover plate with the four 4-40 5/16-inch screws. If the spacer, Fairchild number C360-455 was originally installed, the four tapped holes in the camera body will have to be reamed out to permit passage of the screws.

11. Assembly must be light tight. Place suitable sealing material around openings in cover plate.

*Figure 262 (Sheet 2 of 2 Sheets) — K-22 Camera Modification, Forward Shooting*

*d.* MODIFICATION OF A-5A AND A-7 MAGAZINES. *(See figure 263.)*—Types A-5A (modified), A-8, and A-9 camera magazines contain a blinker light switch as an integral part. Types A-5A (unmodified) and A-7 must be changed to add the blinker light switch. Parts for this modification are in two canvas bags mounted on the aft side of the plastic bulkhead in the camera compartment. Two sets of parts for the A-5A magazine are stowed in one bag, and two sets for the A-7 magazine are stowed in the other bag.




## A-5A CAMERA MAGAZINE

1. Remove the feed-spool knob located directly above the vacuum hose connection.

2. Replace knob with actuating cam, Lockheed part number 195859.

3. Remove two screws from mechanism cover.

4. Install bracket assembly, Lockheed part number 195860, using two AN500A-6-8 screws and two AN960-6 washers.

5. Attach switch assembly, Lockheed part number 177333, to the bracket by pressing the two studs on the switch into the spring clips on the bracket. The spring roller on the switch assembly must rest on the 195859 actuating cam.

## A-7 CAMERA MAGAZINE

1. Loosen the setscrews and remove the spool pivot knob located directly above the hose connection.

2. Replace the knob with a wheel, Lockheed part number 195083, on this shaft.

3. Install bracket assembly, Lockheed part number 177539, with two AN500A-6-18 screws, and two AN960-6 washers. The new screws will fit in the existing threads.

4. Attach switch assembly, Lockheed part number 177333, to 177539 bracket assembly by pressing the studs on the switch into the spring clips of the bracket in such a way that the spring roller on the switch rests on the 195083 wheel.

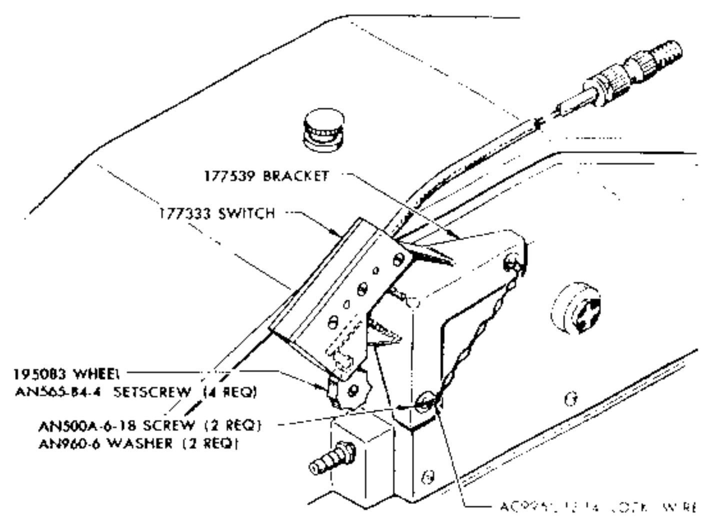



*Figure 263 — A-5A and A-7 Camera Magazine Modification*

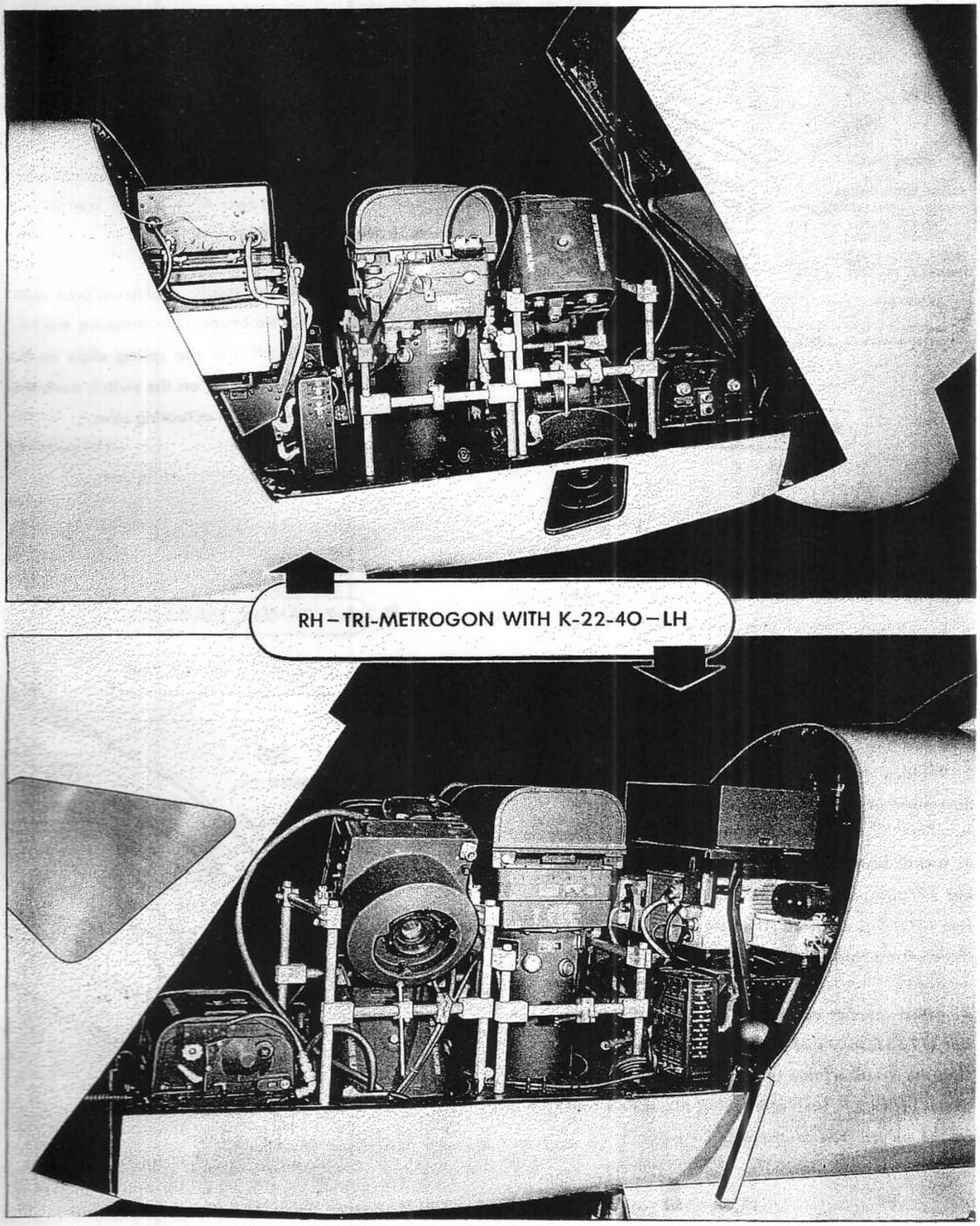



*Figure 264 — Typical Camera Installation*

*e.* RF-80A-15 AND RF-80A-25 AIRPLANES.—The RF-80A-15 and RF-80A-25 photographic airplanes (see figure 264A) are a modification of the F-80A fighter airplane, and are generally similar to the RF-80A-5 and RF-80A-10 airplanes. The nose section has been redesigned to accommodate various camera arrangements.

(1) CAMERA INSTALLATIONS.—Provisions for various cameras and camera combinations are given in figure 264B and in the camera location chart located on the data case in the camera compartment.

Camera control units are located in the cockpit instrument and shelf panels. Pre-setting controls are located in the camera compartmet junction box.

The K-22 camera electrical disconnect terminal box must be relocated on the camera to clear the structure for the forward oblique location. The following is the procedure for this relocation:

*(a)* Remove 45° adapter (if installed).

*(b)* Unsolder three leads from plugs.

*(c)* Install one SPD 711081 extension.

*(d)* Re-solder leads to plugs.

*(e)* Attach terminal box to extension.

*(f)* Camera body must be light tight after rework. If necessary, place suitable sealing material around openings in cover plate.

An A-14 magazine amplifier is located on the deck forward of the radio rack in the aft end of the camera compartment. A-C power for the A-14 magazine amplifier is supplied by a 750 volt-ampere inverter located in the left side of the nose wheel well at Station 111. The A-14 magazine control box is located in the cockpit under the forward right canopy track on a swinging mount. The installation permits removal of the A-14 magazine control and amplifier units when the A-14 magazine is not in use. The cable between the A-14 control and the camera junction box is permanently installed in the airplane. Cables from the camera junction box to camera equipment are removable with the respective cameras. See figure 223B for camera equipment wiring diagram.

(2) FORWARD BAY. *(See figure 264B.)*

*(a)* One vertical K-17B-6 with an A-5A or A-14 magazine.

*(b)* One forward aiming K-22-12 with an A-5A magazine. This camera aims at an angle of 12 degrees below horizontal. Rotate camera 90 degrees from normal fore-and-aft position. SPD 711081 (NA711080) extension required for camera in this position.

*(c)* One forward aiming K-22-24 with an A-5A magazine. Remove sunshade from lens. This camera aims at an angle of 12 degrees below horizontal. Use SPD 711613 mount trunnion.

(3) MID BAY. *(See figure 264B.)*

*(a)* One left oblique K-17B-6 with an A-5A magazine and one right oblique K-17B-6 with an A-5A magazine. Both cameras should be depressed 30 degrees below horizontal.

*(b)* One vertical K-22-12 with an A-5A magazine. SPD 711081 (NA711080) extension required for camera in this position.

*(c)* One vertical K-22-24 with an A-5A magazine.

*(d)* One vertical S-7A-7 Stereo. SPD 711607 trunnion adapter required.

*(e)* One left oblique S-7A-7 Stereo. SPD 711607 trunnion adapter required and also modification of lens housing. Depress camera 25° below horizontal.

(4) AFT BAY. *(See figure 264B.)*

*(a)* One vertical K-22-24 with an A-5A magazine. Remove sunshade from lens.

*(b)* One vertical K-38-24 with an A-8B magazine.

*(c)* One vertical K-38-36 with an A-8B magazine.

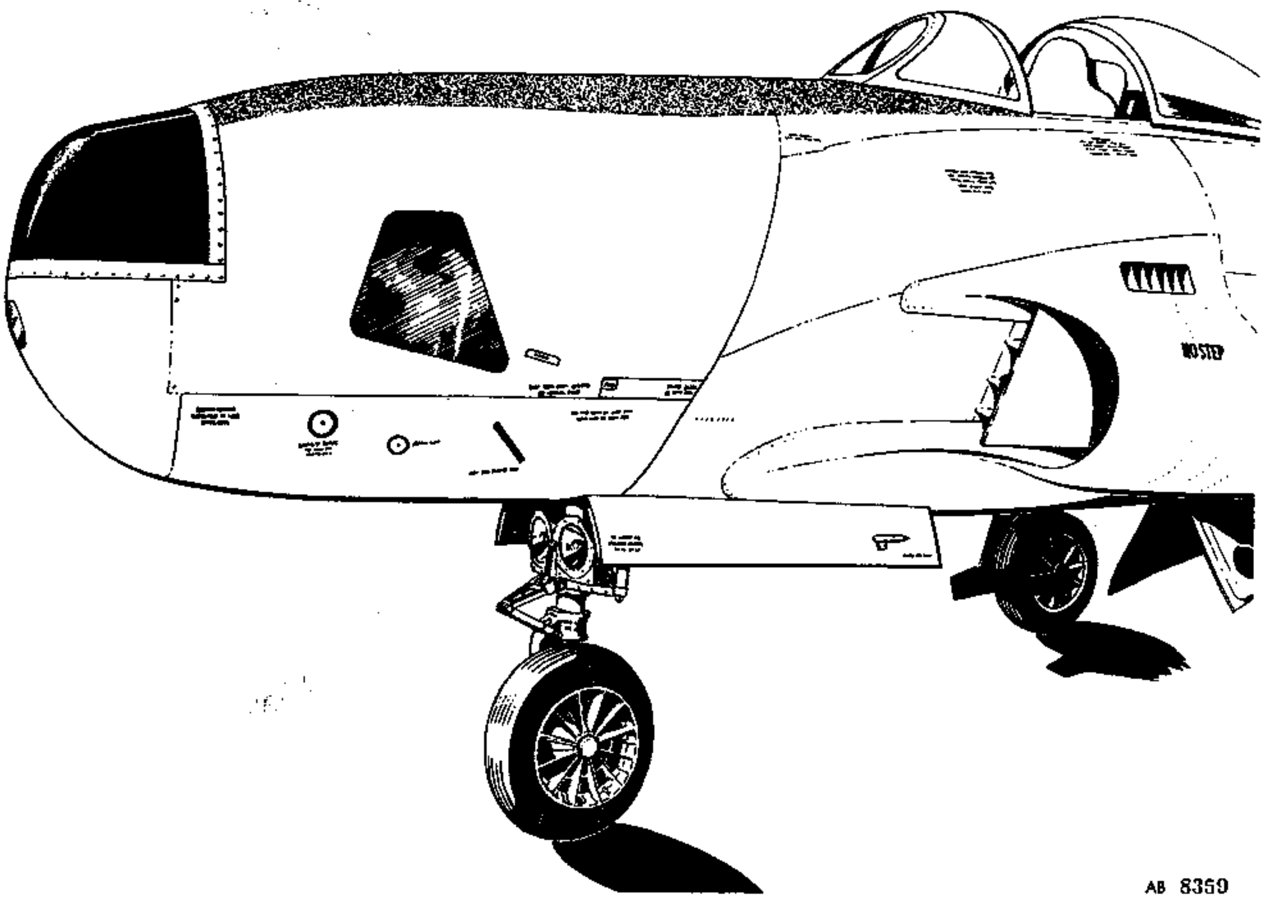
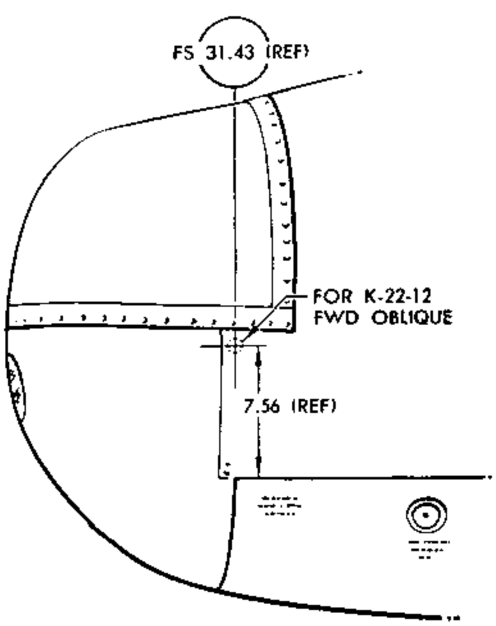


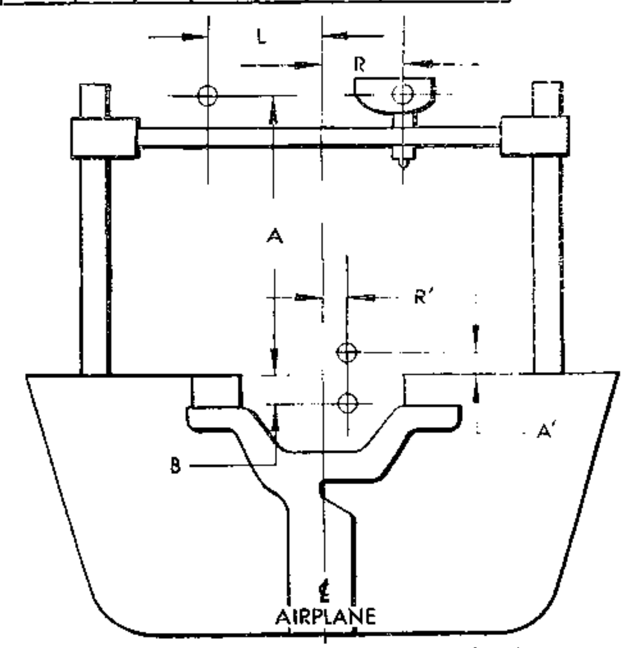

*Figure 264A — Nose Section, RF-80A-15 and RF-80A-25 Airplanes*

CAMERA MOUNTS PROVIDED FOR CAMERAS NOTED BELOW

| CAMERA | LENS | MAGAZINE | POSITION | LOCATION OF TRUNNION ℄ | | | | | | SEE NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | A' | B | L | R | R' | |
| **FORWARD BAY** | | | | | | | | | | |
| K-17B | 6" | A-5A | VERTICAL | | | 1.70 | | | .31 | |
| K-17B | 6" | A-14 | VERTICAL | | | 1.70 | | | .31 | |
| K-22 | 12" | A-5A | FWD OBLIQUE | (SEE VIEW LOOKING INB'D) | | | | | | 1 & 3 |
| K-22 | 24" | A-5A | FWD OBLIQUE | | | 1.50 | | | .31 | 2 & 5 |
| **MIDDLE BAY** | | | | | | | | | | |
| K-17B | 6" | A-5A | LEFT OBLIQUE | 17.56 | | | 4.50 | | | 6 |
| K-17B | 6" | A-5A | RIGHT OBLIQUE | | | .06 | | | 3.50 | 6 |
| K-22 | 12" | A-5A | VERTICAL | | .20 | | | | .85 | 3 |
| K-22 | 24" | A-5A | VERTICAL | 10.50 | | | | .68 | | |
| S-7A | 7" STEREO | | VERTICAL | | .20 | | | | .15 | 7 |
| S-7A | 7" STEREO | | LEFT OBLIQUE | 17.69 | | | .62 | | | 4 & 7 |
| **AFT BAY** | | | | | | | | | | |
| K-22 | 24" | A-5A | VERTICAL | 8.62 | | | | | .38 | 5 |
| K-38 | 24" | A-8B | VERTICAL | 9.12 | | | | | .38 | |
| K-38 | 36" | A-8B | VERTICAL | 11.75 | | | | | .38 | |




VIEW LOOKING INBOARD




VIEW LOOKING FORWARD (TYP)

1. *ROTATE 90° FROM NORMAL FORE AND AFT POSITION. DEPRESS 12° FROM HORIZONTAL.*
2. *USE SPD711613 MOUNT TRUNNION. LOCATION IS FOR MOUNT TRUNNION. DEPRESS 12° FROM HORIZONTAL.*
3. *SPD711081 (NA711080) REQUIRED FOR CAMERA IN THIS POSITION.*
4. *MODIFICATION OF LENS HOUSING REQUIRED. DEPRESS 25° FROM HORIZONTAL.*
5. *REMOVE SUNSHADE FROM LENS.*
6. *DEPRESS 30° FROM HORIZONTAL.*
7. *SPD711607 TRUNNION ADAPTER REQUIRED.*

F8647
M59 (MOD.4).264B

*Figure 264B — Camera Installation Diagram for RF-80A-15 and RF-80A-25 Airplanes*

# SECTION V

# USEFUL OR MILITARY LOAD

## 1. .50 CALIBER MACHINE GUNS.

*a.* GENERAL.—The ammunition for each machine gun is carried in a drawer-type tray located above each gun feed mechanism. Each tray holds 300 rounds of ammunition.

*b.* LOADING. — Ammunition loading procedure is placarded on the outside of each tray and is as follows:

(1) Disconnect quick-disconnect fitting at bottom front of ammunition tray, and remove tray.

(2) Open door on top of tray by disconnecting latch.

(3) Feed the ammunition belt into the tray beginning on the bottom at the sloping end. Place cartridges so they will be pointing forward when trays are installed.

(4) Feed belt toward straight end of tray, then reverse direction and lay second layer of belt over first layer. Continue building up layers until the required capacity is reached.

(5) Feed balance of belt into lower end of feed chute and lock belt in place with belt lock at top of feed chute.

(6) Close and latch door on top of tray.

(7) Install trays in tracks and fasten with fittings at bottom of feed chutes.

(8) Release belt lock and feed the belt from the chute into the machine gun. For loading guns, see section IV, paragraph 20*b*(2).

**Note**

Belt lock must be released, or ammunition will not feed into gun, and armament compartment doors will not close properly.

## 2. BOMBS.

*a.* GENERAL.—A bomb shackle capable of supporting a 100- to 1000-pound bomb is installed in each wing tip. Early airplanes incorporate a type B-10, and later airplanes a type S-1 bomb shackle. Two AN-MK-4 bomb hoists with bomb slings are used to lift a bomb in place. Hooks in the wing-tip fitting assembly are used to support the bomb hoists. Because of the two types of bomb shackle installations, two methods of loading bombs are used.

*b.* LOADING BOMB (B-10 SHACKLE INSTALLATION). *(See figure 232.)*

(1) Remove large access panel in top of wing tip.

(2) Remove small panels on bottom of wing tip marked "MOOR HERE" to provide access to bomb hoist hooks.

(3) In top of wing tip, push shackle release triggers at each end of shackle to release the shackle supports. Remove shackle through slot in fairing in bottom of wing tip.

(4) Engage shackle with lugs on bomb and cock shackle. Be sure end of shackle marked "FRONT" is toward nose of bomb and arming wire is engaged with shackle.

(5) Cock electrical bomb release unit in wing tip.

(6) Attach bomb to bomb hoist with sling and attach bomb hoist to hooks in wing tip.

(7) Hoist bomb and shackle into position and engage shackle supports. Be sure that release and arming levers on shackle are properly engaged with arms on electrical release unit.

(8) Engage shackle supports with shackle release triggers.

(9) Place manual release ring over release lever on shackle.

*c.* LOADING BOMB (S-1 SHACKLE INSTALLATION). *(See figure 233.)*

(1) Remove large access panel in top of wing tip.

(2) Remove two small panels on bottom of wing tip marked "MOOR HERE" to provide access to bomb hoist hooks.

(3) Attach bomb to bomb hoist with sling, and attach bomb hoist to hooks in wing tip.

(4) Hoist bomb into place and cock shackle with cocking ring. The arming wires can be engaged to the shackle arming solenoids after the bomb has been loaded.

(5) Check to be sure the manual release cable is connected.

(6) Install 0.0179-inch brass safety wire through shackle and manual release lever.

## 3. LOADING ROCKETS.

Prior to loading rockets on the aircraft, each rocket igniter must be tested by Ordnance personnel, using a type 680A continuity tester. Load rockets as follows:

*a.* Pull down on aft hinged mounting post, and pull forward on the locking catch located immediately above the pin. This will lock the post in extended position. Repeat operation on other aft post of the pin.

*b.* Pull down the forward hinged mounting post, and lock it in position by sliding the serrated pin down on the inboard side of the post.

*c.* Lift a rocket (two men) and slide it aft to engage two fins in the two rear mounting posts and to engage the rocket forward support pin in the forward post.

*d.* Secure the rocket in the forward post by an 0.102 brass shear wire inserted through the rocket forward support pin.

*e.* Load a lower rocket by sliding it aft until the fins engage with the fins of the upper rocket in the slots provided for that purpose, and the rocket forward support pin engages in the forward support on the upper rocket.

*f.* Secure the lower rocket by an 0.102 brass shear wire through the forward support pin.

**Note**

After installation of rockets, inspect the forward rocket post to be sure the wedges are in the fully locked position, and that there is not excessive play between the wedge pin and cam.

*g.* Repeat operations for each rocket station.

*h.* After rockets are hung on aircraft, use a type B-2 electrical circuit tester, AF Specification 24971, Stock No. 7800-905370, to check rocket firing circuits. Plug tester into lower sockets of each upper round.

**WARNING**

Be sure metal shipping container is placed over nozzles and igniter cable prior to testing firing circuits to prevent accidental plugging in of a rocket instead of a tester cable.

**Note**

Normal firing sequence is: left outboard lower, right outboard lower, left inboard lower, right inboard lower, left outboard upper, right outboard upper, left inboard upper, right inboard upper.

i. Check with the pilot, then plug in the rockets, beginning with either outboard station and working straight across to the opposite outboard station.

**WARNING**

The airplane must be pointing toward an uninhabited area. The armorer must stand at arm's length at the side of, never behind or in front of the rocket being plugged in, nor immediately behind nor in front of any rocket already plugged in.

# SECTION VI

# MATERIALS OF CONSTRUCTION

## 1. RIVET AND BOLT SUBSTITUTION.

The following rivet and bolt substitutions are authorized:

*a.* SUBSTITUTION OF SELF - PLUGGING CHERRY RIVETS OR DUPONT RIVETS FOR SOLID RIVETS.—Do not substitute Cherry or Dupont rivets unless the specific substitution is authorized by the Handbook of Structural Repair Instructions, AN 01-75FJ-3.

**Note**

Do not use Dupont explosive rivets unless the operator is skilled in the technique of installation.

**WARNING**

Do not install a Dupont explosive rivet in any area in which explosive fumes or inflammable liquids may be trapped.

*b.* SUBSTITUTION OF BOLTS FOR RIVETS.—Do not substitute bolts for rivets except where specifically authorized by the Handbook of Structural Repair Instructions, AN 01-75FJ-3. Where bolt-for-rivet substitution is permitted, the bolt holes must be drilled small enough to provide a drive fit for bolts, as shown in AN 01-75FJ-3, table I. An edge distance of 2d and a center-to-center distance of 3d must be maintained.

*c.* SUBSTITUTION OF AD FOR DD RIVETS.—One-quarter inch AD rivets may be substituted for 3/16-inch DD rivets, provided a minimum of 2d edge distance and 3d center-to-center spacing can be maintained. Substitution of AD rivets for 1/4-inch DD rivets is not authorized.

*d.* SUBSTITUTION OF BOLTS FOR HIGH-SHEAR RIVETS (NAS178).—AN3, AN4, AN5, and AN6 bolts may be substituted for NAS178-6, NAS178-8, NAS178-10, and NAS178-12 high-shear rivets respectively. Use either AN310 or AC365 nuts for securing the bolts.

## 2. STANDARD MATERIALS.

In the original manufacture of the airplane, the contractor has made every effort to utilize standard materials to the fullest extent, particularly plate, tubing, electric wiring, cable, etc. If these standard materials are available, they should in all cases be used. Otherwise substitutions may be made, observing the specifications on physical properties, as well as applicable "remarks" shown on the accompanying tables. The tables comprise the standard materials commonly used in the P-80A and FP-80A airplanes.

## 3. PHYSICAL PROPERTIES OF MATERIALS.

Physical properties of materials, as specified in the accompanying tables, are minimum values unless otherwise noted. Symbols used to denote physical properties, together with the meaning of these symbols, are given below:

$F_{tu}$ — Ultimate Tensile Stress
$F_{ty}$ — Tensile Yield Stress
$F_{su}$ — Ultimate Shear Stress
$F_{br}$ — Ultimate Bearing Stress

Physical properties indicated for heat-treated materials represent the lower limit of the range which must be specified for heat treat. Values for cast materials are minimum values for cast test bars.

## 4. VALUES OF MODULI OF ELASTICITY.

The following are values of moduli of elasticity for materials included in the accompanying tables.

| *Material* | *Modulus (PSI)* |
|---|---|
| Steel, Low Carbon | $28 \times 10^6$ |
| Steels, Alloy | $29 \times 10^6$ |
| Steel, Stainless | $26 \times 10^6$ |
| Aluminum Alloys | $10.3 \times 10^6$ |
| Magnesium Alloys, Wrought | $6.5 \times 10^6$ |
| Magnesium Alloys, Cast | $6 \times 10^6$ |
| Inconel (Nickel, Chromium, Iron Alloy) | $31 \times 10^6$ |
| Bronze, Aluminum | $14 \times 10^6$ |

## 5. ELECTROLYTIC ACTION OF DISSIMILAR METALS.

*a.* ANODIC AND CORROSIVE ACTION.—When different metals are in contact in the presence of any conducting solution (moisture or fluid capable of carrying an electric current) one of the metals will be corroded or eaten away while the other one will be unaffected. The metal that is corroded is *anodic* to the other metal.

*b.* PROTECTIVE ACTION. — Any metal in the anodic table (below) may be used to provide corrosive protection to any of the metals listed to the right of it. For example: In the case of 24S Alclad, the structural 24S material is protected from corrosion until the protecting Alclad layer has been corroded away.

In all cases of doubt, the Engineering Officer shall be contacted.

*c.* ANODIC TABLE. — The following table lists metals in their anodic order starting with the most anodic metal at the left. The metals in any one column have such slight anodic differences that they may be used together with negligible corrosive action.

## 6. RADIOACTIVE LUMINOUS MATERIALS.

These materials conform to Spec. TT-R-58 and shall be used as follows:

GRADE 15M Use only where a low luminosity is acceptable and where the area involved makes the use of a higher grade material too costly.

GRADE 22M General purpose, marking of dials, etc.

GRADE 30M Very expensive. Use only where required by customer or extreme design considerations.

ADHESIVES for these materials must conform to Spec. TT-R-58 and shall be used as follows:

TYPE A For exposure to air. (General purpose.)

TYPE B For immersion in liquids.

Designs must indicate both material and adhesive.

## 7. FLUORESCENT LACQUERS.

Fluorescent lacquers require excitation by ultra-violet light to become luminous; therefore all applications must include an available light source.

They should not be immersed in liquids.

Instantaneous dim-out types are:

Spec. AN-L-1 Yellow lacquer, color No. 65.
Spec. 17012 Lacquer.

Type 1, Pale Green—Identification markings.
Type 2, Vivid Pink—Danger markings.
Type 3, Vivid Green—Safety ranges.

## 8. COATINGS.

Radioactive luminous materials must be coated to prevent direct contact by persons; also these materials and fluorescent lacquers both must be protected where subject to abrasion. Protective coatings may be either clear lacquer or clear urea baking varnish, depending on the abrasion conditions involved.

← ANODIC TABLE →

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Magnesium and Mag. Alloy | Zinc | 220<br>52S | Alclad<br>2S<br>3S<br>53S<br>61S<br>A51S<br>43<br>Cad. Plate<br>356<br>13 | A-17S<br>(Rivets only)<br><br>Navy prohibits use with items in Column 6; however, Army allows their use provided they are anodized. | 195<br>14S<br>17S<br>24S | Steel<br>Lead<br>Tin<br>Chromium<br>Brass and Bronze<br>Copper<br>Cor. & H. Res. Stl.<br>Monel<br>Silver<br>Nickel<br>Inconel |

## METALS—FERROUS—CARBON AND ALLOY STEELS

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| TUBE | NE8630 Steel | | | Annealed | 65 | 45 | 40 | 110 | 20 | Use for structural steel tubular parts. May be torch or arc welded but not spotwelded. All sizes are stocked normalized. See Enginering Officer for allowable heat treat values for various wall thicknesses where welding is involved. Refer to Spec. for sizes and tolerances of Type III or IV. See Engineering Officer before specifying heat treated tubing of heavier wall thickness than noted. Note—For open tubes that may be quenched on the inside during heat treatment, twice the noted wall thicknesses are allowable. |
| | | AN-T-15 Type I | Ni, Cr, Mo Round, Seamless | Norm. Wall Thickness 0.035 & Under | 95 | 75 | 55 | 140 | 10 | |
| | | | | Norm. Wall Thickness 0.035 - 0.188 | 95 | 75 | 55 | 140 | 12 | |
| | | | | Norm. Wall Thickness Over 0.188 | 90 | 70 | 55 | 140 | 15 | |
| | | AN-T-15 Type II | Ni, Cr, Mo; Rect. & Sq., Seamless | H. T. Wall Thickness ¾ & Under | 125 | 100 | 75 | 175 | 12 | |
| | | AN-T-15 Type III | Ni, Cr, Mo Streamline, Seamless | H. T. Wall Thickness ½ & Under | 150 | 135 | 90 | 190 | 10 | |
| | | AN-T-15 Type IV | Ni, Cr, Mo Oval, Seamless | H. T. Wall Thickness ¼ & Under | 180 | 165 | 105 | 200 | 8 | |
| | NE8637 Steel | LAC 1-501 | Ni, Cr, Mo Round, Seamless Hot Fin. Tubing | H. T. Wall Thickness 1 & Under | 125 | 100 | 75 | 175 | 12 | Use for heavy walled tubing applications that are to be machined both inside and outside and are to be heat treated. May be welded. All sizes are stocked normalized or strain annealed. See Engineering Officer for allowable heat treat values for various wall thicknesses where welding is involved, and before specifying heat treated tubing of heavier wall thickness than noted. For open tubes that may be quenched on the inside during heat treatment, twice the noted wall thicknesses are allowable. |
| | | | | H. T. Wall Thickness ¾ & Under | 150 | 135 | 90 | 190 | 10 | |
| | | | | H. T. Wall Thickness ⅓ & Under | 180 | 165 | 105 | 200 | 8 | |
| | 1025 Steel | AN-WW-T-846 | Low Carbon, Round, Seamless | Cold Drawn Annealed | 55 | 36 | | | 22 | Use for all non-structural applications where the strength of NE8630 is not required. May be arc, torch or spotwelded. May be flared and beaded for liquid lines where a material of this type is required. |
| CABLE | Cable 7 x 19 Pref. Steel | AN-RR-C-43 | 7 x 19, Extra Flexible Type | | | | | | | Shall be used for all control cables ⅛ dia. and over. |
| | Cable 7 x 7 Pref. Steel | AN-RR-C-43 | 7 x 7, Flexible Type | | | | | | | For control cables under ⅛ dia. |
| WIRE | Music Wire | AN-W-17 | Spring, Carbon Steel | Heat Treated & Cold Drawn | 225 350 | | | | | For small springs (wire dia. less than .125) formed in the heat treated condition. Minimum bend radius=twice wire diameter. |
| | 1070 | AMS5115 | Spring, Carbon Steel | | | | | | | Use for springs that require heat treatment. To be used where the fabrication of springs from music wire is not practical. For applications subject to extreme fatigue resistance or shock loading 6150 should be considered. |
| | 6150 | AMS6450 | Spring, Cr, Va | | | | | | | Use for springs of wire dia. over ⅛ that are subject to extreme fatigue resistance or shock loading. Springs are fabricated from wire in the annealed condition and then heat treated to spring temper. |
| BAR - ROD | 1117 Steel | AMS5022 | Mn, Free Cutting | | 55 | | | | | Use in place of NE8630, where the stresses do not exceed Ftu. Do not weld, surface harden, heat treat, cold heat, swage, or spin. Do not use for primary structure. |
| | 1095 Steel Drill Rod | 57-108 Class A3 | High Carbon | Annealed | 100 | 55 | 55 | 140 | 20 | Use for pins and keys which can be made from rods ground to close tolerances. Do not weld. |
| | | | | Heat Treated | 200 | | | | | |
| BAR—ROD—FORGINGS | 3316 Steel | AMS6254 | Ni, Cr | Heat Treated | 180 | 135 | 105 | 200 | | Use only for parts which are to be surface hardened by pack or liquid-bath carburizing where a core strength of 180,000 psi is required. May be welded before carburizing. |
| | NE8620 Steel | AN-S-13 | Ni, Cr, Mo | Heat Treated For Sizes ¾" & Under | 125 | 80 | 75 | 175 | | Used for parts which are to be surface hardened by pack or liquid-bath carburizing where a core strength of 125,000 psi is adequate. May be welded before carburizing. See Engineering Officer before specifying 125,000 psi core strength for larger sizes than noted. |
| | NE8630 Steel | AN-S-14 | Ni, Cr, Mo | Annld Over 1½ | 55 | 36 | 35 | 90 | 20 | Used for pins, bolts, fittings, and other parts within the specified thicknesses requiring a strong, easily welded, heat-treatable material. Has good Impact strength. May be chromium plated or nitrided if a hard wearing surface Is required. Use 1117 for all applications where strength permits. |
| | | | | Annld 1½ & Under | 65 | 45 | 40 | 110 | 20 | |
| | | | | Normalized Over 3/16 | 90 | 70 | 55 | 140 | 19 | |
| | | | | Normalized 3/16 & Under | 95 | 75 | 55 | 140 | 19 | |
| | | | | H. T. 1½ & Under | 125 | 100 | 75 | 175 | 18 | |
| | | | | H. T. 1 & Under | 150 | 135 | 90 | 190 | | |
| | | | | H. T. ½ & Under | 180 | 165 | 105 | 200 | | |
| | NE8735 Steel | AN-S-15 | Ni, Cr, Mo | H. T. 1½ - 2½ | 125 | 100 | 75 | 175 | 18 | Use in place of NE8630 only for parts with maximum finished sections within the specified thickness range. |
| | | | | H. T. 1 - 1½ | 150 | 135 | 90 | 190 | | |
| | | | | H. T. ½ - ⅞ | 180 | 165 | 105 | 200 | | |

*Materials of Construction Table (Sheet 1 of 19 Sheets)*

## METALS—FERROUS—CARBON AND ALLOY STEELS (Continued)

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | PHYSICAL PROPERTIES $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| BAR — ROD — FORGINGS | NE8740 Steel | AN-S-16 | Ni, Cr, Mo | H.T. 3 - 4 | 125 | 100 | 75 | 175 | 18 | Use in place of NE8630 only for parts with maximum finished sections within the specified thickness range. Must be pre-heated before welding. |
| | | | | H.T. 2 - 3 | 150 | 135 | 90 | 190 | | |
| | | | | H.T. 1½ - 2 | 180 | 165 | 105 | 200 | | |
| | NE8744 Steel | LAC 1-530 | Ni, Cr, Mo | H.T. 3 - 4 | 150 | 135 | 90 | 190 | | Use in place of NE8630 only for parts with maximum finished sections within the specified thickness range. Must be pre-heated before welding. |
| | | | | H.T. 2 - 4 | 18 | 165 | 105 | 200 | | |
| | Nitralloy E Z | AN-S-19 Comp. B | Nitriding, Cr, Mo, Al | H.T. 3 & Under | 125 | 100 | 75 | 175 | | Used in place of carburizing steels for parts to be surface hardened by nitriding in cases where an exceptionally hard surface is required. Also where it is impractical to carburize because of warping difficulties encountered in heat-treating after carburizing. Nitralloy E-Z used for small parts. Nitralloy G Mod. used for larger parts and higher heat treat. |
| | | | | H.T. 1 & Under | 150 | 135 | 90 | 190 | | |
| | Nitralloy G Mod | AN-S-19 Comp. A | | H.T. 1 & Under | 180 | 165 | 105 | 200 | | |
| | | | | H.T. 1 thru 3 | 150 | 135 | 90 | 190 | | |
| CASTINGS | 1035 Steel | QQ-S-681 Class 2 | | Heat Treated | 65 | 35 | | | 20 | Used for all steel castings where physical properties permit. |
| | 4130XX Steel | Class 4C3 QQ-S-681 | Special, Aircraft | Heat Treated | 120 | 100 | 72 | 175 | | Since the chemical composition is not specified in specification QQ-S-681 for Class 4 castings, the approximate composition shall be indicated by the nearest S.A.E. number which shall be followed by XX if the composition differs substantially from the S.A.E. composition indicated. Unless another or other physical properties are required, 4130XX shall be specified for parts heat-treated to 125,000 psi minimum and 4330XX for parts heat-treated to 150,000 psi maximum. |
| | 4330XX Steel | Class 4C4 | | Heat Treated | 150 | 135 | 90 | 190 | | |
| | Special Steel Casting | QQ-S-681 Class 4B3 | Aircraft, Centrifugal | Heat Treated | 100 | 65 | 60 | | 18 | Use for all structural applications where centrifugal steel castings can be utilized. Higher values of Ftu and Fty with corresponding lower elongation may be specified on drawings, but in such cases the composition shall also be specified. |
| | Malleable Iron (Commercial) | | | Heat Treated | 53 Appx. | | | | | Use for tools, handling equipment, etc., that do not become part of the airplane. |
| | Malleable Iron (Pearlitic) | AMS5310 | | Heat Treated | 70 | 50 | | | 8 | Use for non-structural or structural application where the physical properties meet requirements. Low temperature impact strength is not as high as that of 1035 castings. Processes involving heat, such as welding, surface hardening, etc., are quite limited and each proposed application shall be individually investigated. Good abrasion resistance. |
| SHEET—STRIP | 1010 Steel | AMS5040 | Low Carbon Deep Drawing | Cold Rolled and Annealed | 10 Appx. | 25 Appx. | | | 25 | Use for all applications including deep drawing and cupping where heat and corrosion resistance of 302 and 317 is not required, and in place of 8630 or LAC 1-516 where strength permits. May be resistance torch or arc welded. Hardened only by cold work. |
| | 1095 Steel | AN-QQ-S-666 | Annealed, Spring | Annealed | 100 | | | | | For flat springs to be heat treated to spring temper after forming. Not suitable for welding. |
| | | | | Heat Treated | 200 | | | | | |
| | 1095 Steel Spring Temper | 57-136-2 | High Carbon | Spring Temper | | | | | | Use for flat springs. |
| | NE8630 Steel | AN-S-12 | Ni, Cr, Mo | Annealed | 65 | 45 | 40 | 110 | | Use for all stressed steel parts and fittings such as gussets, brackets, straps, plates, clamps, etc. May be torch or arc welded, but not spotwelded. See Engineering Officer for allowable heat treat values for various thicknesses where welding is involved, and before specifying heat treated plate or greater thickness than noted. |
| | | | | Normalized | 90 | 70 | 55 | 140 | 10 | |
| | | | | H.T. Thickness 1½ & Under | 125 | 100 | 75 | 175 | | |
| | | | | H.T. Thickness 1 & Under | 150 | 135 | 90 | 190 | | |
| | | | | H.T. Thickness ½ & Under | 180 | 165 | 105 | 200 | | |
| | Aluminized Steel | AMS5036 | Low Carbon Alum. Coated | Cold Rolled | | | | | | Intended primarily for firewalls. Has fair forming characteristics and may be spotwelded. Hardened only by cold work. |

*Materials of Construction Table (Sheet 2 of 19 Sheets)*

## METALS—FERROUS—CORROSION AND HEAT RESISTANT

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | | PHYSICAL PROPERTIES $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CABLE | Cable 7 x 7 Cor. Res. Steel | AN-RR-C-48 | Flexible & Extra Flexible Pre-formed Type | | | | | | | | Use where a highly corrosion resistant cable is required. This scale has a low "EA" value and a low creep strength, so is not suitable for control cables. 7 x 7 must be specified for cable under 1/8 inch in diameter. |
| CABLE | Cable 7 x 19 Cor. Res. Steel | AN-RR-C-48 | | | | | | | | | |
| WIRE | 302-1A Cor. Res. Steel | AN-W-24 | Chromium Nickel | Cold Drawn Annealed | | | | | | | Use where a soft, non-magnetic stainless steel wire is required Hardened only by cold work. |
| WIRE | 302-1H Cor. Res. Steel | AN-W-24 | | Cold Drawn Spring Temper | | 180 300 | 140 | 125 | | 8 | Use for hinge pins, springs, etc., requiring a corrosion resistant spring temper wire. Springs may be formed from this material in the full hard condition. Do not use for springs exposed to salt water. |
| BAR - ROD | 303 Cor. Res. Steel | AM55641 | Chromium Nickel, Free Machining (18 8) | Annealed | | 75 | | | | 35 | Use for swage type control cable terminals, etc., that require a cold swaging operation. Use where a free machining, corrosion resistant steel is required. |
| | 302-1A Cor. Res. Steel | AMS5515 | Chromium Nickel | Annealed, Pickled, & Passivated | | 75 | 30 | 40 | 75 | 55 | Preferable to 347-1A for parts requiring deep drawing, spinning and formability. Max. operating temp. = 800° F. Use in place of alum. alloy for stressed parts which operate above 200° F and which cannot be formed in harder tempers. Also use for firewalls and other parts which must be fireproof or which receive excessive abrasion. May be resistance welded but not torch or arc welded. Use stabilized stainless steel for welded parts (347-1A). Use 1010 steel where the foregoing requirements do not apply except for firewalls. |
| SHEET—STRIP | 302-1/4H Cor. Res. Steel | AN-QQ-S-772 | | Cold Rolled | | 125 | 75 | 67.5 | 150 | 75 | Suitable for rolling and brake work. Workability decreases as hardness increases. Use where high strength stainless steel sheet is required. Strength decreases with increasing temperature but at elevated temperatures its strength is still higher than that of other structural materials. May be resistance welded. Torch and arc welding must not be used as they will reduce the strength and corrosion resistance at the weld. Max. operating temperature = 800° F. May be aged to increase the tension and compression yield strength. |
| SHEET—STRIP | 302-1/2H Cor. Res. Steel | AN-QQ-S-772 | | Cold Rolled | | 150 | 110 | 80 | 180 | 15 | |
| SHEET—STRIP | 302-H Cor. Res. Steel | AN-QQ-S-772 | | Cold Rolled | | 185 | 140 | 100 | 195 | 8 | |
| | 347-1A Cor. & H. Res. Steel | AN-QQ-S-757 | Chromium Nickel Stabilized with Columbium (347-1A or 321-1A Stainless Steel) | Annealed, Pickled, & Passivated | 70°F | 75 | 30 | 40 | 75 | 40 | Use in place of 302 where operating temp. exceeds 800° F. Use for collector rings, tail pipes, cowl wells, etc., requiring heat and corrosion resisting properties. Strength drops to approx. 55,000 psi at temperatures between 400° F and 1000° F. May be torch, arc or resistance welded. Maximum operating temperature 1000°. |
| | | | | | 1000°F | 50 AAprox. | | | | | |
| TUBING | 302-1A Cor. Res. Steel | AN-WW-T-855 | Chromium Nickel, Seamless | Annealed, Pickled, & Passivated | | 75 | 30 | 40 | 75 | 35 | Preferable to 347-1A for plumbing lines, etc., where Max. operating temp. = 800° F. Less expensive and more easily fabricated than 347-1A. May be resistance but not torch or arc welded. |
| TUBING | 347-1A Cor. and H. Res. Steel | AN-WW-T-858 | Chromium Nickel, Seamless | Annealed, Pickled, & Passivated | | 75 | 30 | 40 | 75 | 35 | Used in place of 302 for parts with operating temp. over 800° F. May be torch, arc or resistance welded. Strength drops to approx. 55,000 psi at temperatures between 400° F and 1000° F. Welded tubing should be used wherever practicable but not for plumbing lines, bearings, or tubes requiring flaring or bending. 347-1A is stabilized with columbium and is interchangeable with 321-1A which is stabilized with titanium. |
| TUBING | 347-1A Cor. & H. Res. Steel Welded | AN-WW-T-861 | Chromium Nickel | Annealed, Pickled, & Passivated | | 75 | 30 | 40 | 75 | 35 | |
| TUBING | Flexible Cor. Res. Steel | AN-T-14 Type II | Chromium Nickel and Heat Resistant | | | | | | | | Use where flexible heat-resisting tubing is required. Copper packed unless otherwise specified. |

*Materials of Construction Table (Sheet 3 of 19 Sheets)*

# METALS—NON-FERROUS—ALUMINUM ALLOYS

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| BAR - ROD | 2S-F Alum. | QQ-A-411 | | As Fabricated | 13 | 12 | 9 | 20 | 20 | For aluminum parts such as tank fittings which have to be welded. Use for all sizes 3/8 dia. and over. For sizes 3/8 dia and under 3/8 dia., use wire. |
| BAR - ROD | 24ST Alum. Alloy | QQ-A-354 | | Heat Treated Up to 3" | 62 | 40 | 37 | 90 | 14 | Used for all structural aluminum alloy parts to be made from bar or rod. Not suitable for any type of welding. |
| | | | | H. T. T80 .125 & Up | 66 | 50 | 44 | 99 | 5 | Suitable for elevated temperature aging to 24S T80 if required for structural purposes. Fittings and similar parts will have slightly lower transverse properties. |
| WIRE | 2S Alum. | QQ-A-411 Cond. ½H | | Cold Rolled | 16 | 14 | 11 | | 20 | For aluminum parts which have to be welded. Use for rod in all sizes up to 3/8 dia. For sizes 3/8 dia. and over, use rod. |

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| CASTINGS | 195-T6 Alum. Alloy | AN-QQ-A-390 Cl. II | Sand Casting (Structural) | Heat Treated and Aged | 32 | 20 | 29 | 45 | 3 | For brackets, fittings and many other structural and non-structural parts. Used for most structural castings because of its good casting qualities. Not weldable. |
| CASTINGS | 220-T4 Alum. Alloy | AN-QQ-A-392 | Sand Casting (Structural) | Heat Treated | 42 | 22 | 31 | 68 | 12 | Has the highest combination of tensile strength, elongation and impact resistance of any of the aluminum alloy castings. Also has good machining qualities. Requires special foundry technique and rigid inspection, so is confined to brackets, anchors, tail wheel forks, control levers and other parts, demanding higher physical properties than obtainable in 195-T6. Has high corrosion resistance. Should not be welded. |
| CASTINGS | 356-T6 Alum. Alloy | AN-QQ-A-394 | Sand Castings (Structural) | Heat Treated | 30 | 20 | 26 | 45 | 3 | Use for structural casting applications which involve widely variant sectional thickness and complicated pattern. Use for parts and fittings which must withstand high fluid pressure. Structural castings must not be welded, although welding is permissible on tank flanges, fittings, and other non-structural parts. Use this alloy in place of aluminum alloy No. 43 |
| | | | | Approx. Strength in Weld Area | 18 | 10 | | | 3 | |
| CASTINGS | 356-T6 Alum. Alloy | QQ-A-596 Class 8 HT No. 1 | Permanent-Mold Casting (Structural) | Heat Treated | 33 | 22 | | | 3 | |
| | | | | Approx. Strength in Weld Area | 18 | 10 | | | 3 | |
| CASTINGS | 13 Alum. Alloy | AN-QQ-A-366 | Die Casting (Non-structural) | As Cast | 30 | 16 | 20 | 45 | 1 | Standard aluminum alloy die casting material. Used for all aluminum alloy die castings such as brackets, fittings, handles, instrument cases, and other parts required in large quantities. Little machining is required on these castings. Very thin sections with accurate surfaces can be cast. Not to be used where parts must be X-rayed. |
| CASTINGS | 13X Alum. Alloy | AMS4292 | Pressure Molding (Structural) | As Cast | 39 | 21 | | | 4.5 | May be used for structural or other parts where the close tolerances available will result in a minimum of machining. Max. section = 3/16 inch thickness. |
| CASTINGS | B195-T6 Alum. Alloy | AN-QQ-A-383 Cl. II | Permanent Mold Casting (Structural) | Heat Treated | 35 | 22 | | | 2 | Used for both structural and non-structural parts where quantity of parts warrants the use of the permanent mold casting process. Impact strength is not as high as that of 195-T6 sand castings. Not to be welded. |
| FORGINGS | 14ST Alum. Alloy | QQ-A-367 Gr. 5 | | Heat Treated | 65 | 50 | 39 | 93 | 10 | Should be used wherever possible for highly stressed fittings. The use of aluminum alloy forgings is highly desirable where full advantage of their high strength and superior corrosion resistance can be utilized. Not to be welded. |
| FORGINGS | A 51ST Alum. Alloy | QQ-A-367 Gr. 3 | | Heat Treated | 44 | 34 | | 70 | 14 | This material is easily forged and should be considered for small, intricate, miscellaneous parts that can be made on light hammers. May be used instead of 14S where strength values permit. Not to be welded except by specific individual approval of the Engineering Officer. |

*Materials of Construction Table (Sheet 4 of 19 Sheets)*

## METALS—NON-FERROUS—ALUMINUM ALLOYS (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SHEET—STRIP—PLATE (Cont) | 61SW Alum. Alloy | QQ-A-327 | | | As Quenched | 30 | 16 | | | 16 | Use for non-structural or lightly stressed parts or in parts where stiffness or rigidity is the primary consideration. The principal reason for using 61SW is that the heat treatment necessary for 24SO can be eliminated. Forming characteristics are similar to those of 24SO. May be resistance or fusion welded; however, area adjacent to weld will be in the annealed condition. May be furnace brazed; however, material will be in the annealed condition unless heat treatment to 61SW after brazing is specified. Should not be heat treated unless absolutely necessary. |
| | | | | | Approx. Strength Annealed | 18 | 8 | | | 22 | |
| | 75ST Clad | AN-A-10 | Al. Alloy | H. T. & Aged | Under .040 | 70 | 60 | 47 | 105 | 7 | Use for structural applications requiring maximum strength and little or no forming. Max. operating temp. [illegible] May be resistance welded but no other method permissible. |
| | | | | | .040 & Over | 72 | 62 | 44 | 108 | 8 | |
| | R301 Clad | AN-A-22 | Al. Alloy Al. Coated | H. T. (W) | (O) Annealed | 25 | 10 | | | 16 | Use for highly stressed parts. Procure in the [illegible] condition. After forming heat treat to W or T condition. [illegible] resistant. May be resistance welded but not torch or arc welded. |
| | | | | | Under .040 | 56 | 37 | | | 14 | |
| | | | | | .040 & Over | 57 | 37 | | | 15 | |
| | | | | (T) H. T. & Aged | Under .040 | 63 | 56 | | | 7 | |
| | | | | | .040 & Over | 64 | 56 | | | 8 | |
| | 53SO Alum. Alloy | QQ-A-331 | | | Annealed | 14 | 6 | 10 | 21 | 18 | 53S extrusions are intended for use where [illegible] is required. They are also the only high strength aluminum alloy extrusions suitable for resistance welding. [illegible] strength is not important, 53SO should be used. [illegible] available in this alloy is required, [illegible] in as hard a temper as possible, as it is not [illegible] heat treat 53SO to 53SW or 53SW to 53ST. [illegible] welded in any physical condition. Torch [illegible] sions is possible, but should be avoided. [illegible] temperature 53SO is 500° F; for 53SW and [illegible] |
| | 53SW Alum. Alloy | QQ-A-331 | | | Heat Treated | 25 | 14 | 18 | 37 | 18 | |
| | 53ST Alum. Alloy | QQ-A-331 | | | Heat Treated and Aged | 32 | 25 | 22 | 48 | 10 | |
| EXTRUSIONS | 24ST Alum. Alloy | QQ-A-354 | | H. T. | .050 thru .249 | 57 | 42 | 35 | 85 | 17 | Use where high strength aluminum alloy extrusions are required. Not suitable for any type of welding. Must be heat treated to 24ST if annealed for forming [illegible] Maximum operating temperature 200° F. |
| | | | | | .250 thru .749 | 60 | 44 | 36 | 85 | 12 | |
| | | | | | .750 thru 1.499 | 65 | 46 | 37 | 85 | 10 | |
| | | | | | 1.500 & Over | 70 | 52 | 38 | 85 | 10 | |
| | | | | Aged to 24ST8 | | 64 | 55 | 39 | 96 | 5 | |
| | 14ST Alum. Alloy | AN-A-8 | | H. T. & Aged | .125 thru .499 | 60 | 50 | | | 7 | Use for extruded shapes. Not available in sections under 1/8 inch in thickness. Use only applications not requiring annealing and/or reheat treatment for forming. Not to be welded. |
| | | | | | .500 thru .749 | 65 | 55 | | | 7 | |
| | | | | | .750 and Over | 68 | 58 | | | 7 | |
| | 75ST Alum. Alloy | AN-A-11 | | | Heat Treated and Aged | 78 | 70 | 47 | 101 | 6 | Suitable for extrusions where maximum strength is desired and little or no forming is required. Max. operating temp. [illegible] 150° F. This material should not be welded. |

*Materials of Construction Table (Sheet 5A of 19 Sheets)*

## METALS—NON-FERROUS—ALUMINUM ALLOYS (Continued)

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | PHYSICAL PROPERTIES $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| TUBING | 24ST Alum. Alloy | WW-T-785 | Seamless | Heat Treated and Stretched | 64 | 42 | 39 | 96 | 12 | Use as purchased (H. T. and stretched) for structural applications where max. physical properties are required, such as push rods, etc. Avoid bending or flaring operations. Do not weld. |
| | | | | Heat Treated | 64 | 40 | 39 | 96 | 12 | Use for high pressure hydraulic lines. [illegible] used because of extensive processing [illegible] |
| | 52SO Alum. Alloy | WW-T-787 | | As Purchased | 26 | 10 | 16 | 39 | 20 | Use for electrical conduit, fuel, oil, and [illegible] lines. For high strength hydraulic lines use 24ST [illegible] resistant steel. |
| | 53SW | 11327 | Seamless | As Quenched | 28 | 14 | 18 | 42 | 14 | Intended for electrical conduit, fuel and [illegible] other tubular parts formerly made from 3S [illegible] tubing. |
| | 61ST Alum. Alloy | WW-T-789 | Seamless | Heat Treated and Aged | 42 | 35 | | | | Use for furnishings, equipment and such applications that may require welding. Welds similar to 53SW and welded area will be annealed. Not AAF approved for liquid lines. Elongation varies with section as follows:<br>Wall Thickness / ¼ to 2" Dia. / Over 2 to 8" Dia.<br>% ELONG .025 - .049 / 10% / 8%<br>.050 - .259 / 12% / 8%<br>.260 - .500 / 14% / 12% |
| | Flexible Alum. Alloy | AN-T-13 Type 1 | (Unpacked) | | | | | | | Use for air ducts where temperatures do not exceed 600°-800° F. Type II is asbestos packed. Length is measured fully extended. |

## METALS—NON-FERROUS—MAGNESIUM ALLOYS

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | PHYSICAL PROPERTIES $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{CY}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| BAR - ROD | AMC57S Mag. Alloy | AN-M-24 | (Dow J-1) | As Fabricated | 40 | 26 | 18 | | 12 | Use for hydraulic valves, etc., located within the fuselage; or exterior parts readily accessible to inspection. May be welded. |
| CASTINGS | AM263 Mag. Alloy | AN-M-16 | Die Casting (Dow K) | As Cast | 30 | 20 | | | 2 | Use for non-structural parts such as handles, housings, brackets, etc., that will not require extensive machining and where large quantities are required. Restricted to interior parts or to exterior locations readily accessible to inspection but not subject to abrasion. Not to be welded. |
| | AM260-T6 Mag. Alloy | 11349 | Permanent Mold Castings (Dow C) | Heat Treated and Aged | 34 | 18 | | | 1 | Use for small non-structural parts suitable for permanent molding such as handles, brackets, housings, etc., restricted to interior parts or to exterior parts readily available to inspection but not subject to abrasion. Not to be welded. |
| | AM265-T6 Mag. Alloy | AN-QQ M-56 Comp. A | Sand Casting (Dow H) | Heat Treated and Aged | 34 | 16 | 18 | 47 | 3 | Use for sand casting applications. More liberal fillet and corner radii are required than for alum. alloys. Not to be welded. |
| FORGINGS | AM65S Mag. Alloy | AN-M-23 | Hammer Forging (Dow L) | As Forged | 36 | 22 | 14 | 14 | 7 | Use for small forgings where high production is required. Lack of experience hammer forgings facilities warrants careful consideration of its use. Do not weld. |
| | AMC58S Mag. Alloy | AN-M-21 | Hydraulic Press Forging (Dow O-1 | As Forged | 42 | 26 | 20 | 20 | 5 | Use for small hydraulic press forgings where advantage can be taken of their low density and in such locations that the part is readily accessible to inspection. Do not weld. |
| SHEET | AM3SO Mag. Alloy | AN-M-30 | (Dow M) | Annealed | 28 | | 16 | | 12 | Use for non-structural interior parts such as compartments, interior doors, containers, furnishings, etc. Severe or double curvature forming will require hot die forming with approximately the same forming characteristics as 24SO and 61SW. May be welded. An Engineering Officer shall be contacted on all mag. alloy sheet design. |
| | AMC52SO Mag. Alloy | AN-M-29 | (Dow FS-1) | Annealed | 32 | | 17 | | 12 | Use for non-structural interior parts where physical properties of AM3SO are not satisfactory. May require hot die forming. An Engineering Officer shall be contacted on all mag. alloy sheet design. May be welded. |
| TUBE | AMC57S Mag. Alloy | AN-T-71 | Round, Seamless (Dow J-1) | As Extruded | 36 | 16 | | | 7 | Use for non-structural interior tubular parts that do not require forming such as straight run handrails, spacers, furnishings, etc. May be welded. An Engineering Officer shall be contacted on all design that requires forming. |
| EXTR. | AMC57S Mag. Alloy | AN-M-24 | (Dow J-1) | As Extruded | 40 | 22 | 18 | 18 | 10 | Use for non-structural interior parts that do not require forming such as mounting brackets for equipment. An Engineering Officer shall be contacted on all design that may require forming. |

*Materials of Construction Table (Sheet 6 of 19 Sheets)*

## METALS—NON-FERROUS—COPPER ALLOYS—LEAD

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | PHYSICAL PROPERTIES $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| WIRE | Copper, Soft | QQ-W-341 | | Annealed | | | | | | Copper wire for electrical purposes. |
| WIRE | Wire Cloth | RR-C-451 | (Mesh) | | | | | | | This spec. covers nine grades of wire cloth. Grades B, E and G, corresponding to brass, monel, and aluminum wire cloths respectively, are standard for aircraft. Specify grade, mesh and wire diameter. |
| BAR—ROD | Copper, Hard | QQ-C-501 | | Hard Drawn | 32-50 | | | | 25-10 | Use for busbars and other electrical parts. Refer to Specification QQ-C-501 for physical properties. |
| BAR—ROD | Naval Brass ½H or Harder | QQ-B-636 | | .5 and Less | 60 | 27 | | | 30 | Use for all brass and bronze parts which are to be machined from rod and bar stock and which do not require the high strength of aluminum bronze, nor the anti-friction properties of the leaded bronze. Use for bushings, nuts, bolts, forgings or other parts requiring high corrosion resistance or anti-friction properties. Easily welded or brazed. Hollow drawn bar should be specified for large bushings. |
| | | | | .501 to 1.000 | 60 | 27 | | | 35 | |
| | | | | 1.001 to 2.500 | 58 | 26 | | | 35 | |
| | | | | 2.501 and Over | 54 | 25 | | | 35 | |
| BAR—ROD | Alum. Bronze Cont. Cast. | AN-QQ-B-672 | Solid or Hollow | Heat Treated | 85 | 40 | | | 3 | Use for large bushings subjected to high shock loads. Has a Brinell hardness of 200. |
| BAR—ROD | Wrought Alum. Bronze | QQ-B-666 Gr. B | | .5 and Less | 80 | 40 | | | 15 | Intended for bushings subjected to high shock loads and for high strength parts requiring anti-friction and corrosion resisting properties. |
| | | | | .501 to 1.000 | 75 | 37.5 | | | 15 | |
| | | | | Over 1.000 | 72 | 35 | | | 20 | |
| BAR—ROD | Leaded Bronze | LAC 1-650 | (Olds Alloy) | As Cast | Yield Strength in Comp. at .35% set......17,000 psi | | | | | Cast solid and cored bars of this material are used for bushings operating under moderate loads at slow speeds with little or no lubrication. Should not be used under pounding loads. |
| CASTINGS | Aluminum Bronze | QQ-B-671 Gr. B | Sand Casting | Heat Treated | 80 | | | | 5 | Use for parts requiring high strength and ductility along with good bearing properties, also where excellent resistance to corrosion is required. |
| CASTINGS | Aluminum Bronze | AN-QQ-B-672 | Sand Casting | Heat Treated | 85 | 40 | | | 3 | The wear resistance, corrosion resistance and anti-friction properties of this material make it an excellent material for gears, screws, and similar parts. |
| CASTINGS | Manganese Bronze | QQ-B-726 Class C | Sand Casting | As Cast | 110 | 60 | | 135 | 12 | Use where high strength castings are required which are subject to high bearing loads. This is a manganese modified alum. bronze and will have same difficulties in soldering and welding as other aluminum bronzes. Excellent corrosion resistance. |
| CASTINGS | Manganese Bronze | QQ-B-726 Class A | Die Casting | As Cast | 65 | 25 | 40 | 80 | 20 | Use in place of aluminum die castings where higher strength and more resistance to corrosion are required. Max. operating temp. = 200° F. |
| CASTINGS | Lead | QQ-L-171 Gr. B | | As Cast | | | | | | Use for counterbalance weights in control surfaces. For weight calculations, a density of .400 pounds per cubic inch should be used. |
| FORG. | Manganese Bronze | QQ-B-721 Gr. A Soft | | Annealed | 55 | 22 | | | 20 | Use where bronze forgings can be used to advantage. |
| SHEET - STRIP | Phosphor Bronze | QQ-B-746 Gr. A Spr. Temp. | | Spring Temper | 90 | | | | | Suitable for use as flat springs in place of steel where stiffness considerations permit. High electrical conductivity makes it suitable for spring contacts. Cannot be hardened by heat treatment and spring properties are reduced by a dip tinning process. |
| SHEET - STRIP | Copper, Hard | QQ-C-501 | | Hard Rolled | 35 | | | | | Use for bus bars, jumpers and other electrical parts. If the part requires annealing, the annealing Spec. is 98-10026. |
| SHEET - STRIP | Commercial Brass, ½H | QQ-B-611 Comp. C | | Cold Rolled | 53 | | | | 15 | Use for anti-friction spacer washers, and miscellaneous parts requiring a fairly corrosion-resistant material. May be soldered. |
| SHEET - STRIP | Laminated Shim Brass | S-122 | | | | | | | | Consists of thin laminations of brass conforming to Specification QQ-B-611, Comp. C. Laminations are either .002 or .003 inch in thickness unless otherwise specified. |
| TUBE | Copper, Soft | WW-T-799 Type N | Round Seamless | Annealed | 30 | | | | | Formerly used for exhaust gas analyzer lines and primer lines. Replace with aluminum alloy or stainless steel wherever possible. |
| TUBE | Yellow Brass ½ H | WW-T-791 Gr. 3 | Seamless | Cold Drawn | 35 | | | | | Used for small bushings. |

*Materials of Construction Table (Sheet 7 of 19 Sheets)*

# PLASTICS

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | *PHYSICAL PROPERTIES Water Abs % | Rock'l Hard "M" | Tens'l Str psi 1000 | Flex'l Str psi 1000 | Flex'l Mod psi $10^5$ | Impact Notched IZOD Ft lb/In | Heat Dist'n Temp Deg. F. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SHEET | Phenolic Resin | HH-P-256 Gr. C | Laminated heavy weave fabric base | 2.5 | *105 | 7.5 | 16 | *7 | *3.5 | *320 | For fairleads, insulators, and other sheet parts requiring best mechanical and fair electrical insulating properties. Grade L is for sheet 1/16 and less in thickness, and for small gears and fine machining applications. Suitable for simple forming operation. |
| | | HH-P-256 Gr. L | Laminated fine weave fabric base | 1.6 | *110 | 7.0 | 15 | *7 | *2.0 | *320 | |
| | | HH-P-256 Gr. XX | Laminated paper base | 1.3 | *105 | 6.0 | 12 | *9 | *0.5 | *320 | For parts requiring very good electrical insulating properties. Has only fair machining properties. |
| | Laminated Glass Cloth | LAC 1-826 | Fuel cell backing | 2.0 | *105 | 25 | 20 | 10 | 15 | *300 | Used only as backing sheets for support of self sealing fuel cells. |
| | Acrylate Base Plastic | AN-P-44 | Clear, General purpose | 1.0 | * 70 | *7.5 | *14 | *2.8 | *0.6 | *160 | For windows and other transparent sheet parts. Not used for windshields and parts requiring perfectly undistorted vision. May be formed to desired shape. Has very good electrical insulating properties. |
| | | | Clear, heat-resistant | *0.4 | * 80 | *7.5 | *14 | *3.0 | *0.4 | *190 | |
| | Cellulose Acetate | 12025 | Clear | 4.0 | * 45 | 4.5 | * 7 | *2.0 | *1.6 | *150 | For thin sheet parts requiring toughness but sacrificing optical properties and dimensional stability. May be formed. |
| | Laminated Glass | AN DD-G-551 Type I Gr. A | Non-shatterable | | | | | | | | Type I, Grade A is for use where perfectly undistorted vision is necessary for navigation and other accurate observations. |
| | | AN DD-G-551 Type I Gr. B | | | | | | | | | Type I, Grade B is for windshield where clear undistorted vision is required. |
| | | AN DD-G-551 Type II | | | | | | | | | Type II is for use where perfectly undistorted vision is not required. Suitable for cabin windows. |
| | | 12031 | Laminated bullet resistant | | | | | | | | Use where a bullet-resistant glass is required. Thicknesses: 1⅛, 1½, 2, 2½, 3, 4¼, and 5½. |
| | Plate Glass | 75-357 Type I Thru VI | Selected (Photographic) | | | | | | | | Used for windows thru which photographs are taken. Types are for different angles of obliquity from 10° for Type I to 60° for Type VI. Indicate visual area on drawings. |
| | Glass | AN-C-70 Classes A, B, C, D | Light-transmitting covers | | | | | | | | For use in light assemblies: Class A is a general purpose glass; Classes B and C are heat resistant glass. Class D is a thermo plastic material with Sp. Gr. 1.40 max. Specify non diffusing or diffusing, clear or colored. See Spec. AN-C-56 for chromaticity and transmission requirements. Shapes may be specified. |
| TUBING | Phenolic Resin | HH-P-256 Gr. C | Laminated heavy weave fabric base | 3.0 | *100 | 5.5 | *12 | *7 | *3.0 | *320 | For bushings, spacers and electrical insulating parts. Grade L is for wall thicknesses of 1/16 or less. Grade LE is for parts requiring maximum guaranteed insulating properties available in fabric base type. |
| | | HH-P-256 Gr. L and LE | Laminated fine weave fabric base | 1.8 | *105 | 6.5 | *12 | *7 | *2.0 | *320 | |
| | | HH-P-256 Gr. XX | Laminated paper base | 1.7 | *100 | 7.0 | *12 | *7 | *0.5 | *320 | Maximum electrical insulating properties. Not as strong mechanically as the fabric base tubing. |
| | Flexible | LAC 1-800 | Clear | 1.5 | | 1.5 | | | | *212 | For electrical insulation to be slipped over conductors and terminals. Also for pail handle protectors, conduit, chafing sleeves, etc. Flexible at —40° F. |
| TAPE | Cellulose Tape | 17019 Class B | Adhesive back | | | | | | | | Use for marking plumbing lines and electrical cable. |
| MOLD ROD | Phenolic Resin | HH-P-256 Gr. C | Laminated heavy weave fabric base | 2.5 | *105 | 7.5 | 16 | *7 | *3.5 | *320 | For tube rollers, fairleads, bushings, and similar parts which can be made from this strong light weight material. Grade L should be specified for rods less than ½ inch in diameter and for fine machining applications. Recommended maximum operating temperature, 250° F. |
| | | HH-P-256 Gr. L | Laminated fine weave fabric base | 1.6 | *110 | 7.0 | 15 | *7 | *2.0 | *320 | |
| | | HH-P-256 Gr. XX | Laminated paper base | 1.3 | *105 | 6.0 | 12 | *9 | *0.5 | *320 | For parts requiring better electrical insulating properties than found in Grade C or L. Also takes a better finish than Grade C or L when used for knobs. Recommended maximum operating temperature, 250° F. |

*Physical properties, typical, not covered by the applicable specifications.

*Materials of Construction Table (Sheet 8 of 19 Sheets)*

## PLASTICS (Continued)

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | *PHYSICAL PROPERTIES Water Abs % | Rock't Hard "M" | Tens'l Str psi 1000 | Flex'l Str psi 1000 | Flex'l Mod psi $10^5$ | Impact Notched IZOD Ft#/In | Heat Dist'n Temp Deg F. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MOLDED SHAPES | Phenolic Resin | 32212 Type I | Cellulose filler general purpose | *0.5 | *115 | 6.0 | 10 | *10 | *0.3 | *280 | For general purpose electrical insulation and for general mechanical purposes. Used for electrical terminals, control handle knobs, window frames, and similar parts. Recommended maximum operating temperature, 250° F. |
| | | 32212 Type II | Cellulose filler high impact strength | *0.8 | *110 | 6.2 | 9 | *10 | *2.0 | *290 | Used for parts requiring maximum impact strength available in phenolic resin type material. Not recommended for parts of intricate shape or parts requiring best appearance. Recommended maximum operating temperature, 250° F. |
| | | 32212 Type III | Mineral filler | *0.2 | *110 | 5.0 | 10 | *14 | *0.3 | *250 | For parts requiring good electrical properties, low moisture absorption or resistance to temperatures up to 400° F. Standard colors are black and brown. |
| | Cellulose Acetate Butyrate | ASTM D707, TY. 2 | General purpose | 1.8 | *64 | 5.2 | *8.5 | *1.6 | 1.3 | 164 | Used for applications such as tab control wheels, knobs, handles, etc. Good properties at —40° F. Available in transparent, translucent, opaque—all colors. |
| | | ASTM D707, TY. 4 | Impact resistant | 1.7 | *55 | 4.0 | *6.3 | *1.3 | 2.2 | 138 | Used for applications requiring greater toughness, but less dimensional stability. Good properties at —40° F. Available in transparent, translucent, opaque—all colors. |
| | Acrylate Base Plastic | LAC 1-808 | Clear | 0.4 | *70 | 5.5 | *14 | *2.8 | 0.4 | 140 | Used for applications requiring a high degree of optical clarity. Has good electrical insulating properties. Tubes and rods are available. Colors may be specified. |
| | Polystyrene | ASTM D703, TY. 2 | Electrical purpose | *0.1 | *80 | *6.0 | *12 | *3.0 | 0.3 | 169 | Used for applications requiring superior electrical properties. Power factor, max., at 60 and 1000 cycles is 0.0003; at 1,000,000 cycles it is 0.0005. Dielectric constant at 60 and 1000 and 1,000,000 cycles is 2.55±.05. Has good inorganic chemical resistance. |

*Physical properties typical, not covered by the applicable specifications.

## RUBBER AND RUBBER GOODS

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | PHYSICAL PROPERTIES Ftu Psi Min. | Shore Hard ±5 | Elong. % in 2", Min. | Compr. Set % of Defl. | Oper. Temp. Range Deg. F. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| MOLDED PARTS | Synthetic Rubber | AMS 3212 | Aromatic Fuel Resistant | 1700 | 60 | 400 | 60 | —40 +200 | Use for gaskets, seals, packing, etc., requiring good resistance to the solvent and swelling actions of blended aromatic fuels. |
| | | AMS 3213 | | 1000 | 80 | 150 | 50 | —40 +200 | |
| | | AMS 3226 | Hot Oil and Coolant Resistant | 1200 | 50 | 350 | 55 | —40 +250 | Use for gaskets, seals, packing, etc., requiring good resistance to the solvent and swelling actions of ethylene glycol and lubricating oils. |
| | | AMS 3228 | | 1000 | 70 | 250 | 50 | —40 +250 | |
| | | AMS 3201 | Dry Heat Resistant | 1200 | 40 | 300 | 75 | —40 +250 | Use for grommets, seals, packing, etc., requiring good resistance to the shrinking and hardening actions of dry heat, and the solvent and swelling actions of lubricating oils. |
| | | AMS 3202 | | 1500 | 60 | 250 | 50 | —40 +250 | |
| | | AMS 3200 | Hydraulic Fluid (Petroleum Base) Resistant | 1400 | 60 | 250 | 75 | —70 +200 | Use for gaskets, seals, packing, etc., requiring good resistance to the solvent and swelling actions of petroleum base hydraulic fluids. |
| | | LAC 1-899 | Aromatic Fuel Sealing | 600 | 35 | 600 | | —70 +160 | Use only for aromatic fuel tank seals. |
| | Synthetic Rubber & Cork Composition | LAC 1-889 | General Purpose | | 40 | 100 | 70 | —40 +200 | Use for tank strap pads, tube clamp blocks, and other parts to provide a resilient mount or prevent abrasion. Material is resistant to the deteriorating action of water and oils. The 60-shore compound is recommended for tube clamp blocks. |
| | | LAC 1-888 | | | 50 | 100 | 70 | | |
| | | LAC 1-887 | | | 60 | 75 | 80 | | |
| | Synthetic Rubber Sponge | AMS 3197 | Soft | | | | | +200 | General purpose material for molded sponge parts. The medium sponge is most generally applicable. Not suitable for exposure to excessive amounts of gasoline and oil. |
| | | AMS 3198 | Medium | | | | | +200 | |
| | | AMS 3199 | Firm | | | | | +200 | |
| | Bound Hair | AN-H-5 2 ± .2 #/FT³ | Light Weight | | | | | —70 +160 | Use for seat backs, pads, and such applications where a soft, light-weight material is required. |
| | | AN-H-5 3.7 ± .2 #/FT³ | | | | | | —70 +160 | Use for heavy duty seat cushions, pads, and such applications where a medium weight material is required. |

*Materials of Construction Table (Sheet 9 of 19 Sheets)*

## RUBBER AND RUBBER GOODS (Continued)

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | PHYSICAL PROPERTIES Ftu Psi. Min. | Shore Hard ±5 | Elong. % in 2", Min. | Compr. Set % of Defl. | Oper. Temp. Range Deg. F. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| MOLDED PARTS AND EXTRUSIONS | Synthetic Rubber | AMS 3207 | Weather Resistant | 500 | 30 | 400 | 85 | —40 +200 | General purpose material for window channels and weather seals, bumper strips, grommets, etc., the 50-shore compound is most generally applicable. Not suitable for exposure to excessive amounts of gasoline and oil. |
| | | AMS 3208 | | 1200 | 50 | 300 | 70 | —40 +200 | |
| | | AMS 3209 | | 1700 | 70 | 200 | 70 | —40 +200 | |
| | | AMS 3204 | Low Temperature Resistant | 800 | 30 | 350 | 75 | —70 +200 | Use for sleeves, grommets, seals, etc., requiring good resistance to the hardening and embrittling actions of low temperatures. At —70° F. the material stiffens but will flex without cracking. Not suitable for exposure to excessive amounts of gasoline and oil. Not satisfactory for cementing. |
| | | AMS 3205 | | 1000 | 50 | 300 | 75 | —70 +200 | |
| SHEET—STRIP | Synthetic Rubber | AMS 3207 | Weather Resistant | 500 | 30 | 400 | 85 | —40 +200 | General purpose material for sheet parts. The 50 shore compound is most generally applicable. Not suitable for exposure to excessive amounts of gasoline and oil. |
| | | AMS 3208 | | 1200 | 50 | 300 | 70 | —40 +200 | |
| | | AMS 3209 | | 1700 | 70 | 200 | 70 | —40 +200 | |
| | | AMS 3226 | Hot Oil and Coolant Resistant | 1200 | 50 | 350 | 55 | —40 +250 | Use for sheet parts requiring good resistance to the solvent and swelling action of lubricating oils and ETHYLENE GLYCOL. |
| | | AMS 3201 | Dry Heat Resistant | 1200 | 40 | 300 | 75 | —40 +250 | Use for sheet parts requiring good resistance to the shrinking and hardening action of dry heat, and the solvent and swelling action of oils. |
| | | AMS 3212 | Aromatic Fuel Resistant | 1700 | 60 | 400 | 60 | —40 +200 | Use for sheet parts requiring good resistance to the solvent and swelling action of aromatic fuel. |
| | | AMS 3200 | Hydraulic Fluid (Petroleum Base) Resistant | 1400 | 60 | 250 | 75 | —70 +200 | Use for gaskets, seals, packing, etc., requiring good resistance to the solvent and swelling actions of petroleum base hydraulic fluids. |
| | Synthetic Rubber Sponge | AMS 3197 | Soft | | | | | +200 | General purpose material for sheet sponge parts. Not suitable for exposure to excessive amounts of gasoline and oil. The medium sponge is most generally applicable. |
| | | AMS 3198 | Medium | | | | | +200 | |
| | | AMS 3199 | Firm | | | | | +200 | |
| | Synthetic Rubber and Cork Composition | LAC 1-889 | General Purpose | | 40 | 100 | 70 | —40 +200 | Use for gaskets and padding where a light, resilient oil and gasoline resistant material is required. The 50-shore compound is most generally applicable. |
| | | LAC 1-888 | | | 50 | 100 | 70 | | |
| | | LAC 1-887 | | | 60 | 75 | 80 | | |
| | Synthetic Rubber Coated Fabric | LAC 1-882 | .010" 11 oz./sq. yd. | 4000 x 2000 | | | | —30 +250 | Use for gaskets, seals, and other applications requiring an oil-resistant and waterproof fabric with good weather-resistent properties. |
| | | LAC 1-883 | .025" 25 oz./sq. yd. | 3200 x 3200 | | | | —30 +250 | |
| | | LAC 1-884 | .035" 38 oz./sq. yd. | 7100 x 4900 | | | | —30 +250 | |
| | | LAC 1-879 | .050" 64 oz./sq. yd. | 4500 x 3200 | | | | —30 +250 | |
| | Synthetic Rubber Fabric Reinforced | LAC 1-885 | .125" 2-ply | 1600 x 1600 | | | | —30 +250 | Used for gaskets, seals, and diaphragms in service against water, oils, and warm air. The fabric reinforcement reduces tendency to "cold flow" under clamping pressure. |
| HOSE — TUBING | Synthetic Rubber Tubing | AMS 3208 | Weather Resistant | 1200 | 50 | 300 | 70 | —40 +200 | General purpose material for tubular parts. Not suitable for exposure to excessive amounts of gasoline and oil. |
| | Synthetic Hose | AN-ZZ-H-456 | Aromatic Fuel Resistant AN 884 | | | | | | For use in aromatic fuel lines. See Spec. for properties. |
| | | 26577 | Oil and Coolant Resistant AC 878 | | | | | | For use in engine oil and liquid coolant lines. See Spec. for properties. |
| | Hydraulic Hose | AN-H-4 | Three Braided | | | | | | Use for medium pressure hydraulic lines. See Spec. for properties. |
| | Fireproof Hose | CAA-AO-19 | Medium Pressure | | | | | | Use for medium pressure hydraulic lines requiring fireproof hose. See CAA P & P Spec. #3 for properties. |
| | Self-Sealing Hose | 26587 | Aromatic Fuel Resistant | | | | | | Use for aromatic fuel hose requiring self-sealing characteristics. See Spec. for properties. |

*Materials of Construction Table (Sheet 10 of 19 Sheets)*

## RUBBER AND RUBBER GOODS (Continued)

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | PHYSICAL PROPERTIES Ftu Psi, Min. | Shore Hard ± 5 | Elong. % in 2", Min. | Compr. Set % of Defl. | Oper. Temp. Range Deg. F. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| SHEET—STRIP | Hose Assembly | AN-ZZ-H-626 Type A | Low Pressure AN855 and 856 | | | | | | Use for flexible connections between instruments and instrument lines. See Spec. for properties. |
| | | AN-ZZ-H-629 | Medium Pressure AN859 and 864 | | | | | | Use for medium pressure hydraulic lines. See Spec. for properties. |
| | | AN-ZZ-H-623 | High Pressure AN861 H 862 | | | | | | Use for high pressure hydraulic lines. See Spec. for properties. |
| | | 26579 | Low Pressure Oxygen | | | | | | Use for low pressure lines for breathing oxygen. See Spec. for properties. |
| | | 26576 | High Pressure Oxygen | | | | | | Use for high pressure lines for breathing oxygen. See Spec. for properties. |

## PACKING AND GASKETS

| FORM | DESIGNATION COMMERCIAL | DESIGNATION SPEC. | REMARKS |
|---|---|---|---|
| SHEET—STRIP | Fiber Packing | HH-P-96 | A general purpose gasket material for use with oil, gasoline, and water flanged connections. Not recommended for use at temperatures exceeding 250° F. |
| | Cork-Fiber Packing | LAC 1-403 | Used where a low-compression modulus and high resiliency are desired in a sheet packing material. Not recommended for temperatures exceeding 250° F. |
| | Asbestos Gaskets | AMS 3232 | For general use at temperatures up to 700° F. Suitable for use with hot oil, gasoline, and water. Also use for rubbing strip where a semi-flexible fireproof material is required. |
| | Asbestos, Woven | LAC 1-400 | Webbing and cloth. For high temperature gasketing and insulating purposes. May be doped with sodium silicate. |
| | Asbestos, Woven, With Wire | LAC 1-401 | Use for flame barrier and for high temperature insulation. Not to be doped with sodium silicate. |
| | Asbestos, Woven, Coated | LAC 1-402 | For high temperature insulation and rubbing strips. The synthetic rubber coating protects against wear and unraveling. |
| | Compressed Cork | HH-C-576, Cl. 2 | For normal temperature gasketing and insulating purposes. |
| TUBE | Asbestos, Woven | LAC 1-405 | Used for light-duty heat insulation over tubes, lines and electrical conductors. |

## LEATHER

| FORM | DESIGNATION COMMERCIAL | DESIGNATION SPEC. | REMARKS |
|---|---|---|---|
| SHEET | Artificial Leather | 12026 | Use for upholstery material or other applications requiring the use of fireproof artificial leather. Weight is 19 ounces per square yard. Specify color and grain. |
| | Chrome Leather | KK-L-201 Ty. C, Cl. I | A soft, pliable, full-grain leather for boots and chafing strips except in connection with control cables. Standard thickness is 1/16 inch for sheet, 1/32 inch for strip. Standard color is natural gray. |
| | Oak Tanned Leather | KK-L-271 Gr. 8; Cl. I | A strong, stiff, full-grain leather for straps, pads, linings, etc. Standard thickness is 1/8 inch. 1/16-inch strips can be made by splitting. Specify thickness, and color, as natural russet or black. |
| | Upholstery Leather | KK-L-291 Gr. A, Type I | Full-grain leather for upholstery work. Standard thickness is .051 inch. Specify grain and color. |
| | Horsehide Leather | 9-77 | Full-grain, chrome-tanned leather upholstery material. Standard thickness is .035 inch. Standard color is seal brown. |

## TEXTILES AND FABRICS

| FORM | DESIGNATION COMMERCIAL | DESIGNATION SPEC. | REMARKS |
|---|---|---|---|
| TAPE | Friction Tape | HH-T-101, Gr. A | For wrapping electrical wire at joints and terminals. |
| | Fiberglas Lagging | 35C15, Type C | Widths of 1½ and 3, .005 diameter. Use for protecting fiberglas insulation. |
| | Fiberglas Lagging | 35C15, Type E | Widths of 2, 3, .007 thick. Heat-resistant protective cover for fiberglas insulation. |
| | Surface Tape | 6-62 | Pinked edge. Applied to fabric covered surfaces at ribs and edges for reinforcement. |
| | Reinforcing Tape | AN-DDD-T-91 | Placed over ribs and edges to prevent wear between ribs and fabric covering. |
| | Synthetic Rubber Coated Fabric | | See "Synthetic Rubber Coated Fabrics" under Rubber and Rubber Goods. |

*Materials of Construction Table (Sheet 11 of 19 Sheets)*

## TEXTILES AND FABRICS (Continued)

| FORM | DESIGNATION COMMERCIAL | DESIGNATION SPEC. | REMARKS |
|---|---|---|---|
| FELT | Hard White Felt | AN-F-14 Type 1 | Intended primarily for oil retaining washers. This felt is hard and thus suitable for parts which must be cut to close tolerances and which must retain their shape in assemblies. Also use for sealing, compression and load resistance where highest quality material is necessary. |
| | Hard Gray Felt | AN-F-14 Type 3 | Intended for dust-proofing washers, hard pads, gaskets and similar parts. Also use for parts requiring reasonable resistance to wear such as bumper pads and strips, chafing strips, etc. Replaces sponge and compounded rubber for such appliances. |
| | Soft White Felt | AN-F-14 Type 5 | Use for soft pads. |
| | Soft Gray Felt | AN-F-14 Type 13 | Use for grease-retaining washers and soft pads such as base pads, hold-down strip liners where abrasion is not a factor. Replaces sponge and compounded rubber (synthetic and natural) for such parts. |
| | Upholstery Felt | AM53288 | Use for thin pads, lining strips and similar applications. Thickness is approximately 1/16 inch. Available in any color. |
| | Filter Felt | LAC 1-875 Type 7 | Use as an air cleaning medium. |
| | | LAC 1-875 Type 8 | Use to make containers to hold a filtering medium, as activated charcoal, in a renewable cartridge form. |
| INSULATION | Fiberglas Insulation | LAC 1-408 | Heat insulating, sound proofing. Thicknesses of ½, 1, 1½, 2. Should be protected either with sewn cotton or fiberglas cloth or tape, with metal, wood, etc. Half the weight of Kapok, and about equal in thermal and accoustical properties. 2 pounds per cu. ft. Suitable for air duct heat insulation. |
| | Fiberglas Insulation | LAC 1-410 | Heat insulating, sound proofing. Thickness of ½, 1, 1½, 2. Should be protected either with sewn cotton or fiberglas cloth or tape, with metal, wood, etc. 1 lb./cu. ft. |
| FABRICS | Fiberglas Cloth | ECC-11-108 | Spun from continuous filament fiberglas. Heat-resistant protective cover for fiberglas insulation. |
| | Airplane Cloth | AN-C-121 | Use as a covering for airplane surface. Mercerized cotton. |
| | Duck, Cotton, 7-oz. | CCC-D-761 Type I Class A (Gray) or Class B (Dyed) | A light-weight duck suitable for stowage bags, glare shields, curtains and cushions subject to medium duty. Use for majority of applications where canvas-like material is required. |
| | Duck, Cotton, 10-oz. | | A medium weight duck suitable for tool bags, empty ammunition case containers and cushions subject to heavy duty. |
| | Duck, Cotton, 12-oz. | | A heavy-weight duck suitable for seat backs and bottoms, cushions and such applications where severe wearing qualities are required. For additional information of any of above ducks and other types, contact Engineering Officer. |
| | Synthetic Rubber Coated Fabric | | Refer to "Synthetic Rubber Coated Fabrics" under Rubber and Rubber Goods. |
| | Blue Denim | CCC-D-151 Class B | Use for miscellaneous trim purposes. |
| | Unbleached Sheeting Predoped | LAC 1-864 | Use for covering lightening holes. |
| | Unbleached Sheeting | CCC-S-291 | Use for covering lightening holes and for trim purposes. |
| | Cheesecloth | CCC-C-271 Type I, Class B | Use for trim purposes. |
| ROPE | Cotton Rope | T-R 571 | Spec. covers twisted cotton rope of ⅛ to 1 inch diameter. |
| | Manila Rope | 16090 | High-grade Manila rope for maximum durability, resistance to wear, and high tensile strength. |
| CORD | Lacing Cord | AN-C-122 | 1/16-inch waxed coreless braided cotton cord for lacing fabric to ribs. |
| | Braided Cotton Cord | LAC 1-850 | Glazed. For trim and other flexible cord requirements. Sizes not covered by Spec. T-C-571. Sizes 3/32, 1/8, 5/32. |
| | | T-C-571 (Specify Type) | Solid braided cord for trim purposes, etc. Sizes: 3/16, 7/32, 1/4, 5/16, 3/8. Type A, unfinished; Type B, polished |
| | Waxed Cotton Cord | AN-T-46 Style A, Type 1 100% Waxed | Use for serving and whipping rope splices, rope ends and similar parts on aircraft. Specify the number of plies. |
| | Linen Blocking Cord | 15-9 | Hard glazed. A high strength cord. Refer to Spec. for tensile strength values. Specify the cord number. |
| | Serving Cord | 15-10 | For use in serving the ends of shock absorber cord. Has a tensile strength of 75 pounds. |
| | Fiberglas 1/64 Fiberglas 1/32 | LAC 1-822 | Spun from continuous filament fiberglas. Use for securing fiberglas tape. |
| THREAD | Cotton Thread | V-T-276 | Use for most seams and stitches. Specify type, size, finish, and color. For example: Thread-Cotton-Spec. V-T-276-Type 1B2-16/4 machine—Silk Finish—White. |
| | Linen Thread | V-T-291 | Use where high strength thread is required. Specify type, number on ply and color. See Spec. for type and sizes. |
| | Silk Thread | V-T-301 | Use where required for appearance. |
| WEBBING | Cotton Webbing | 6-185 Type IIA<br>6-185 Type III | Type IIA is satisfactory for most 1/16-inch webbing requirements and Type III is satisfactory for most 1/8-inch webbing requirements. Refer to Spec. for construction, strength and weight of these types of webbing. Other types are covered by the Spec. and may be specified when particular requirements must be met. |
| | Safety Belt Webbing | Rusco S-1316 Rusco S-1316WD | Rusco S-1316 webbing is constructed for use in making safety belts. Rusco S-1316WD webbing is also intended for safety belts. A wing design is formed on the surface of the latter type by the weave construction. |
| | Hood Lacing | Belco | Use for chafing and binding strip. |

*Materials of Construction Table (Sheet 12 of 19 Sheets)*

## WOOD

| FORM | DESIGNATION: COMMERCIAL | DESIGNATION: SPEC. | Wgt. @ 15% Moisture Lbs/cu. ft. | Static Bending PSI: Fiber Stress @ Elastic Limit | Static Bending PSI: Mod. of Rupture | Static Bending PSI: Mod. of Elastic | Comp. Parallel to Grain PSI: Fiber Stress @ Elas. Lim. | Comp. Parallel to Grain PSI: Max. Crushing Strength | Compress. Perpendicular to Grain Psi | Shear Parallel to Grain Psi | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LUMBER | Balsa | 15056 | | | | | | | | | A very light wood with little strength or resistence to wear; of no structural value. |
| | Fir | AN-F-7 Class N | 34 | 8,000 | 11,500 | 1,700 | 5,600 | 7,000 | 1,300 | 810 | Use for applications requiring max. strength-weight ratio values. Should be laminated for best results. |
| | Maple | 82-1 | 44 | 9,500 | 15,000 | 1,600 | 5,620 | 7,500 | 2,170 | 1,520 | Exceptionally hard. Use for maximum bearing, compression and shear. Use for attachment fittings utilizing bolts. |
| | Pine | AN-P-18 | 27 | 6,000 | 9,300 | 1,310 | 4,240 | 5,300 | 750 | 640 | Use as a general application lumber; quite available on the west coast. |
| | Poplar | AN-P-17 | 28 | 6,000 | 9,100 | 1,300 | 3,750 | 5,000 | 810 | 800 | Use for ribs, gussets, corner blocks (bulkhead assemblies), etc. Interchangeably with spruce. Not readily available. |
| | Spruce | AN-S-6 | 27 | 6,200 | 9,400 | 1,300 | 4,000 | 5,000 | 840 | 850 | Use where a light structural wood is required. Does not have quite as good strength-weight ratio values as Douglas fir. Applicable for ribs, gussets, corner blocks (Bulkhead Assemblies), etc. Not readily available. |
| PLYWOOD | Basswood (Specify core) | AN-NN-P-511 | | | | | | | | | Use for general applications where good strength-weight ratio is required. Used extensively for floor boards, upholstery backing, etc. Refer to Specification for physical properties, core materials, thickness and plies required. |
| | Fir (Specify core) | AN-NN-P-511 | | | | | | | | | Use for parts of general nature, as skins for access doors, landing gear doors, integral bulkheads, etc. Use interchangeably with poplar and spruce. Refer to Specification for physical properties, core materials, thickness and plies required. |
| | Mahogany (Specify core) | AN-NN-P-511 | | | | | | | | | Use interchangeably with fir and spruce. Same remarks as fir. |
| | Sweet Gum (Specify core) | AN-NN-P-511 | | | | | | | | | General applications. |
| | Birch (Specify core) | AN-NN-P-511 | | | | | | | | | Use where durable, thin plywood is required. Birch is a higher density wood, has greater strength and resistance to abrasion than any other plywood listed herein. |
| | Spruce (Specify core) | AN-NN-P-511 | | | | | | | | | Use interchangeably with fir and mahogany. Same remarks as fir. |
| | Paper Surfaced | LAC 1-903 Ty. I, II, and III | | | | | | | | | Use for parts requiring hard, durable surfaces, e. g., wainscoting, access doors, etc. |

## ELECTRICAL: CABLE—SHIELDING—CONDUIT—WIRE

| FORM | COMMERCIAL | SPEC. | REMARKS |
|---|---|---|---|
| CABLE | Cable, Elect. H. T. Ign. | 32427 | Army standard cable for use in high tension circuits. Insulation consists of oil, gasoline and water resistant synthetic rubber optionally covered with cotton braid and coated with an oil, gasoline and water resistant protective coating. |
| | Cable, Low Tens. Unshld. Elect. | AN-J-C-48 | Use for all low tension aircraft electrical wiring, including low tension radio wiring. |
| | Cable, Low Tens. Elect., 3 Cond. #26, Unshielded | LAC 1-161 | For distribution circuits of three-phase alternating current systems. |
| | Cable, Low Tens. Shld. Elect. | 95-27273 | Single or multiple AN-J-C-48 cable, shielded with tinned copper braid. Use for audio circuits in radio. |
| | Cable Ant. Silicon Bronze | NAF47024 | Standard antenna wire. Consists of 6 strands of 7 wires, each #33AWG twisted over a 5-cord cotton center. |
| SHLDG. | Shielding, Braided Tinned Copper | 94-40229 | Use for shielding of electrical conductors and for bonding purposes. May be soldered. |

*Materials of Construction Table (Sheet 13 of 19 Sheets)*

## ELECTRICAL: CABLE-SHIELDING — CONDUIT — WIRE (Continued)

| FORM | DESIGNATION COMM'L | DESIGNATION SPEC. | CLASSIF'N | CONDITION | $F_{TU}$ PSI 1000 | $F_{TY}$ PSI 1000 | $F_{SU}$ PSI 1000 | $F_{BR}$ PSI 1000 | Elong % in 2" | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| CONDUIT | Conduit, Flex. Alum. Shld. | | AN-WW-C-561, Type I | | | | | | | Use where non-soldering type of flexible conduit may be used. |
| CONDUIT | Flexible Plastic | | LAC 1-800 | | | | | | | For electrical insulation to be slipped over conductors and terminals. Also use for general applications such as pail handle protectors, conduit, chafing sleeves, etc. Good to —50° F. |
| CONDUIT | Conduit; Flex. Alum. Shld. Plastic Covered | | LAC 1-610 | | | | | | | Use where flexible conduit with gas and oil resistant covering is required. Identical to AN WW-C 561 Type II except covering is plastic to LAC 1-800. |
| CONDUIT | Conduit; Extra Flex. Alum. Shld. Plastic Covered | | LAC 1-611 | | | | | | | Use where a more flexible conduit than that conforming to LAC 1-600 is required. This material is Breeze #177 conduit with plastic covering to LAC 1-800. |
| WIRE | Wire Ant., Army | | 71-526, Type W-106 | | | | | | | Standard Army antenna wire. Copper clad steel. |
| WIRE | Wire Ant. Enameled Copper Weld | | | | | | | | | Use where high strength antenna wire is required to withstand ice loading conditions. |

# RAW MATERIAL TOLERANCES

**The following tolerances are for the most commonly used materials in aircraft design. All materials used on this list are merely used as reference, and are not necessarily stock materials.**

## WIRE — CABLE

### 7x7 & 7x19 PREFORMED STEEL CABLE

| NOMINAL DIAMETER OF CABLE | TOLERANCE + ONLY |
|---|---|
| 1/16 | .010 |
| 3/32 | .012 |
| 1/8 | .014 |
| 5/32 | .016 |
| 3/16 | .018 |
| 7/32 | .018 |
| 1/4 | .018 |
| 9/32 | .020 |
| 5/16 | .022 |
| 11/32 | .024 |
| 3/8 | .026 |

### 7x7 & 7x19 CORROSION RESISTANT STEEL CABLE

TOLERANCES — SAME AS 7x7 & 7x19 PREFORMED STEEL CABLE

### 304-1A CORROSION RESISTANT STEEL WIRE

| DIAMETER | TOLERANCES ± |
|---|---|
| thru .249 | .001 |
| over .249 | .003 |

### 2S ALUMINUM WIRE

| DIAMETER | TOLERANCES ± |
|---|---|
| thru .036 | .0005 |
| over .036 thru .064 | .0010 |
| over .064 thru .500 | .0015 |
| over .500 thru 1.000 | .0020 |
| over 1.000 thru 1.500 | .0025 |
| over 1.500 thru 3.00 | |

### MUSIC WIRE

| TOLERANCES | DIAMETER — | DIAMETER + |
|---|---|---|
| thru .025 | 0 | .0005 |
| over .025 thru .032 | 0 | .0010 |
| over .032 thru .091 | 0 | .0020 |
| over .091 thru .180 | 0 | .0030 |

### 1070 WIRE

| NOMINAL DIAMETER | TOLERANCES ± |
|---|---|
| thru .148 | .001 |
| over .148 thru .177 | .0015 |
| over .177 thru .250 | .002 |

### 304-1H CORROSION RESISTANT STEEL WIRE

| DIAMETER | TOLERANCES + | TOLERANCES — |
|---|---|---|
| thru .025 | .000 | .0005 |
| over .025 thru .032 | .000 | .0010 |
| over .032 thru .180 | .000 | .0020 |

### ANNEALED BRASS WIRE

| DIAMETER | TOLERANCES ± |
|---|---|
| thru .0375 | .0004 |
| over .0375 thru .0500 | .0005 |
| over .0500 thru .080 | .0008 |
| over .080 thru .100 | .0010 |
| over .100 thru .150 | .0015 |
| over .150 thru .1875 | .0020 |
| over .1875 thru .250 | .0025 |

*Materials of Construction Table (Sheet 14 of 19 Sheets)*

## SHEET — STRIP — PLATE

### 302 CORROSION RESISTANT STEEL SHEET AND STRIP

| THICKNESS | TOLERANCES ± |
|---|---|
| thru .005 | .001 |
| over .005 thru .007 | .0015 |
| over .007 thru .0160 | .002 |
| over .0160 thru .026 | .003 |
| over .026 thru .040 | .004 |
| over .040 thru .058 | .005 |
| over .058 thru .072 | .006 |
| over .072 thru .083 | .007 |
| over .083 thru .098 | .008 |
| over .098 thru .114 | .009 |
| over .114 thru .130 | .010 |
| over .130 thru .145 | .012 |
| over .145 thru .176 | .014 |

### 1095 TEMPERED SPRING STEEL

| THICKNESS | TOLERANCES ± WIDTH THRU 2 | OVER 2 THRU 6 | OVER 6 THRU 9 |
|---|---|---|---|
| thru .019 | .0010 | .0010 | .0015 |
| .020 thru .034 | .0010 | .0015 | .0020 |
| .035 thru .079 | .0015 | .0020 | .0030 |
| over .079 | .0020 | .0030 | .0040 |
| Max. variation in any one sheet | .0050 | .0010 | .0020 |

### ALUMNIZED STEEL — LOW CARBON

| THICKNESS | TOLERANCES ± |
|---|---|
| thru .020 | .003 |
| over .020 thru .030 | .004 |
| over .030 thru .050 | .005 |
| over .050 thru .070 | .006 |
| over .070 thru .080 | .007 |
| over .080 thru .090 | .008 |

### INCONEL STEEL SHEET

| THICKNESS | TOLERANCES ± |
|---|---|
| thru .034 | .002 |
| over .034 thru .062 | .003 |
| over .062 thru .125 | .004 |
| over .125 thru .187 | .005 |
| over .187 thru .218 | .006 |
| over .218 thru .234 | .007 |
| over .234 thru .250 | .008 |

### LOW CARBON ALLOY STEEL

| THICKNESS | TOLERANCES ± WIDTH OVER 20 THRU 32 | OVER 32 THRU 40 | OVER 40 THRU 48 |
|---|---|---|---|
| thru .0141 | | .002 | .002 |
| .0142 thru .0194 | .002 | .002 | .002 |
| .0195 thru .0313 | .003 | .003 | .003 |
| .0314 thru .0388 | .004 | .004 | .004 |
| .0389 thru .0508 | .005 | .005 | .005 |
| .0509 thru .0567 | .006 | .006 | .006 |
| .0568 thru .0709 | .006 | .006 | .006 |
| .0710 thru .0821 | .007 | .007 | .007 |
| .0822 thru .0971 | .007 | .008 | .008 |
| .0972 thru .1419 | .008 | .009 | .010 |
| .1420 thru .1874 | .008 | .009 | .010 |
| .1875 thru .2499 | .008 | .009 | .010 |

### 347 CORROSION AND HEAT RESISTANT STEEL

| THICKNESS | TOLERANCES ± WIDTH THRU 14 | OVER 14 |
|---|---|---|
| thru .018 | +.001 - .002 | .002 |
| over .018 thru .028 | +.002 - .003 | .003 |
| over .028 thru .037 | .003 | .003 |
| over .037 thru .049 | .003 | .004 |
| over .049 thru .061 | .004 | .004 |
| over .061 thru .077 | .004 | .005 |
| over .077 thru .107 | .006 | .006 |
| over .107 thru .138 | .006 | .007 |
| over .138 thru .184 | .006 | .008 |
| over .184 thru .245 | .008 | .010 |
| over .245 thru .368 | .010 | .012 |
| over .368 thru .490 | .012 | .014 |
| over .490 | .014 | .016 |

### 1095 SPRING STEEL AND 1010 LOW CARBON STEEL SHEET

TOLERANCES — SAME AS 347 CORROSION & HEAT RESISTANT STEEL

### X4130 SHEET STEEL AND PLATE

TOLERANCES — THE SAME AS 347 STAINLESS STEEL

### PHOSPHOR BRONZE

| THICKNESS | TOLERANCES ± WIDTH THRU 6 | OVER 6 THRU 9 | OVER 9 THRU 14 | OVER 14 THRU 20 |
|---|---|---|---|---|
| thru .0100 | .0011 | .0012 | .0013 | .0014 |
| .0101 thru .0179 | .0015 | .0016 | .0017 | .0018 |
| .0180 thru .0320 | .0020 | .0021 | .0023 | .0024 |
| .0321 thru .0570 | .0025 | .0027 | .0029 | .0031 |
| .0571 thru .1019 | .0030 | .0032 | .0034 | .0036 |
| .1020 thru .1819 | .0035 | .0037 | .0039 | .0041 |
| .1820 thru .3249 | .0040 | .0042 | .0044 | .0046 |
| .3250 thru .4600 | .0043 | .0045 | .0047 | .0049 |

### HARD COPPER

| THICKNESS | TOLERANCES ± WIDTH THRU 8 | OVER 8 THRU 14 | OVER 14 THRU 20 | OVER 20 THRU 28 |
|---|---|---|---|---|
| thru .004 | .0003 | .0006 | | |
| .005 thru .006 | .0004 | .0008 | .0013 | |
| .007 thru .009 | .0006 | .0010 | .0015 | |
| .010 thru .013 | .0008 | .0013 | .0018 | |
| .014 thru .017 | .0010 | .0015 | .0020 | |
| .018 thru .021 | .0013 | .0018 | .0020 | |
| .022 thru .026 | .0015 | .0020 | .0025 | .0030 |
| .027 thru .037 | .0020 | .0020 | .0025 | .0035 |
| .038 thru .050 | .0020 | .0025 | .0030 | .0040 |
| .051 thru .073 | .0025 | .0030 | .0035 | .0050 |
| .074 thru .130 | .0030 | .0035 | .0040 | .0060 |
| .131 thru .205 | .0035 | .0040 | .0045 | .0070 |
| .206 thru .300 | .0040 | .0045 | .0050 | .0090 |
| .301 thru .500 | .0045 | .0050 | .0060 | .0120 |
| .501 thru .750 | .0055 | .0070 | .0090 | .0150 |
| .751 thru 1.00 | | .0090 | .0110 | .0180 |
| 1.001 thru 1.50 | | | | .0220 |
| 1.501 thru 2.00 | | | | .0260 |

*Materials of Construction Table (Sheet 15 of 19 Sheets)*

## SHEET — STRIP — PLATE (Continued)

### COMMERCIAL BRASS

| THICKNESS | TOLERANCES ± WIDTH THRU 6 | OVER 6 THRU 9 | OVER 9 THRU 14 | OVER 14 THRU 20 |
|---|---|---|---|---|
| .4600 | .0043 | .0045 | .0047 | .0049 |
| .4096 | .0042 | .0044 | .0046 | .0048 |
| .3648 | .0041 | .0043 | .0045 | .0047 |
| .3249 | .0040 | .0042 | .0044 | .0046 |
| .2893 | .0039 | .0041 | .0043 | .0045 |
| .2576 | .0038 | .0040 | .0042 | .0044 |
| .2294 | .0037 | .0039 | .0041 | .0043 |
| .2043 | .0036 | .0038 | .0040 | .0042 |
| .1819 | .0035 | .0037 | .0039 | .0041 |
| .1620 | .0034 | .0036 | .0038 | .0040 |
| .1443 | .0033 | .0035 | .0037 | .0039 |
| .1285 | .0032 | .0034 | .0036 | .0038 |
| .1144 | .0031 | .0033 | .0035 | .0037 |
| .1019 | .0030 | .0032 | .0034 | .0036 |
| .0907 | .0029 | .0031 | .0033 | .0035 |
| .0808 | .0028 | .0030 | .0032 | .0034 |
| .0719 | .0027 | .0029 | .0031 | .0033 |
| .0640 | .0026 | .0028 | .0030 | .0032 |
| .0570 | .0025 | .0027 | .0029 | .0031 |
| .0508 | .0024 | .0026 | .0028 | .0030 |
| .0452 | .0023 | .0025 | .0027 | .0029 |
| .0403 | .0022 | .0024 | .0026 | .0028 |
| .0359 | .0021 | .0023 | .0025 | .0026 |
| .0320 | .0020 | .0021 | .0023 | .0024 |
| .0284 | .0019 | .0020 | .0021 | .0022 |
| .0253 | .0018 | .0019 | .0020 | .0021 |
| .0225 | .0017 | .0018 | .0019 | .0020 |
| .0201 | .0016 | .0017 | .0018 | .0019 |
| .0179 | .0015 | .0016 | .0017 | .0018 |
| .0159 | .0014 | .0015 | .0016 | .0017 |
| .0142 | .0013 | .0014 | .0015 | .0016 |
| .0126 | .0012 | .0013 | .0014 | .0015 |
| .0112 | .0011 | .0012 | .0013 | .0014 |
| .0100 | .0011 | .0012 | .0013 | .0014 |
| .0089 | .0010 | .0011 | .0012 | .0013 |
| .0079 | .0010 | .0011 | .0012 | .0013 |
| .0070 | .0009 | .0010 | .0011 | .0012 |

### 35O & 525O MAGNESIUM ALLOY

| THICKNESS | TOLERANCES ± WIDTH THRU 36 | OVER 36 THRU 48 |
|---|---|---|
| .015 thru .036 | .0020 | .0025 |
| .037 thru .050 | .0025 | .0030 |
| .051 thru .080 | .0030 | .0040 |
| .081 thru .250 | 5% T | 5% T |

### 61SW ALUMINUM ALLOY

| THICKNESS | TOLERANCES ± WIDTH THRU 36 | THRU 54 OVER 36 | THRU 60 OVER 54 |
|---|---|---|---|
| .010 thru .017 | .0015 | .0020 | |
| .018 thru .036 | .0020 | .0025 | |
| .037 thru .050 | .0025 | .0030 | .0040 |
| .051 thru .072 | .0030 | .0040 | .0050 |
| .072 thru .091 | .0030 | .0040 | .0060 |
| .092 thru .125 | .0045 | .0050 | .0070 |
| .126 thru .249 | 5% T | 5% T | 6% T |

### 24S — ALCLAD & BARE — SHEET & PLATE

| THICKNESS | TOLERANCES ± WIDTH THRU 18 | OVER 18 THRU 36 | OVER 36 THRU 54 | OVER 54 THRU 60 |
|---|---|---|---|---|
| .010 thru .017 | .0015 | .0015 | .002 | |
| .018 thru .036 | .0015 | .002 | .0025 | |
| .037 thru .050 | .002 | .0025 | .003 | .004 |
| .051 thru .072 | .0025 | .003 | .004 | .005 |
| .073 thru .091 | .003 | .003 | .004 | .006 |
| .092 thru .128 | .004 | .0045 | .005 | .007 |

### 3S ALUMINUM SHEET

TOLERANCES — THE SAME AS 24S SHEET AND PLATE

### 52S SHEET ALUMINUM (QQ-A-318)

| Thickness (Inch) | TOLERANCE + OR — WIDTH Up to 36 | Over 36 to 42 | Over 42 to 48 | Over 48 to 54 | Over 54 to 60 |
|---|---|---|---|---|---|
| 0.010-0.016 | 0.0015 | | | | |
| 0.016-0.018 | 0.002 | | | | |
| 0.019-0.024 | 0.002 | 0.003 | | | |
| 0.025-0.029 | 0.0025 | 0.003 | | | |
| 0.030-0.036 | 0.0025 | 0.003 | 0.003 | | |
| 0.037-0.050 | 0.0025 | 0.003 | 0.003 | 0.003 | 0.004 |
| 0.051-0.072 | 0.003 | 0.004 | 0.004 | 0.004 | 0.005 |
| 0.073-0.080 | 0.003 | 0.004 | 0.004 | 0.004 | 0.006 |
| 0.081-0.091 | 0.003 | 0.004 | 0.004 | 0.004 | 0.006 |
| 0.092-0.125 | 0.0045 | 0.005 | 0.005 | 0.005 | 0.007 |
| 0.126-0.249 | 4% T | 5% T | 5% T | 5% T | 6% T |

## TUBING

### AMC 57S MAGNESIUM ALLOY

| NOMINAL OUTSIDE DIAMETER | TOLERANCES ± |
|---|---|
| thru 1/2 | .007 |
| over 1/2 thru 1 | .010 |
| over 1 thru 2 | .012 |
| over 2 thru 3 | .015 |
| over 3 thru 4 | .018 |
| over 4 thru 5 | .020 |
| over 5 thru 6 | .022 |
| over 6 thru 7-1/2 | .025 |

| WALL THICKNESS | OUTSIDE DIAMETER THRU 3/4 | OVER 3/4 THRU 1 3/4 | OVER 1-3/4 THRU 3 | OVER 3 THRU 5 | OVER 5 THRU 7-1/2 |
|---|---|---|---|---|---|
| thru .049 | .007 | .008 | .009 | | |
| .050 thru .120 | .007 | .010 | .012 | .015 | |
| .121 thru .203 | .008 | .012 | .015 | .018 | .025 |
| .204 thru .300 | | .014 | .020 | .025 | .031 |
| .301 thru .375 | | .016 | .025 | .035 | .045 |
| .376 thru .500 | | .018 | .035 | .047 | .055 |

*Materials of Construction Table (Sheet 16 of 19 Sheets)*

## TUBING (Continued)

### YELLOW BRASS — SEAMLESS

| OUTSIDE DIAMETER | TOLERANCES ± |
|---|---|
| thru .50 | .0020 |
| over .50 thru .75 | .0025 |
| over .75 thru 1.00 | .0030 |
| over 1.00 thru 1.25 | .0035 |
| over 1.25 thru 1.50 | .0040 |
| over 1.50 thru 1.75 | .0045 |
| over 1.75 thru 2.00 | .0050 |
| over 2.00 | .25% outside dia. |

### SOFT COPPER

| NOMINAL SIZE | WALL THICKNESS | TOLER. ± | ACTUAL OUTSIDE DIAMETER | TOLER. ± |
|---|---|---|---|---|
| 3/8 | .049 | .0040 | .500 | .0025 |
| 1/2 | .049 | .0040 | .625 | .0025 |
| 3/4 | .065 | .0045 | .875 | .0030 |
| 1 | .065 | .0045 | 1.125 | .0035 |
| 1-1/4 | .065 | .0045 | 1.375 | .0040 |
| 1-1/2 | .072 | .0045 | 1.625 | .0045 |
| 2 | .083 | .0050 | 2.125 | .0050 |
| 2-1/2 | .095 | .0050 | 2.625 | .0050 |
| 3 | .109 | .0050 | 3.125 | .0050 |
| 3-1/2 | .120 | .0050 | 3.625 | .0050 |
| 4 | .134 | .0060 | 4.125 | .0050 |
| 5 | .160 | .0060 | 5.125 | .0050 |
| 6 | .192 | .0070 | 6.125 | .0050 |

### LEADED BRONZE

| | + | — |
|---|---|---|
| INSIDE DIAMETER | .000 | 1/16 |
| OUTSIDE DIAMETER | 1/16 | .000 |

### X4130 STEEL — ROUND

| NOMINAL OUTSIDE DIAMETER | TOLERANCES ± OUTSIDE DIAMETER A & N CONDITIONS | HT CONDITIONS | WALL THICKNESS |
|---|---|---|---|
| thru .5 | .005 | .010 | 15% |
| over .5 thru 1.5 | .005 | .015 | 10% |
| over 1.5 thru 3.0 | .010 | .030 | 10% |
| over 3.0 thru 5.5 | .015 | .045 | 10% |
| over 5.5 | .020 | .060 | 10% |

### X4130 STEEL — SQUARE & RECT.

| LARGEST NOMINAL WIDTH | TOLERANCES ± WIDTH | WALL THICKNESS |
|---|---|---|
| thru .75 | .010 | 10% |
| over .75 thru 1.5 | .015 | 10% |
| over 1.5 thru 2.5 | .020 | 10% |
| over 2.5 thru 3.5 | .025 | 10% |
| over 3.5 thru 5.5 | .030 | 10% |

### 1015 LOW CARBON

| OUTSIDE DIAMETER | RATIO: WALL THICK. TO OUTSIDE DIA. (%) | OUTSIDE DIA. TOLERANCE + | — |
|---|---|---|---|
| 3/16 thru 1/2 | 3 and over | .004 | 0 |
| over 1/2 thru 1-1/2 | 3 and over | .005 | 0 |
| over 1-1/2 thru 3-1/2 | 3 and over | .010 | 0 |
| over 3-1/2 thru 5-1/2 | 3 and over | .015 | 0 |
| over 5-1/2 thru 8 | 3 to 5 | .030 | .030 |
| over 5-1/2 thru 8 | 5 thru 7-1/2 | .020 | .020 |
| over 5-1/2 thru 8 | over 7-1/2 | .030 | 0 |
| over 8 thru 10-3/4 | 3 to 5 | .045 | .045 |
| over 8 thru 10-3/4 | 5 thru 7-1/2 | .035 | .035 |
| over 8 thru 10-3/4 | over 7-1/2 | .045 | 0 |

### 61ST ALUMINUM ALLOY

| NOMINAL OUTSIDE DIAMETER | TOLERANCES ± MEAN DIA. MEASUREMENT | INDIV. DIA. MEASUREMENT |
|---|---|---|
| thru 1/2 | .003 | .006 |
| over 1/2 thru 1 | .004 | .008 |
| over 1 thru 2 | .005 | .010 |
| over 2 thru 3 | .006 | .012 |
| over 3 thru 5 | .008 | .016 |
| over 5 thru 6 | .010 | .020 |
| over 6 thru 8 | .015 | .030 |
| over 8 thru 10 | .020 | .040 |
| over 10 thru 12 | .025 | .050 |

| NOMINAL WALL THICKNESS | INDIV. READINGS MIN. | MAX. | NOMINAL WALL THICKNESS | INDIV. READINGS MIN. | MAX. |
|---|---|---|---|---|---|
| .022 | .020 | .025 | .109 | .098 | .120 |
| .025 | .023 | .028 | .120 | .108 | .132 |
| .028 | .025 | .031 | .134 | .120 | .148 |
| .032 | .029 | .036 | .148 | .133 | .163 |
| .035 | .032 | .039 | .165 | .148 | .182 |
| .042 | .038 | .047 | .180 | .162 | .198 |
| .049 | .044 | .054 | .203 | .182 | .223 |
| .058 | .052 | .064 | .220 | .198 | .242 |
| .065 | .059 | .072 | .238 | .214 | .262 |
| .072 | .065 | .080 | .259 | .233 | .285 |
| .083 | .075 | .092 | .284 | .255 | .312 |
| .095 | .085 | .105 | .300 | .270 | .330 |

### 24ST ALUMINUM ALLOY

| NOMINAL OUTSIDE DIAMETER | TOLER. ± | WALL THICKNESS | TOLER. ± |
|---|---|---|---|
| 1/4 thru 1/2 | .003 | .010 thru .035 | .002 |
| over 1/2 thru 1 | .004 | .036 thru .049 | .003 |
| over 1 thru 2 | .005 | .050 thru .120 | .004 |
| over 2 thru 3 | .006 | .121 thru .203 | .005 |
| over 3 thru 5 | .008 | .204 thru .300 | .008 |
| over 5 thru 6 | .010 | .301 thru .375 | .012 |
| over 6 thru 8 | .015 | .376 thru .500 | .032 |

### 53SW & 17ST ALUMINUM ALLOY

TOLERANCES—THE SAME AS 24ST ALUM. ALLOY

### FLEXIBLE CORROSION RESISTANT STEEL

| SIZE | TOLERANCES ± INSIDE DIA. + | — | OUTSIDE DIA. + | — |
|---|---|---|---|---|
| Thru 2 | .015 | .000 | .000 | .020 |
| Over 2 | .020 | .000 | .000 | .030 |

### FLEXIBLE ALUMINUM ALLOY

TOLERANCES—SAME AS FLEX. CORROSION RES. STEEL

### 347-1A CORROSION & HEAT RESISTANT STEEL

| NOMINAL DIMENSIONS OUTSIDE DIAMETER | WALL THICKNESS | TOLERANCES OUTSIDE DIAMETER | WALL THICK-NESS (%) |
|---|---|---|---|
| to .5 | All Thicknesses | +.010 —.000 | ±15 |
| .5 to 1.5 | to .065 | +.020 —.000 | ±10 |
| | .065 & over | +.010 —.000 | |
| 1.5 to 3.5 | to .095 | ±.020 | ±10 |
| | .095 & over | ±.010 | |
| 3.5 thru 4 | to .148 | ±.030 | ±10 |
| | .148 & over | ±.015 | |

*Materials of Construction Table (Sheet 17 of 19 Sheets)*

# BAR — ROD

## HARD COPPER

| WIDTH | THICKNESS | THICKNESS TOLERANCES DRAWN | ROLLED |
|---|---|---|---|
| | thru 1/8 | .0015 | .003 |
| | over 1/8 thru 1/4 | .0020 | .004 |
| Thru 6 | over 1/4 thru 1/2 | .0025 | .005 |
| | over 1/2 thru 3/4 | .0035 | .007 |
| | over 3/4 | .0045 | .009 |
| Over 6 | over 1/4 thru 1/2 | .0035 | |
| Thru 8 | over 1/2 thru 3/4 | .0050 | |

| WIDTH | WIDTH TOLERANCES ± DRAWN | ROLLED |
|---|---|---|
| thru 1/2 | .0030 | .0050 |
| over 1/2 thru 2 | .0050 | .0075 |
| over 2 thru 4 | .0075 | .0100 |
| over 4 thru 6 | .0100 | .0200 |
| over 6 | 1/64 | 1/32 |

## AMC 575 MAGNESIUM ALLOY

| DIAMETER OR DISTANCE ACROSS FLATS | TOLERANCES ± |
|---|---|
| thru .50 | .007 |
| over .50 thru 1.00 | .010 |
| over 1.00 thru 2.00 | .012 |
| over 2.00 thru 3.00 | .015 |
| over 3.00 thru 4.00 | .018 |
| over 4.00 thru 5.00 | .020 |
| over 5.00 thru 6.00 | .022 |
| over 6.00 thru 7.00 | .025 |
| over 7.00 thru 8.00 | .030 |
| over 8.00 thru 9.00 | .035 |
| over 9.00 thru 10.00 | .040 |
| over 10.00 thru 11.00 | .045 |
| over 11.00 thru 12.00 | .050 |

## COPPER SILICON (QQ-C-591)

Permissible Variations in Diameter or Thickness, Rods and Bars, Except Forging Stock.

| Diameter or Thickness (Inches) | TOLERANCES Rounds + | — | Rectangular Square Hexagonal + or — |
|---|---|---|---|
| 0.50 and less | 0.000 | 0.0030 | 0.0030 |
| Over 0.50 thru 1.0 | 0.000 | 0.0040 | 0.0040 |
| Over 1 00 thru 2.5 | 0.0025 | 0.0025 | 0.0025 |
| Over 2.5 | 0.15%D | 0.15%D | 0.30%T |

## NAVAL BRASS (QQ-B-636)

TOLERANCES — THE SAME AS COPPER SILICON

## WROUGHT ALUMINUM BRONZE

| DIAMETER OR THICKNESS | TOLERANCES ROUNDS + | — | RECT., SQ., HEX. ± |
|---|---|---|---|
| thru .50 | 0 | .003 | .0030 |
| over .50 thru 1.0 | 0 | .006 | .0040 |
| over 1.0 thru 2.5 | .004 | .004 | .0050 |
| over 2.5 | .15% | .15% | .30% |

## 3115 STEEL — ROUND & SQUARE

| SIZE SPECIFIED | TOLERANCES + | — | OUT OF ROUND OR SQ. |
|---|---|---|---|
| thru 5/16 | .005 | .005 | .008 |
| over 5/16 thru 7/16 | .006 | .006 | .009 |
| over 7/16 thru 5/8 | .007 | .007 | .010 |
| over 5/8 thru 7/8 | .008 | .008 | .012 |
| over 7/8 thru 1 | .009 | .009 | .013 |
| over 1 thru 1-1/8 | .010 | .010 | .015 |
| over 1-1/8 thru 1-1/4 | .011 | .011 | .016 |
| over 1-1/4 thru 1-3/8 | .012 | .012 | .018 |
| over 1-3/8 thru 1-1/2 | .014 | .014 | .021 |
| over 1-1/2 thru 2 | 1/64 | 1/64 | .023 |
| over 2 thru 2-1/2 | 1/32 | 0 | .023 |
| over 2-1/2 thru 3-1/2 | 3/64 | 0 | .035 |
| over 3-1/2 thru 4-1/2 | 1/16 | 0 | .046 |
| over 4-1/2 thru 5-1/2 | 5/64 | 0 | .058 |
| over 5-1/2 thru 8 | 3/32 | 0 | .070 |

## X4130 STEEL (AN-QQ-S-684) COLD FINISHED BARS

| ROUNDS Diameters | Tolerances + | — | HEXAGONS AND SQUARES Dimensions Bet. Opp. sides | Tolerances Hexagons + | — | Squares + | — |
|---|---|---|---|---|---|---|---|
| 1 and less | 0.0 | .003 | 0.3 and less | 0.0 | .003 | 0.0 | .004 |
| Over 1 thru 2 | 0.0 | .004 | Over .3 to 1 | 0.0 | .004 | 0.0 | .005 |
| Over 2 thru 4 | 0.0 | .005 | Over 1 to 2½ | 0.0 | .005 | 0.0 | .006 |
| Over 4 thru 6 | 0.0 | .006 | Over 2½ to 4 | 0.0 | .006 | 0.0 | .008 |
| Over 6 thru 8 | 0.0 | .008 | | | | | |

FLATS TOLERANCES ON SPECIFIED WIDTHS AND THICKNESSES

| WIDTHS | Thickness Thru 0.3 + | — | 0.3 Thru 1 + | — | 1 Thru 2½ + | — |
|---|---|---|---|---|---|---|
| Up to 1½ | 0.0 | .004 | 0.0 | .005 | 0.0 | .006 |
| 1½ thru 4 | 0.0 | .006 | 0.0 | .006 | 0.0 | .008 |
| Over 4 thru 6 | 0.0 | .010 | 0.0 | .012 | 0.0 | .012 |

## STEEL DRILL ROD

| DIMENSIONS | | TOLERANCES + | — |
|---|---|---|---|
| ROUND | thru 7/16 | .0005 | .0005 |
| | over 7/16 | .0010 | .0010 |
| SQUARE | thru .3 | .0005 | .0005 |
| OR | over .3 thru 1 | .0010 | .0005 |
| RECT. | over 1 thru 2.5 | .0015 | .0010 |
| | over 2.5 thru 4 | .0020 | .0010 |

## 1117 STEEL — COLD FORMED

| DIAMETER | TOLERANCES CARBON THRU .30% + | — | CARBON OVER .30 THRU .50% + | — |
|---|---|---|---|---|
| thru 1 | 0 | .002 | 0 | .003 |
| over 1 thru 2 | 0 | .003 | 0 | .004 |
| over 2 thru 4 | 0 | .004 | 0 | .005 |
| over 4 thru 6 | 0 | .005 | 0 | .006 |
| over 6 thru 8 | 0 | .006 | 0 | .008 |

*Materials of Construction Table (Sheet 18 of 19 Sheets)*

## BAR — ROD (Continued)

### LEADED BEARING BRONZE (L.A.C. 1-650)

The Eccentricity of the Cored Bars Shall Be Such That When the Outside Diameter is Machined to Plus a Minimum of .010 Inch from the Nominal Inside Diameter the Diameters Will Be Concentric.

| | Permissible Variations (Inches) + | — |
|---|---|---|
| Inside Diameter | .000 | 1/16 |
| Outside Diameter | 1/16 | .000 |

### 2S — 17S — 24S ALUMINUM ALLOY

TOLERANCES ±

| Diameter or Least Distance Between Parallel Faces | Rounds | | Squares, Hexagons, Octagons | | |
|---|---|---|---|---|---|
| Rectangles Up to 3 Inches in Width and 3 Sq. In. Max. Cross Sectional Area | | | Rectangles With More Than 3 Sq. In. Cross Sectional Area or Greater than 3 In. Width | | |
| | | | Thickness | | Width |
| thru .0359 | .0005 | | | | |
| .036 thru .064 | .001 | .0015 | .0015 | | |
| .065 thru .500 | .0015 | .002 | .002 | .006 | |
| .501 thru .750 | .002 | .0025 | .0025 | .008 | |
| .751 thru 1.000 | .002 | .0025 | .0025 | .012 | |
| 1.001 thru 1.500 | .0025 | .003 | .003 | .016 | |
| 1.501 thru 2.000 | .008 | .016 | .005 | .016 | .031 |
| 2.001 thru 3.000 | .008 | .020 | .005 | .020 | .031 |
| 3.001 thru 3.499 | .008 | | | | .031 |
| 3.500 thru 4.000 | +.031 —.016 | | | | .031 |
| 4.001 thru 5.000 | +.031 —.016 | | | | .047 |
| 5.001 thru 6.000 | +.063 —.031 | | | | .047 |
| 6.001 thru 8.000 | +.063 —.031 | | | | .063 |
| 8.001 thru 10.000 | | | | | .063 |

### NE 8630 & 6150 STEEL — AND NITRALLOY

| DIAMETER OR LEAST DISTANCE BETWEEN PARALLEL FACES | TOLERANCES ROUNDS HEXS + | — | SQUARES FLATS * + | — |
|---|---|---|---|---|
| thru 1 1/2 | .000 | .006 | .000 | .008 |
| over 1 1/2 | STOCKED HOT ROLLED (See Engineering Officer) | | | |

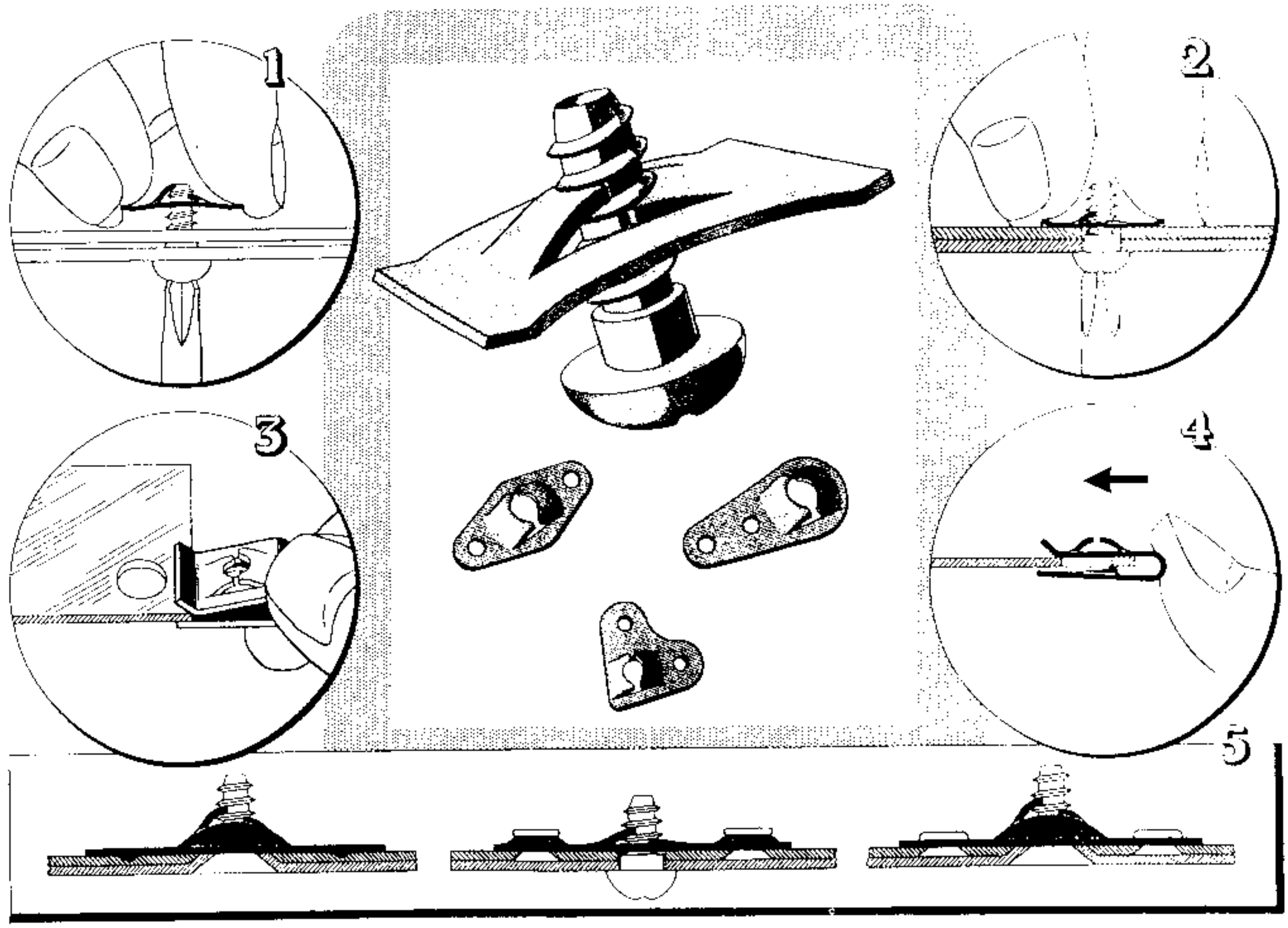
* Tolerances apply to thickness as well as width.

### PHENOLIC RESIN (HH-P-256)
### ROLLED OR MOLDED TUBING OR ROD

| Outside Diameter (Inches) | Tolerance + or — |
|---|---|
| Less than 1 15/16 | .005 |
| 2 to 4 | .008 |
| 4 1/8 to 12 1/8 (Rolled Only) | .025 |

| Wall Thickness (Inch) | TOLERANCE IN INCHES + OR — Rolled Tubing I. D. Over | | | Molded Tubing I. D. Over | | |
|---|---|---|---|---|---|---|
| | 1/8 to 1/4 | 1/4 to 1/2 | Over 1/2 | 1/8 to 1/4 | 1/4 to 1/2 | Over 1/2 |
| Less than 1/16 | .006 | .010 | .009 | .008 | .008 | .008 |
| 1/16 and less than 1/8 | .007 | .011 | .009 | .011 | .011 | .011 |
| 1/8 and less than 1/4 | .009 | .013 | .011 | .017 | .015 | .011 |
| 1/4 to 1/2 inclusive | .011 | .015 | .013 | .025 | .018 | .013 |

*Materials of Construction Table (Sheet 19 of 19 Sheets)*




1. Insertion of screw in "Flat" type speed nut.
2. Speed nut properly tightened showing arched base flattened and flush against sheet and lowest prong flush with base of speed nut.

3 & 4. Assembly of "U" and "J" type speed nuts.

5. "Anchor" type speed nuts installed.

NOTES: Never use sharp pointed or SAE screws.

Never drive screws into speed nuts with a hammer.

Never pry against the nut when aligning holes. Align holes only by prying against sheet.

Tighten to at least a half turn of spring drag on the s rew.

Use only "Z" type screws. Speed nuts are made for one specific screw size only. The screw size is stamped on most speed nuts. However, the type "Z" speed nuts can be easily recognized as being of heavier gage (.002 to .028) than the machine screw type which is .016 to .022.

For determining the proper screw to nearest standard length, plus or minus 1/16 inch, to be used with speed nuts the following rule should be used:

For No. 8 and No. 10 screws add 5/16 inch to total grip.

For No. 4 and No. 6 screws add 1/4 inch to total grip.

*Figure 265 — Installation of Speed Nuts*

*Figure 266—Deleted by Revision dated 10 March 1948*

# SECTION VII
# FINISH SPECIFICATIONS

## 1. MATERIALS REQUIRED.

*a.* Primer Zinc chromate Spec. AN-TT-P-656. When tinted prime finish is specified, darken prime with black enamel to Color 611 or use Color 611 Spec. AN-E-7 enamel as top coat.

*b.* Thinner, Toluene, Spec. AN-R-T-541.

*c.* Lacquer Spec. AN-L-29 Color 514 Instrument black flat (or camouflage Color 604 Spec. AN-L-21).

*d.* Lacquer, acid proof, U. S. Army Spec. 3-168.

*e.* Thinner Dope and Lacquer, Spec. AN-TT-T-256.

*f.* Enamel:

(1) Spec. AN-E-3 Color 502 Insignia Blue, or Spec. AN-E-7 Color 605.

(2) Spec. AN-E-3 Color 511 Insignia White, or Spec. AN-E-7 Color 601.

(3) Spec. AN-E-3 Color 509 Insignia Red, or Spec. AN-E-7 Color 619.

(4) Spec. AN-E-3 Color 515 black or Spec. AN-E-7 Color 604.

(5) Spec. AN-E-7 Color 612 medium green.

*g.* Wood Sealer—Spec. AN-V-26 Varnish thinned 50 percent with Naphtha Spec. AN-VV-N-96.

*h.* Naphtha for thinning enamels—Spec. AN-VV-N-96.

*i.* Pigment, Aluminum Paste Spec. AN-TT-A-461.

*j.* Polish, Navy Spec. P-69.

*k.* Wax, Clintons Spray.

*l.* Compound, Liquid, Abrasive R-Mir-Dek for walkways.

*m.* Solvent, cleaning, Spec. P-S-661.

*n.* Cement, General Purpose, Synthetic Rubber Base, Spec. 26609.

*o.* Sealer, General Purpose, Snythetic Rubber Base, EC612.

## 2. GENERAL REQUIREMENTS.

Primary protective treatments for metallic and non-metallic materials are in accordance with the latest revision of LAC Process Specification F-D. The finish specification for the photographic airplane is the same as for the fighter airplane, except as noted.

*a.* ALUMINUM.

(1) Aluminum alloys that require anodizing, shall receive a minimum of two coats of zinc chromate primer unless otherwise specified herein.

(2) Aluminum alloys that do not require anodizing shall not be painted unless otherwise specified herein.

*b.* STEEL.—Steel parts requiring primary protective coatings shall receive one coat of zinc chromate primer unless otherwise specified herein.

*c.* MAGNESIUM.—Magnesium alloy parts shall receive, in addition to the primary protective treatment, a minimum of four coats of zinc chromate primer, or two coats of zinc chromate primer and two coats of lacquer or enamel.

## 3. SPECIFIC REQUIREMENTS.

*a.* FUSELAGE.

(1) COCKPIT.—Metallic surfaces and or parts shall be finished with one coat of tinted zinc chromate primer unless otherwise specified herein.

*(a)* INSTRUMENT PANEL.—The instrument panel shall be painted with one coat of zinc chromate primer and two coats of dull black lacquer, Specification AN-L-29, on the face side only.

*(b)* SIDE CONTROL PANELS.—The side control panels shall be painted with one coat of zinc chromate primer and two coats of dull black lacquer, Specification AN-L-29, on surfaces which are visible within the cockpit.

*(c)* FLOOR PANELS.—Floor panels shall be sprayed with two coats of wood sealer, then sprayed with two coats of tinted zinc chromate primer on top surfaces only.

*(d)* PLASTIC TRIM PANELS.—Plastic trim panels shall conform in color to No. 611 of ANA Bulletin 157a.

*(e)* CONTROL STICK.—The control stick shall be painted with two coats of tinted zinc chromate primer. The handle shall be dull black in color.

*(f)* PILOT'S SEAT.—All metallic parts of the pilot's seat, except adjustment surfaces, shall be painted with one coat of tinted zinc chromate primer. Adjustment surfaces shall be wear-resistant hard chrome plate.

(*g*) LEVERS.—Levers shall be painted with one coat of zinc chromate primer and two coats of dull black lacquer, Specification AN-L-29. Engine control handles shall be painted with one coat of zinc chromate primer and two coats of insignia red lacquer, Color No. 509 of ANA Bulletin 166. Emergency levers, handles, and knobs shall be finished with one coat of zinc chromate primer and two coats of insignia red lacquer, except hydraulic control levers and handles used for emergency operation, which shall be a combination of red and white stripes painted diagonally around the handle. Hydraulic control handles and levers shall be finished with one coat of zinc chromate primer and two coats of insignia white lacquer, color No. 511 of ANA Bulletin 166. Plastic knobs and handles in which the color is incorporated in the plastic shall not be painted.

(*h*) CANOPY REINFORCEMENTS, SUPPORTS, AND WINDSHIELD STRUCTURE.—These parts shall be painted on surfaces within the cockpit with one coat of tinted zinc chromate primer and two coats of dull black lacquer, Specification AN-L-29.

(*i*) RUDDER PEDALS.—All control mechanism attached to the rudder pedals, located within the cockpit area, shall be painted with one coat of zinc chromate primer and two coats of dull black lacquer, Specification AN-L-29.

(*j*) HEAD REST STRUCTURE.—All metallic surfaces which are visible within the cockpit through the transparent canopy, including the armor plate, shall be painted with one coat of tinted zinc chromate primer.

(2) ARMAMENT COMPARTMENT. — There shall be no paint finish applied on the interior surfaces of the armament compartment, structure, or doors, except as required in paragraph 2, preceding.

(*a*) AMMUNITION TRAYS AND CHUTES.—Low-carbon steel parts attached to corrosion-resistant steel trays and chutes shall be Parkerized and oiled.

(*b*) GUN CAMERA.—Structure and surfaces immediately adjacent to the gun camera, including the lens tube, etc., shall be painted with one coat of zinc chromate primer and two coats of dull black lacquer, Specification AN-L-29.

(3) ENGINE COMPARTMENT. — In general, paint coatings shall not be applied to the interior surfaces of the engine compartment structure except as noted in paragraph 2, preceding.

(*a*) ENGINE STRUTS.—Engine struts or similar closed steel tubular assemblies shall be cadmium plated and treated on interior surfaces in accordance with LAC Process Specification F-E10.

(*b*) FORGED ALUMINUM ALLOY ENGINE SUPPORTS.—Forged aluminum alloy engine supports shall be painted with one coat of zinc chromate primer.

(*c*) CLIPS, CLAMPS, AND BRACKETS.—Clips, clamps, and brackets fabricated from steel shall be cadmium plated only.

(4) BATTERY AREA. — Battery supports, tie downs, and other surfaces or structure within 12 inches of storage batteries, subject to spillage and spray, shall be painted with two coats of black acidproof lacquer.

(5) CAMERA COMPARTMENT.

(*a*) HOOD.—Prior to the application of the finish to the interior of the hood, the camera window and the plastic section in the nose must be masked. Before installing the fiberglas blanket, the interior of the camera compartment hood shall be painted with one coat of zinc chromate primer. After the fiberglas blanket is installed, the hood shall have two coats of dull black quick-drying camouflage enamel, color No. 604 of ANA Bulletin 157, Specification AN-E-7.

(*b*) FUSELAGE NOSE STRUCTURE.—The interior surfaces of the nose structure shall be painted with two coats of dull black quick-drying camouflage enamel, Specification AN-E-7. Enamel shall not be applied to government furnished equipment, electrical conduit and fittings, plumbing, and adjustable camera supports. It is not necessary to paint nuts, bolts, and washers used to install equipment after application of black enamel.

(1) SPAR EXTRUDED CAPS.—No paint coatings shall be applied to the forward spar extruded caps if they form interior surfaces of wing leading-edge integral fuel tanks. If spar extruded caps are machined on exterior surfaces after completion of the wing, it will be necessary to apply a 5 percent chromic-acid solution to those exterior surfaces from which the anodic film has been removed, prior to the application of zinc chromate primer.

(2) WHEEL WELL AREAS.—Aluminum alloys 2S, 3S, 52S, 61S, and Alclad, or corrosion-resistant steel surfaces within the wheel well shall not be painted. All other surfaces except as noted in paragraph *d* following, shall be finished with two coats of zinc chromate primer and two coats of aluminized lacquer.

*c*. EXTERIOR SURFACES. — Exterior surfaces, including exposed surfaces in the scoop, shall be bare bright natural aluminum color, except as otherwise noted. If airplane is to be stored, clean it as instructed in step (1) following, and spray it with Clinton's spray wax. Rub a cloth lightly over this wax; it is not necessary to buff the surface.

(1) CLEANING.—Remove oil, grease, dirt and stains with a cloth wet with metal cleaner, Lockheed Material Specification 1-354. Use Bon Ami where necessary. Wash all exterior surfaces with a 6- to 7½-percent phosphoric acid wash applied with a cloth and wiped dry. Do not rinse.

**CAUTION**

Wear rubber gloves when using acid.

(2) NON-CLAD ALUMINUM ALLOY AND STEEL PARTS.—Non-clad aluminum and steel parts shall be finished with one coat of zinc chromate primer and two coats of aluminized lacquer.

(3) NATIONAL INSIGNIA.—Apply the national insignia in accordance with Specification AN-I-9 over one coat of zinc chromate primer. The star and rectangles shall conform in color to insignia white, color No. 511 of ANA Bulletin 166, and the blue ground and border shall conform in color to No. 502 of ANA Bulletin 166. Materials shall be lacquer, Specification AN-L-29. Miscellaneous markings or other required data on exterior surfaces shall be in accordance with LAC Drawing No. 175375, and shall be stenciled, using gloss black lacquer. For material see paragraph 1*b*, this section.

(4) MISCELLANEOUS EXTERIOR MARKINGS. —All exterior markings shall be applied in accordance with LAC Drawing No. 175375, using gloss black lacquer, color No. 515 of ANA Bulletin 166.

(5) ANTI-GLARE AREA.—The anti-glare area as shown on LAC Drawing No. 175375 shall be painted with quick-drying green enamel, color No. 612 of ANA Bulletin 157, Specification AN-E-7.

(6) WALKWAY.—Spray the walkway area as specified on LAC Drawing No. 175375, with P-010 Vulcabond over the zinc chromate primer. Spray from an unagitated pressure pot. The walkway surface shall be flush, and on a level with adjacent finish lacquer.

(7) VERTICAL STABILIZER TIP.—The plastic tip of the vertical stabilizer, which houses the command radio antenna, shall be painted on its exterior surface with two coats of light grey gloss lacquer, color No. 512 of ANA Bulletin 166, Specification AN-L-29.

*d.* MISCELLANEOUS PARTS AND SURFACES.

(1) ARMOR PLATE.—Steel armor plate requires no primary surface treatment, and shall be finished with two coats of darkened zinc chromate primer and the word "FACE" stenciled on the side of initial impact in one-inch white letters.

(2) JUNCTION BOXES. — Junction boxes need not be painted except to match surrounding color schemes. Paint coatings shall not be applied to interior surfaces.

(3) LINES AND CONDUIT.—Piping lines and conduit shall not be painted. Flexible metal tubing shall not be painted or processed.

(4) PLASTICS.—Rubber and thermoplastic materials shall not be painted.

(5) FAYING SURFACES.—It shall not be necessary to apply zinc chromate primer to contacting surfaces of bolts, nuts, washers, rivets, dzus springs, fasteners, and similar fastening devices prior to assembly. It will not be necessary to prime inside surfaces of holes for bolts, rivets, screws, etc., including countersunk surfaces.

(6) RETOUCHING AND REFINISHING. — It shall not be necessary to apply paint finishes to nuts, bolt heads, washers, rivet heads, and similar items after assembly.

(7) OPEN-ENDED TUBULAR AND HOLLOW PARTS.—Interior surfaces of hollow or tubular metal parts, or members which are open-ended, shall be finished with zinc chromate primer. The coating may be applied by filling or dipping. Internally threaded steel tubular parts, to which the application of zinc chromate primer to interior surfaces is not practicable, shall be greased.

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PAGE 424 DELETED IN REVISION DATED 10 MARCH 1948

# SECTION VIII

# TUBING DATA

## 1. TUBE SIZES AND GAGES.

All non-structural tubing material is 52S-O aluminum alloy.

| Outside Diameter | Inside Diameter | Wall Thickness (Inches) | Cockpit Pressurization | Fuel System | Hydraulic System | | Instruments | Oxygen System |
|---|---|---|---|---|---|---|---|---|
| | | | | | Low Press. | High Press. | | |
| 1/4 | .180 | .035 | | | x | x | | |
| 5/16 | .242 | .035 | | | x | x | | x |
| 3/8 | .305 | .035 | | | x | x | | |
| 1/2 | .430 | .035 | | | x | | x | |
| 1/2 | .402 | .049 | | | | x | | |
| 3/4 | .680 | .035 | | | x | | | |
| 1 | .930 | .035 | | x | x | | | |
| 1 1/4 | 1.152 | .049 | x | x | x | | | |

## 2. TUBE LENGTHS.

In replacing a damaged tube select a tube of the same size and gage as that of the damaged tube. Cut the piece of tubing approximately 10 percent longer than the length of the tube to be replaced. After required bends have been made, and allowance made for the flaring operation, cut off the amount of tubing in excess of the required dimensions.

## 3. TUBE IDENTIFICATION.

The tubing of each system is identified by color bands at the ends of each tube. (See figure 267.)

Place identification tape on tube in conspicuous place. Place tapes in the following manner:

*a.* Clean and dry the surfaces.

*b.* Wrap cellulose tape around the tube; overlap the tape 1/4 turn.

*c.* Brush tape with a coat of clear lacquer, Specification AN-L-29, to prevent deterioration. Be sure edges of tape are covered.

*d.* Store tape in a cool, dry place.

*e.* If identification tape is not available, paint suitable colored stripes on the tube to designate the system. Protect when dry with a coat of clear lacquer. If paint is not available, mark the tube by gluing a piece of white paper, on which the name of the line is printed clearly, around the tube. Protect the paper with a coat of clear lacquer.

## 4. TUBE TEMPLATE.

If the old tube is intact and the bends have not been changed, use it as a template or pattern from which to bend a new tube.

If a new model or template must be made, select a soft iron wire or a 1/8-inch tube, either of which may be bent easily by hand. Place the material selected for use as a template in one of the fittings where the tube is to be connected. Form the necessary bends in order to place the opposite end of the template in the other connection. When the template is properly formed to span the area between the two fittings, remove it and use the pattern for bending the new tube.

**Note**

If new supports are required, place them as close to bends as possible to minimize the amount of overhang of the tube from a straight line between supports.

## 5. TUBE CUTTING.

Use a standard cutting tool and cut the tube at right angles to the surface. Be careful to avoid forcing the tube out of round. Use a hack saw if a standard cutting tool is not available.

After the tube has been cut off, file the end square using a fine-toothed flat file. Hold the tube in a vise or flaring block while filing. If a hack saw was used for cutting, file the tube ends until all hack saw marks are removed.

After filing, remove all burrs from the inside and outside of the tube. A burnishing spoon is suitable for this purpose.

## 6. TUBE BENDING.

Tube bending may be accomplished with any one of a variety of hand-bending tools or power production bending tools. Take care to avoid bending in smaller radius than the limits of the tube will allow. Avoid flattened, kinked, or wrinkled bends. The permissible bend radii are given on AND-10111.

## 7. FLARING TUBE ENDS.

Select the proper flaring tool and vise for the tube to be worked. With a hammer-type tool, tap the pin lightly first, then use more force. Do not crack tube ends or overflare. In the event a flaring pin and block are not available, a ball peen hammer can be substituted in the flaring operation. Secure the tube and form the flange by placing the round end of the hammer against the end of the tube, tapping the opposite end of the hammer with another hammer. This method is not recommended for shop practice.

Check the flare by placing a T-square over the tube. The outside diameter of the flare should extend beyond the toe of the sleeve but not beyond the outside diameter of the sleeve. Flares made too long will stick and jam on the threads and are likely to seat on the bottom of the coupling rather than on the tapered seat. Flares made too short may be squeezed thin on installation and prevent full utilization of the clamping area.

| *Tube* | *Flare Angle* | | *Recommended Flare Dia.* | |
|---|---|---|---|---|
| *OD* | *OD* | *ID* | *Max.* | *Min.* |
| 1/4 | 33° | 37° | .359 | .349 |
| 5/16 | 33° | 37° | .421 | .411 |
| 3/8 | 33° | 37° | .484 | .474 |
| 1/2 | 33° | 37° | .656 | .646 |
| 3/4 | 33° | 37° | .937 | .927 |
| 1 | 33° | 37° | 1.187 | 1.172 |
| 1 1/4 | 33° | 37° | 1.500 | 1.485 |

*Table 1 — Flare Dimensions*

## 8. INSTALLING A TUBE.

*a.* Attach a piece of clean cloth as large as can be pulled through the tube to a wire six inches longer than the tube. Thread the wire through the tube and pull the cloth through as many times as is necessary to clean out oil, grease, or other foreign matter.

*b.* Inspect flares to see that the inside is clean.

*c.* Place the tube in position and take up the nut finger-tight.

*d.* With an end wrench or a crescent wrench hold the fitting in position while taking up the nut to the proper torque with a torque wrench. (See table 2 for recommended torque.)

**CAUTION**

Use a torque wrench to avoid over-tightening and consequent system failure.

*e.* Test the installation for tightness by applying pressure to the system.

| *Tube OD (Inch)* | *Torque (Inch - Pounds)* |
|---|---|
| 1/4 | 40 — 65 |
| 5/16 | 60 — 80 |
| 3/8 | 75 — 125 |
| 1/2 | 150 — 250 |
| 3/4 | 300 — 500 |
| 1 | 500 — 700 |
| 1 1/4 | 700 — 900 |

*Table 2 — Recommended Tightening Torque for Tubing Fittings Used with 52S-O Aluminum Tubing*

## 9. TUBE LEAKS AND FAILURES.

*a.* GENERAL.—Trouble in a tubing system may be broadly classified into two groups, namely, leaks and failures.

*b.* LOCATING LEAKS.—Wipe the system clean and track the flow of liquid to source of leak. For leaks in oxygen or air lines, apply solution of neutral soap and watch for bubbles. Leaks generally occur at joints, around shafts or seals, and infrequently at pinhole leaks in unit bodies.

*c.* CAUSES OF LEAKS AT JOINTS.

(1) Poor flare; rough surface, cracks, splits.

(2) Improper wrench torque.

(3) Foreign material under flares.

(4) Damaged fitting.

(5) Mismated parts.

(6) Threads seized or galled; damaged threads; threads crossed.

(7) Sealing compound used improperly or washed out.

(8) Wrong size gaskets; wrong type gasket; no gasket.

(9) Re-use of gasket.

(10) Improper positioning of gasket.

(11) Insufficient wrench torque to squeeze gasket and make seal.

(12) Improper positioning of fitting boss.

*d.* FAILURES.—If a tube bursts, it is usually because of faulty material, since the tubing is designed to withstand several times the operating pressure to which it is subjected. Vibration resulting from chattering or insufficient support is also a common cause of failure.

# SECTION IX

# CHARTS AND TABLES

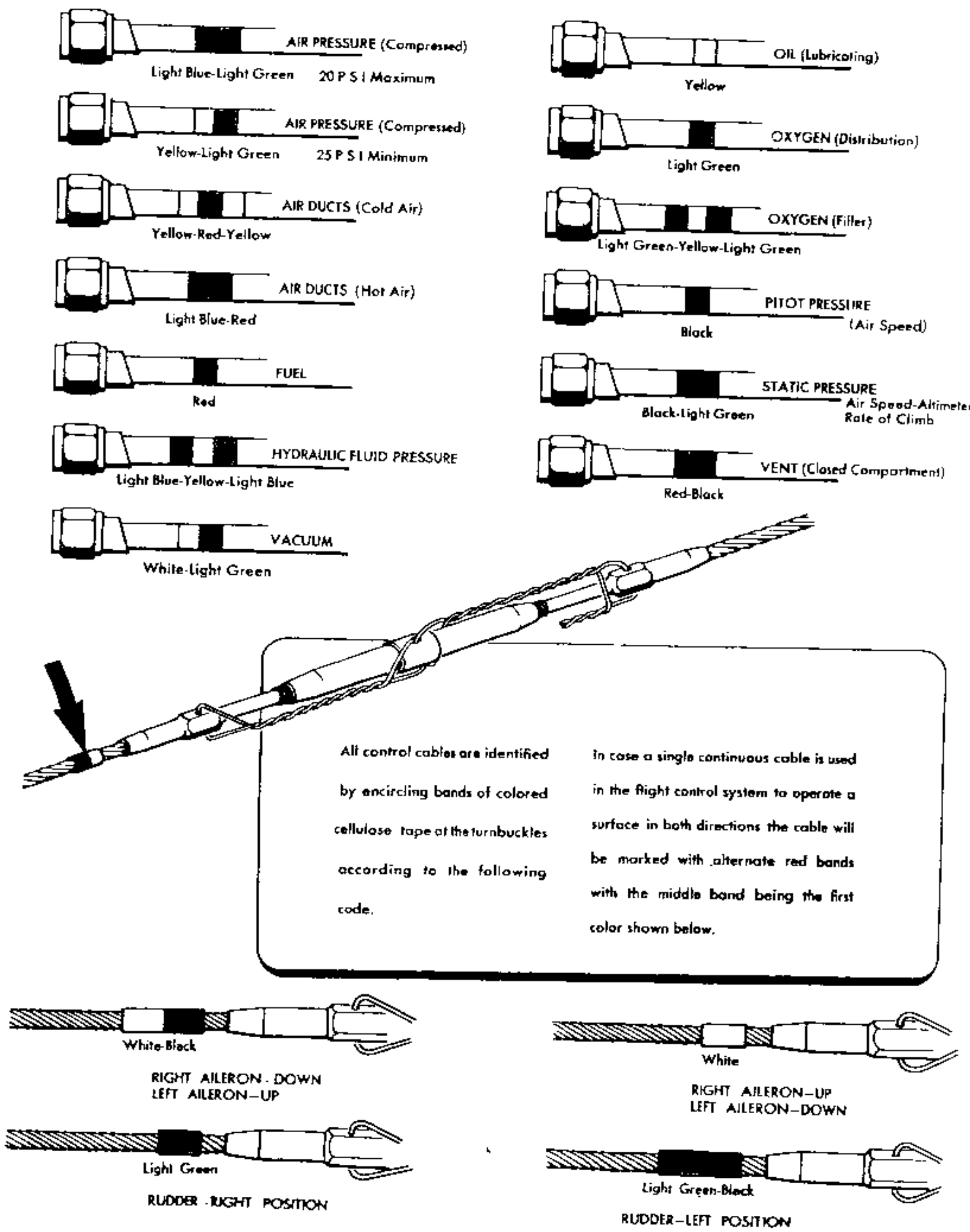


Figure 267 — Color Codes

| CABLE DESIGNATION | NO. REQ. PER A/P | LAC DRAWING NO. | L LENGTH IN INCHES | DIA IN INCHES | MATERIAL | END FITTINGS | | ANCHOR FITTING | | TURNBUCKLE BARRELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | A FITTING | B FITTING | LAC NO. | X INCHES | TYPE | NO. REQ |
| **AILERON CONTROL SYSTEM** | | | | | | | | | | | |
| BOOSTER TO RH METAL-CLAD CABLES | 1 | 176353-6 | 39 3/4 | 1/4 | 7x19 PREF STEEL | AN669-8R | AN669-8R | 175258 | 18 29/32 | | |
| BOOSTER TO LH METAL-CLAD CABLES | 1 | 176343-4 | 32 7/8 | 1/4 | 7x19 PREF STEEL | AN669-8R | AN669-8R | 175258 | 15 1/16 | | |
| METAL-CLAD CABLES | 4 | 175261 | 127 | 1/4 | 7x19 PREF STEEL | AN669-8L | AN669-8R | | | AN155-8DL | 8 |
| TO AILERON DRUM | 2 | 176343-2 | 61 1/4 | 1/4 | 7x19 PREF STEEL | AN669-8L | AN669-8L | 175258 | 30 | | |
| **RUDDER CONTROL SYSTEM** | | | | | | | | | | | |
| RH PEDAL TO QUICK DISCONNECT | 1 | 175578-4 | 167 3/4 | 3/16 | 7x19 PREF STEEL | AN669-L6LH | AN669-L6LH | | | AN155-46L(AFT)<br>AN155-46S(FWD) | 1<br>1 |
| LH PEDAL TO QUICK DISCONNECT | 1 | 175578-2 | 163 3/8 | 3/16 | 7x19 PREF STEEL | AN669-S6LH | AN669-L6LH | | | AN155-46L<br>AN155-46S | 1<br>1 |
| QUICK DISCONNECTS TO RUDDER HORN | 2 | 175578-6 | 155 1/2 | 3/16 | 7x19 PREF STEEL | AN667-6 | AN669-L6RH | | | 176938 | 1 |
| **CANOPY JETTISON CONTROL** | | | | | | | | | | | |
| OUTSIDE OPERATING CABLE | 1 | 176242-2 | 33 1/2 | 1/16 | 7x7 PREF STEEL | *RA1862-2 | 174595 | | | | |
| OPERATING LEVER CABLE | 1 | 176242-5 | 30 1/4 | 1/16 | 7x7 PREF STEEL | *RA1862-2 | 174595 | | | 174592 | 1 |
| OUTSIDE OPERATING CABLE | 1 | 176242-7 | 23/4 | 1/16 | 7x7 PREF STEEL | 174683 | *RA1862-2 | | | 174592 | 1 |
| FORWARD LATCH CABLES | 2 | 176242-10 | 27 1/8 | 1/16 | 7x7 PREF STEEL | 174687 | 174595 | | | 174592 | 1 |
| JETTISON LANYARD | 1 | 1786[illegible]-7 | 127/32 | 1/16 | 7x7 PREF STEEL | AN662-2RH | AN664-C2 | | | | |
| **PARKING BRAKE CONTROL** | | | | | | | | | | | |
| CONTROL HANDLE TO PARKING BRAKE | 1 | 175356 | 19 29/32 | 1/16 | 7x7 PREF STEEL | AN667-2 | AN667-2 | | | | |
| PARKING BRAKE LEVER P-80A-5 | 1 | 177473 | 48 1/4 | 1/16 | 7x7 PREF STEEL | 233149 | 233149 | | | | |
| PARKING BRAKE PAWL P-80A-1 | 1 | 175357 | 29 3/16 | 1/16 | 7x7 PREF STEEL | 233149 | 233149 | | | | |
| **BOMB MANUAL RELEASE CONTROL** | | | | | | | | | | | |
| HANDLE TO RH TIP SPLICE | 1 | 176669-500 | 314 1/4 | 1/16 | 7x7 PREF STEEL | *RA1862-2 | SOLDERED END | | | ** | 1 |
| HANDLE TO LH TIP SPLICE | 1 | 176669-501 | 301 1/2 | 1/16 | 7x7 PREF STEEL | *RA1862-2 | SOLDERED END | | | ** | 1 |
| WING TIP SPLICE TO SHACKLE | 2 | 176669-502 | 22 | 1/16 | 7x7 PREF STEEL | AN667-2 | SOLDERED END | | | | |
| **GUNSIGHT CONTROLS** | | | | | | | | | | | |
| LOWER CONTROL | 1 | 178105-7 | 48 | 1/32 | 3x7 PREF STEEL | 178105-2 | 178105-2 | | | | |
| UPPER CONTROL | 1 | 178105-8 | 48 | 1/32 | 3x7 PREF STEEL | 178105-2 | 178105-2 | | | | |
| **HYDRAULIC FUSE CONTROLS** | | | | | | | | | | | |
| HYDRAULIC FUSE CABLE | 1 | 176669-507 | | 1/16 | 7x7 PREF STEEL | *RA1862-2 | SOLDERED END | | | ** | 1 |
| COCKPIT CABLE | 1 | 176669-509 | | 1/16 | 7x7 PREF STEEL | *RA1862-2 | SOLDERED END | | | | |
| **JATO JETTISON CONTROL** | | | | | | | | | | | |
| CONTROL HANDLE TO BRIDLE | 1 | 179086-3 | 153 1 2 | 1 16 | 7x7 PREF STEEL | AN664-C2 | 174687 | | | | |
| BRIDLE TO JATO JETTISON MECHANISM LH | 1 | 179091-3 | 16 7 8 | 1 16 | 7x7 PREF STEEL | 174687 | AN664-C2<br>*RA2500-2 | | | | |
| BRIDLE TO JATO JETTISON MECHANISM RH | 1 | 179091-4 | 17 1/8 | 1/16 | 7x7 PREF STEEL | 174687 | AN664-C2<br>*RA2500-2 | | | | |

*MANUFACTURED BY AMERICAN CHAIN AND CABLE CO., INC., BRIDGEPORT, CONN.
**1/16 SAFELINE WIRE ROPE CLAMP, NATIONAL PRODUCTION CO., DETROIT, MICH.

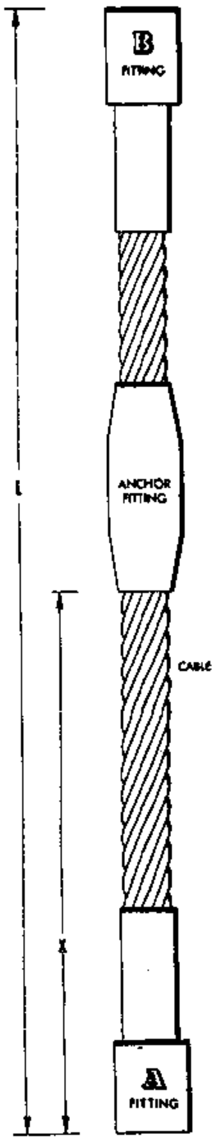


Figure 268 — Cable Chart

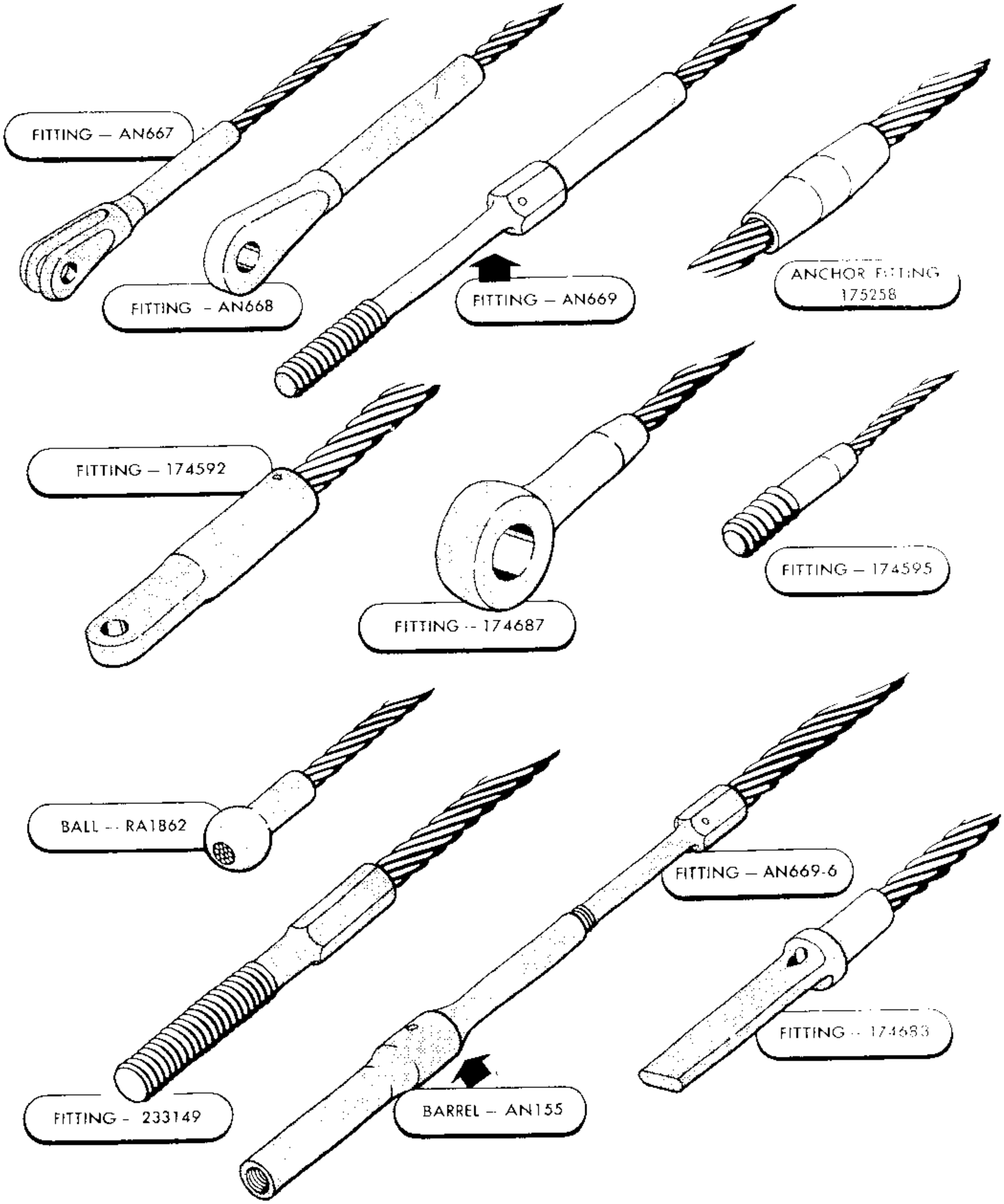


Figure 269 — Cable Fitting Chart

## Wrench Torque Table

TORQUE VALUES IN INCH-POUNDS

| *Standard Nuts, Bolts, and Screws* | | | *High Shear Nuts, Bolts, and Screws* | *Maximum Allowable Tightening Torque* | |
|---|---|---|---|---|---|
| *Bolt, Stud or Screw Size* | *Tension-Type Nuts AN310 and AN365 (40,000 psi in Bolt)* | *Shear-Type Nuts AN320 and AN364 (60% of Column 2)* | *Tension-Type Nuts* | *Tension-Type Nuts AN310 and AN365 (90,000 psi in Bolt)* | *Shear-Type Nuts AN320 and AN364 (60% of Column 5)* |
| *Column 1* | *Column 2* | *Column 3* | *Column 4* | *Column 5* | *Column 6* |
| *Fine Thread Series* | | | | | |
| 8-36 | 12-15 | 7-9 | 15-18 | 20 | 12 |
| 10-32 | 20-25 | 12-15 | 25-35 | 40 | 25 |
| 1/4-28 | 50-70 | 30-40 | 70-90 | 100 | 60 |
| 5/16-24 | 100-140 | 60-85 | 140-203 | 225 | 140 |
| 3/8-24 | 160-190 | 95-110 | 190-351 | 390 | 240 |
| 7/16-20 | 450-500 | 270-300 | 500-756 | 840 | 500 |
| 1/2-20 | 480-690 | 290-410 | 690-990 | 1,100 | 660 |
| 9/16-18 | 800-1,000 | 480-600 | 1,000-1,440 | 1,600 | 960 |
| 5/8-18 | 1,100-1,300 | 660-780 | 1,300-2,160 | 2,400 | 1,400 |
| 3/4-16 | 2,300-2,500 | 1,300-1,500 | 2,500-4,500 | 5,000 | 3,000 |
| 7/8-14 | 2,500-3,000 | 1,500-1,800 | 3,000-6,300 | 7,000 | 4,200 |
| 1-14 | 3,700-5,500 | 2,200-3,300 | 5,500-9,000 | 10,000 | 6,000 |
| 1 1/8-12 | 5,000-7,000 | 3,000-4,200 | 7,000-13,500 | 15,000 | 9,000 |
| 1 1/4-12 | 9,000-11,000 | 5,400-6,600 | 11,000-22,500 | 25,000 | 15,000 |
| *Coarse Thread Series* | | | | | |
| 8-32 | 12-15 | 7-9 | 15-18 | 20 | 12 |
| 10-24 | 20-25 | 12-15 | 25-35 | 35 | 21 |
| 1/4-20 | 40-50 | 25-30 | 50-68 | 75 | 45 |
| 5/16-18 | 80-90 | 48-55 | 90-144 | 160 | 100 |
| 3/8-16 | 160-185 | 95-110 | 185-248 | 275 | 170 |
| 7/16-14 | 235-255 | 140-155 | 255-428 | 475 | 280 |
| 1/2-13 | 400-480 | 240-290 | 480-792 | 880 | 520 |
| 9/16-12 | 500-700 | 300-420 | 700-990 | 1,100 | 650 |
| 5/8-11 | 700-900 | 420-540 | 900-1,350 | 1,500 | 900 |
| 3/4-10 | 1,150-1,600 | 700-950 | 1,600-2,250 | 2,500 | 1,500 |
| 7/8-9 | 2,200-3,000 | 1,300-1,800 | 3,000-4,140 | 4,600 | 2,700 |
| 1-8 | 3,700-5,000 | 2,200-3,000 | 5,000-6,840 | 7,600 | 4,500 |
| 1 1/8-8 | 5,500-6,500 | 3,300-4,000 | 6,500-10,800 | 12,000 | 7,200 |
| 1 1/4-8 | 6,500-8,000 | 4,000-5,000 | 8,000-14,000 | 16,000 | 10,000 |

TIGHTENING HOSE CLAMPS, TORQUE REQUIREMENT. Hose clamps installed on fuel, alcohol, and fluid injection system self-sealing hose, and on blast tubes, air ducts, vacuum lines, de-icer lines and drain vent lines shall be tightened to a torque value of 15 inch-pounds. Hose clamps on fuel cell interconnectors shall be torqued to between 20 and 30 inch-pounds, and shall not be rechecked after original torquing.

Hose clamps shall be rechecked a minimum of 12 hours after installation on self-sealing hose, or 8 hours after installation on other hose. Personnel responsible for tightening clamps shall, whenever possible, use torque wrenches to tighten clamps to the above-mentioned torques.

CAUTION: Do not loosen hose clamps to inspect them.

NOTE: Drop-tank-attachment hose clamps should be finger-tightened only.

SWAY BRACES. When wing tip fuel or chemical tanks are installed, tighten sway braces evenly from 90 to 100 pounds (fuel tanks must be filled). Shake tank and retorque braces.

| Size | Torque (Inch-pounds) | Torque (Foot-pounds) |
|---|---|---|
| ALUMINUM COUPLE NUTS | | |
| 7/16–20 | 40—65 | |
| 9/16–18 | 75—125 | |
| 3/4 –16 | 150—252 | |
| 7/8 –14 | 200—350 | |
| 1 1/16–12 | | 25—42 |
| STEEL COUPLE NUTS | | |
| 7/16–20 | 100—150 | |
| 9/16–18 | 205—275 | |
| 3/4 –16 | | 27—35 |
| ALUMINUM UNIVERSAL FITTINGS | | |
| 9/16–18 | 150—204 | |
| 3/4 –16 | | 23—30 |
| 1 1/16–12 | | 45—67 |
| 1 5/8 –12 | | 80—100 |

| Size | Torque (Inch-pounds) | Torque (Foot-pounds) |
|---|---|---|
| STEEL UNIVERSAL FITTING LOCK NUTS | | |
| 1 7/8 –12 | | 60—80 |
| ALUMINUM UNIONS | | |
| 1 1/16–12 | | 45—67 |

**Note**

Do not apply full torque at the first draw-down. Such a procedure may produce uneven tension and overstressing of parts with resultant warped or distorted split line surfaces. Tighten unit in staggered sequence until parts are firmly seated at the split line, then tighten finally in a series of gradually increased torque applications until required tension is obtained.

***Table of Engine Fuel and Oil Lines Torque Limits***

| Unit | Torque (Inch-pounds) | Torque (Foot-pounds) |
|---|---|---|
| Scavenge tube oil filter assembly | | 30—45 |
| 3/4-in. brass plug in accessory drive gear casing | | 35—60 * |
| 1/2-in. brass plug in accessory drive gear casing | | 30—45 * |
| 5/8-18 x 2 5/8 bolts retaining trunnion support to compressor casing | | 80—100* |
| Straight thread plugs in diffuser assembly | | 18—30 * |
| Fuel nozzle in air adapter | | 80—90 * |
| Spark plug mounting nuts | 70—85 | |
| Filter plug in air adapter | | 60—80 * |
| 1/4-20 bolt, fastening liner and clip assembly in ring assembly | 45—60 * | |
| Hex-head bolts retaining air baffle sectors to ring and tube assembly | 35—45 | |
| Front trunnion support bolts | | 80—100* |
| 3/8-16 bolts and nuts fastening exhaust unit to turbine unit | 225—265* | |
| 5/16-24 bolts retaining ball support to accessories gear case | 160—200 | |
| 5/16-24 nuts retaining tachometer generator adapter to accessories drive casing | 100—140 | |
| 3/8-24 nuts retaining generator and starter to accessories drive gear casing | 275—375 | |
| 1/4-28 bolts retaining tachometer generator to adapter | 80—100 | |
| 5/16-24 bolts retaining oil pump to accessories drive gear casing | 150—180 | |
| Tube nut on fuel filter stack assembly | | 35—45 |
| Fuel filter element assembly in filter head | 100—110 | |
| Fuel filter sump on head | | 35—40 |
| 5/16-24 oil filter cover nut | 70—80 | |
| 5/16-24 tail pipe adapter to exhaust cone attaching bolts (stainless steel) | 50—100* | |
| 1/4-28 air adapter to compressor casing bolts | 50—60, then 75—85 | |
| Spindle Trunnion | 500—600 | |

* Use MIL-C-5544 thread lubricant

***Table of Engine Structural Torque Limits***

# FUELS AND LUBRICANTS

| *Specification* | *Type* | *Use* |
|---|---|---|
| AN-F-32 | JP-1, Kerosene | Fuel |
| AN-G-25 | Grease, Low Temperature Lubricating (Low Volatility Type) | Anti-friction bearings, activators, and working joints of doors where low temperature is expected and high torque is not applicable. |
| AN-G-10 | Grease, Extreme Pressure, Low Temperature, Lubricating | Sprockets and chains, screw jacks, etc. |
| AN-G-15 | Grease, General Purpose, Aircraft Lubrication | Wheel bearings and support members |
| AN-G-5 | Grease, High Temperature, Water Resistant | Wheel bearings |
| AN-O-3 | Oil, Low Temperature Lubricating, Gear | Emergency fuel pump |
| AN-O-6 | Oil, Lubricating, Low Temperature | General squirt-can lubrication |
| AN-O-366 | Oil, Hydraulic Fluid, Mineral, Low Temperature | Main gear up lock |
| 2-36 | Oil, Recoil, Medium and Light | Machine gun buffers |
| 2-120 (AXS-777) | Oil, Lubricating, Preservative, Special | Machine Guns |
| AN-G-24 | Graphite, Lubricating | Graphite lubrication for sliding surfaces and general "residual" type lubrication |
| AF3607 | Grease, Lubricating Graphite | Pressure seals of controls |
| AN-C-52, Types I & II | Corrosion Preventive Exterior Surface | Cable coating as corrosion preventive |
| AN-VV-C-576 | Corrosion Preventive Compound (Concentrate) | Interior rust preventive |
| AN-C-116 | Aircraft Compass Liquid | Compass |
| AN-O-9 | Oil, Low Temperature Lubricating, Grade 1010 | Jet engines, turbine and cooler |
| AN-G-14 | Grease, Gasoline and Oil Resistant | Gasket lubrication |
| AN-C-53 | Anti-sieze, Threaded Fitting | |
| AN-C-86 | Anti-sieze, Oxygen System | |
| AN-F-13 | Anti-icing | |
| AN-C-147 | Anti-sieze Compound, Graphite Petrolatum | |
| AN-F-28 | Grade 100/130 Gasoline | Fuel, low-temperature starting |
| AN-A-18 | Alcohol | De-icing and fluid injection |
| AN-A-24 | Alcohol | Fluid injection |
| AN-VV-K-211 | Kerosene Solvent | Paper-element filters |
| PS661 | Solvent | General cleaning |
| AN-TT-T-256 | Lacquer Thinner | Paper-element filters |

# SECTION X

SERVICE INSPECTION (DELETED). REFER TO T. O. NO. 00-20A-2-F-80.

PAGES 433 THROUGH 442 DELETED.

ALL REFERENCES TO PAGES 433 THROUGH 442 IN ALPHABETICAL INDEX SHOULD BE DISREGARDED.

# ALPHABETICAL INDEX

* Denotes Illustration

PAGE 448 DELETED