Flight MANUAL

Mustang P-51A

NORTH AMERICAN AVIATION, INC.
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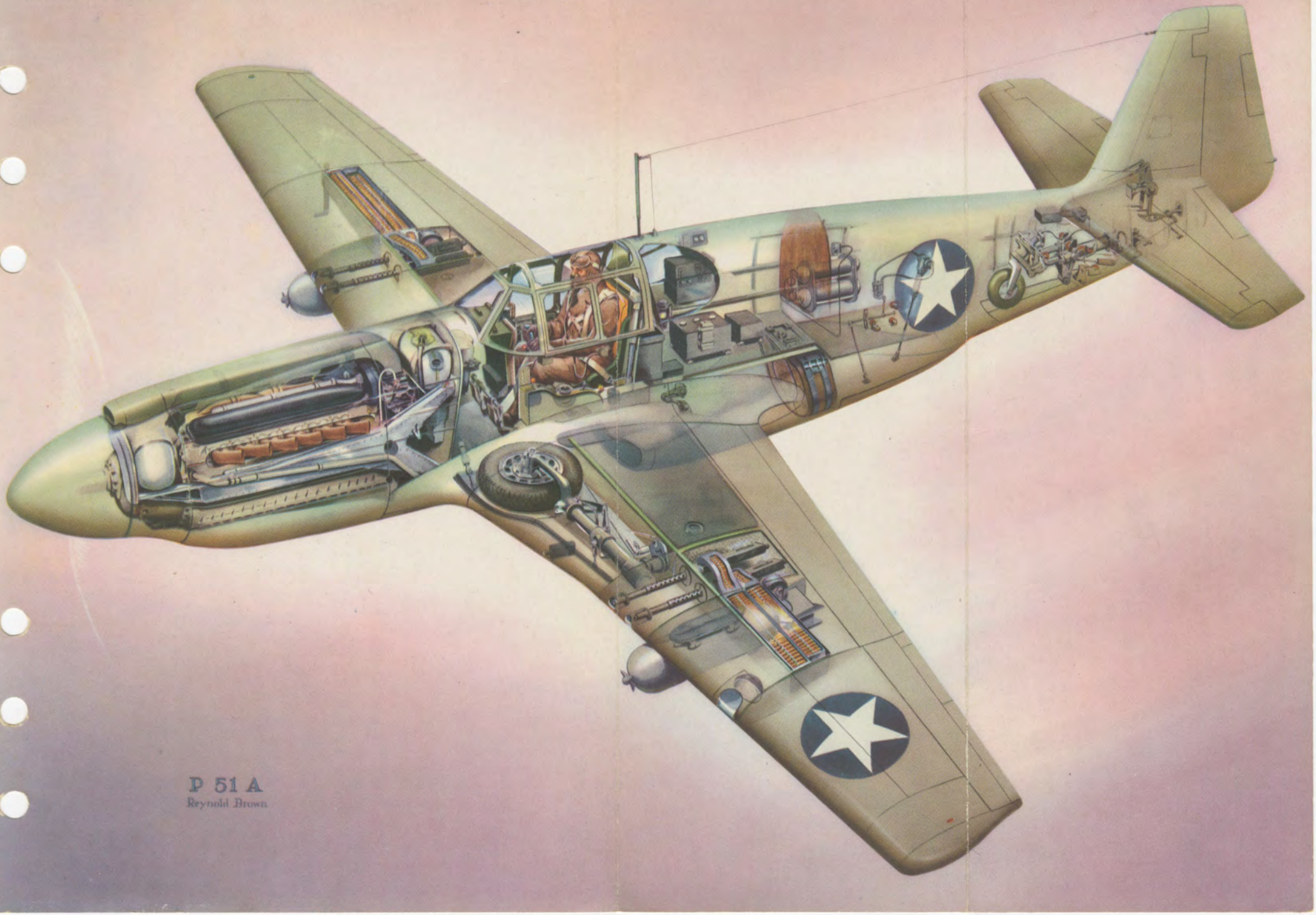

P 51 A

Reynold Brown

Introduction

This Manual has been prepared as an aid to flight and ground personnel who operate P-51A Airplanes. We have made every effort to present this material in the clearest and most convenient manner possible. It is hoped that all personnel—regardless of past experience—will read the entire Manual thoroughly.

The Manual consists of eight sections, of which the first four fall into a group containing a general description of the airplane, complete instructions regarding the sequence of operations to be followed in flying the airplane, operation of special equipment (including guns, bombs, and radio), and all charts to be used in normal flight. The last portion of the book comprises Special Ferrying Instructions, including charts designed for long-range flying; this information was compiled for use with P-51A Airplanes equipped with ferrying fuel tanks.

From the contents page, any desired section may be readily selected by opening the book at the tabbed separator corresponding to the section title. On the back of each separator will be found a detailed list of the section contents. An index has been included at the back of the book to provide an alphabetical listing of the contents. A short glossary of American-British terms is also provided.

Figures in U. S. gallons are followed by their equivalents in Imperial gallons, and all temperatures quoted in degrees centigrade are followed by Fahrenheit equivalents. For converting additional units of measurement into their equivalents in the metric system,

Continued on Next Page

or U. S. statute miles into knots, a table of unit conversion factors will be found on the last page of the index.

The following handbooks are also provided with each airplane:

Operation and Flight Instructions..T.O. 01-60JC-1
Service Instructions .....T.O. 01-60JC-2
Structural Repair Instructions.....T.O. 01-60JC-3
Parts Catalog .....T.O. 01-60JC-4
Cold Weather Instructions .....T.O. 01-60JC-5

Your cooperation in reporting all problems concerning operation and maintenance of our airplanes is solicited. In addition to reports submitted through the regular channels, reports may also be submitted to any North American Aviation Field Service Representative who may be in your territory, or they may be sent directly to the Field Service Department at Inglewood, California. Such reports are an important factor in rendering prompt and efficient service, and in improving the design of our airplanes.

NORTH AMERICAN AVIATION, Inc.
Field Service Department

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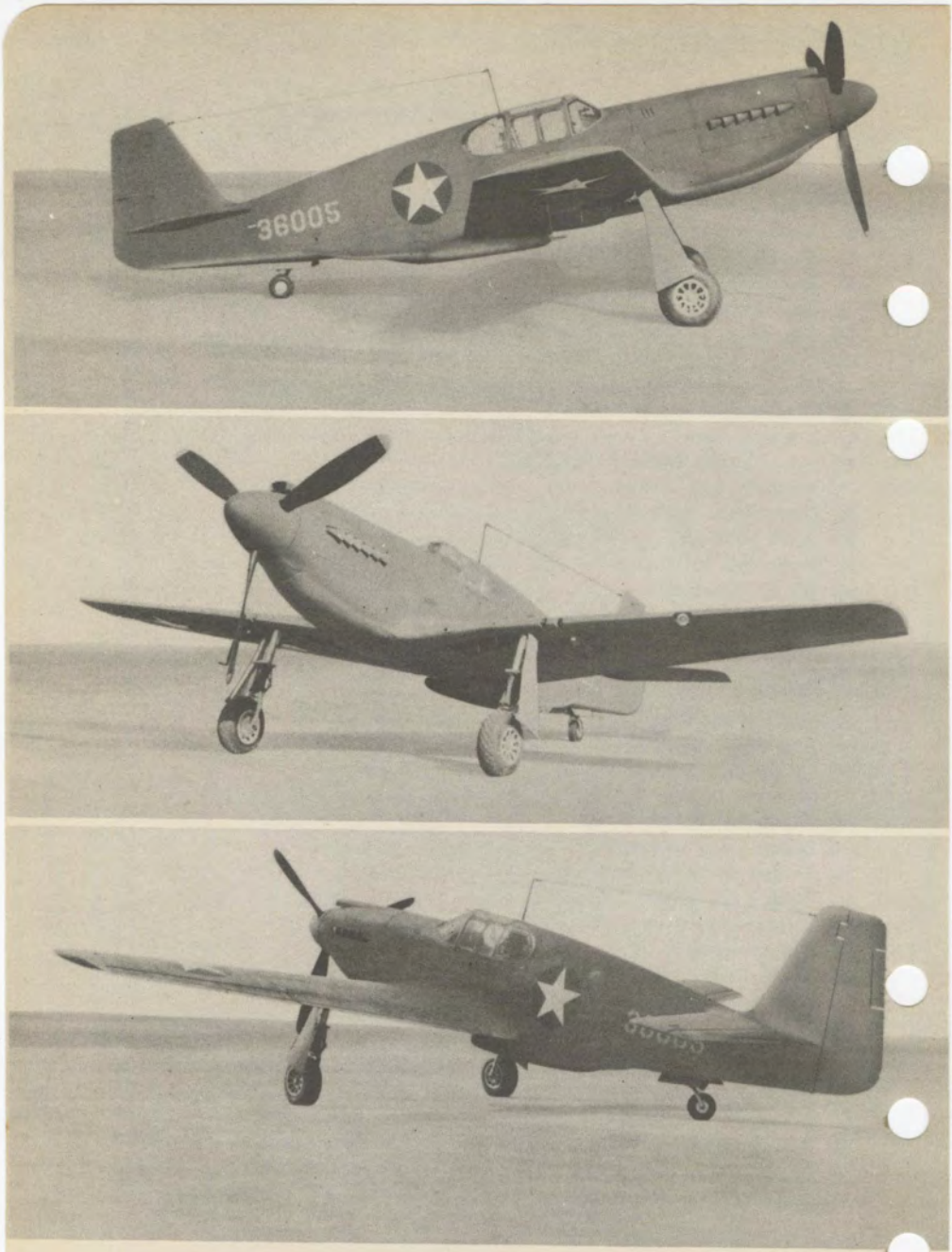


Fig. 2 THREE VIEWS OF AIRPLANE

Section 1

"There's one bird that ain't grounded."

Contents

SECTION 1

Description

GENERAL

The Model P-51A Series Airplane, contract AC30479, is a single-place, low-wing fighter airplane. A 12-cylinder, liquid-cooled engine drives an electric constant-speed, three-blade propeller which operates at half engine crankshaft speed. The airplane has a wing span of 37 feet 5/16 inch and an over-all length of 32 feet 2 3/16 inches. The over-all height, with the tail down, is 12 feet 8 inches. Armament consists of four .50-caliber machine guns mounted in the wings. A streamline bomb rack is installed under each wing. Each rack will accommodate one 100, 250, 300, or 500-pound bomb and is readily removable.

BLOCK NUMBERING SYSTEM

Because of changes made in the P-51A Airplane both in production and out in the field, a block numbering system has been

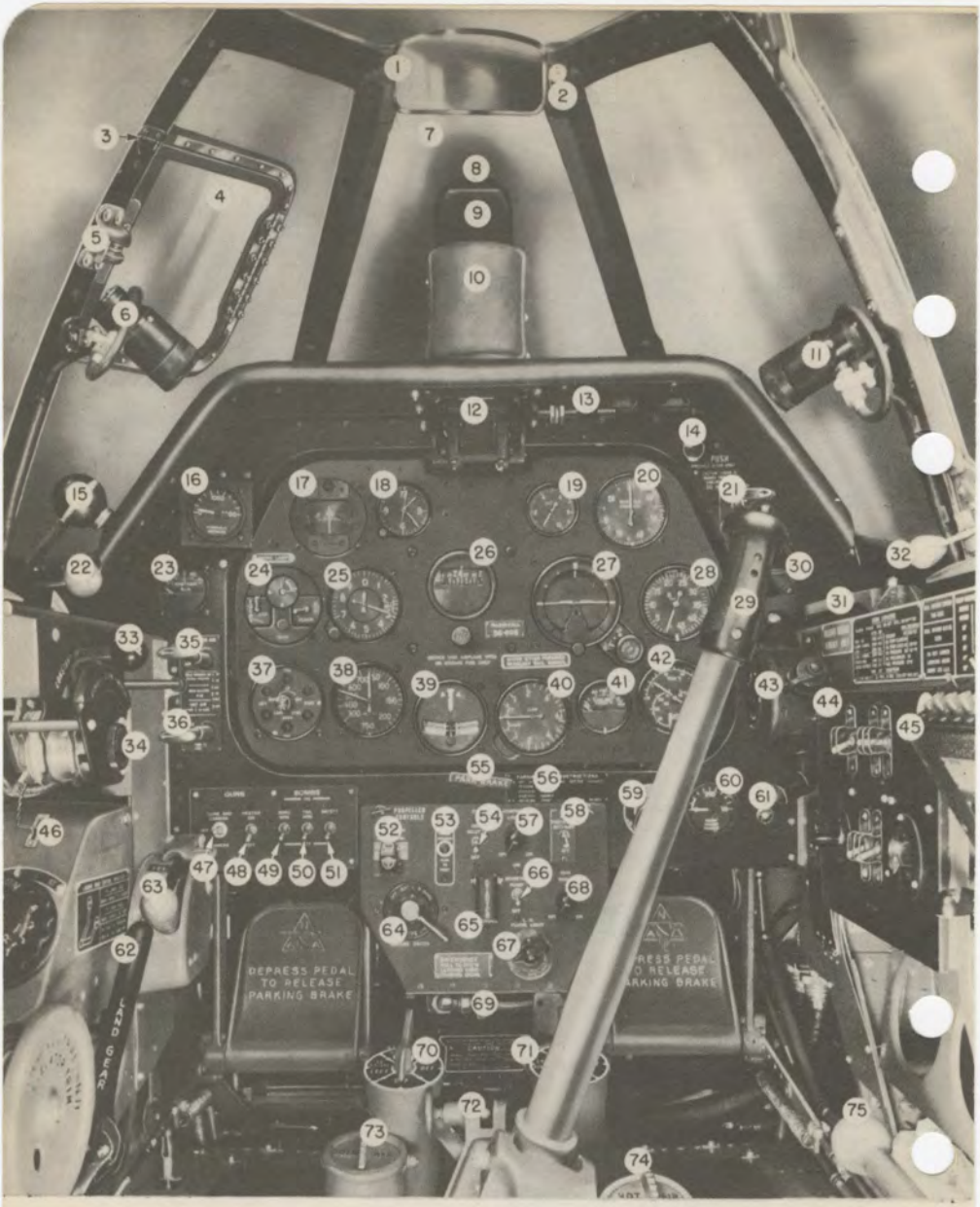


Fig. 3 COCKPIT — FRONT VIEW

NOMENCLATURE

(Figure 3)

1. Mirror
2. Ring Sight Socket
3. Enclosure Handle Safety Lock
4. Clear-vision Panel
5. Clear-vision Panel Lock
6. Cockpit Fluorescent Light
7. Armor Plate Glass
8. Sunscreen
9. Gun Sight Reflector
10. Crash Pad
11. Cockpit Fluorescent Light
12. Optical Gun Sight
13. Ring-and-Bead Gun Sight Stowed
14. Windshield De-icer Control
15. Throttle
16. Hydraulic Pressure Gage
17. Compass
18. Clock
19. Suction Gage
20. Manifold Pressure Gage
21. Carburetor Filter Control
22. Mixture Control
23. Carburetor Temperature Gage
24. Remote Contactor
25. Altimeter
26. Directional Gyro
27. Flight Indicator
28. Tachometer
29. Control Stick Grip
30. Oxygen Flow Blinker
31. Emergency Enclosure Release
32. Sliding Window Lock
33. Propeller Control
34. Quadrant Friction Control
35. Carburetor Air Control
36. Carburetor Heat Control
37. Landing Gear Indicator
38. Airspeed Indicator
39. Bank-and-Turn Indicator
40. Rate-of-Climb Indicator
41. Coolant Temperature Gage
42. Oil Temperature and Fuel and Oil Gage
43. Oxygen Regulator
44. Right-hand Switch Panel
45. SCR-522 Controls
46. Throttle Break-through Seal
47. Gun Camera Safety Switch
48. Gun Heater Switch
49. Bomb Nose Arming Switch
50. Bomb Tail Arming Switch
51. Bomb Safety Switch
52. Propeller Selector Switch
53. Propeller Circuit-breaker Switch
54. Oil Dilution Switch
55. Parking Brake Handle
56. Parking Brake Instructions
57. Compass Light Rheostat
58. Propeller Anti-icer Switch
59. Engine Primer
60. Oxygen Pressure Gage
61. Oxygen System Warning Light
62. Landing Gear Control Handle
63. Bomb Release Control Handle
64. Ignition Switch
65. Starter Switch
66. Booster Pump Switch
67. Left-hand Fluorescent Light Control
68. Gun Sight Rheostat Control
69. Fairing Door Emergency Release
70. Main Fuel System Selector Valve
71. Auxiliary Fuel System Selector Valve
72. Surface Control Lock
73. Cockpit Cold Air Valve
74. Cockpit Hot Air Valve
75. Hydraulic Hand-pump

NOMENCLATURE

(Figures 4 and 5)

15. Throttle
22. Mixture Control
31. Emergency Enclosure Release
32. Sliding Window Lock
33. Propeller Control
34. Quadrant Friction Control
35. Carburetor Air Control
36. Carburetor Heat Control
43. Oxygen Regulator
44. Right-hand Switch Panel
45. SCR-522 Controls
46. Throttle Break-through Seal
59. Engine Primer
62. Landing Gear Control Handle
63. Bomb Release Control Handle
71. Auxiliary Fuel System Selector Valve
74. Cockpit Hot Air Valve
75. Hydraulic Hand-pump
76. Engine Limitations Plate
77. Airplane Restriction Plate
78. Pitot Heater Switch
79. Wing Position Lights Switch
80. Tail Position Light Switch
81. Right-hand Fluorescent Light Control
82. Landing Light Switch
83. Generator-disconnect Switch
84. Ammeter
85. Cockpit Light
86. SCR-535 Radio Control Box
87. Map Case
88. Detonator Switch
89. Right Fuel Tank Gage
90. Sliding Window Handle
91. Microphone Press-to-Talk Switch
92. Compass Correction Card
93. Signal Pistol Holder
94. Cockpit Light
95. Fuel System Diagram
96. Break-through Seal Instructions
97. Bomb Rigging Instructions
98. Flap Control Handle
99. Scoop Control Handle
100. Rudder Trim Tab Control
101. Aileron Trim Tab Control
102. Landing Gear Control Instructions
103. Elevator Trim Tab Control
104. Left Fuel Tank Gage

adopted so that personnel can readily identify equipment carried in a certain airplane by referring to the dash number following the model designation.

P-51A-1 Airplanes, the first 155 built, are equipped with a carburetor air scoop which provides direct ram air to the carburetor.

P-51A-5 Airplanes are equipped with a retractable filter in the carburetor air scoop, a landing gear warning light, and provisions for a chemical tank installation.

P-51A-2 and P-51A-10 Airplanes incorporate all the features of P-51A-5 Airplanes plus a carburetor heating duct. (P-51A-2 Airplanes are those which have been reworked in the field; P-51A-10 Airplanes are those which left the factory with equipment installed.)

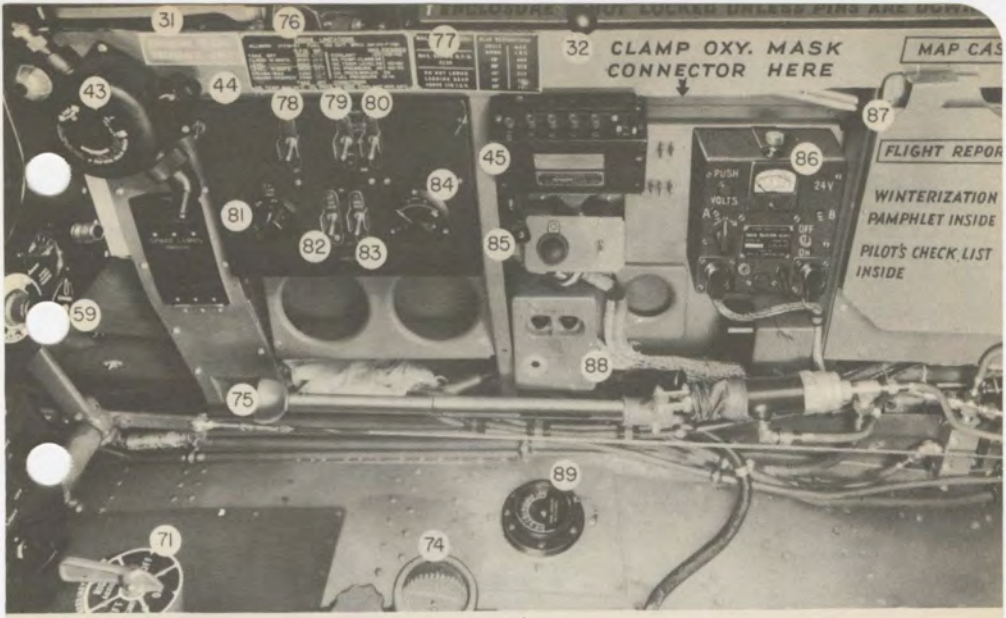


Fig. 4 COCKPIT — RIGHT SIDE

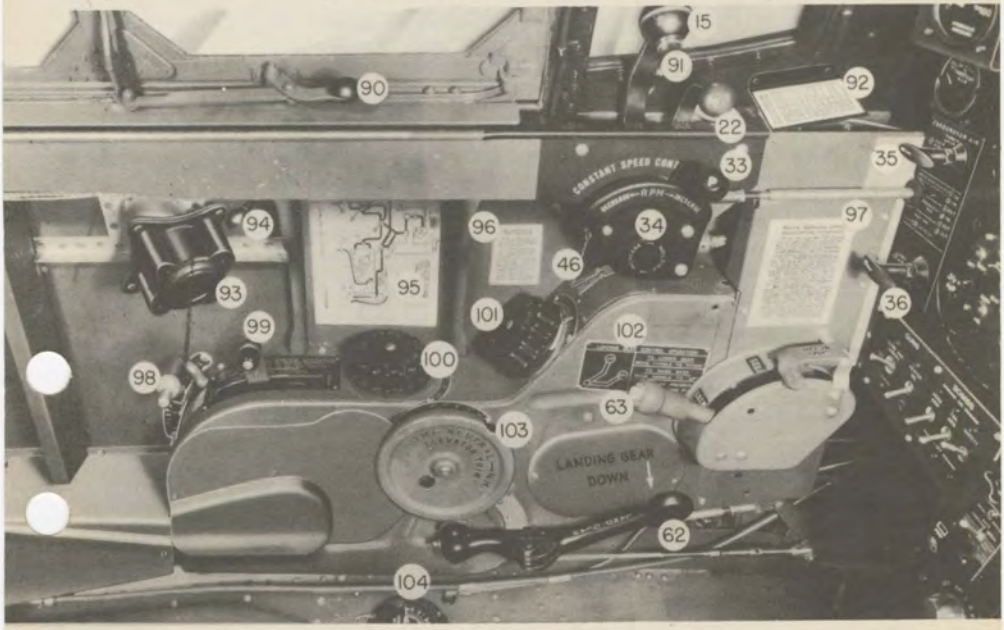


Fig. 5 COCKPIT — LEFT SIDE

WING

The wing is a semimonocoque, full-cantilever structure consisting of two sections bolted together. The airfoils are of the low-drag, laminar-flow type, and the upper and lower surfaces to the 40% chord line have been painted with a surfacer to assure smoothness of the airfoil sections. Both ailerons are metal covered and are statically and dynamically balanced by means of two lead weights attached to the forward edge of each aileron. The right aileron is equipped with a booster tab; the left aileron includes a combination booster and trim tab controllable from the cockpit. Hydraulically operated, sealed-type wing flaps extend from the ailerons to the fuselage.

EMPENNAGE

The empennage consists of a horizontal stabilizer, vertical stabilizer, elevators, and rudder. The elevators and rudder are fabric covered and are equipped with trim tabs controllable from the cockpit. Lead weights are attached to the leading edges to balance statically and dynamically the elevators and rudder.

SURFACE CONTROLS

The ailerons, elevators, and rudder are conventionally operated by a control stick and rudder pedals. The ailerons are actuated by side movement of the control stick and have an angular movement of 10° up and 10°down. The elevators are controlled by fore and aft movement of the control stick and have an angular movement of 30° up and 20° down. The rudder is controlled by pedals and has an angular movement of 30° to either the left or right. The wing flaps are hydraulically controlled and have an angular movement of 50° down. They can be preselected for any position within the angular range by the control handle on the aft end of the control pedestal. Trim tab controls for the left aileron, the rudder, and the elevator are located on the control pedestal on the left side of the cockpit. A pointer integral with each control wheel mechanism indicates the trim position in degrees. The rudder pedals are adjustable for leg length by means of a lever at the inboard side of each pedal.

Surface Control Lock

A locking gear for the surface controls and the tail gear is located forward of the base of the control column. By depressing a safety

catch, the locking gear may be pulled backward to engage with one of the two holes in the lip protruding from the control stick socket. When the locking gear is engaged in the lower hole, the ailerons, rudder, and the elevator are locked, and the tail wheel is locked in line with the fuselage. When the locking gear is engaged in the upper hole, the ailerons, rudder, and elevator are locked, but the tail wheel can swivel 360°. This latter locking position is used when the airplane is to be towed on the ground.

FUSELAGE

The fuselage is a semimonocoque, aluminum alloy structure divided into three sections: engine mount, main fuselage, and aft section. The engine mount is comprised of two box-beam structures, each mounted at two points of attachment to the firewall and extending forward on its respective side of the engine. This mount structure serves as the sole support for all parts of the airplane forward of the firewall. The main fuselage is of the four-longeron type incorporating an A-shaped overturn structure aft of the pilot's seat. Armor plate is provided behind the pilot's seat and as part of the firewall. The aft section of the fuselage is constructed to afford effective resistance against side and torsional shear.

Cockpit Enclosure

The cockpit is covered with a flush-type transparent hood consisting of an upper and two side panels. Both side panels have two sections, the forward section constructed as a sliding window controllable from within the cockpit only and secured by a locking handle. The hood may be opened or locked shut from either inside or outside the airplane. The top panel hinges upward, and the left side panel hinges downward against the side of the fuselage. In an emergency, the entire hood may be released from the airplane. This is accomplished by pulling the emergency release handle which automatically detaches the hinges holding the side panels to the fuselage and shoves the hood upward so that it will be carried overboard by the slip stream. Two red warning indicator pins in the right-hand sliding window track will protrude upward into the track if the cockpit hood is not properly secured in place.

WARNING: **Check the enclosure warning pins before take-off in order to prevent the cockpit enclosure releasing in flight.**

Windshield

The forward windshield panel is armor plate glass. A hinged clear-vision panel in the left panel of the windshield can be opened to afford the pilot better vision while flying in rain, sleet, or snow. A negative area at this point prevents the elements from entering the cockpit when the clear-vision panel is opened.

Rear Windows

The two windows located aft of the cockpit may easily be removed for access to the radio equipment. The windows are held in place by a spring at the aft end and by two latches at the forward end. These latches can be released from the inside only.

LANDING GEAR

The landing gear consists of two main gear and an auxiliary tail gear. All three units are fully retractable hydraulically, and are controlled simultaneously by a handle on the control pedestal on the left side of the cockpit.

When the landing gear is retracted, the main gear is completely enclosed in the wings, and the auxiliary tail gear is completely enclosed in the fuselage. The tail wheel is steerable and full-swiveling. A safety mechanism prevents the landing gear from being retracted when the weight of the airplane is supported by the gear. The wheels

Fig. 6 CLEAR-VISION PANEL

of the main oleo struts are fitted with disc-type hydraulic brakes. The tail wheel may be locked by pulling the control stick back of neutral. In the locked position, the tail wheel is steerable 6° to the right or left through use of the rudder pedals. The tail wheel may be unlocked for full-swiveling action by pushing the stick forward of neutral.

A single landing gear electrical position indicator, located on the lower left corner of the instrument panel, indicates the down and locked or up and unlocked condition of all landing gears. If one gear is not down and locked, the indicator lamp for that gear will show the gear in the **up** position. The red lights indicate that the gears are in the **up** position, the green lights that the gears are in the **down** position and locked. A **push-test** button in the center of the instrument enables the pilot to determine quickly whether the position indicator lights are functioning properly. The indicator is provided with a dimmer mask to vary the brilliancy of the lights. The P-51A-2, -5, and -10 Airplanes are further equipped with a landing gear warning signal light consisting of a red jeweled light mounted to the left of the optical gun sight. Whenever the landing gear is not locked in the down position and the engine is turning over at approximately 1700 RPM or less, this light will flash on to warn of an unsafe landing condition. As soon as the gear is in a properly locked position for landing, the light will go out.

BRAKE SYSTEM

The main landing wheel brake system employs hydraulically actuated disc-type brakes. Each brake is operated by individual master brake cylinders located directly forward of the instrument panel. The brakes are selectively controlled by means of toe pedals incorporated into the rudder pedal assembly.

The brake system is entirely separate from the general hydraulic system; however, the brake master cylinders receive hydraulic fluid directly from the reservoir of the hydraulic system. A standpipe arrangement in the reservoir ensures a reserve of fluid for brake operation even though the supply of fluid for normal hydraulic operation has been lost.

A parking brake, controlled by the parking brake control handle just below the center of the instrument panel, is incorporated into the brake system to hold the wheels in a locked condition over long periods of time.

A thermal relief valve between the brake master cylinders compensates for fluid expansion or contraction as the result of temperature changes.

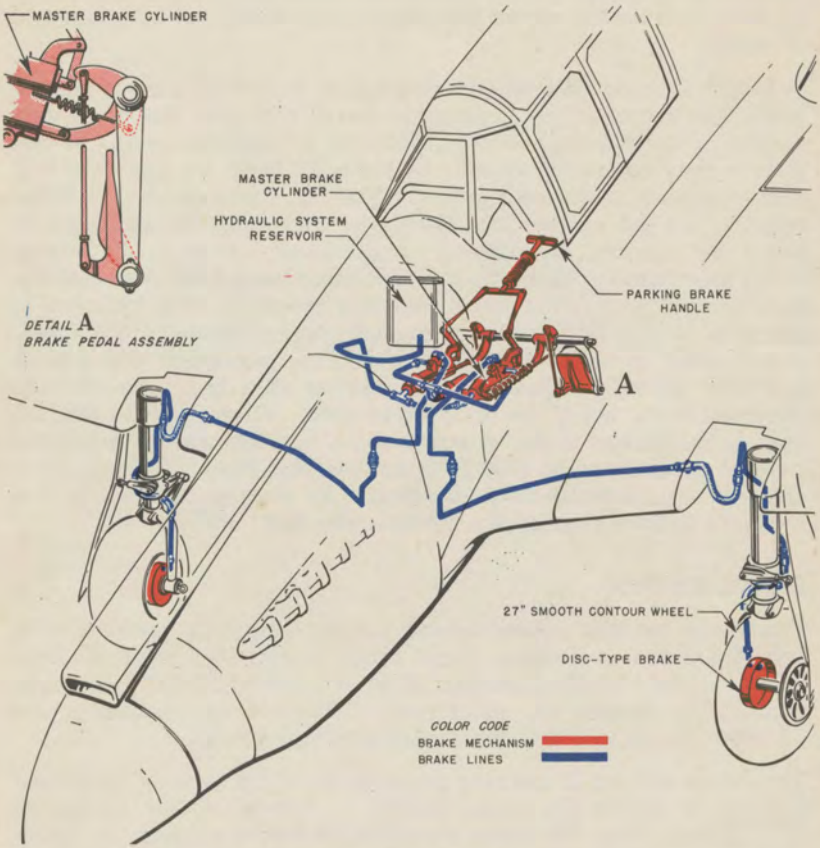


Fig. 7 BRAKE SYSTEM

HYDRAULIC SYSTEM

General

A single high-pressure (1000 lbs./sq. in.) hydraulic system provides for the simultaneous operation of the main gear and tail gear,

and the selective operation of the wing flaps and radiator air scoop. An entirely separate brake system is supplied with oil from a standpipe arrangement in the hydraulic system reservoir, and is available for brake operation even if the entire oil supply for the hydraulic system is lost. In the event of hydraulic pressure failure, a hand-pump, at the right of the pilot's seat, may be used to operate the flaps and radiator air scoop. Emergency lowering of the landing gear is identical to normal operation; however, the gear will not fall all the way by gravity. Rocking the airplane will force the gear to the down-locked position.

Note: The hand-pump cannot be used to bring the gear down.

The following tabulation gives the operating speeds of the various systems during normal flight:

Landing Gear	Down	10-15 seconds
	Up	12-15 seconds
Wing Flaps	Down	11-15 seconds
	Up	11-15 seconds
Radiator Air Scoop	Open	11-15 seconds
	Close	11-15 seconds

The hydraulic system is designed to use fluid conforming to Spec. AN-VV-O-366A (red color) and to operate at temperatures down to —40°C (—40°F). Hydraulic lines are all provided with the color identification band: blue — yellow — blue.

Power System

The engine-driven pump sucks oil from the reservoir and discharges it to the system. The pump is coupled directly to an engine drive shaft and operates automatically as long as the engine is running. The pump output is governed by the engine RPM, and consequently is greatest during take-off when it is desirable to retract the landing gear swiftly and immediately thereafter raise the flaps and set the radiator air scoop. The system pressure of 1000 lbs./sq. in. is automatically regulated by the accumulator (preloaded with 400 lbs./sq. in. buffer air) and the engine pump unloading valve. Hydraulic system pressure is registered by the gage on the upper left instrument subpanel. A shut-off valve, located immediately below and behind the hand-pump, prevents

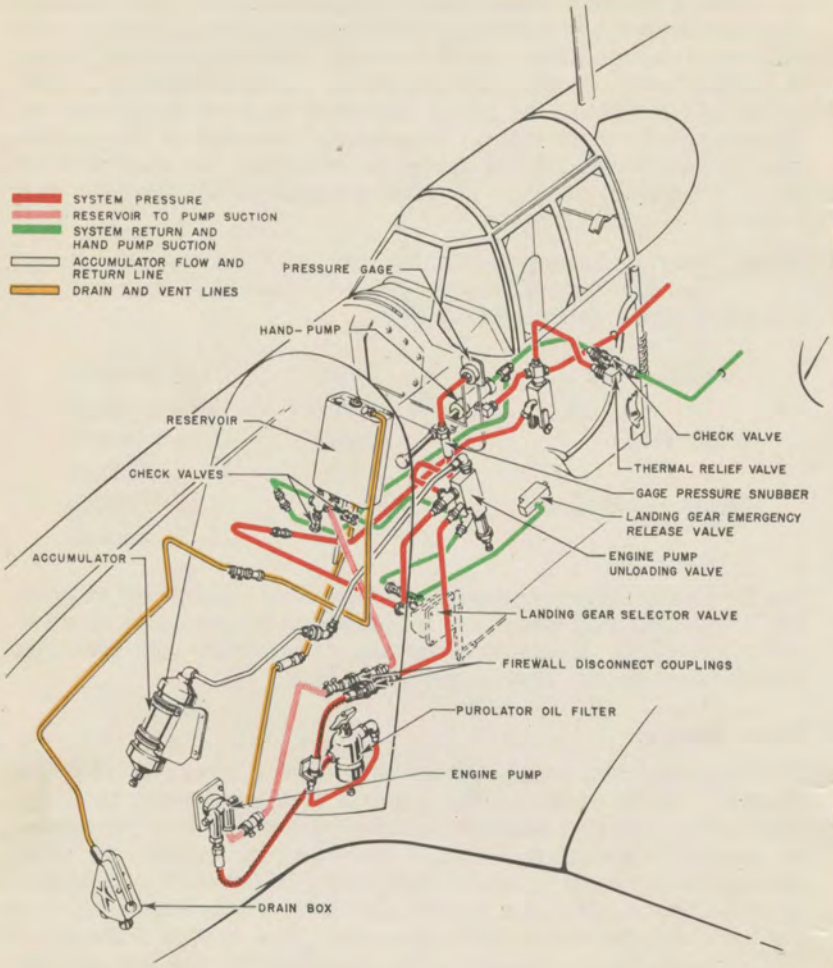


Fig. 8 HYDRAULICS — POWER SYSTEM

fluid draining from the wing flap and radiator air scoop systems to the landing gear system in the event of failure of the landing gear or power systems.

Note: It is important that the shut-off valve lever be released at all times to separate the systems. The valve should never be touched when the airplane is in flight.

Landing Gear System

The main landing gear and tail gear are operated concurrently by the same setting of the landing gear selector valve. As the tail gear places very little load on the system, it will pop in or out (as the case may be) almost instantaneously when the landing gear control handle is repositioned, mechanically closing or opening its fairing doors as it does so. When the main gear is being extended, the normal cycle of operations is this: Fairing doors open and gear extends; fairing doors close. While the gear is extending, the control lever is automatically locked until the doors are closed and the operation is completed; however, this is not the case when the gear is being retracted. Therefore, a normal extension is assured if it is desired to lower the gear immediately after they have started to retract, as might be the case during take-off.

Emergency lowering of the gear is identical to normal operation. Push the control handle to gear **down;** when the gear has fallen as far as it will by gravity, rock the airplane until the green lights on the electrical indicator go on. If the fairing doors should fail to open, as a last resort pull the control valve lever beneath the pilot's switch panel to the forward notch. This will release the landing gear system pressure. Be sure to release the handle as soon as the gear is safely down and locked. If the tail wheel does not lock, increase the airplane's speed to increase the air load on the partially extended wheel.

Wing Flap System

The wing flap system is characterized by a preselective follow-up arrangement which interconnects with the pilot's control handle in such a manner that the flaps automatically go to a position relative to that selected by the pilot, and remain there until another setting is preselected. To operate the wing flaps with the hand-pump, first preselect the desired position and then pump until sudden resistance is met.

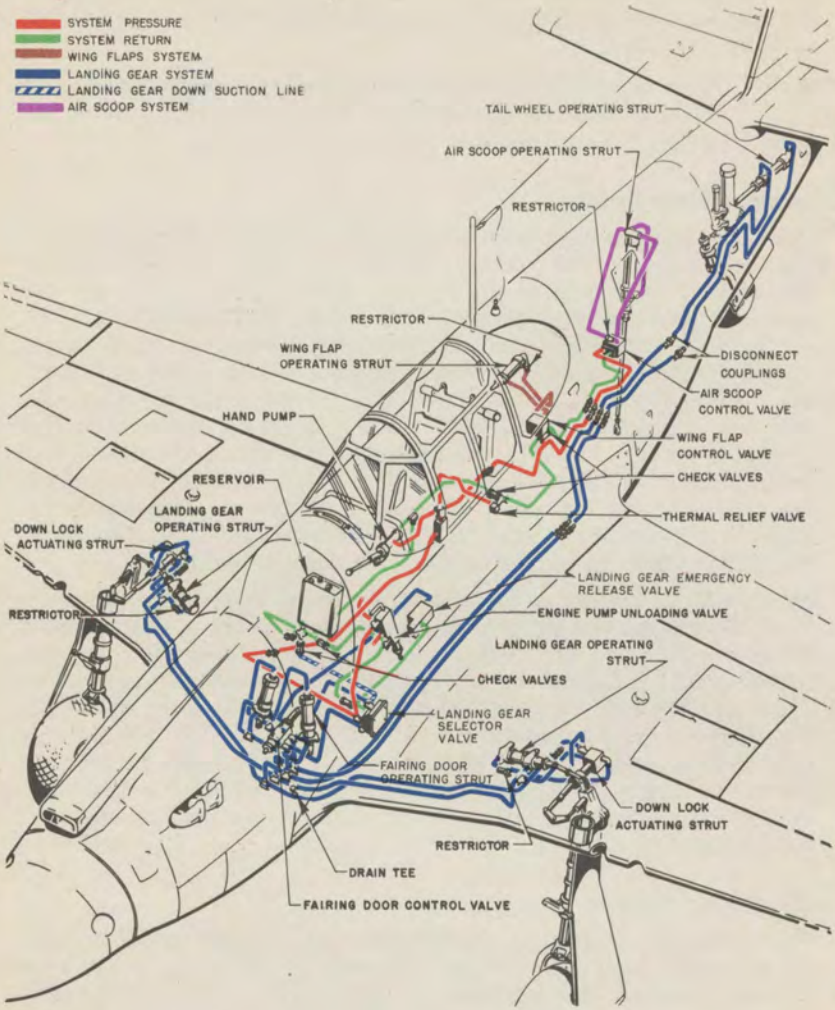


Fig. 9 HYDRAULICS
LANDING GEAR, WING FLAPS, AND AIR SCOOP

Radiator Air Scoop System

The radiator air scoop system also incorporates a preselective follow-up arrangement consisting of linkage and operating cables connected to the control handle on the pilot's pedestal. Six air scoop settings may be preselectively chosen by movement of the pilot's handle to the corresponding notch of the quadrant. The scoop will remain in that position until another setting is preselected.

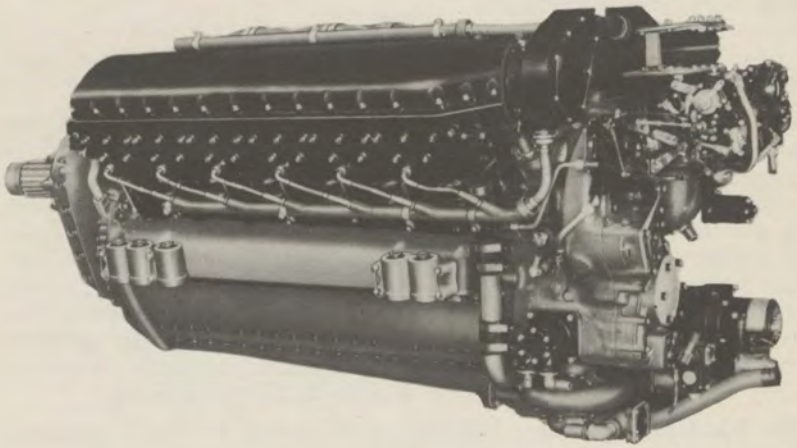


Fig. 10 ALLISON V-1710-81 ENGINE

POWER PLANT

General

The power plant is an Allison V-1710-81 engine equipped with an injection-type carburetor fitted with a double diaphragm acceleration pump, and an automatic manifold pressure regulator. The engine rating at sea level take-off is 1200 BHP at 3000 RPM with 52 in. Hg manifold pressure for 5 minutes of operation only. The normal rating at 14,000 feet is 1000 BHP at 2600 RPM with 38.3 in. Hg manifold pressure.

Carburetion

The fuel injection carburetor is designed to afford the pilot these advantages:
No ice formation from the vaporization of fuel in the carburetor throttle body.
Complete maneuverability. Gravity and inertia effects are negligible.
Accurate metering at all engine speeds and loads, independent of changes in altitude, propeller pitch, or throttle position. Metering is completely automatic.
Pressure atomization of the fuel, resulting in increased economy, flexibility, and smoothness.
Protection against fuel boiling and vapor lock.

Carburetor Air

Air is supplied to the carburetor through the scoop located in the top cowling. An elbow duct containing hot and cold air doors is mounted aft of the scoop directly above the carburetor intake. If icing conditions are prevalent, the pilot may close the cold air door to shut off the stream of cold air flowing through the scoop. When this door is closed, the hot air door opens simultaneously, allowing heated air from the engine compartment to enter the elbow duct. If the air scoop is closed because of icing conditions, the hot air door opens automatically as the result of suction existing in the carburetor intake. The pilot may then manually close the cold air door to open the hot air door to its fullest capacity.

On P-51A-1 Airplanes a lightweight air scoop furnishes rammed, unfiltered air to the carburetor. This scoop is interchangeable with the retractable filter scoop.

P-51A-2, -5, and -10 Airplanes are equipped with a retractable filter permanently installed in the air scoop duct. When the filter is placed in operation, a door at the top of the duct opens and shuts off the ram air, and nonram air is admitted through an aperture in the top of the duct. When the filter is retracted, ram air flows through the duct unimpeded by any baffle or screen. The filter is controlled by rods and bellcranks which are attached to a flexible push-pull control in the cockpit.

On P-51A-2 and -10 Airplanes a carburetor heating duct provides for the elimination of any ice which may have formed in the carburetor intake. This duct extends from the carburetor air scoop

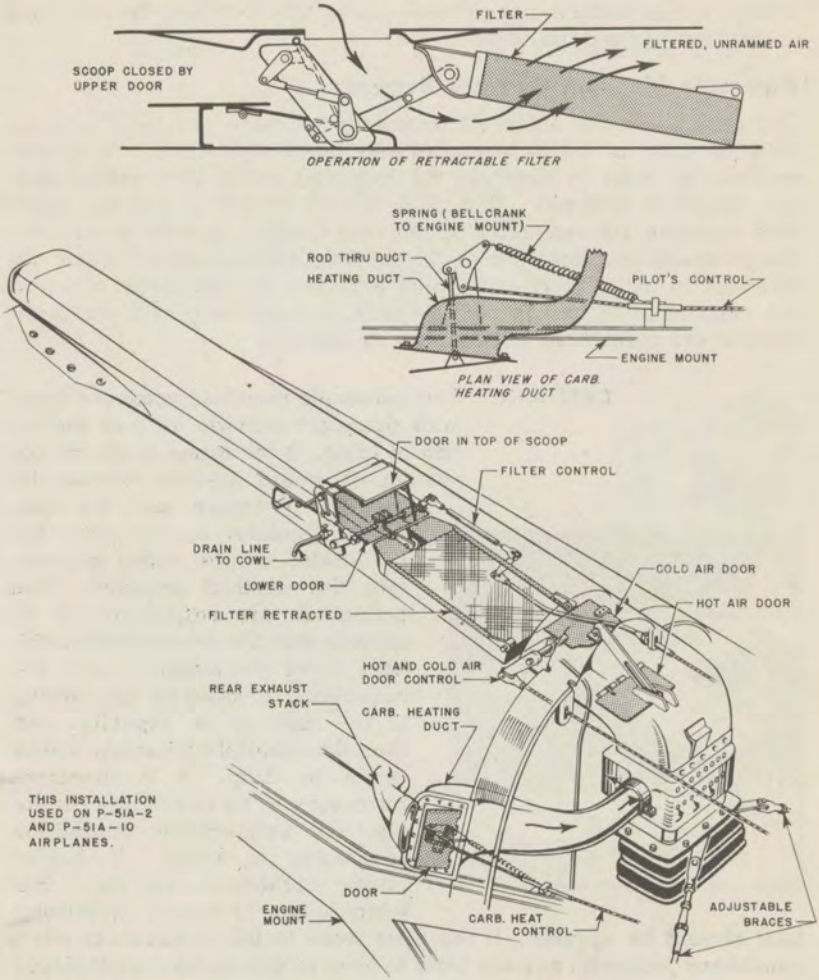


Fig. 11 CARBURETOR AIR SCOOP

elbow to a spring-loaded door directly behind the aft left-hand exhaust stack. When the door is opened by means of the push-pull control in the cockpit, hot exhaust gas is admitted into the duct and is directed to the carburetor intake.

Automatic Manifold Pressure Regulator

The purpose of the automatic manifold pressure regulator is to relieve the pilot of the necessity of making cockpit throttle lever corrections in order to maintain the required manifold pressure during ascent or descent. The pilot simply selects a desired manifold pressure by manually setting the cockpit throttle lever, and the pressure regulator then automatically compensates for the differences in air density at various altitudes by gradually opening the carburetor throttle as the altitude is increased, and smoothly closing the carburetor throttle during descent.

CAUTION: **The automatic manifold pressure regulator does not provide for any indication of icing. If ice forms in the intake system, it would tend to reduce the manifold pressure, and the automatic regulator would open the carburetor throttle wider to maintain the desired pressure. The action of this regulator is so smooth that the pilot would probably have no warning until the regulator had opened the throttle to the limit of its capacity, and then the manifold pressure would begin to drop. It is therefore necessary to be constantly on the alert for atmospheric conditions conducive to icing. If atmospheric conditions are such that icing is apt to occur, carburetor heat should be applied. If the pilot were to fail to consider icing conditions properly, and ice were to form in the intake manifold and cause the boost control to compensate automatically for it until almost full throttle were obtained, a heavy accumulation which might be very difficult to remove by the application of carburetor heat could form.**

War Emergency Rating

The use of war emergency power is permitted under combat or precombat conditions with the restrictions described in Section 2, paragraph entitled "Cruising."

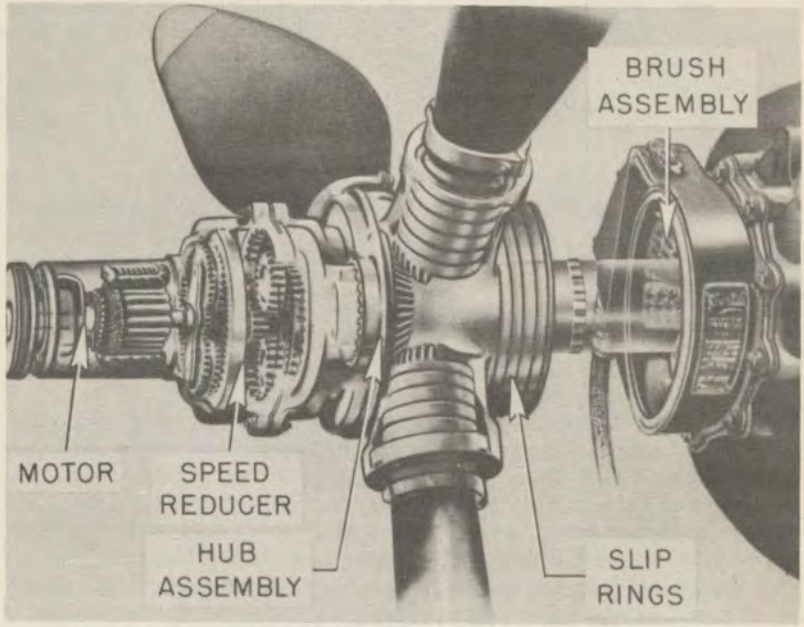


Fig. 12 CURTISS ELECTRIC PROPELLER

PROPELLER

The airplane is equipped with a Curtiss constant-speed three-blade, electrically controlled propeller, with a diameter of 10 feet 9 inches. The blades are set at a 23° angle for low pitch and a 58° angle for high pitch. The propeller pitch may be changed by either of two controls; one a manual control lever mounted on the control quadrant, the other a selector switch mounted on the pilot's switch panel. The manual control lever is used principally when the toggle switch is placed in the **auto constant speed** position. The electric control may be used when the switch is placed in the **fixed pitch** position. Pulling the switch down to either the left or

right automatically increases or decreases the RPM. When the switch is released, it will snap back to **fixed pitch.** An electric circuit breaker serves to cut off the power to the propeller in case of an overload. The circuit breaker may be reset by pressing a button located to the right of the propeller selector switch. When set in **auto constant speed,** the propeller maintains a given RPM regardless of throttle setting or manifold pressure; when the propeller is set in **fixed pitch,** the RPM may be changed with the throttle lever. A streamline, dynamically balanced spinner is attached to the propeller.

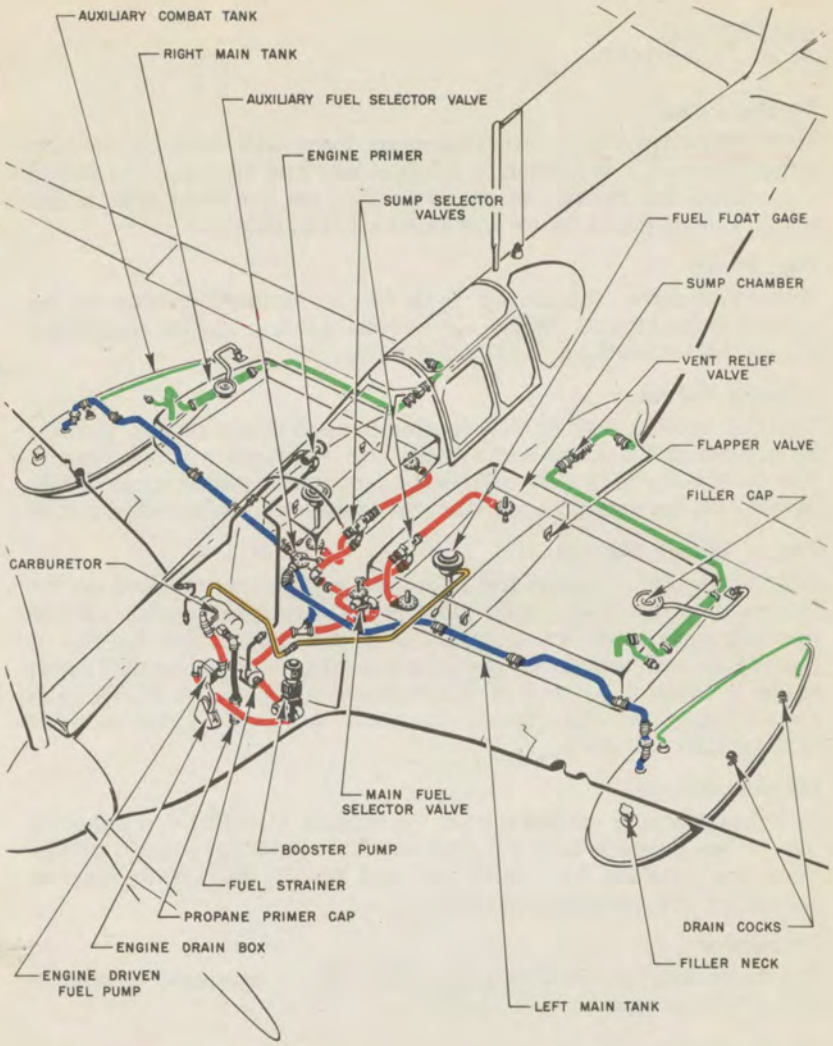
FUEL SYSTEM

The engine is supplied with fuel from the two main self-sealing tanks in the wings, and from combat tanks and ferrying tanks when they are installed. The regular fuel flow is from the main tanks, through the selective sump valves to the selector valve, through the fuel strainer and booster pump, and on to the engine fuel pump and carburetor. The auxiliary tanks consist of droppable ferrying or combat tanks, one mounted beneath each bomb rack. For further details concerning the ferrying tanks, refer to Part 2, Section 5 of this Manual. When combat or ferrying tanks are used, the fuel from them passes through the auxiliary system selector valve and on to the main fuel lines. The main fuel lines are of the self-sealing type, and aluminum tube lining is used at critical bends. The tanks are not interconnected, and it is necessary to switch from one tank to the other to provide smooth operation of the engine.

The engine is assured of a sufficient supply of fuel during steep climbs or dives as a result of the arrangement of the two outlet lines, one at the forward end and one at the aft end of each tank. These lines are interconnected by a selective sump ball-and-socket valve to a single line. Additional facilities for furnishing the engine with sufficient fuel when the fuel level becomes low are the booster pump installation, and a sump chamber in each tank over the fuel outlet. The carburetor is of the fuel injection type, contains an idle cutoff device, and is equipped with a vapor line extending to the left main fuel tank.

Main Fuel Tanks

Each main tank has a total fuel capacity of 90 U.S. gallons (75 Imperial gallons) and has a magnetic-type fuel gage mounted on it. A long vent line extends from each tank into the fuselage and has its outlet at the wing fillet.



COLOR CODE

- MAIN FUEL LINES
- AUXILIARY FUEL LINES
- VENT LINES
- DRAIN LINES
- PRIMER LINES
- CARBURETOR VAPOR VENT LINES

NOTE:
LONG RANGE FUEL FERRYING TANKS MAY BE INSTALLED IN PLACE OF COMBAT TANKS

Fig. 13 FUEL SYSTEM

Booster Pump

The electric booster pump, Thompson Type G10, may be used for either the main fuel system or the auxiliary fuel system. The switch controlling the booster pump is located on the right side of the pilot's switch panel below the instrument panel.

Fuel Pump

An engine-driven fuel pump, Type G9, is mounted directly on the engine at the aft end. When the engine is being started, this pump should be assisted by the booster pump.

Selector Valves

Two fuel selector valves, one located in each wheel recess, provide for control of the main fuel system and the auxiliary fuel system. The valves are manually operated by control handles located side by side on the cockpit floor, directly under the pilot's switch panel.

Engine Primer System

An engine primer pump and operating handle are installed on the subpanel at the lower right side of the instrument panel. When priming operations are completed, make certain the handle is pushed in and turned clockwise to the **off** position. The distributor valve is located forward of the carburetor on top of the engine. Four lines extend from the distributor to the forward and aft ends of the intake manifolds.

Propane Primer

In extremely low temperatures, the engine should be primed by use of the propane priming system. The plug for outside attachment is accessible through the ground heating door of the engine accessory compartment cowling.

Carburetor

The carburetor, a Stromberg Type PD-12K6, is mounted on the aft end of the engine.

OIL SYSTEM

The airplane is equipped with a self-thawing oil radiator mounted in the top center of the coolant radiator. The oil-coolant radiator is located in the bottom of the fuselage, aft of the cockpit. The flow of air through the air scoop is regulated by the movable aft scoop, which is operated by a hydraulic strut controlled from the cockpit

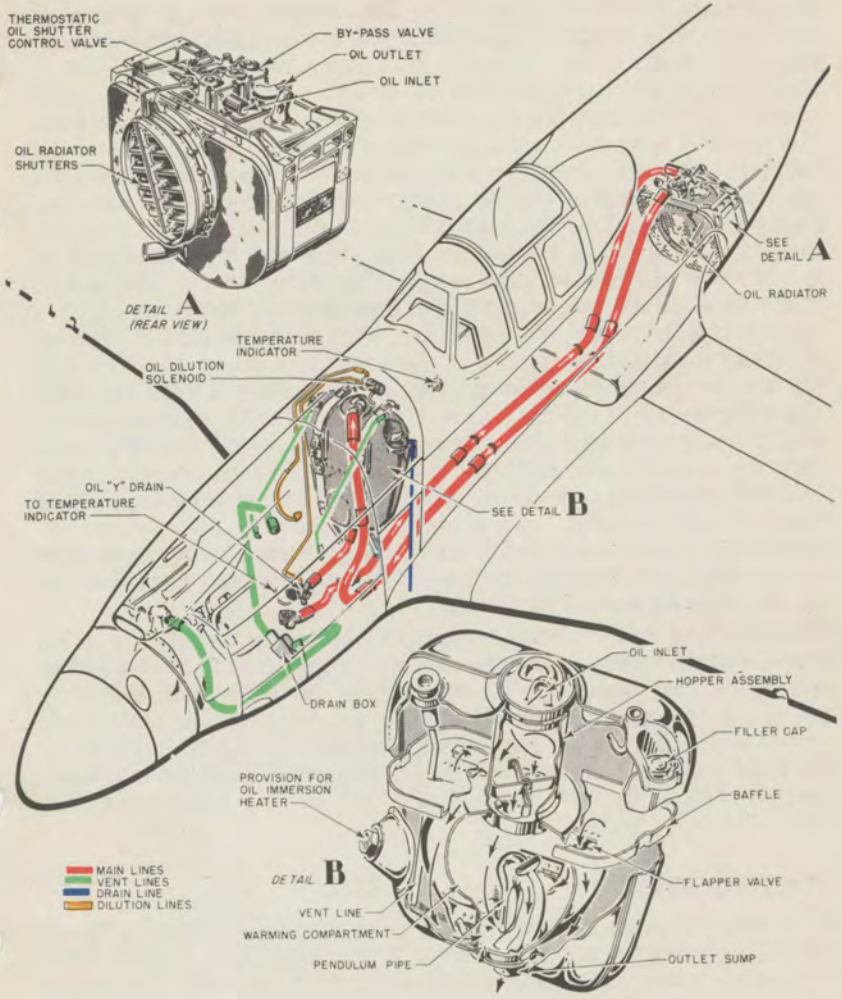


Fig. 14 OIL SYSTEM

by a preselector control handle at the aft end of the control pedestal, to the left of the pilot's seat. In addition to this method of temperature control of the oil in the system, the oil radiator is equipped with shutters operated by a thermostatic control valve mounted on top of the radiator. This valve is built integral with a surge valve which permits the oil at excessive pressure, a result of cold oil, to by-pass the radiator completely and return to the tank. The oil tank, located on the forward side of the firewall, is of the hopper type. With this type of oil tank, it is necessary to drain the lubricating oil only at engine change, except when some unusual circumstance, such as the failure of an engine part, makes it necessary to change the oil before that time. The tank is so designed as to allow the airplane to assume any attitude when the tank is full, and to feed oil adequately to the engine in a vertical climb or dive when the tank is only one-fourth full. However, because of the loss of oil pressure and the failure of the scavenger pump to operate in the inverted position, **inverted flying must be limited to 10 seconds.** The oil lines aft of the firewall are lagged for cold weather protection, but the tank and lines forward of the firewall are not, since they are heated sufficiently by the engine. The oil pressure gage line is filled with a light-grade oil to assure proper operation of the gage in cold weather, and a restrictor elbow is installed at the engine end of the gage line to dampen out fluctuations of pressure at the gage, and to retard the loss of oil from the engine in case of an oil pressure gage line failure.

Provision has been made on the oil tank for the installation of an immersion oil heater when the airplane is assigned to cold weather operation. The receptacle for connecting the immersion heater to an outside source of electrical energy is located in the right-hand wheel well. The Army Air Forces standard oil dilution system is installed on the airplane; its proper use will tend to eliminate starting difficulties. The proper oil to use for the system is Spec. AN-VV-O-446, Grade 1120.

COOLING SYSTEM

A solution of ethylene glycol with triethanolamine phosphate, Spec. AN-E-2, is used to cool the engine. The coolant liquid flows from the coolant pump into the engine at the bottom, through the engine and out the top, then aft to the coolant radiator. The coolant liquid enters the radiator at the top, flows through the cooling tubes of the radiator to the outlet at the bottom, and then back again to the coolant pump. The coolant tank is interconnected with the pump

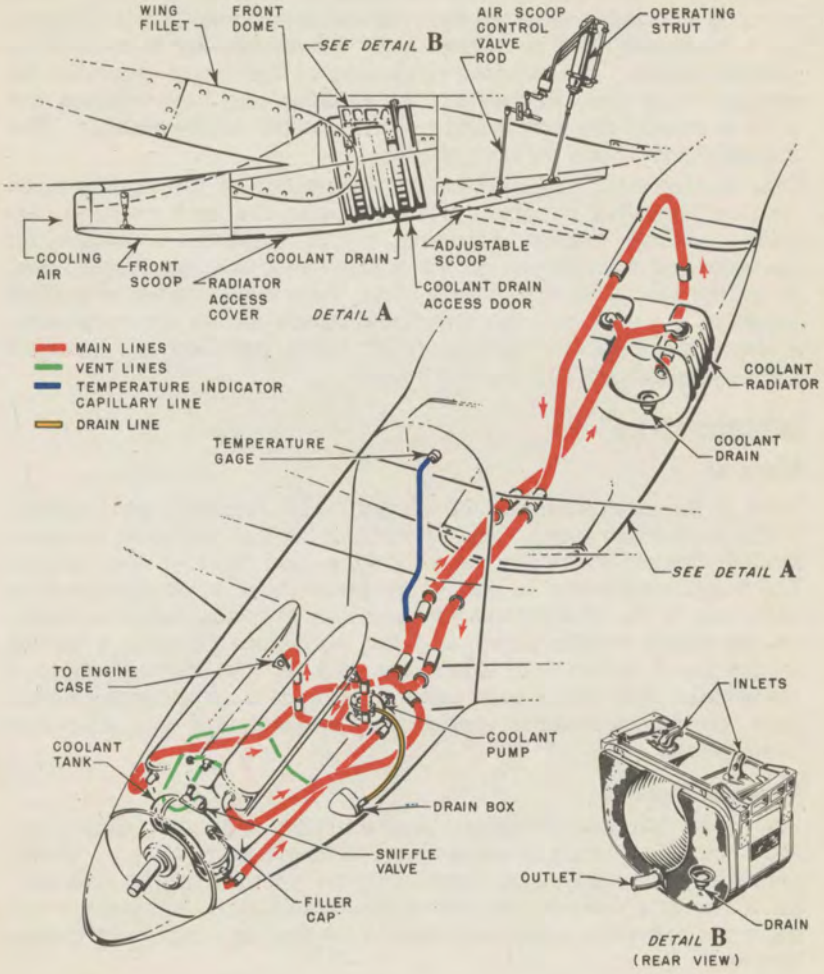


Fig. 15 COOLING SYSTEM

to replenish the coolant supply in the system. The radiator is mounted in the center of an air scoop assembly designed to concentrate a flow of air through the radiator. The forward end of the scoop is stationary, whereas the rear end is movable and is adjusted by a hydraulic strut controlled from the cockpit by a preselector control handle. The opening or closing of this scoop regulates the amount of air flowing through the radiator and thus enables the pilot to control the temperature of the coolant in the radiator. The movable scoop can be fully closed.

The coolant tank, mounted on the inside top of the engine nose ring, is protected by armor plate between the tank and the propeller. When heated, ethylene glycol expands considerably; therefore the filler flange on the coolant tank is so positioned that, when the tank is filled to overflowing, there is one gallon of coolant liquid in the tank and the remaining space serves for expansion. A two-way, pressure-vacuum relief valve installed on the tank provides pressure and suction relief.

INSTRUMENTS

General

Most of the instruments in the Model P-51A Airplane are mounted in the instrument panel. The exceptions are the carburetor temperature indicator, hydraulic pressure gage, and the fuel level gages. The instrument panel is lighted by fluorescent lights mounted on each side of the cockpit; the left-hand light is controlled by a switch on the pilot's switch panel, and the right-hand light by a switch on the panel on the right side of the cockpit. The instruments may be divided into these four general groups: vacuum instruments, pitot static instruments, engine instruments, and miscellaneous instruments.

Vacuum System

The gyro horizon indicator, bank-and-turn indicator, directional gyro, and the suction gage are part of the vacuum system, which essentially consists of an engine-driven vacuum pump, vacuum relief valve, a vacuum regulating valve, and an oil separator. The gage indicates the amount of suction for the turn and flight indicators only.

Pitot Static System

The pitot static instruments and associated equipment consist of an airspeed indicator, an altimeter, and a rate-of-climb indicator.

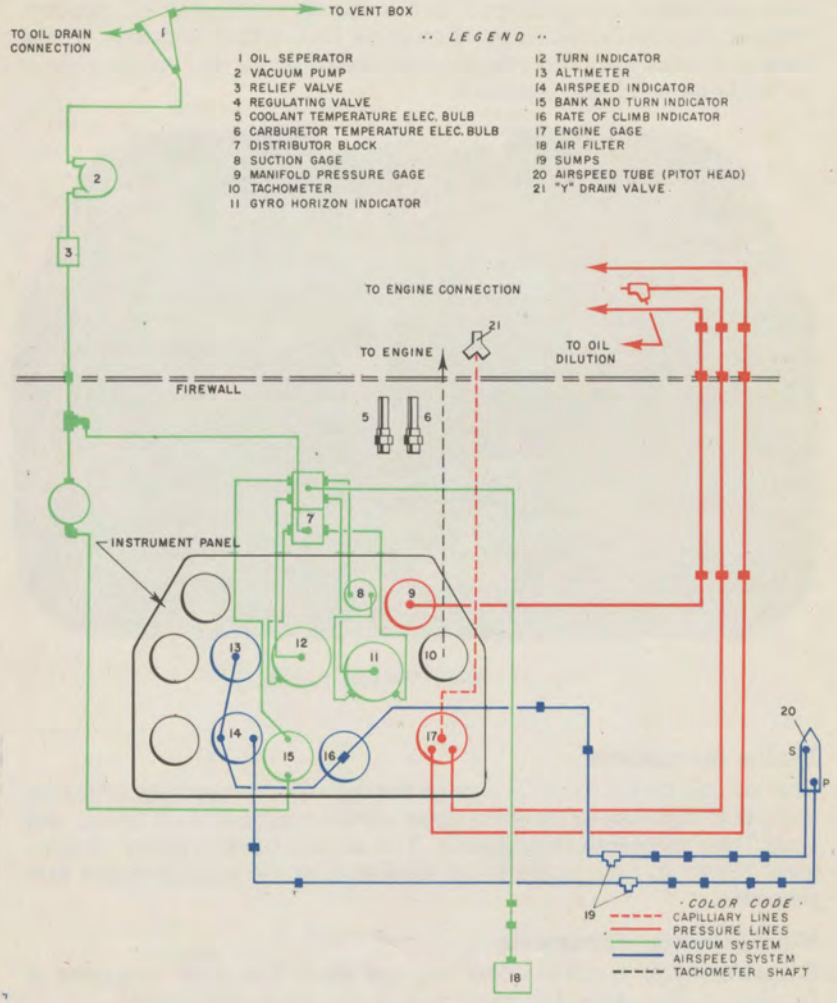


Fig. 16 INSTRUMENT AND VACUUM SYSTEM

All are mounted on the instrument panel. The pitot static or airspeed head, located on the right outer wing panel, supplies pressure and static air conditions to the above-mentioned instruments through the pitot static lines. The static line, which connects to the airspeed, altimeter, and rate-of-climb instruments, is merely a static outlet to atmospheric pressure.

Fig. 17 INSTRUMENT PANEL

Engine Instruments

The engine instruments comprise the following: manifold pressure indicator, tachometer, engine gage, coolant temperature gage, and carburetor temperature indicator. The engine gage consists of three instruments in one, namely: oil temperature, oil pressure, and fuel pressure.

Miscellaneous Instruments

Compass—The quick-reading vertical mounting type compass is located on the upper left-hand side of the instrument panel.

Hydraulic Pressure Gage—The hydraulic pressure gage is on the subpanel to the left of the instrument panel.

Landing Gear Position Indicator—The landing gear position indicator is situated in the lower left-hand corner of the instrument panel. The up position of the landing gear is indicated when the red lights are on; the down position, when the green lights are on. The intensity of the lights may be varied by a knob in the center of the indicator. A **push test** button in the center of the indicator may be used to determine the proper functioning of the lights.

Carburetor Temperature Indicator—The carburetor temperature indicator, mounted on the left-hand subpanel, is electrically actuated by a resistance bulb located in the carburetor air intake.

Fuel Gages—The two fuel capacity gages are of the direct-reading magnetic type. One gage is attached to the upper side of each fuel tank at the inboard end. The gages are situated on the cockpit floor forward of each side of the pilot's seat.

Ammeter—The ammeter is mounted on the right-hand switch panel and indicates the amount of amperage used in the system.

Clock—A clock is located on the upper left side of the instrument panel.

LIGHTS

The exterior lighting installation consists of one sealed beam landing light in the leading edge of the left wing, and conventional position lights on the upper and lower surfaces of the wing tips and at the trailing edge of the rudder. Provision is made for the installation of an AN3089 interaircraft signal light which may be stowed to the left of the pilot's seat. Two Type C-5 lamps, swivel-jointed to permit changes in the direction of their beams, are mounted on the lower uprights of the windshields. The housings of these lamps may be rotated to increase or decrease the amount of light thrown. In rotating the housing one way an ultra-violet filter is placed between the light and the instrument panel, causing the fluorescent markings on the instruments to glow strongly. Rotating housing the other direction places a visual light beam on the instruments. The intensity of the light is controlled by rheostats, marked **fluor light,** located on the pilot's switch panel and the right-hand switch panel. Cockpit lights, on each side of the cockpit, are controlled by switches on the base of the lights. Compass and gun sight lights, also included in the cockpit, are operated by individual rheostats located on the pilot's switch panel.

WARNING: **Do not leave the landing light switch on when the airplane is on the ground, as the heat generated by the lamp will melt the plexiglas lens.**

HEATING AND VENTILATING

The heating system consists of a tube extending from aft of the radiator to the forward end of the cockpit. Warm air from the radiator is forced through the tube to a valve at the right side of the control column. Three windshield defroster tubes are tapped off the main heating tube, and heat entering these tubes is controlled by a knob located just forward of the hot air valve. Cool air, picked up by a scoop in the forward radiator scoop, is piped into the cockpit and is released by operating a valve at the left of the control column. A wooden bulkhead aft of the cockpit serves to keep drafts at a minimum.

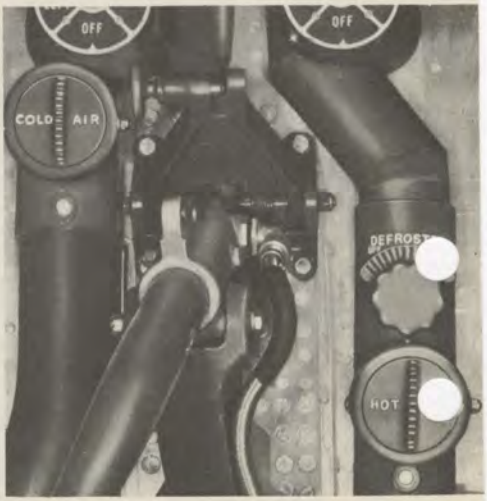


Fig. 18 HEATING AND VENTILATING CONTROLS

MISCELLANEOUS EQUIPMENT

Pyrotechnics

A signal pistol is located on the left side of the cockpit within reach of the pilot. The flares for the pistol are stowed to the left and aft of the pilot's seat.

Pilot's Seat

The pilot's seat is made of plywood and will accommodate a seat-type parachute. The back cushion is kapok-filled and may therefore be used as a life preserver. The seat is equipped with a Type B-11 safety belt and a standard-type shoulder harness

attached to a spring-loaded mechanism. The control lever for the shoulder harness is on the forward side of the seat, and the seat vertical adjustment lever is located on the forward right side.

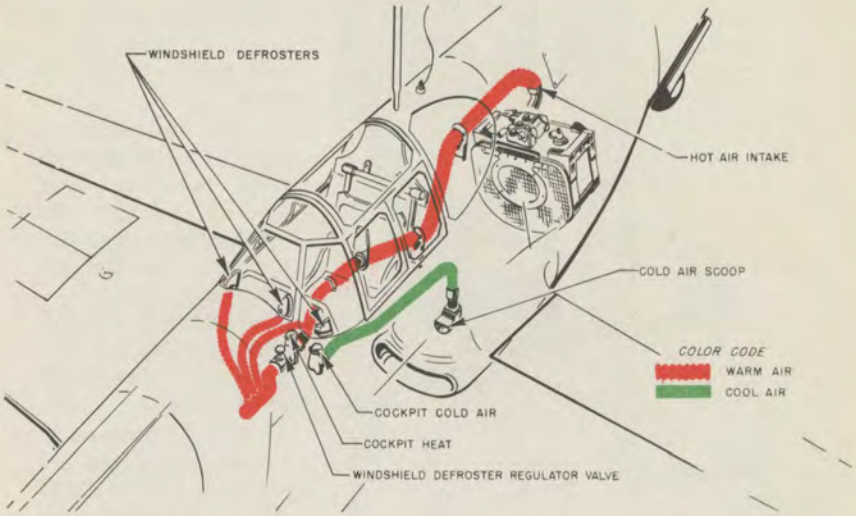


Fig. 19 HEATING AND VENTILATING SYSTEM

Pilot's Relief Tube

The relief tube horn is stowed on a bracket on the floor of the cockpit at the left of the pilot's seat. The tubing extends along the lower inboard side of the fuselage, emerging through an aluminum scoop outlet beneath the rudder.

First-aid Kit

A medical first-aid kit is attached to a bracket on the left fuselage side panel in the radio compartment.

Incendiary Bombs

Two incendiary bombs, for the destruction of the airplane if it is forced down in hostile territory, can be stowed one on each side of the pilot's seat.

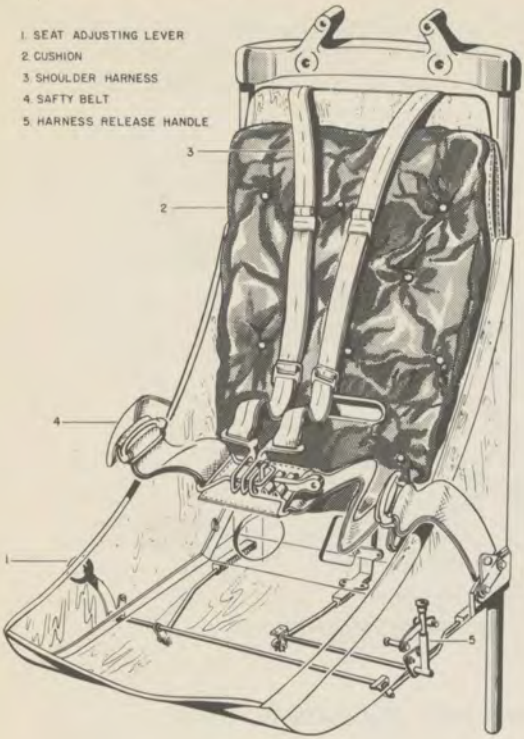


Fig. 20 PILOT'S SEAT

Dust Excluders

The following canvas dust excluders are furnished with the airplane: Two dust excluders for the main landing gear struts and one for the tail strut.

A dust excluder installed inside of each main landing gear well to protect the mechanisms from flying mud or dirt on landing or take-off.

Dust excluders for all other polished hydraulic surfaces in the airplane.

All of the above-mentioned excluders remain on the airplane during flight as well as on the ground. In addition, two detachable dust excluders to cover the entire main landing gear wells are provided for use when the airplane is on the ground and not in use. Dust plugs, attached to a line, are provided to plug all openings where dirt and dust might accumulate while the airplane is not in use. These plugs must be inserted at the end of each day's flight and removed just before the airplane is again put into operation.

Engine Crank

An engine crank and extension tube are stowed on brackets at the back of the right-hand main landing gear well.

Mooring

Prior to mooring, head the airplane into the wind, set the parking brake, and lock the surface control lock, using the lower locking

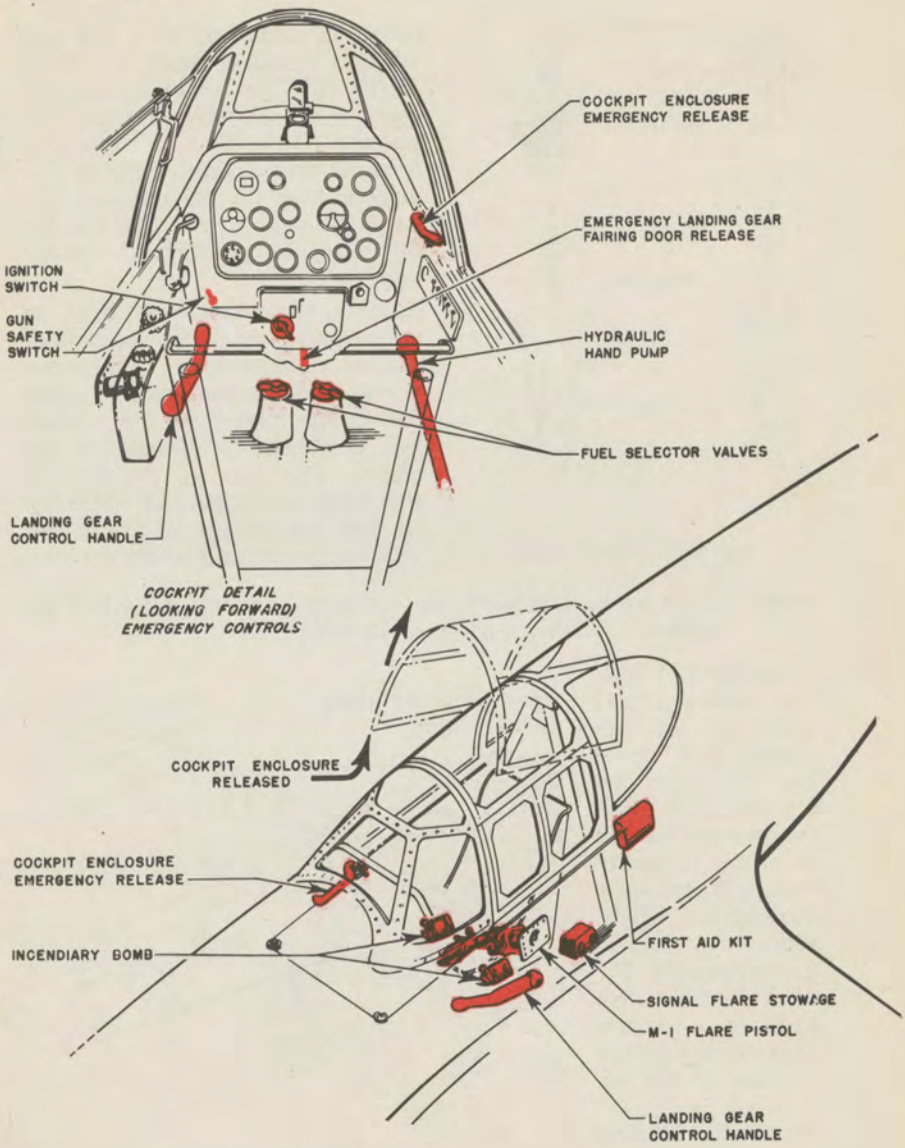


Fig. 21 EMERGENCY EQUIPMENT

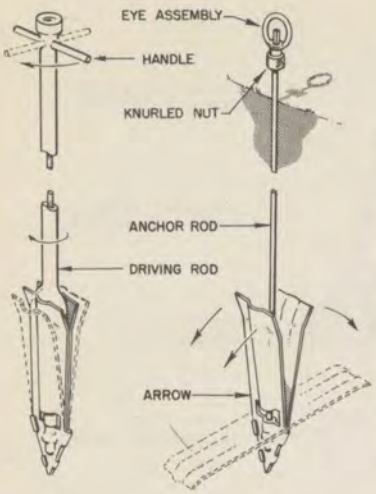


Fig. 22 MOORING STAKE

notch in order to lock the tail wheel. Mooring rings are fitted flush with the lower surface of each wing, slightly aft and outboard of the gun bays. Pry at the forward end of each ring to disengage from the stowed position. Lash the tail of the airplane by threading a rope through the lift tube.

Remove the mooring kit from its stowed position on the left side of the rear compartment. Screw the anchor rod into the arrow and slip the driving rod over the anchor rod and into the socket of the arrow. The cam on the driving rod must be positioned correctly so that the prongs of the arrow will not be spread while driving.

Note: If the ground is hard, the hardened surface must first be broken by using a ground breaking pin.

Align the rod with the attachment point on the airplane, and drive the rod into the ground until the driving rod handle is within approximately 3 inches of the ground. Then rotate the handle approximately 90° and strike the handle a sharp blow to spread the prongs of the arrow.

Return the driving rod to the driving

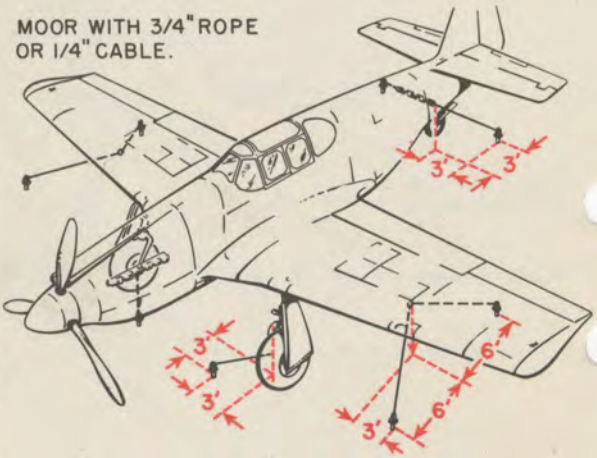


Fig. 23 AIRPLANE MOORING

position and withdraw it from the ground. Align the squared socket of the eye assembly with the square end of the anchor rod, fit it into place, and secure the knurled nut. Attach the mooring rope to the eye assembly and give an upward pull to the anchor to spread the arrow prongs. Then secure the mooring ropes to the airplane. To withdraw the anchor rod, detach the mooring ropes and unscrew the anchor rod by turning the ring of the eye assembly counterclockwise, leaving the arrow buried in the ground.

Towing

A towing ring is provided on the inboard side of each wheel axle. When a tow bar is available, the airplane may be towed by inserting the angle hooks of the tow bar through the towing rings. When towing, the tail wheel should be unlocked and one man should be stationed in the cockpit to operate the brakes; another man should be assigned to each wing tip when touring near other obstacles.

Note: Never tow the airplane by means of the tail wheel.

Notes

Section 2

"Whew!! Just pulled out in time."

Contents

SECTION 2

Pilot's Operating Instructions

Note: A pilot's check list and an engine limitations plate are provided in the pilot's cockpit for a quick check of airplane operations.

BEFORE ENTERING COCKPIT

Make sure that the airplane has been serviced and is ready for flight, particularly in regard to proper quantities of fuel, oil, coolant, hydraulic oil, and oxygen. Ascertain that the total weight of fuel, oil, ammunition and special equipment carried are suited to the mission to be performed. This is most important in the case of combat missions, as the rate-of-climb of the airplane may vary as much as 500 feet per minute, depending on the load carried.

Fig. 24 RIGHT-HAND SWITCH PANEL

ON ENTERING COCKPIT

When night flying is anticipated, the following checks should be made:

1. Test operate cockpit swivel lights. These lights are switched on by means of a knurled knob on top of the fixture base.
2. Test operate landing light. The switch is located on the right-hand switch panel.

Fig. 25 RUDDER PEDAL ADJUSTMENT

3. Test operate gun sight illumination. The on-off switch and rheostat are controlled by the same knob.
4. Test operate position lights. The switch is on the right-hand switch panel.
5. Test operate fluorescent instrument lights. The rheostat knob for the left light is located on the pilot's switch panel. The knob for the right light is located on the right-hand switch panel.
6. Test operate the compass light. The on-off switch and rheostat are controlled by a knob on the pilot's switch panel.

The following procedures should be carried out prior to all flights:

1. Adjust the rudder pedals for proper leg length so as to obtain full brake control while taxiing. Adjustment may be made with the foot by pressing the lever located on the inner side of each rudder pedal.
2. Adjust the seat level to obtain full travel of the rudder pedals in the extreme positions. The adjustment lever for raising or lowering the seats is located on the lower right side of the seat.
3. Pull out on the handle of the emergency hydraulic hand-pump, at the right of the pilot's seat, and rotate clockwise to lock it in its fully extended position. Operate the pump and check the gage at the upper left of the instrument panel to see whether hydraulic pressure can be obtained.
4. Check the radio system to see that it is working properly. Instructions for operating the radio system will be found in Section 3.
5. Close the cockpit enclosure by first pulling the left side into position and then lowering the upper portion. Make certain that the hook on each end of the upper portion is secure on its respective support pin. Pull the enclosure handle back to

allow the upper portion of the enclosure to engage with the left side, and then push the handle forward to lock the enclosure. Pull down the safety latch—which is an additional safeguard against accidental release of the enclosure—into place before take-off. **The warning pins in the right sliding window track must be down flush to indicate proper fastening of the enclosure.**

Fig. 26 ENCLOSURE HANDLE LOCK

WARNING: **The sliding windows should be kept closed at all times on the ground with the engine running to prevent exhaust gases entering the cockpit.**

6. If bombs, fuel tanks, depth charges, or chemical tanks are installed on the bomb racks, make sure that the bomb release handle is in the locked position and the antisalvo guard is in place. **See that the bomb and gun safety switches are in the off position.**
7. Set the altimeter to the proper reading.
8. Unlock the surface control lock, which is at the bottom and just forward of the control stick, by pulling the plunger on the left side of the lock. Test the controls for free and correct operation.
9. See that the landing gear control handle is in the down position.
10. Set the parking brakes by pulling out the handle below the center of the instrument panel, depressing the rudder pedals, releasing the pedals, and then releasing the handle. If chocks are available, use them also.

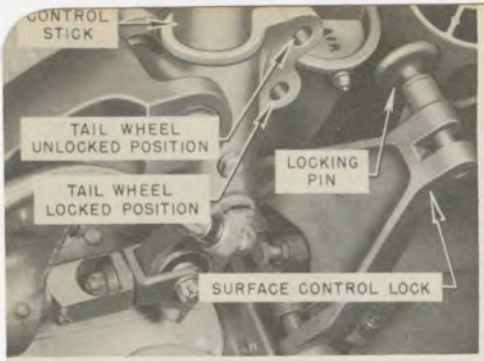


Fig. 27 SURFACE CONTROL LOCK

STARTING ENGINE

The sequence of operations listed below should be used to start the engine.

1. Turn the ignition switch to the **off** position.
2. Turn the generator disconnect switch to **on.**
3. Pull the propeller through severals turns if the engine has been idle for more than two hours.
4. Place the carburetor air control at the position marked **cold** so as to limit the danger in case of backfire.
5. Set the throttle approximately ¾ inch open.
6. Set the mixture control at the **idle cut off** position.
7. Set the propeller control at **increase RPM** (low pitch).
8. Turn the main system fuel selector valve to **left;** auxiliary system **off.**
9. See that personnel is clear of the propeller; then turn the ignition switch to the **both** position.
10. Set the fuel booster pump switch, located on the pilot's switch panel, to the **on** position. The fuel pressure gage should indicate 10 lbs./sq. in. shortly after the booster pump is turned on.
11. Prime the engine three or four strokes when cold, one stroke when warm. The priming system is independent of

Fig. 28 CARBURETOR AIR CONTROL

the carburetor and is extremely effective; consequently, **caution must be exercised not to overprime the engine.** After priming make certain that the primer is locked in the **off** position.

Note: No priming action nor fuel discharge is accomplished by pumping the throttle.

12. Set the propeller selector switch in the **auto constant speed** position and push the propeller circuit-breaker button to ascertain that the electrical circuit to the propeller governor is complete. Raise the safety guard over the selector switch. Both propeller controls are located on the pilot's switch panel.

13. Uncover the starter switch by pulling the hinge cover upward. Press the starter switch to the **energize** position; when the flywheel has reached maximum speed, press the switch upward to the **crank** position to engage the starter with the engine. A plug connector in the fillet on the right side of the fuselage, aft of the pilot's cockpit, provides for the connection of an external electrical supply. Provisions are also made for hand-starting the engine by means of a starter crank and extension stowed in the right wheel well. The starter crank may be removed by loosening the wing nut on the clamp around the arm of the crank. The extension tube is removed by

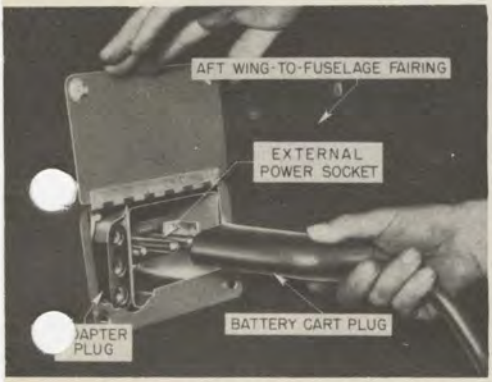


Fig. 29 EXTERNAL POWER SOCKET

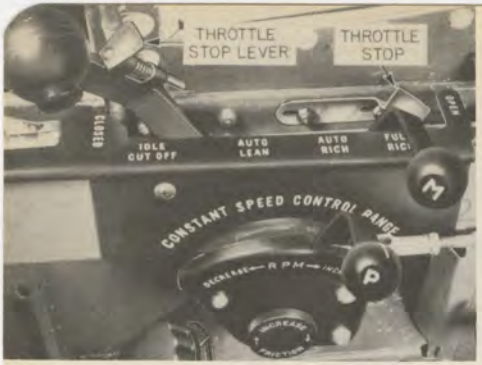


Fig. 30 ENGINE AND PROPELLER CONTROLS

twisting up and pulling outward. To hand-start the engine, insert the crank and extension through the hole in the lower aft engine cowl into the funnel-shaped starter attachment.

14. As the engine starts, move the mixture control to the **auto rich** position. If the engine does not start after one or two turns, move the mixture control out of then back to **idle cut off** position.

15. If a heavy viscous oil is indicated by oil pressure that is too high, or by oil pressure that fluctuates or falls back when the engine RPM is increased, hold the dilution switch in the **on** position to dilute the oil and correct this condition. Over-dilution will result in extremely low oil pressure and should be avoided.

Note: If engine heat is excessive, the fuel will evaporate out of the oil and leave only high viscosity oil in the engine. When this condition is encountered, shut off the engine and allow it to cool for 15 minutes; then restart as above.

ENGINE WARM-UP

Warm up the engine at 1000 to 1200 RPM until the oil temperature shows a definite increase and the oil pressure remains steady when the throttle is opened. **If the oil pressure does not reach 60 lbs. sq. in. within 30 seconds, stop the engine and investigate.** The desired coolant and oil temperatures may be obtained by operating the radiator air scoop. The control for the scoop is located on the control pedestal at the left side of the seat. The scoop is hydraulically operated by merely moving the radiator air control to the desired position.

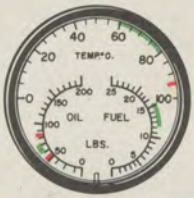
TESTING

After the engine has warmed sufficiently, proceed with these tests:

1. Check the instruments for the following engine limitations:

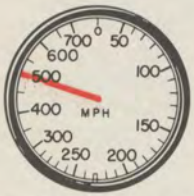
	Desired	Maximum
Oil Pressure	60-70 lbs./sq. in.	85 lbs./sq. in.
Oil Temperature	60°-180° C	95°
Coolant Temperature	105°-115° C	125°
Fuel Pressure	12-16 lbs./sq. in.	16 lbs./sq. in.

- MAX. TAKE-OFF MANIFOLD PRESSURE–52 IN. Hg (132.08 CM. Hg)
- OPERATING RANGE 23.0-30.7 IN. Hg (58.42-77.87 CM. Hg)

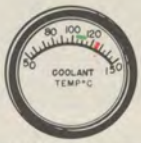


- MAX. PERMISSIBLE OIL TEMPERATURE 95°C (203°F)
- OPERATING OIL TEMPERATURE 60-80°C (140-176°F)
- MAX. PERMISSIBLE OIL PRESSURE 85 LBS./SQ. IN.
- MIN. PERMISSIBLE OIL PRESSURE 55 LBS./SQ. IN.
- OPERATING OIL PRESSURE RANGE 60-70 LBS./SQ. IN.
- OPERATING FUEL PRESSURE RANGE 12-16 LBS./SQ. IN.

- MAX. TAKE-OFF R.P.M. 3000
- OPERATING RANGE 1950-2280



- MAX. PERMISSIBLE INDICATED AIRSPEED 505 MPH (808 Km PH, 440 KNOTS)



- MAX. COOLANT TEMPERATURE 125°C (257°F)
- OPERATING RANGE 105-115°C (221°F TO 239°F)

2. Check the magnetos at 2200 RPM and 30 in. Hg MP. To obtain this power setting, open the throttle to approximately 30 in. Hg MP and decrease the RPM by manual operation of the propeller selector switch; then return the switch to **fixed pitch.** A maximum loss of 80 RPM on either magneto is allowable. This check should be made in as short a time as possible.

WARNING: **Do not decrease RPM by more than 200. Further variations of RPM could cause serious damage to the engine.**

3. Press the propeller selector switch back to the **auto constant speed** position and move the propeller governor control to determine whether there is a change in RPM. Then move the control forward to the full **increase RPM** position.
4. With the propeller in full **increase RPM,** check the automatic manifold pressure regulator. Open the throttle to 2400 RPM and note the manifold pressure. Change the engine speed from 2400 RPM to 2200 RPM by moving the propeller control toward **decrease RPM.** The manifold pressure should remain constant within one in. Hg.

Fig. 31 PILOT'S SWITCH PANEL

5. Test the operation of the flaps with the engine-driven hydraulic pump. Check the hydraulic pressure gage for a pressure indication of 1000 lbs.
6. Ascertain that the artificial horizon is caged and that the engine-driven suction pump is producing between 3.75 and 4.25 in. Hg vacuum pressure. Line up the adjustable airplane silhouette with the center of the caged horizon.
7. Recheck the signal-to-noise ratio of the radio receiver with the engine running, in accordance with instructions contained in Section 3.
8. Having observed that the oil pressure does not exceed 85 lbs., decrease the engine revolutions gradually to 2000 RPM, and confirm the following:

   That the ammeter registers no more than 100 amperes.

   That the suction pump registers no more than 4.25 in. Hg.

   That the fuel pressure gage registers no more than 16 lbs. or no less than 12 lbs.

   That each position of both fuel selector valves functions properly.

9. Be sure that the cockpit hood is closed and locked.
10. Check the operation of all surface controls.
11. Set the rudder trim 5° to the right. Set the elevator trim 3° back.

Fig. 32 FUEL VALVE CONTROLS

TAXIING

For ordinary taxiing, observe the following generalities:

1. Raise the radiator air scoop and the wing flaps.
2. **Steer a zigzag course to survey the area obstructed by the engine.**
3. Taxi with the stick slightly aft of neutral. This will lock the tail wheel. In the locked position, the tail wheel may be turned 6° to the right or left by use of the rudder pedals. For sharp turns, push the stick forward of the neutral position to allow the tail wheel full swiveling action.
4. Use the brakes as little as possible and always taxi cautiously.
5. On reaching the take-off position, stop the airplane crosswind so that approaching airplanes may be plainly seen.

WARNING: **Always taxi with the wing flaps and retractable air scoop in the up position to avoid damage by objects thrown by the tires.**

TAKE-OFF

When the field is clear, quickly check the following:

1. See that the fuel booster pump is **on.**
2. See that the mixture control is in the **auto rich** position.
3. See that the propeller control is fully forward in the **increase RPM** (low pitch) position, and the propeller selector switch is in the **auto constant speed** position. Depress the propeller circuit-breaker button.
4. Ascertain that the main fuel system fuel selector valve is in the **left** position and the auxiliary system fuel selector valve is **off.**
5. See that the generator disconnect switch is turned to **on.**
6. Open the radiator air scoop as required.
7. Check for:
   Min. Oil Temp. **20° C**
   Max. Oil Press. **85 lbs./sq. in.**
   Min. Coolant Temp. **85° C**
8. If high obstacles are to be cleared and only a short run is available, set flaps at 20° down. Take-off position or 20° down position is marked beside the flap control handle and is selected and locked by moving the flap control to the desired position.

Fig. 33 PROPELLER CONTROL SWITCHES

9. Open the throttle to **52 in. Hg manifold pressure** and take off at **3000 RPM** (5 minutes maximum).
10. **Do not attempt to lift the tail too soon as it increases the torque action.**

ENGINE FAILURE DURING TAKE-OFF

If the engine fails immediately after the take-off, act quickly as follows:

1. Maintain speed by depressing the nose at once so that the airspeed does not drop below 110 MPH.
2. Release the cockpit enclosure by pulling the emergency release located on top of the longeron just to the right of the instrument panel.
3. Make sure that the landing gear has started to come up. There is no time to take further action; and even if it is only unlocked and on the way up, the gear will collapse on landing. Do not try to lower it. There is less likelihood of personal injury if the airplane is landed with the landing gear up.
4. Lower the flaps fully, if possible.
5. Land straight ahead, only changing direction sufficiently to miss obstructions.
6. If there is time, switch off the engine to reduce the risk of fire. In any case, do it after landing, and turn the fuel selector valves off.
7. After landing, get out of the airplane as quickly as possible and remain outside.

CLEARING THE FIELD

As soon as the airplane is sufficiently clear of the ground, proceed as follows:

1. Retract the landing gear by pulling the landing gear control handle inboard and up. The handle is located on the control pedestal to the left and just forward of the seat. Note the landing

gear position as shown by the electrical indicator located on the left side ot the instrument panel.

2. If the flaps have been partly lowered for the take-off, raise them, provided that the airspeed is at least 110 MPH and all obstacles are sufficiently cleared, by pulling the flap control to the fully up position. No sink is noticeable when the flaps are raised.
3. Check the coolant and oil temperature, and the oil pressure.
4. Position the fuel selector valve to the tank to be used.

WARNING: **Make certain that the selector valve for the fuel system not being used is in the off position. The engine will not run if either selector valve is set on an empty tank.**

CLIMBING

As the rate-of-climb can vary widely depending on weight being carried, external loading, and altitude, refer to the **Climb Control Charts** in Section 4 for the rate-of-climb applicable to the particular mission to be conducted.

CRUISING

Consult the **Flight Operation Instruction Charts** in Section 4 for fuel consumption and range data.

Periodically check for these desired instrument readings:

Coolant Temperature..... **105°-115°C** (Min. 85°C; max. 125°C)
Oil Temperature..... **60°- 80°C** (Min. 20°C; max. 95°C)
Oil Pressure..... **60-70 lbs./sq. in.**
(Min. 55 lbs./sq. in.; max. 85 lbs./sq. in.)
Fuel Pressure..... **12-16 lbs./sq. in.**

If auxiliary fuel tanks are installed, use the fuel from them first and periodically shift from the left tank to the right tank to prevent excessive wing heaviness. When the main fuel system is in operation, use the fuel from the left and right fuel tanks alternately. Be sure that one selector valve control is **off** when the other is in use.

WARNING: **Approximately 10 seconds is required to switch from one auxiliary tank to the other.**

GENERAL FLYING CHARACTERISTICS

Engine

Operating Conditions — Normal engine operating conditions are adequately covered in the charts of Section 4.

Use of War Emergency Ratings— The basis for establishing the War Emergency Ratings given in Section 4 is to make available to a pilot in combat the absolute maximum manifold pressure at which the engine may be operated, within reasonable safety limits, for a 5-minute period under emergency conditions.

These War Emergency Ratings are considerably in excess of the ratings given in the engine specification under which the engine was delivered, and the use of War Emergency Ratings will probably decrease the normal service life and time between overhauls. War Emergency Rating operation should, therefore, be held for use only where emergency conditions exist. War Emergency Ratings are not guaranteed power ratings; they are maximum manifold pressure ratings, available for emergency operation only, as established by the correct setting of the automatic manifold pressure regulator, and the correct setting of the propeller governor to allow the propeller to turn at 3000 RPM.

War Emergency Ratings are to be used only when each of the following requirements is strictly complied with:

1. In combat or precombat areas as designated by the Army Air Forces, and then only when emergency conditions exist.
2. Only when Spec. AN-VV-F-781 Amend. No. 5 fuel is used.
3. The mixture control must be set in either **auto rich** or **full rich** position.
4. Only when Champion C35S or C34S, or AC L885 spark plugs are installed.

5. The break-through seal must be installed on the bottom of the quadrant to inform the crew chief that the engine has been operated at War Emergency Ratings, so that he will then make special inspections and checks. Close coordination between the pilot, crew chief, and engineering officer will be required to maintain an accurate record of the amount of time any engine has operated at War Emergency Rating conditions. When five hours time has accumulated, the engine should be pulled for tear-down inspection and reconditioning.

   Note: The amount of time an engine will stand up under the use of War Emergency Ratings will vary considerably in accordance with the area in which the airplane is stationed; for example, the length of time of operation in areas having sandy runways will be less than that of operation in areas having concrete runways. Variations in operating time between extremely cold, moderate, and hot climates will also be noticeable.

- The engineering officer will have to take these factors into consideration in establishing the total time of operation at War Emergency Ratings to be accrued before engine should be removed. Close correlation with the experience of engineering officers in other areas will be valuable.
- Engines must be carefully maintained and checked out for satisfactory operations under current operating instructions prior to their being considered satisfactory for the use of War Emergency Ratings in case of emergencies.

6. All operations at War Emergency Ratings must be carried out with the propeller control set in **auto constant speed** position to maintain 3000 RPM.

7. During the use of War Emergency Ratings, with Spec. AN-VV-O-446 lubricating oil in the system, the following oil inlet temperatures must not be exceeded: **95°C** (203°F) with Grade 1120, **85°C** (185°F) with Grade 1100.

   CAUTION: **If oil dilution has been used, it is desirable that the engine be given 10 to 15 minutes operation at from 80% normal to military power prior to the use of War Emergency Ratings.**

8. During the use of War Emergency Ratings, the coolant system should be filled with ethylene glycol to AN-E-2 specification,

and the coolant outlet temperature should not be permitted to exceed **125°C** (257°F).

Airplane Stability The airplane is stable at all normal loadings but the directional trim changes at low speeds as speed and horsepower output is varied. The rudder tab is effective and should be used as necessary.

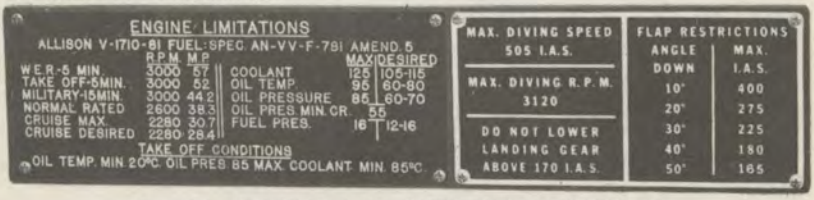


Fig. 34 ENGINE AND AIRPLANE LIMITATIONS

The wing flaps must not be fully lowered when the airplane is being flown in excess of 165 IAS.

The landing gear must not be lowered when the airplane is being flown in excess of 170 IAS.

The effect of flap and landing gear operation on the trim of the airplane in flight is as follows:

Landing gear retracted—airplane becomes tail heavy.

Landing gear extended—airplane becomes nose heavy.

Flaps lowered—airplane becomes nose heavy.

Flaps raised—airplane becomes tail heavy.

Flaps raised at 110 MPH—no apparent sink.

These flap setting airspeed restrictions must be observed:

With wing flap setting at 10°, do not exceed 400 IAS.

With wing flap setting at 20°, do not exceed 275 IAS.

With wing flap setting at 30°, do not exceed 225 IAS.

With wing flap setting at 40°, do not exceed 180 IAS.

With wing flap setting at 50°, do not exceed 165 IAS.

The tab controls are sensitive and must be used with care. Care must be taken while sideslipping to see that the airspeed does not fall below **110 MPH.**

However, a sustained sideslip cannot be performed in this airplane. Recovery from a sideslip should be effected above 200 feet.

STALLS

Though the stall most commonly occurs at low speed, it should be remembered that it may occur at any speed if the control stick is brought back far enough to put the airplane at stalling incidence. The following is a brief description of the stalling characteristics of this airplane:

1. With flaps and landing gear up, the stalling incidence is reached at about **85 MPH indicated,** when a wing will drop. If backward movement on the stick continues when the wing drops, the airplane will fall into a steep spiral.
2. With the flaps and landing gear down, the stalling incidence is reached at about **90 MPH indicated.** As speed is reduced, a wing will drop rather slowly; and unless recovery is effected immediately, the airplane will fall into a steep spiral. An indicated speed of **165 MPH** should not be exceeded with the flaps fully down.
3. The stall in this airplane is comparatively mild in that it does not whip at the stall but rolls rather slowly, and has very little tendency to drop into a spin. If the stick and rudder are released at the stall, the nose drops sharply and the airplane recovers from the stall almost instantly. In a straight power-off stall, some warning is given about 3 to 4 MPH above the stall by slight elevator buffet. A high-speed stall is preceded by sharp buffeting at the elevators and wing root, but recovery is almost immediate when pressure on the stick is released.
4. Recovery from any stall in this airplane is entirely normal; that is, by the release of back pressure on the stick and the application of rudder opposite the dropping wing.

SPINS

Differences

There are marked differences between a sustained left and right spin in this airplane:

1. The left spin oscillates from 80° below the horizon back to the horizon during the first turn, dampens out 50% during the second turn, and then becomes stable, smooth, and quiet with the nose approximately 30° to 40° below the horizon.
2. The right spin starts exactly the same as the left spin, but the oscillations continue without increasing or decreasing in magnitude.

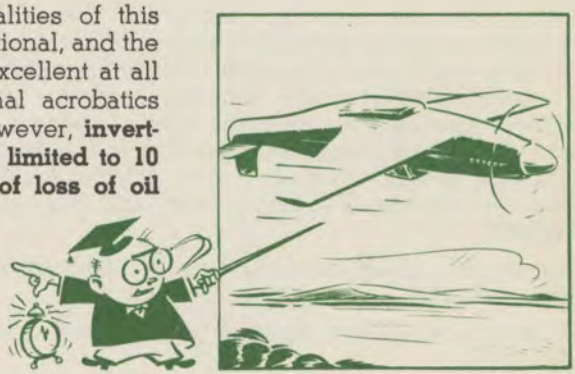
Recovery

Recovery is the same in both a left and right spin. Upon application of opposite rudder, the nose drops slightly and the spin speeds up rapidly for one and one-quarter turns, after which the spin stops. Rudder force is light at first, becomes very heavy for a period of about one second at the first half turn after starting recovery, then drops to zero as the spin stops. Recovery is effected in the normal manner; that is, by applying full opposite rudder followed by movement of the stick to neutral.

Note: Slight rudder buffet occurs during the spin. If recovery from the dive is attempted too soon after the spin is stopped, a rather heavy elevator and rudder buffet will occur.

ACROBATICS

The acrobatic qualities of this airplane are exceptional, and the lateral control is excellent at all speeds. All normal acrobatics are permitted. However, **inverted flying must be limited to 10 seconds because of loss of oil pressure and failure of the scavenger pump to operate in inverted position.**



DIVING

The maximum permissible diving speed is 505 IAS, during which the engine must not exceed 3120 RPM. During a dive in which high power is used, it is not necessary to pull back the propeller control; however, if diving at reduced throttle, the propeller should be set at 2300 RPM to prevent exceeding 3120 RPM. The use of elevator tabs is not required for dive recovery because of the low elevator control forces.

WARNING: **As this airplane gains speed very rapidly in a dive, it is of the utmost importance to make allowance for ample altitude for a safe recovery before starting the dive. Section 4 contains a chart complete with instructions for its use, which indicates minimum safe altitudes required for a pull-out from dives of 90°, 70°, 50°, and 30°, with a constant 4G acceleration. Pull-outs should not be attempted at greater than 4G's unless the pilot has special equipment to enable him to withstand greater accelerations without blacking out.**

GLIDING

Gliding may be carried out at any safe speed down to the recommended margin of about 25% above stalling speed. With the landing gear and flaps up, the glide is fairly flat with the nose very high. Forward visibility in this condition is poor. Lowering either the flaps or landing gear, or both, greatly steepens the gliding angle for a given speed, and the rate of descent is greatly increased. The following speeds are subject to ± 5 MPH, depending on loading: Best gliding speed—landing gear and flaps up: approximately **140 IAS.**

Best gliding speed—landing gear and flaps down: approximately **125 to 135 IAS.**

Engine-assisted glide—landing gear and flaps down: **100 to 110 IAS.**

ENGINE FAILURE DURING FLIGHT

In the case of total engine failure, release the cockpit enclosure by pulling the emergency release situated on top of the longeron just to the right of the instrument panel. Land with the gear in the retracted position. The flaps may be lowered as desired; however, it should be kept in mind that, after loss of hydraulic pressure, the flaps must be lowered by use of the hydraulic hand-pump and this is a rather slow process.

RAIN OR POOR VISIBILITY

When flying in conditions of bad visibility, open the clear-vision panel in the left side of the windshield. As a negative pressure area exists at this point, the elements will not enter the cockpit. If moisture or frost forms on the inside of the windshield, open the defroster system by turning the knob marked **defroster,** which is located on the hot air valve to the right of the control stick. If ice forms on the outside of the windshield, put the de-icer system into operation by holding in the knob marked **windshield de-icer spray** on the upper right of the instrument panel. Since the de-icer system uses glycol from the engine coolant system, it should be used sparingly. In rain or icing conditions, the alternate source for furnishing air to the carburetor should be used; do this by pulling out and locking the control marked **cold air** on the left of the instrument panel. If icing conditions become severe and ice has formed in the carburetor, the carburetor **hot air** control on the left side of the instrument panel should be used. When flying in dusty or sandy conditions, pull the carburetor air filter control located on the right side of the instrument panel.

Fig. 35 WINDSHIELD DE-ICER CONTROL

Fig. 36 CARBURETOR AIR FILTER CONTROL

Reduce flying speed during poor visibility by retarding power and RPM and by partly lowering the flaps.

NIGHT FLYING

In flying this airplane at night, the sequences outlined for daylight operation should be even more strictly observed. In addition, make the following preparations:

1. Switch on the two cockpit lights on each side of the cockpit by turning the knob at the base of the light.
2. Turn on the ultraviolet fluorescent spot lights above and to each side of the instrument panel by means of the rheostat knobs located on the pilot's switch panel, and on the right-hand switch panel. The fluorescent lights are mounted on toggle joints to permit flexibility of movement. The front section of the lamp housing is rotatable, permitting varying intensity of visible light and also an even beam of ultraviolet.
3. Switch on the position lights. The switches are on the right-hand switch panel. There are two intensities available, **bright** and **dim.**
4. Switch on the compass light by rotating the rheostat located on the pilot's switch panel. Adjust the intensity of the light to provide sufficient illumination for night operation.
5. The switch for the landing light is on the right-hand switch panel.
6. A switch and rheostat for the gun sight light is located on the pilot's switch panel.

Get used to the position of the various lights by feel, especially the switch for the landing lights.

Note: In case of a bulb burning out, spares may be obtained from the small compartment on the right forward side of the cockpit. Spare fuses in the right-hand switch panel are of various capacities. Each is held by a fuse clip and marked as to capacity.

EMERGENCY EXIT

The cockpit enclosure may be released as a unit for emergency

exit. The emergency exit control handle is located on the right forward side of the cockpit. To release the hood, pull the handle back all the way. This releases the enclosure hinge cams which force the enclosure up and into the slip stream. If the force of the air does not pull the enclosure from the airplane, apply a straight upward push to the roof of the hood. If, in the event of a crash landing, the attitude of the airplane is such that it is resting on the nose-over structure, pull back on the emergency release handle and push outward on the left panel.

APPROACH

When the airplane approaches the field, this sequence of operations should be followed:

1. Turn the fuel selector valve to the desired tank.
2. Turn on the fuel booster pump.
3. Set the propeller selector at 2600 RPM with the propeller switch at **auto constant speed.**
4. Set the mixture control to **auto rich.**
5. Adjust the radiator air scoop as desired.
6. Adjust the power and trim to maintain 150 MPH in level flight.
7. Switch off the gun heater if used.
8. **Lower the landing gear below 170 IAS by pulling the landing gear handle inboard and pushing it down.** Upon full extension of the landing gear, spring-loaded steel pins will drop behind the extended members and lock them securely in the extended position. The position of the landing gear should be checked by the electrical indicator on the lower left side of the instrument panel. On P-51A-2, P-51A-5, and P-51A-10 Airplanes, an additional warning light to the left of the optical gun sight will indicate an unsafe position of the landing gear when the throttle is retarded.

9. If desired, the flaps may be lowered 15° to give a steeper approach angle. When the airplane has been brought into the wind for landing, the flaps should be lowered fully at an altitude of at least 400 feet, provided the indicated airspeed is **below 165 IAS and above 100 IAS.** To lower the flaps, push the flap control handle to the desired position as marked.

LANDING

Having turned into the field and lowered the flaps, maintain a correct gliding speed of between **105 to 110 MPH.** Adjust the elevator trim tab to assist in landing. Having stopped after landing, raise the flaps and turn off the fuel booster pump. Open the radiator air scoop while taxiing; close the scoop before stopping the engine.

Mislanding—In the case of an unsuccessful attempt to land, open the throttle and then push the propeller control forward to **increase RPM.** Raise the landing gear immediately; then, when the airspeed has reached 110 MPH, raise the flaps.

Cross-wind Landing—As this airplane has a landing gear of wide tread and a locked tail wheel, cross-wind landings may be negotiated safely. Keep one wing down, into the wind, to counteract drift.

Emergency Operation of Landing Gear—In the event of a complete hydraulic failure when the landing gear is in the retracted position, proceed as follows:

1. Place the landing gear control handle in the down position. The tail wheel will drop and lock of its own weight. The main landing gear will partially drop of its own weight.
2. If the fairing doors should fail to open, as a last resort pull the control valve lever beneath the pilot's switch panel to the forward notch. This will exhaust the landing gear system pressure. Be sure to release it again as soon as the landing gear is safely down and locked.
3. Yaw the airplane to the left by use of the rudder. The air load against the left gear fairing will down and lock the gear. Repeat the process to the right to down and lock the right gear.
4. After the landing gear has dropped downward, check the position of the landing gear and the down-lockpins as shown by the electrical position indicator on the left side of the instrument panel.
5. The landing gear doors will remain down, but the effect will not be noticeable except when landing in a cross wind.

STOPPING ENGINE

When the airplane has stopped rolling, proceed with the following:

1. If a cold weather start is anticipated, press the oil dilution switch to **on** and dilute the oil system for four minutes at 800 RPM.
2. Set the mixture control in the **idle cut off** position at 1200 RPM and move the throttle fully **open.**
3. Turn the ignition switch to the **off** position after the engine ceases firing.
4. Turn both fuel selector valves to **off.**
5. Leave the mixture control lever at **idle cut off** as a precaution against accidental starting.

BEFORE LEAVING COCKPIT

Before leaving the cockpit, make a general survey of the compartment and proceed as follows:

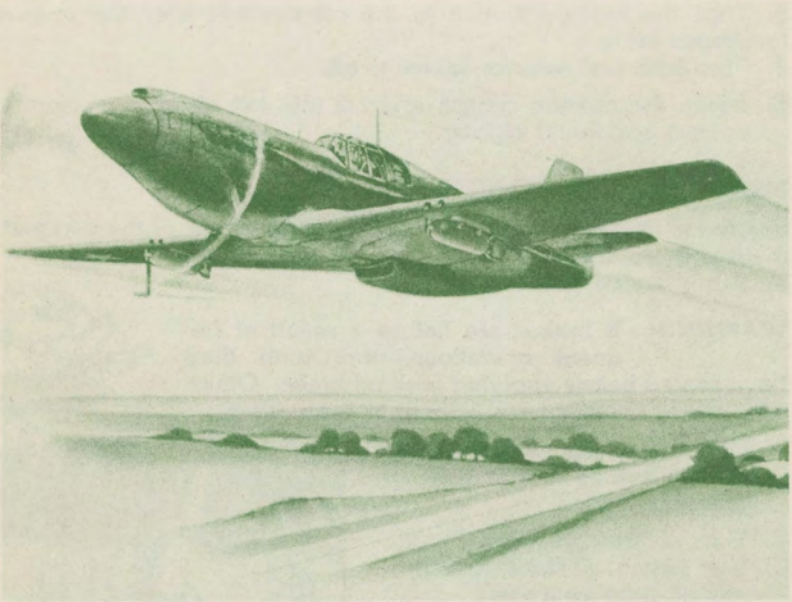
1. Apply the parking brake.

WARNING: **If brakes are hot as a result of frequent operations, wait until they have cooled before applying parking brake. Otherwise the brake discs will adhere to each other.**

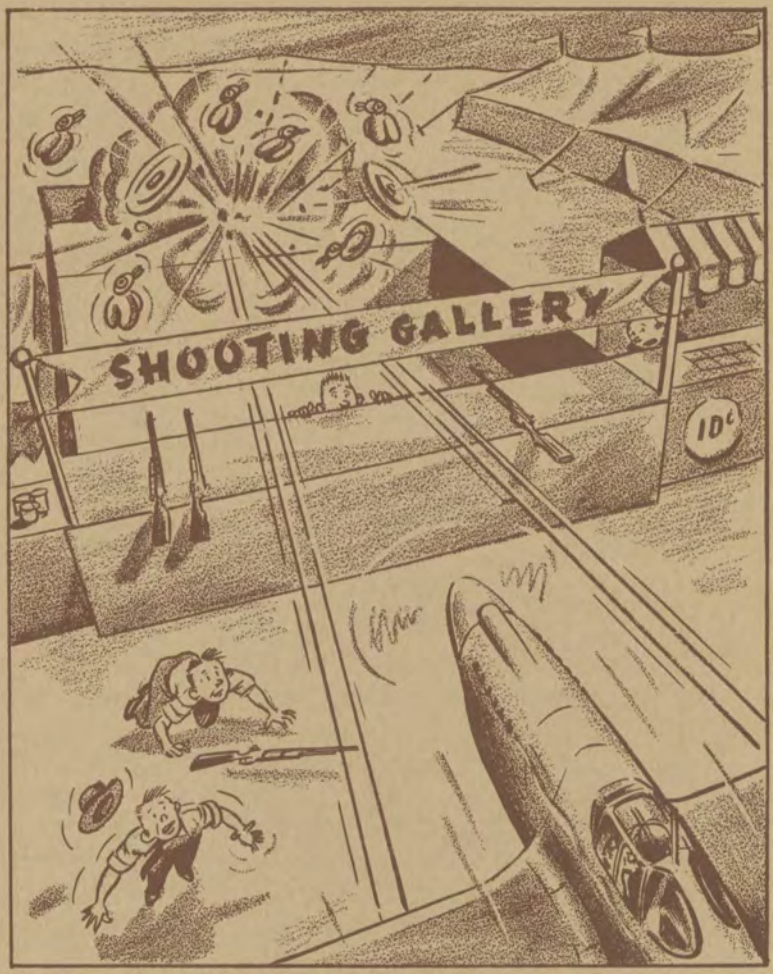
2. Lock the control surfaces. The lock is located just forward of the control stick.
3. Turn off the generator-disconnect switch, all radio switches, and all light switches.

MANEUVERS PROHIBITED

All normal maneuvers are permitted with this airplane except when external fuel tanks or bombs are installed. With the 150-gallon ferrying tanks installed, all maneuvers are prohibited and the stalling speed of the airplane is increased 10 MPH.



Section 3



Contents

SECTION 3

Special Operational Equipment

GUNNERY EQUIPMENT

General

The gunnery equipment consists of four fixed .50-caliber Browning machine guns, two mounted in the leading edge of each wing. All four guns fire simultaneously and are electrically controlled by the trigger switch on the control stick grip. The guns must be charged manually on the ground. Additional equipment includes an optical gun sight, an auxiliary ring-and-bead gun sight, gun heaters, and a gun camera. The pilot is protected by armor plate as shown in Figure 39.

Guns

Description The four guns are so situated in the wings that their fire passes outboard of the plane of propeller rotation. Two guns and their accessories are located in one gun compartment in each wing, and the removable ammunition boxes for both guns occupy a single ammunition compartment enclosed within the wing structure. The guns are adjusted horizontally and vertically so that

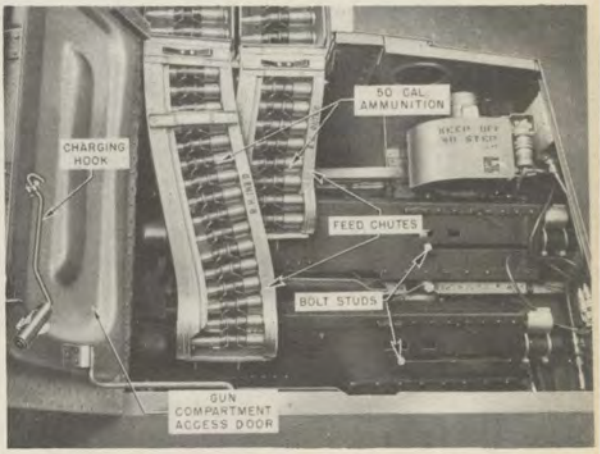


Fig. 37 GUN INSTALLATION

their fire converges with the line of sight at 300 yards.

Loading To gain access to either gun compartment, loosen the dzus fastener on each door handle, lift the handle, and swing the door forward. Remove the coverplate by sliding it forward. To remove the ammunition compartment coverplate, loosen the six dzus fasteners which hold it to the wing. Load the guns as follows:

1. Remove the boxes by means of the handle on each end.
2. Prepare two belts of 280 rounds each for the outboard guns and two belts of 350 rounds each for the inboard guns. Make certain that the links are properly and securely loaded.
3. Start each belt from the inboard corner of the outboard section of the box. Load the belts in smooth and regular layers. Allow approximately 22 cartridges for the inboard gun feed chutes and 14 cartridges for the outboard gun feed chutes.
4. Place the boxes in the ammunition compartment. Push the box handles down.
5. Attach the outboard gun feed chutes first. Attach the feed chute to the gun before engaging the bolt with the grooves in the support brackets. Check the freedom of movement of the belts in the feed chutes. The belts should slide into and through the chutes easily.
6. Load each gun by inserting the double-loop end and the first cartridge into the gun feedway until the belt holding pawl holds the cartridge. Charge each gun by pulling the gun bolt back twice with a charging hook.
7. Replace the ammunition compartment and gun compartment coverplates and secure the access doors.

Firing To fire the guns, turn the gun and camera safety switch, located on the armament control panel, to **guns and camera** and squeeze the trigger switch on the control stick grip. All guns fire simultaneously.

Fig. 38 GUN AND BOMB CONTROLS

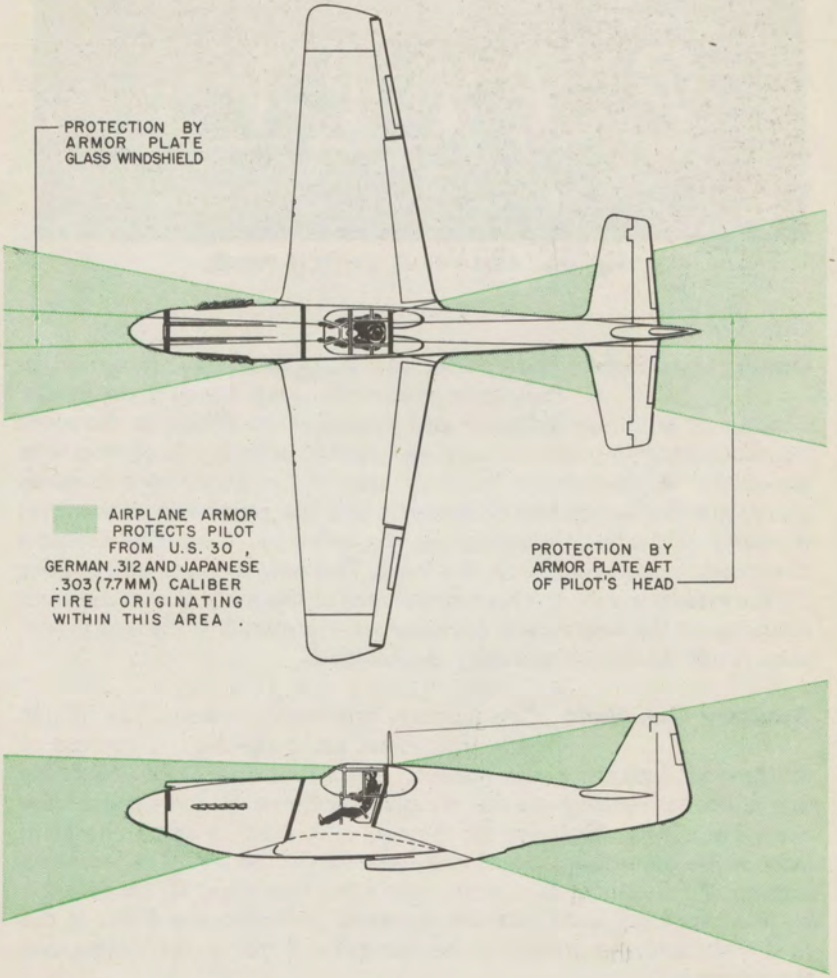


Fig. 39 ARMOR PROTECTION

Fig. 40 ARMAMENT SWITCH PANEL

Gun Sights

Optical Gun Sight The optical gun sight assembly, mounted in the center of the instrument panel glare shield, consists of an image reflector and sunscreen mounted on the sight housing, which contains a lamp and socket, reticle, mirror, and lens assembly. A rheostat on the right side of the pilot's switch panel controls both the lighting of the lamp and the regulation of the light intensity of the reticle image on the reflector. Turn the rheostat clockwise toward **on** to light the lamp. The reticle image will appear on the reflector with the first movement of the switch, and the light intensity of the image will increase as the switch is turned clockwise, until maximum intensity is obtained.

Auxiliary Gun Sight The auxiliary gun sight consists of an adjustable front bead sight attached to the top of the firewall forward of the cockpit, and a rear ring sight which fits into a socket located on the windshield frame to the right of the rearview mirror. Stowage for the rear ring sight is under the right side of the instrument panel glare shield. In the event of malfunctioning of the optical gun sight, install the ring sight by pulling the knurled spring-loaded plunger outward, inserting the stem of the ring sight into the socket in the windshield frame, then releasing the plunger.

Make certain that the plunger engages securely with the stem of the ring sight.

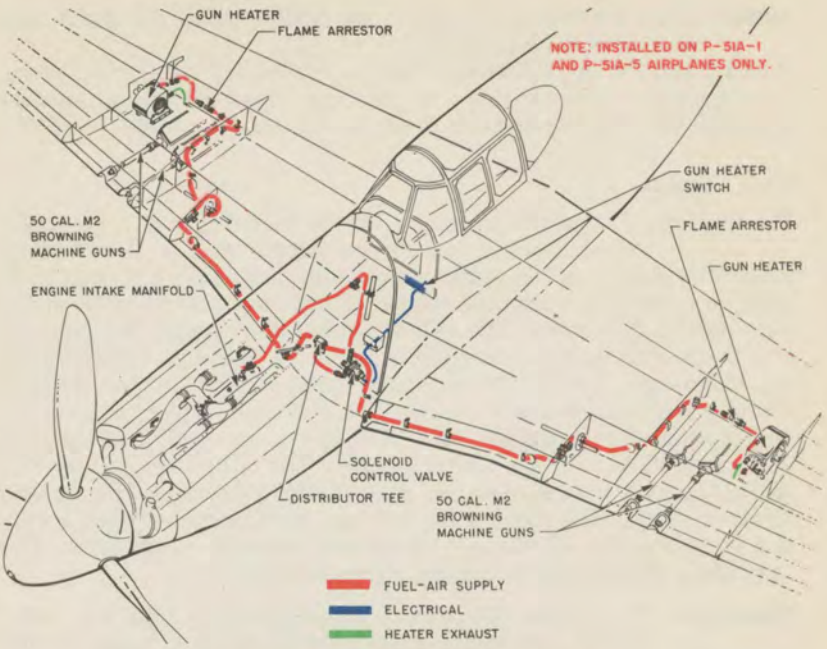


Fig. 41 GUN HEATING SYSTEM

Gun Heaters

P-51A-1 and P-51A-5 Airplanes are provided with one gun heater in each gun compartment. The heaters use a fuel-air mixture which is piped from the engine intake manifold to a solenoid-operated valve on the forward side of the firewall; from the valve the gas passes to a tee for distribution to the gun heater in each wing. The solenoid valve and heaters are controlled by a heater switch on the armament switch panel. To turn on the heaters, lift the heater switch to **on.**

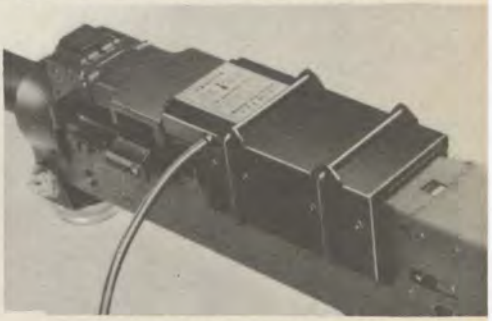


Fig. 42 ELECTRIC GUN HEATER

Note: Turn the heater switch to **off** before firing the guns, and during take-off or landing.

P-51A-2 and P-51A-10 Airplanes are provided with an electric heater for each gun. These heaters fit over the cover of the gun and are controlled by the heater switch on the armament panel.

Gun Camera

Description Provisions are made for the installation of a gun sight aiming-point camera equipped with a 3-inch plain lens. The camera is located in the left wing inboard of the gun compartment and is adjusted to converge with the line of sight of the gun sight at 300 yards. The self-contained film magazine used with this installation is interchangeable on all 16 mm gun sight aiming-point cameras. An aligning indicator, used to align the camera with the gun sight, slips into the magazine chamber of the camera and sights through the camera lens. Heater resistors and a heater cut-out are installed in the camera body. The cutout closes at 7°C (45°F), turning the heaters on, and opens at 32°C (90°F), turning the heaters off. The camera has a 3-inch f.4.5 telephoto lens, a sun-shade, and a No. 12 minus-blue interchangeable glass filter. The lens stops are marked for bright, hazy, and dull.

Operation To operate the camera simultaneously with the guns, lift the gun and camera safety switch, situated on the lower left side of the instrument panel, to the **guns and camera** position, and depress the trigger switch on the control stick grip.

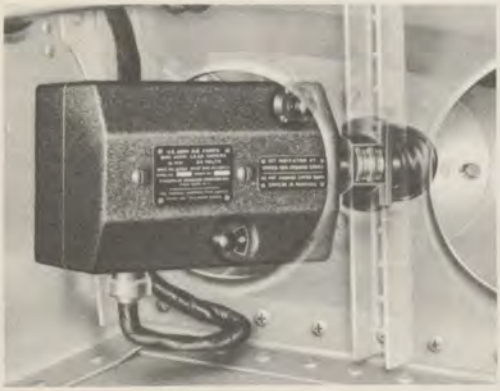


Fig. 43 GUN CAMERA

To operate the camera without firing the guns, place the gun and camera safety switch in the **camera** position and depress the trigger switch.

When through photographing, place the gun and camera safety switch in the **off** position.

Note: It is necessary that the guns and camera safety switch be in the **off**

position when the camera is not in use because, if the temperature should drop and the switch were on, the heaters in the camera would automatically begin to function.

Loading—The procedure for loading the camera is as follows:

1. Access to the camera may be gained from the left wheel well. Open the magazine access cover at the end of the camera by pressing the eccentric knob forward toward the camera body and pushing the magazine access cover toward the mounting plate.
2. Move the magazine latch out of the way.
3. Insert a Type A-6 film magazine into the camera with the aperture facing the lens and the footage indicator on the magazine toward the mount side of the camera. Note the footage of film in the magazine for setting the camera film footage indicator.
4. Move the magazine latch over the magazine end as far as it will go.
5. Close the magazine access cover.
6. Depress and turn the camera footage indicator to show the number of feet of film in the magazine. Set the shutter speed to the desired position.
7. Set the lens diaphragm stop.

Setting Shutter Speed The shutter speeds are 16, 32, and 64 exposures per second, and are controlled by turning the shutter speed knob on the camera body. An index mark indicates the speed for which the knob is set.

CAUTION: **Never change the shutter speed when the camera is running.**

Always align the index marks on the shutter speed knob and top cover before operating the camera.

Setting Lens Diaphragm Set the lens diaphragm in this manner:

1. The desired shutter speed, as indicated on the index ring, must be set against the index mark on the lens barrel.
2. Now set the diaphragm ring so that its index mark is set against the proper stop, as indicated on the index ring. The letters **B, H,** and **D** stand for bright, hazy, and dull.
3. It is important that the shutter speed knob on the camera body and the index ring on the lens are always set at the same shutter speed.

Bore Sighting

General The bore sighting operation consists of several adjustments which must be made in sequence. The airplane must first be aligned so that its centerline is perpendicular to a target board or to a vertical wall upon which marks can be made for bore sighting, and then leveled laterally and positioned in flight attitude. The optical and auxiliary gun sights must then be adjusted for alignment with the flight path of the airplane, and the guns adjusted or bore sighted to align with the gun sight. The Gun Sighting Chart in the Manual (Figure 44) or the chart provided in the map case in the cockpit may be used in determining the flight attitude (angle of attack of the fuselage reference line) for a predetermined speed of the airplane. The Bore Sighting Chart gives the horizontal and vertical dimensions necessary for gun sight, gun, and gun camera adjustments. Leveling lugs are located aft of the cockpit on the upper longerons.

Leveling the Airplane Position the airplane so that the forward datum point is 1000 inches (83 feet 4 inches) from the target board. Align the vertical line of the sight bull's-eye on the target board so that it is in alignment with the centerline of the airplane, or align the airplane centerline perpendicular to a vertical wall and draw a vertical line on the wall in alignment with the airplane centerline. This can be done by suspending plumb lines from the forward datum point and the aft datum point (see Figure 46).

Jack up the wings and tail to take the weight of the airplane off the landing gear. To prevent a nose-over, suspend a 100-lb. weight from each end of a bar inserted through the lifting tube. Level the airplane laterally by placing a level bar across the forward right leveling lug and the left leveling lug, then raising the appropriate wing.

Note: Jacks are necessary to support the airplane in the adjusted position during the bore sighting operation. If hydraulic-type jacks are used, check them against creeping during the adjustments.

Referring to the Gun Sighting Chart (see Figure 44), determine the angle of attack required. Raise or lower the tail until the correct angle, as indicated by a protractor level, is obtained.

Optical Gun Sight Adjustment Prior to adjusting the optical gun sight, see that the gun sight wires are properly connected to the forward side of the sight. Turn on

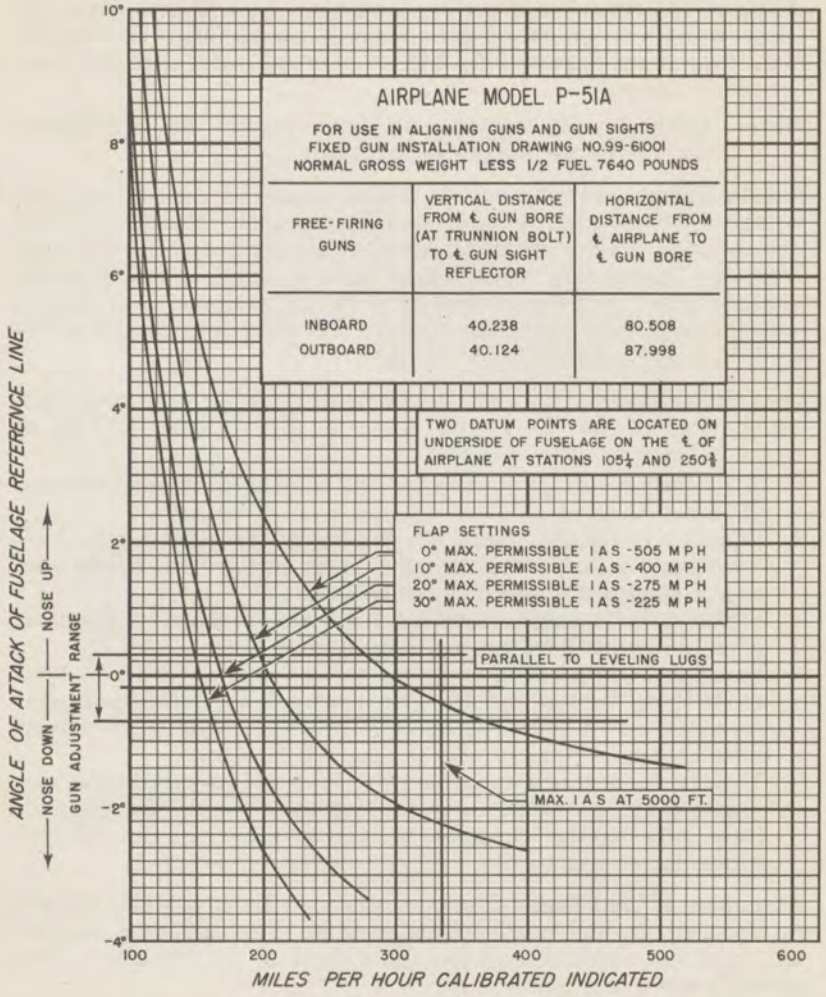


Fig. 44 GUN SIGHTING CHART

the gun sight rheostat and check the sight lamp and rheostat for proper functioning. Adjustment of the gun sight in elevation is made by means of the two adjustment bolts on the sides of the sight. Azimuth adjustment is made by loosening the reflector assembly and rotating it on the gun sight housing. In addition, reticle adjustment (explained immediately below) may be used to obtain finer azimuth adjustment.

Note: Normally the reticle and lens require no adjustment throughout the life of the gun sight.

Reticle Adjustment—Project the reticle image on the vertical centerline of the reflector by turning on the gun sight rheostat. Loosen the setscrew on the adjusting knob at the right side of the sight housing. Slowly turn the adjusting knob to move the reticle image into alignment with the centerline of the reflector, or in alignment with the gun sight alignment marks. Securely lock the adjusting knob in position by means of the setscrew.

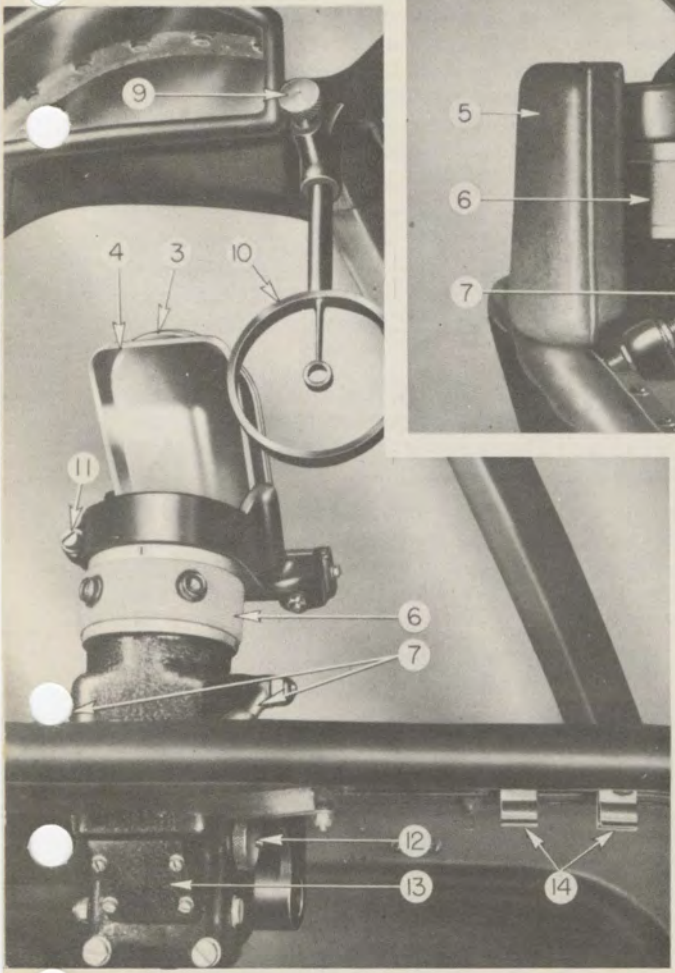
Lens Adjustment—The main lens assembly of the gun sight must be adjusted so that the reticle image on the reflector will be in focus. This is done as follows:

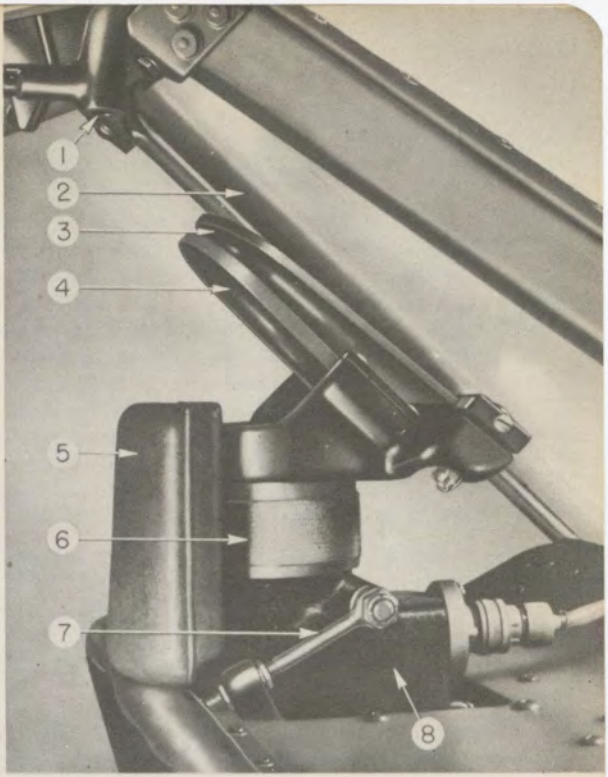
1. Remove the gun sight reflector and sunscreen assembly from the sight housing.
2. Unscrew the dust shield from the top of the sight housing by inserting a suitable tool into the holes in the dust shield ring and rotating the shield counterclockwise.
3. Back out the lockscrew, located at the side of the sight housing, which prevents the lens cell from turning.
4. Rotate the lens assembly until the reticle image, which is viewed as reflected through the reflector glass and superimposed upon the target board or wall, does not change as the eyes are moved over the 2-inch circular field of vision of the sight.
5. Replace the lockscrew, turning the lens cell as required to engage the end of the screw in the nearest notch of the lens cell. **Make sure that the lockscrew is tight;** then reinstall the reflector and sunscreen assembly.

Alignment of Gun Sight—The gun sight may be aligned by several methods, all of which effect alignment of the sight parallel to the centerline of the airplane and the flight path of the airplane. Two methods are given below:

1. **Using Sight Line Level Indicator**—Install a Type A-2 sight line level indicator (AAF No. 41D3689) on the gun sight reflector, and

1. AUXILIARY RING SIGHT SOCKET
2. ARMOR PLATE GLASS WINDSHIELD
3. SUN FILTER
4. REFLECTOR
5. CRASH PAD
6. CRASH PAD STRAP





7. VERTICAL ADJUSTMENT BOLTS
8. GUN SIGHT HOUSING
9. SPRING-LOADED PLUNGER
10. AUXILIARY RING SIGHT
11. REFLECTOR ASSEMBLY LOCK SCREW
12. RETICLE ADJUSTMENT KNOB
13. MIRROR ACCESS COVERPLATE
14. AUXILIARY RING SIGHT STOWAGE CLIPS

Fig. 45 OPTICAL GUN SIGHT

adjust the sight level by means of the knurled knob until the level bubble is centered. Sight through the level and check to see that the line of sight falls on the centerline of the sight bull's-eye on the target board or the vertical line on the wall. If not, loosen the reflector assembly attaching screw and rotate the assembly to bring the level line of sight on the centerline; then tighten the lockscrew. Raise or lower the target board until the line of sight of the level falls on the sight bull's-eye on the target board, or mark a point on the vertical line on the wall where the line of sight falls. Remove the level indicator from the reflector, and adjust the gun sight in elevation and azimuth to train the reticle image dot on the sight bull's-eye.

2. **Using a Level**—Place a leveling instrument at the height of the forward datum point (see Figure 46) and adjust it until the level bubble is centered. Sight along the level and establish a datum line on the wall, or position the target board so that the horizontal line through the gun bull's-eye is 14.68 inches above the sight line along the level.

Note: The datum line is a plane which is located 14.68 inches above the forward datum point. It passes through the centers of both inboard wing gun bores at the front trunnions and is parallel to the flight path of the airplane.

On the vertical line on the wall, mark a point which is the distance up from the datum line required for the sight aligning point. Draw a circle around the point to facilitate locating it from the cockpit. Adjust the gun sight in elevation and azimuth to train the reticle image dot on the sight bull's-eye.

Auxiliary Gun Sight Adjustment Adjust the auxiliary gun sight at the same time the optical gun sight is adjusted. The adjustment procedure is similar. Azimuth adjustment is made by sliding the bead sight in the attachment slot. Elevation adjustment is made by means of the attaching check nuts.

Adjusting Guns Prior to adjusting the guns, pull the bolts back and lock them. Install barrel reflectors. The neutral firing angle is plus 13 minutes with respect to the fuselage reference line. The guns are adjusted to toe-in so that their fire converges with the centerline of the airplane and the line of sight at 300 yards. Adjust the guns to bore sight on their respective bull's-eye on target board. The guns are adjusted in elevation and azimuth at the rear mounts by loosening the locknuts and rotating the

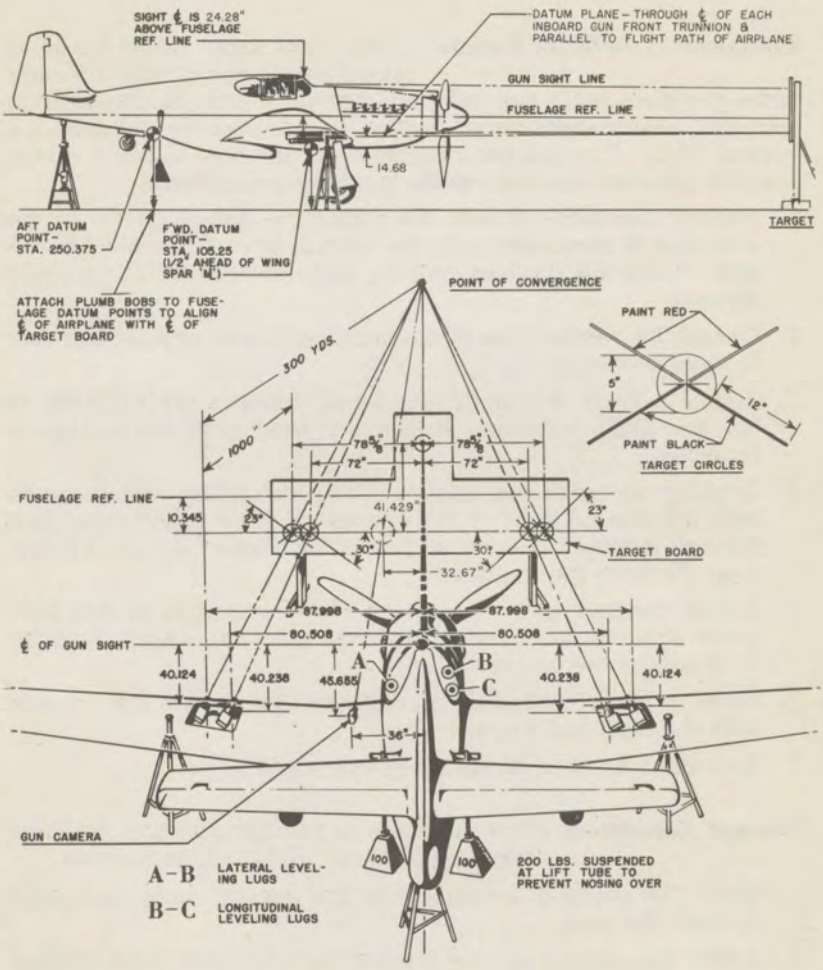


Fig. 46 BORE SIGHTING CHART

post, and by loosening the locknut and turning the special bolt and threaded sleeve.

Permanent Bore Sight Pattern If the bore sight target board is raised and lowered with difficulty when the sight bull's-eye is being aligned, it may be desirable to establish a permanent target pattern by painting the pattern on a vertical wall. The following variation in the bore sighting operation will provide accurate results if carefully conducted:

1. Position the airplane with the centerline perpendicular to the wall and in alignment with the vertical line of the sight bull's-eye. Level the airplane laterally and raise the tail to the flight attitude.
2. Extend the vertical line of the sight bull's-eye at least one foot in each direction.
3. Attach a Type A-2 sight line level indicator (AC41D3689) to the gun sight reflector. Adjust the level until the bubble is centered.
4. Establish an additional mark on the wall which will coincide with the line of sight of the indicator. Draw a horizontal line through the mark and across the vertical line of the sight bull's-eye. Remove the indicator.
5. Adjust the gun sight to train on the intersection of this horizontal line and the vertical line of the sight bull's-eye. Remove or disregard the horizontal line.
6. Raise or lower the tail of the airplane to align the line of sight with the sight bull's-eye.
7. Bore sight the guns to their respective bull's-eye.

Camera Adjustment The camera is to be aligned when the guns are bore sighted. Proceed as follows:

1. Insert the aligning indicator into the camera body and sight through the lens.
2. Adjust the camera on the bracket by loosening the mounting nuts and moving the entire unit until the indicator shows that the lens is centered on the camera aligning mark on the bore sighting target.
3. Fix the camera in position by tightening the mounting nuts.

BOMBING EQUIPMENT

Description

General An external, removable bomb rack is installed on the lower outer wing panel of each wing. Both bomb racks are identical and each accommodates one 100, 250, 300, or 500-pound bomb, one depth charge, or one chemical tank. When bombs are not carried, a 75-gallon capacity combat fuel tank or a 150-gallon capacity ferry fuel tank may be installed on each bomb rack. These tanks are dropped by the normal operation of the bomb control system.

Bomb Racks The bomb racks consist of a housing incorporating the bomb release mechanism, a solenoid assembly, and integral sway braces which are adjustable for the three different sizes of bombs that can be carried.

Mechanical Control System—The bomb rack cocking arm, when positioned aft, obtains a rack lock condition by means of an internal lock within the rack. With the arm in the vertical, or selective, position, the bombs may be released electrically. When the cocking arm is moved to the forward, or **salvo,** position, the internal lock is released, allowing the bombs to drop. The **lock, sel** (selective), and **salvo** positions of the racks are governed by a cockpit control handle which is connected by cables to an actuating sector above each rack.

Fig. 47 BOMB CONTROL HANDLE POSITIONS

Electrical Control System The system is used for the selection of nose or tail arming of bombs, to release bomb, depth charges, and fuel tanks when the control handle is in the **sel** position, and to ignite the chemical tanks. The control system consists of a bomb release switch on top of the pilot's control stick, and four toggle switches on the armament control panel. A bomb safety switch connects or disconnects the bomb circuit, another switch arms the bomb tail fuse on both racks, and separate switches nose arm the bombs on the left and right racks. The bombs are armed and released by three solenoids housed in each bomb rack and wired to respective switches in the cockpit.

Chemical Tank Installation Provisions are made for the installation of a streamlined chemical tank on each bomb rack. Each tank when filled weighs 588 pounds. Release of chemicals from the tanks is accomplished by pressing the bomb safety switch to **on** and then pressing the desired nose arming switch (right rack, left rack, or both) to the **on** position. Both tanks are dropped by following the same procedure as used for dropping bombs.

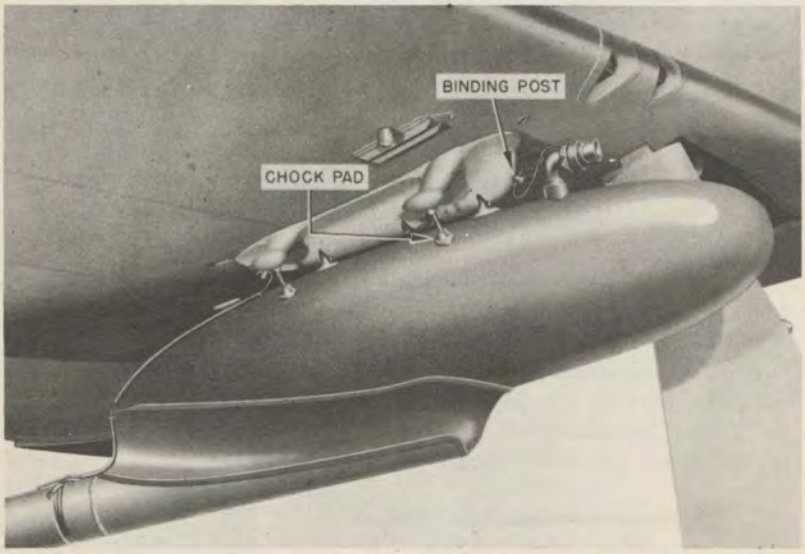


Fig. 48 CHEMICAL TANK

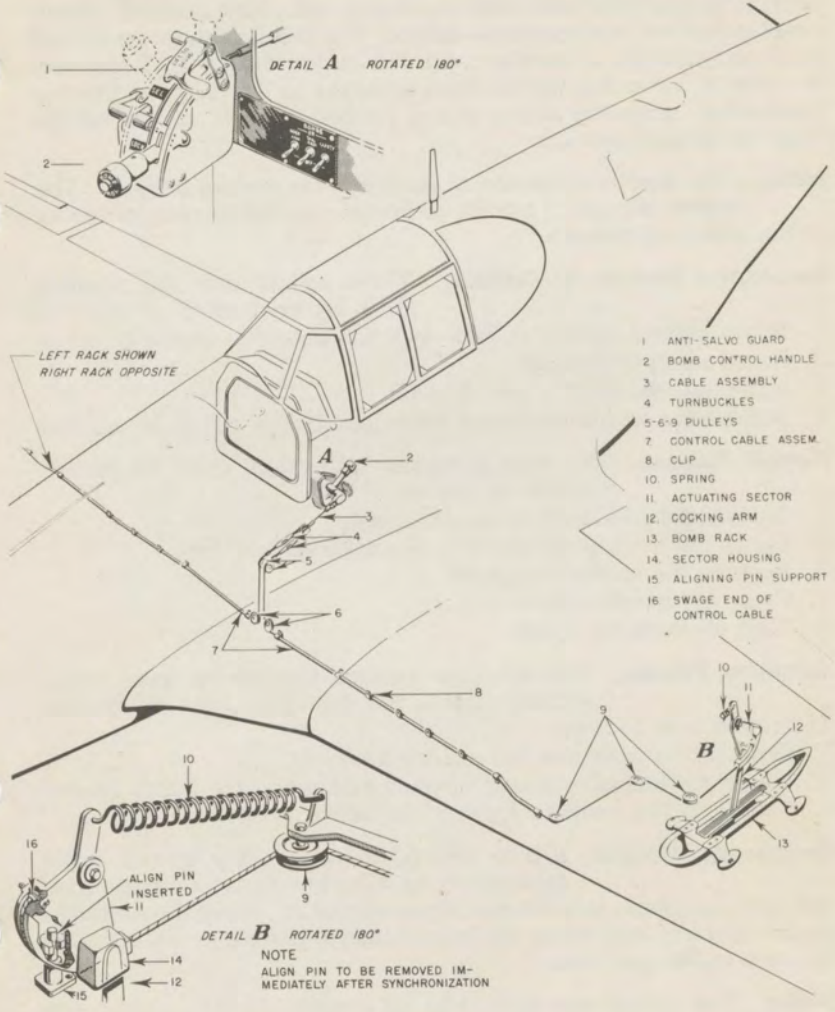


Fig. 49 BOMB CONTROLS SYSTEM

Operating Instructions

The bomb control handle, located on the forward left side of the cockpit, is provided with three positions: aft—**lock** (locked), center —**sel** (selective), and forward—**salvo.** The handle cannot be moved from one position to another until the button on top is depressed. In order to move the handle from selective to the salvo position, a mechanical antisalvo safety guard located forward of the handle must be hinged upward.

Note: The electrical release of bombs is the normal release. The **salvo** release of bombs is recommended in case of failure of the electrical release.

Inoperative Position of Controls When not in use, the controls shall be positioned as follows:

1. Bomb control handle in **lock** with the antisalvo guard in place.
2. Bomb safety switch **off.**
3. Nose and tail arming switches **off.**
4. Bomb support hooks closed when bombs are not to be carried.

Normal Release The normal release of bombs shall be accomplished as follows:

1. Move the bomb control handle to **sel.**
2. Move the arming switches to the desired position.
3. Position the safety switch **on.**
4. Press the bomb release switch.
5. Turn all switches to **off.**

Alternate Release The alternate release should be used when normal release has failed to drop the bombs. Operation is as follows:

1. Position the nose and tail arming switches.
2. Hinge the antisalvo guard upward and move the bomb control handle to the extreme forward, or **salvo,** position.

Emergency Release If it is desired to release the bombs in an emergency, or if the bombs are to be dropped in a safe condition, turn the electrical control off, hinge the antisalvo guard upward, and move the bomb control handle to the extreme forward, **salvo,** position.

Note: The optical gun sight may be used as a bomb sight. The bombs may be released when the airplane is in any attitude of flight from a 30° climb to a vertical dive.

CAUTION: **To prevent either bomb from falling into the propeller, do not release the bombs when sideslipping more than 5° in a vertical dive. Do not land with bombs in the racks.**

Preloading Inspection

Prior to loading bombs, a preloading inspection shall be made. First inspect the bomb racks and control system for safety, security, and proper stringing; then proceed as follows:

Test for Defective Rack—To test for a defective bomb rack, proceed as follows:

1. Place the bomb control handle in **sel** position.
2. Turn the ignition switch to **bat.**
3. Turn the bomb safety switch to **on.**
4. Push the bomb release switch on top of the control stick to **on** and then open the bomb support hooks on both racks.
5. Without moving the control handle, attempt to load a 100-pound test weight by pushing the weight support rings against the upper portion of both support hooks simultaneously. The rack should be unable to hold the weight under these conditions. Should the weight be held, either the rigging is incorrect or the rack is defective.
6. Move the controls to inoperative position.

Fig. 50 INSTALLING TEST WEIGHT

Rack Lock Test — The bomb rack lock is tested in this manner:

1. Cock the bomb rack by moving the control handle to **lock.**
2. Position the control handle in **sel.**
3. Push the bomb release switch to **on** and open the bomb support hooks on both racks. Do not change the position of the control handle.
4. Lift the test weight and hold the support rings against the support hooks of the rack. Hold this position while the bomb control handle is moved slowly into the **lock** position; the bomb rack should retain the weight
5. Move the control handle slowly to the selective position. If the rack does not hold the weight, either the rigging is incorrect and does not permit the rack to lock completely, or the rack is defective.
6. Move all controls to the inoperative position.

Fig. 51 TEST WEIGHT INSTALLED

Electrical Control Test—The bomb control electrical system is tested as follows:

1. If the test weight and controls have been changed from their last positions in the Rack Lock Test, above, **repeat that test.**
2. Turn the ignition switch to **bat.**
3. With the nose and tail arming switches **off,** the arming hooks should be unlocked.
4. Turn the arming switches to **on**—the arming hooks should now be locked.
5. Turn the bomb safety switch to the **on** position.
6. With the bomb control handle in **lock,** press the bomb release switch. The test weight should not release.
7. Move the bomb control handle to the selective position and press the bomb release switch. The test weight should release.
8. Move all controls to the inoperative position.

Note: If the results of procedures 6 and 7 are contrary to those described, recheck the rigging. If the rigging is correct, the rack is defective.

Salvo Test The following check should be made to assure proper functioning of the mechanical release:

1. Cock the bomb rack by moving the control handle to lock.
2. Place the bomb control handle in the **sel** position.
3. Turn the ignition switch to **on.**
4. Turn the bomb safety switch to **on.**
5. Press the bomb release switch and open the bomb support hooks.
6. Place the bomb control handle in the **lock** position.
7. Load the test weight on the rack.
8. Lift up the antisalvo guard and move the bomb control handle to **salvo.** The test weight should release.
9. Hold the bomb control handle in the **salvo** position and open the bomb support hooks.
10. Move the control handle to **lock.**
11. Load the test weight on the rack.
12. Lift up the antisalvo guard and move the bomb control handle to **salvo.** The test weight should release.

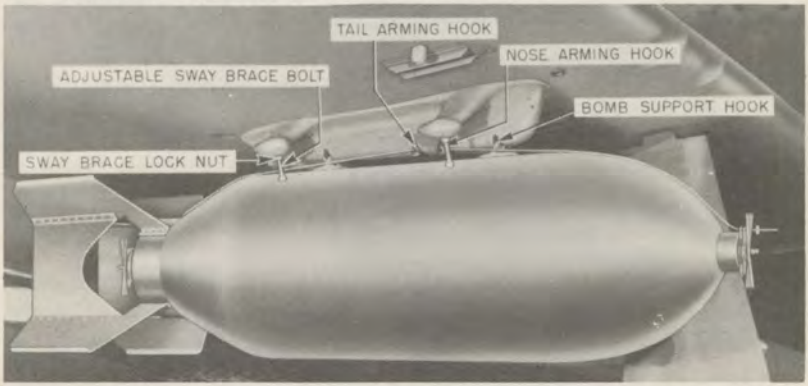


Fig. 52 BOMB INSTALLED

Loading

A preloading inspection must be made before bombs are loaded. After that inspection is completed, proceed as follows to load bombs:

1. Cock the racks by placing the bomb control handle in **lock.**
2. Move the bomb control handle to **sel.**
3. Turn the bomb safety switch to **on** and depress the bomb release switch while opening the bomb support hooks on both racks.
4. Move the bomb control handle to **lock** with the antisalvo guard in the down position.
5. Turn the bomb safety switch to **off.**
6. Make certain the nose and tail arming switches are in the **off** position.
7. Lift the bomb until both bomb support lugs have entered the two slots in the rack, then bump the lugs against the upper portion of the rack support hooks. The hooks will snap shut and lock the rack, and the bomb will then hang in its proper position.
8. Turn down the inboard sway brace bolts to the bomb. Do not move the bomb by turning the bolts too far.
9. Tighten the outboard sway brace bolts down to the bomb. Do not draw the sway brace bolts too tight—tighten only until the heads of the bolts touch the bomb case on all four bolts and then give each of the four bolts one full turn.

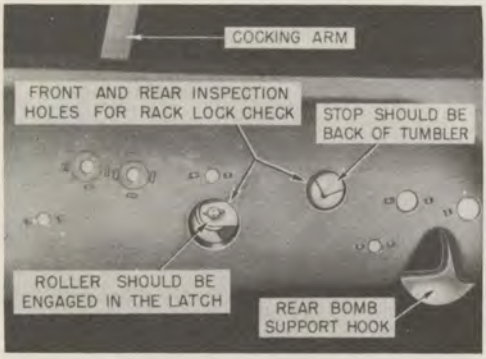


Fig. 53 BOMB RACK MECHANISM

CAUTION: **Secure all sway brace locknuts.**

10. Install the nose arming wire on the forward arming hook; then connect the other end of the wire to the nose fuse of the bomb.
11. Install the tail arming wire on the aft arming hook; then connect the other end of the wire to the tail fuse of the bomb.
12. Make a visual check through the inspection holes on the side of the bomb rack to make sure that the roller has engaged in the latch (forward inspection hole) and that the stop is back of the tumbler (rear inspection hole).

RADIO EQUIPMENT

General

There are two types of radio equipment installed in the P-51A Series Airplanes: The command set and the identification equipment. The command radio may be either of two sets: SCR-522-A or SCR-274-N. Since the operation of the two sets is dissimilar, each type of radio will be described separately below. Identification radio equipment may be any of three sets: SCR-535, SCR-515, or SCR-695.

Use of Hand Microphone If a hand microphone is used, these rules should be followed:

1. Hold the microphone close to the face with the lips just touching the surface.
2. Keep the head in a vertical position while transmitting, so that the plane of the microphone face is substantially vertical.
3. Do not shout. Forget the surrounding noise and imagine that you are speaking directly into the ear of the listener.
4. Finish each word completely before starting the next.
5. Emphasize with a distinct hiss all sibilants such as S, C, and Z. Emphasize all terminal consonants such as T and G.

Use of Throat Microphone—When using the throat microphone for radio communication, adjust it so that its two circular elements are held snugly against each side of the throat just above the Adam's apple. Speak slowly, distinctly, and in a normal tone of voice. **Shouting will seriously distort the voice signal.**

Command Set SCR-522-A

Description The radio set SCR-522-A is a push-button type of transmitter-receiver operating on the 100 to 156 mc band. A control box for this equipment is located just aft of the right-hand switch panel in the cockpit. The small lever on the rear of the box controls the momentary or permanent action of the transmit-receive toggle switch. The small lever at the forward end of the

Fig. 54 SCR-522 CONTROLS

control box regulates the brightness of the indicator lamps by moving a dimmer mask over them. The microphone furnished for this equipment is of the dynamic type and is normally mounted in a face mask. Leave the switch on the back of the microphone in the **on** position.

Reception Ascertain that the toggle switch at the bottom of the control box switch panel is in the **R** (receive) position. To start the equipment, press button **A, B, C,** or **D,** depending on which band is desired. Allow the set approximately one minute to warm up. A slight background noise should be heard, but should not be excessively loud. Reception of a signal will give an indication as to whether the receiver is operating properly or not. To turn the set off, press the button marked **off.**

Note: When operating the SCR-522-A radio set on the ground without an external power supply connected to the airplane, the time of operation should be kept to a minimum to prevent excessive drain on the battery.

Transmission To start the equipment, press button **A, B, C,** or **D,** depending upon the band to be used. Allow the set approximately one minute to warm up; and during this time, check the switch on the back of the microphone for an **on** position and check the contactor switch for both **on** positions. For transmission, the toggle switch at the rear of the control box panel should be pushed to the **T** (transmit) position. To check whether the set is transmitting properly or not, make contact with a nearby station. The set is turned off by pushing the button marked **off.**

Remote Contactor The contactor is located on the left-hand side of the instrument panel. It consists of a switch operated by a clock, and serves to switch the transmitter from any of the four voice-modulated bands to the **D** band, tone modulated, for 14 seconds of every minute. The pointer on the face of the contactor indicates when the switching action will take place. This warns the pilot that speech will not be transmitted until the special

of the receiver control box. The purpose of this switch is to destroy the **Radar** equipment should it be necessary to abandon the airplane over enemy territory. When both push buttons are pressed, a detonator inside the receiver is set off, thus destroying the receiver internally without damaging the airplane.

Note: Regeneration adjustment of the Radar set must be made on the ground prior to flight to ensure correct operation of the equipment.

INTERAIRCRAFT SIGNAL LAMP

Provisions have been made to the left and aft of the pilot's seat for the stowage of a Type AN-3089 quick signaling lamp for communication between airplanes without using the radio equipment. A sight on top of the lamp permits accurate control of the direction of the signal beam. Four snap-on filters, usually stowed in this map case, control the color of the beam.

Fig. 59 INTERAIRCRAFT SIGNAL LIGHT

COLD WEATHER PROVISIONS

General

Certain cold weather installations are provided for this airplane. These installations are described below together with instructions for their use in the sequence they will be needed.

Propeller Anti-icer System—The airplane is equipped with a propeller anti-icing system comprised of an alcohol fluid tank, electric motor-driven pump, and a propeller anti-icing slinger ring. Leading edge feed shoes for the propeller blades will be installed in the field as they are needed. The system distributes alcohol along the leading edge of the propeller blades to prevent the adhesion or accumulation of ice on the propeller. The operation of the system is controlled by an off-and-on circuit-breaker switch located on the right side of pilot's switch panel. The pump delivers alcohol to the propeller at the rate of one and one-quarter gallons per hour. The pump is located on a bracket

Fig. 60 PROPELLER ANTI-ICER SHOE

on the forward side of the firewall, and the tank is located aft of the pilot's seat. If the airplane is to be used for combat flying, the tank should be filled with noninflammable fluid. A separate anti-icing system, provided for long-range use, is described in Section 6.

WARNING: **If noninflammable fluid is not available, it is recommended that the combat anti-icer tank be removed.**

Windshield De-icer System A system of windshield de-icing which uses hot coolant from the engine system is provided on the airplane. A self-closing control valve on the upper right-hand corner of the instrument panel operates the system. The spray tube is mounted forward of the windshield.

Propane Primer System The propane priming system serves to facilitate quicker starting in cold weather. Propane is a highly volatile gas and its only method of use is from an outside source. The priming equipment connection is accessible through an access hole in the engine cowling on the bottom side of the accessory compartment. The fitting is located on a support bracket attached to the anti-icer pump support bracket. The propane priming system is independent of and in addition to the regular priming system of the airplane.

Immersion Oil Heater— Provision has been made on the oil tank for the installation of an immersion heater when the airplane is assigned to winter operation. The receptacle for connecting the external 110-volt

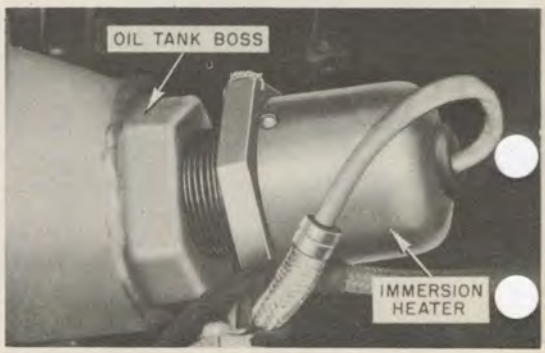


Fig. 61 OIL IMMERSION HEATER

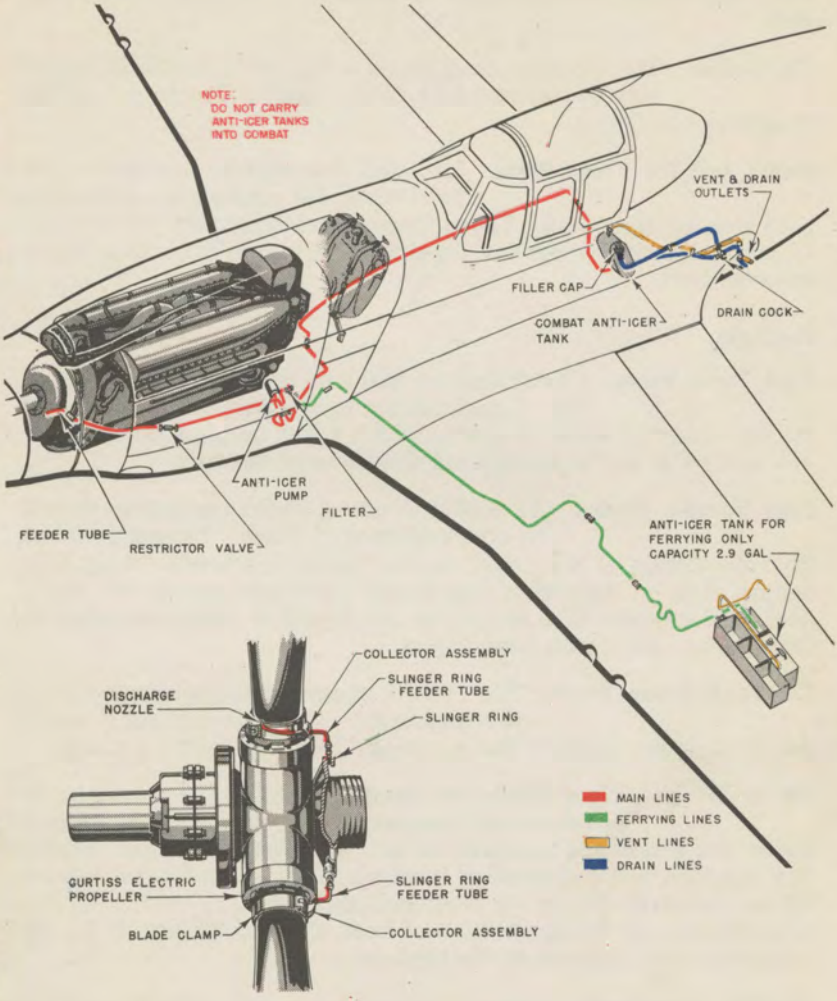


Fig. 62 PROPELLER ANTI-ICER SYSTEM

electrical supply for the heater is located in the right-hand wheel well.

Oil Cooler The airplane is equipped with a self-thawing oil cooler considered satisfactory for use under cold weather operating conditions.

Snow and Ice Tread Tires Ice tread tires will be installed in the field when the airplane is assigned to cold weather operation. These tires are provided with metal cleats to assure traction when the airplane is operating on snow- or ice-covered fields.

Preflight

Fuel Tank Vents Check that the fuel tank vent lines are free from ice. Condensation in the vent lines could cause the formation of water droplets, which upon freezing could result in a stoppage and a consequent distortion of the tank.

Fuel System Drains All fuel tank and fuel system drains should be checked prior to flight. If gasoline flows from the drains, it is evident that no water is present. If no flow occurs, it is an indication that frozen water has prevented liquid flow, and a heater tube should be employed to warm the sump or drain point until liquid flow occurs.

Oil Tank Sump Drain The oil tank sump should be drained prior to every flight. If no flow occurs, it is evidence of frozen water in the sump and heat should be applied.

Ice in Wings When there are sharp changes from moderate to extreme cold, condensation will cause ice to form inside the wings and fuselage as well as outside. Careful inspection must be made to ensure freedom of all controls and mechanisms. Removal of such ice is difficult and generally can be accomplished only by the application of heat, since chipping off the ice might result in damage to the airplane.

Heating Instruments When temperatures fall below —21°C (—5°F), heat should be applied to the instruments. If the airplane is to remain on alert, heat must also be applied to the armament equipment to assure its immediate operability.

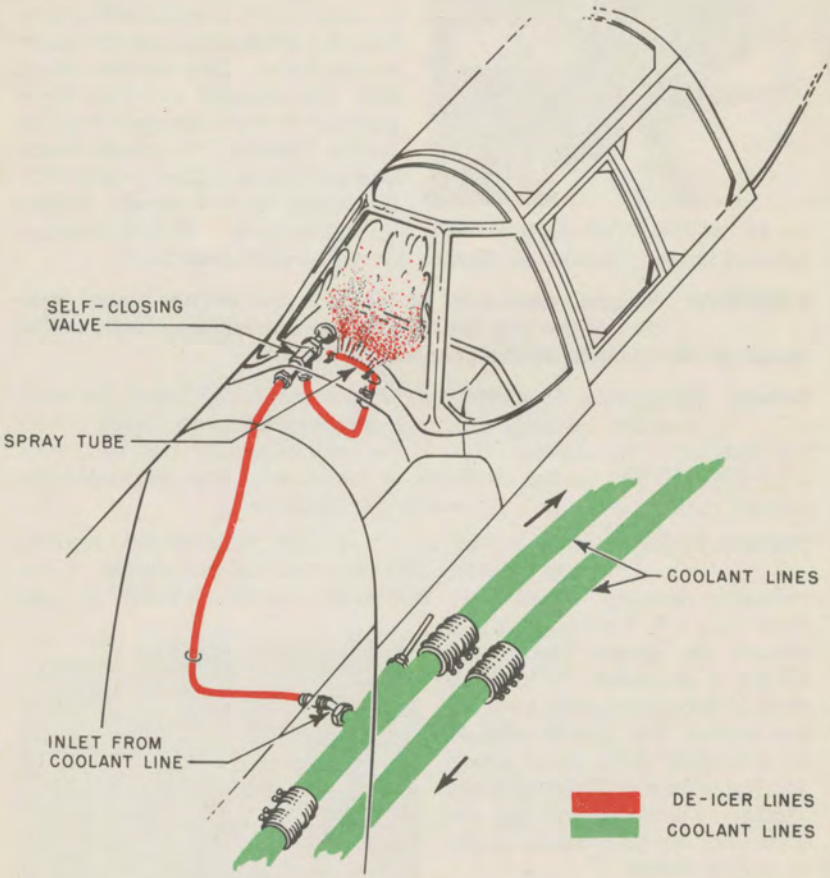


Fig. 63 WINDSHIELD DE-ICER SYSTEM

Fig. 64 ENGINE COVER HEATING SOCK

Starting

Preheating Engine—When operating under freezing conditions, a portable ground heater should be employed, if available, to preheat the engine and cockpit prior to the flight. The engine cover and the cockpit cover are equipped with ground heating socks. Remove the access doors and enclosure panel in line with the socks on the covers, before applying heat. When using a ground heater, be sure to protect the self-sealing fuel hose.

CAUTION: **Extreme care must be taken to prevent accidental ignition of the gas fumes from the engine breathers, as the result of vaporization of the gasoline in the oil.**

Battery Energizers or battery carts are generally used for cold weather starting, as this is more practicable than heating the battery. The battery should be maintained at not less than —12.2°C (10°F). Lower voltage at extremely low temperatures causes malfunctioning of all electrical equipment.

Starting Engine Always turn a cold engine three or four revolutions by hand before engaging the starter. Considerable priming is necessary to ensure a successful start in cold weather. A light priming should be given before the starter is engaged. While the engine is being turned over by the starter, the primer should be operated with short sharp strokes until regularity of firing results. Do not prime the engine until actually ready to engage the starter.

Propane Primer When the primer system of the airplane proves inadequate to start the engine, an outside primer source should

Fig. 65 COCKPIT COVER HEATING SOCK

be used if available. The exact temperatures at which this efficient priming system is required are undetermined, but it is usually when the ground temperature reaches freezing. Immediately after using the propane system the intake cap should be screwed on finger-tight and safetied.

CAUTION: **Propane is a highly volatile gas (not a fluid), and extreme care should be exercised when using it to prime the engine.**

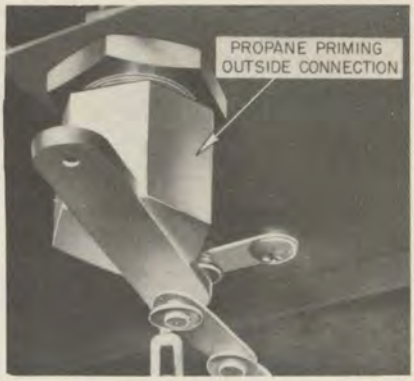


Fig. 66 PROPANE CONNECTION

Moisture on Plugs Moisture quickly forms on the spark plugs during cold starts. After three or four unsuccessful attempts to start the engine, remove at least one plug from each cylinder and heat the plugs to 65°C to 75°C (145°F to 167°F)—comfortably warm in the hand—to dry the points. Make another attempt to start the engine immediately after replacing the plugs.

CAUTION: **Do not grasp tools or other metal articles with the bare hand during sub-zero weather, as the skin will freeze to the article and result in a painful tearing of the flesh.**

Warm-up

Do not run the engine to more than 900 RPM until the oil has reached a temperature of 40°C (104°F).

Take-off

Ice on Wings **Do not take off with snow, ice, or frost on the wings.** Even loose snow cannot be depended upon to blow off, and only a thin frost layer is necessary to cause loss of lift and very treacherous stalling characteristics. Remove any accumulation of ice, snow, or frost

in this way: Using hot water, melt one small area of the surface at a time and then flush this area with denatured alcohol before the water freezes. Particular attention should be paid to the hinges and the controls. Alcohol is used for cleaning the frost off the cockpit enclosure. Under some conditions, it may be necessary to taxi out to the take-off position before removing the protective covers from the flight surfaces, since frost formation is very rapid at certain times.

Snow in Airplane Light blowing snow will accumulate in all parts of the airplane where openings remain uncovered. Prior to take-off, the wings and the fuselage in the vicinity of all openings must be carefully inspected to prevent an attempted take-off with an overload consisting largely of drifted snow.

Snow on Take-off Area If deep, heavy snow interferes with the take-off run, but permits the airplane to taxi, **move slowly up and down the take-off course several times to pack down the snow on the runway before attempting the actual take-off.**

Ice on Take-off Area When taking off or landing on a narrow strip of clear ice, cross winds are particularly dangerous, because of the loss of maneuverability caused by the lack of traction. The airplane may, if the wind is gusty, be blown completely off the ice before control can be regained.

Flight

After Take-off Following take-off from snow- or slush-covered fields, operate the landing gear and flaps through two or three complete cycles to preclude the freezing of the gear or the flaps in the up position. The pitot tube heater should be turned on by moving the switch marked pitot heat to the **on** position.

WARNING: **Do not turn on this switch when the air-**

plane is on the ground, as there is insufficient cooling in the pitot head.

Propeller Anti-icer System If ice starts to form on the propeller, turn on the anti-icer system switch located on the right side of the pilot's switch panel. The system contains sufficient fluid for 45 minutes of continuous operation.

Windshield De-icer System When the windshield starts to ice up, push the windshield de-icer control valve and then release. Care should be taken to minimize the use of this system, since liquid is taken from the engine coolant system. About two gallons of liquid are available; this is sufficient for approximately 50 intermittent applications.

Flight Plan Stay on a prearranged flight course, if possible, so that searchers will be able to find you if you are forced down. Except in extreme emergency, it is better to land or crash-land than to bail out.

Landing

Temperature inversions are common in winter and the ground air may be 15° to 30°C (59° to 86°F) colder than that at altitude. Therefore, care must be taken to avoid excessive cooling when letting down. Lower the landing gear and use partial flaps to reduce airspeed while descending. Retain considerable power and regulate the air scoop to eliminate cooling the engine excessively. If possible, maintain the coolant temperature above 60°C (140°F) and the oil temperature above 30°C (86°F) during all letdowns. Lower readings than these may result in the engine cutting out or the failure of the engine to respond when the throttle is advanced.

After Landing

Oil Dilution This system provides a method of diluting or thinning the engine oil with gasoline at the end of each flight, in order to facilitate starting the engine in cold weather. Dilution of the oil is accomplished as follows:

1. Operate the engine at 800 RPM, and maintain an oil temperature of 5°C to 50°C (40°F to 122°F).

2. For ground temperatures from 5°C to —7°C (40°F to 20°F), hold the oil dilution switch in the **on** position for four minutes, stop the engine, and then release the oil dilution switch.
3. For ground temperatures from —7°C to —30°C (20°F to —20°F), dilute the oil for a second four-minute period, 15 minutes after the first dilution.
4. For ground temperatures below —30°C (—20°F), dilute the oil for a third four-minute period, 15 minutes after the second dilution.

Note: It is impossible to dilute the engine oil unless the engine is running.

Battery To safeguard the battery when the airplane is to be idle, remove the battery from the airplane and store in a heated location.

Protective Covers An engine and cockpit cover are provided with the airplane, but the entire airplane should be covered with tarpaulins to prevent snow, ice, and frost accumulation.

Tires When parking the airplane on snow or ice, **it is essential to provide some type of insulating material under the wheels to prevent the tires from freezing to the surface.** Lack of such precautions frequently results in tearing off large chunks of rubber from the tires when the airplane is again moved.

Brakes The parking brakes should not be used on the parked airplane, as ice formed by condensation will lock the wheels.

Mooring If the mooring kit supplied with the airplane cannot be used to moor the airplane because of frozen ground, snow, or ice, suitable mooring points can be made in this way: Dig holes approximately eight inches deep and eight inches square. Place two notched stakes

crosswise in each hole, and then tie the mooring ropes to the stakes. Fill the holes with water, which will freeze and hold the stakes and ropes fast. If possible, head the airplane into the wind before tying down. Other similar methods of mooring the airplane may be improvised, depending on the availability of material. Mooring lines should be tight to prevent the airplane from rocking in the wind. A slack line is of little value.

Coolant Liquid When clean containers and heating facilities are available, the coolant liquid should be drained from the airplane, warmed, and replaced in the airplane just prior to starting the engine. Warm coolant materially assists in starting the engine. Do not drain the coolant until the coolant temperature falls to approximately 5°C (40°F) in order to avoid sudden chilling of the engine parts. Always leave the drain plugs open until just before the heated coolant is returned to the system.

CAUTION: **Care should be exercised when making emergency repairs or in replacing equipment which is very cold not to use too much tension when tightening nuts, bolts, plugs, etc. These will expand upon warming up and may freeze or snap.**

Frosting When the airplane is parked for the night, the enclosure should be left partly open to permit the circulation of air inside the cockpit and so prevent the windows from frosting over. This is certain to occur in cold weather if no circulation of air is permitted.

Oil Immersion Heater The heater maintains the oil at a satisfactory temperature and prevents congealing, thereby promoting the immediate circulation of the engine oil when quick starting is essential. The immersion heater should be put into operation as soon as possible after stopping the engine and left in operation until the engine is to be started again.

Communication Equipment The following communication equipment is adversely affected by extreme cold weather:

1. **Dynamotor**—The increased viscosity of bearing lubricants may prevent the dynamotor from starting, resulting in blown fuses. If this occurs, the grease should be removed and oil substituted as a lubricant.
2. **Operating Controls, Hand Switches**—Stiffness of operation may

occur. The oil should be removed in order to prevent drag and binding.

3. **Storage Battery**—The battery should be kept charged above 1.290 specific gravity to prevent cracking around the edges of the case.

4. **Microphone**—The hand microphone is unsuitable for use in cold weather. Moisture collects and freezes in the small holes of the microphone cap. A throat-type microphone should be used for all cold weather operations.

5. **Transmitter**—In certain types of transmitters, frequency shifts occur with wide changes in temperature. Consequently, the transmitter must be retuned and checked until a relatively stable temperature is reached.

Personal Considerations

General Personnel undertaking Arctic flight operations should exercise great care in preparing the person for flight or ground activities. Failure to comply with the instructions below may result in physical discomfort or serious injury to the persons involved. Follow the instructions and you will find Arctic operations more pleasant.

Sweating Sweating is always dangerous in sub-zero temperatures. If your feet or other parts of your body perspire, make sure that your clothing and body are absolutely dry before you go outside in severe weather conditions. Ice will form in the clothing and damp portions of the body will freeze almost immediately.

Clothing Suitable and adequate clothing should be worn at all times. The greatest danger from freezing is in the spring when the sun shines brightly and the temperature warms up to 15°F (—10°C) or 25°F (—4°C) during the day, as personnel is tempted to go out wearing less clothing than usual. At sundown the temperature will drop rapidly, although many hours of daylight may be left. During the night the temperature may drop as low as —50°F (—46°C).

Face Masks—In extreme temperatures, face masks should be worn.

Overexertion When the temperature is —25°F (—31.7°C) or below, there is danger of freezing the lungs through deep breathing following overexertion. If you unknowingly over-

exert and start gasping large breaths of air, put your head down and breathe from inside your clothing until the heavy breathing stops.

Shelter Light tent shelters or heater nose hangars must be provided to enable maintenance crews to work efficiently with tools and equipment.

Insulating Tools Metal tools may be insulated against cold by wrapping the handles with a light cord.

Gasoline Spillage Gasoline spilled on the hands or clothing in subzero weather has an effect similar to that of liquid air; it will freeze flesh in a few seconds after contact.

Forced Landing In case of a forced landing, personnel is directed to remain in the vicinity of the aircraft in order to conserve energy, to avoid exertion, and to simplify rescue, as it is impossible to traverse normal Arctic terrain except under the most favorable circumstances.

Fig. 67 OXYGEN INSTALLATION

OXYGEN EQUIPMENT

Description

The oxygen system consists primarily of two Type D-2 low-pressure oxygen cylinders mounted in the fuselage aft of the radio compartment, a Type A-12 demand regulator, a cylinder pressure gage, a low-pressure warning signal, a flow indicator, and a filler valve. The mask used with this system may be Type A-9, A-9A, or A-10.

DANGER: **If oxygen comes in contact with oil or any material containing oil, spontaneous combustion and explosions are certain to occur. Every precaution must be observed to keep oil, grease, and all readily combustible materials well away from all oxygen apparatus. Be sure hands and clothes are clean.**

Operation

The A-12 demand regulator, mounted in the forward right-hand corner of the pilot's cockpit, normally requires no adjustment; the mixing of air and oxygen and the compensation for change in altitude are fully automatic. The air valve assembly has been designed in such a way that air is automatically mixed with the oxygen until the altitude attained requires the use of pure oxygen. The air valve then automatically closes and only a stream of pure oxygen passes to the oxygen mask. If pure oxygen is desired prior to the automatic shutoff, turn the automatic mixture lever at the side of the case to the **off** position. No air will then enter the regulator mixing chamber. In case the regulator mechanism fails, turn the red emergency knob on the front of the regulator to **on;** oxygen will then feed directly into the main chamber of the case, and then into the oxygen mask at a normal fixed rate of flow. When the automatic mixture lever on the regulator is set in the **on** position, the oxygen mask need not be connected to the regulator until oxygen is required, as the operation of the regulator is controlled by the breathing of the individual when the mask is connected to it.

Flow Indicator and Warning Signal A blinker flow indicator on the right side of the instrument panel operates with the breathing of the wearer, indicating proper functioning of the system. When the pressure of the cylinders drops to the danger point (100 lbs./sq. in.), a signal lamp on the instrument panel is illuminated.

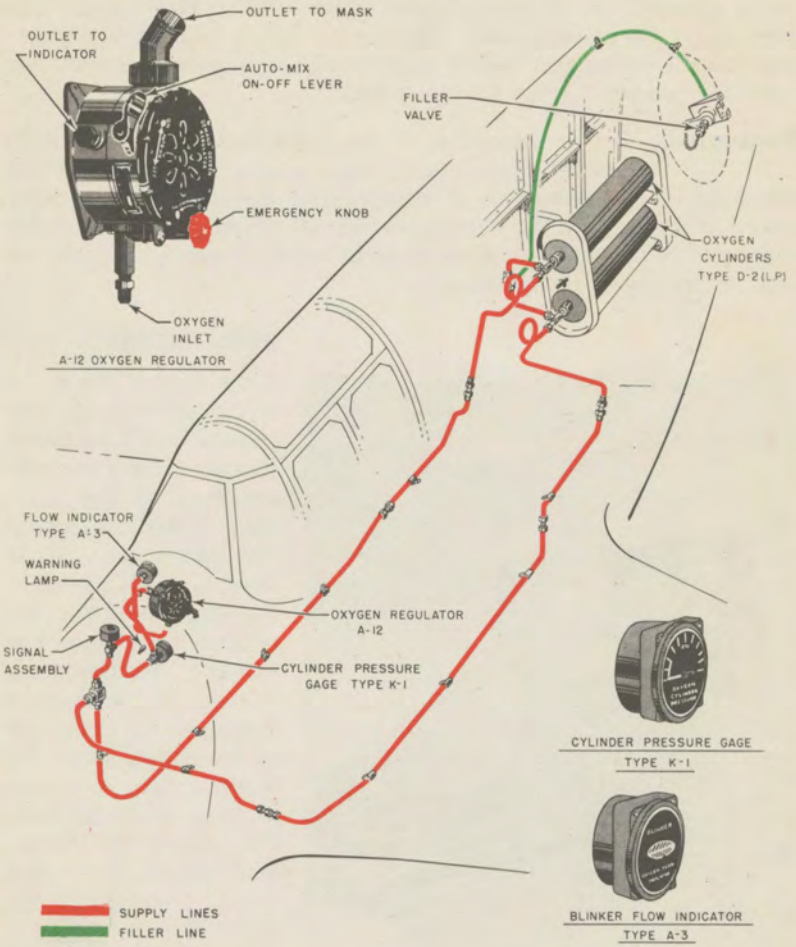


Fig. 68 OXYGEN SYSTEM

Filling Cylinders The oxygen cylinders may be refilled without removal from the airplane by means of a filler valve situated aft of the cylinder access door. The normal full pressure of the system is 365 lbs./sq. in. Before take-off, make certain that the cylinder pressure gage on the instrument panel shows sufficient oxygen supply for the mission.

Precaution: The construction of the Type A-9, A-9A, and A-10 oxygen masks is of such nature that they will not stand abuse. Consequently, it is imperative that masks be properly stored or hung up in the airplane when not in use. Care should be exercised to prevent the mask from being exposed to sunlight, as this causes rapid deterioration.

Fig. 69 SIGNAL PISTOL

PYROTECHNICS

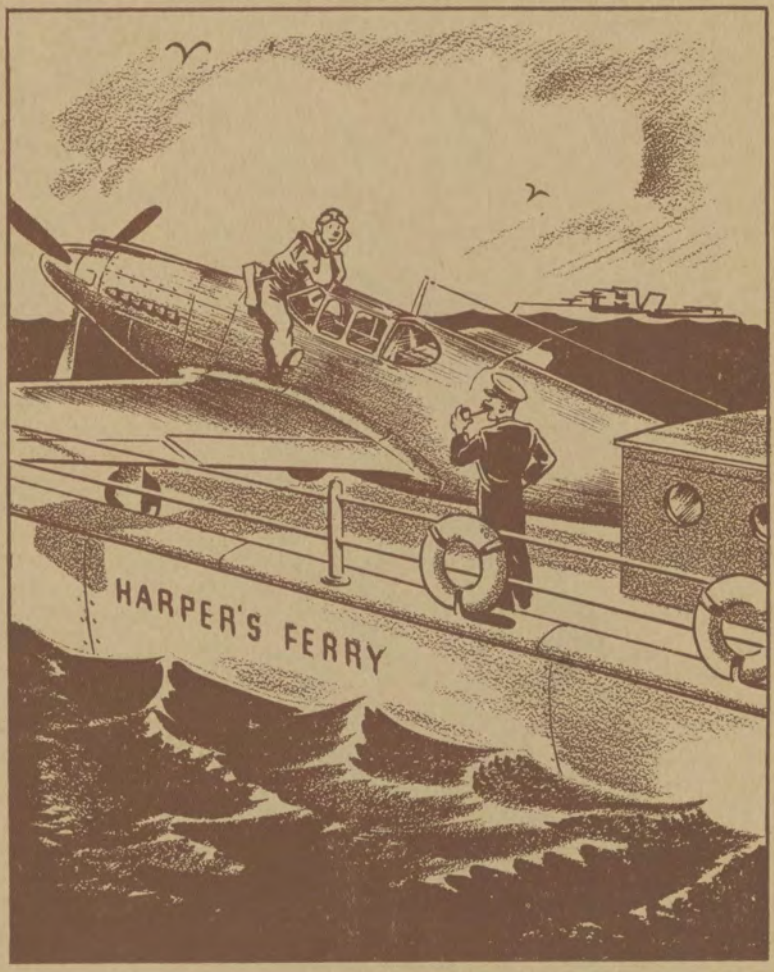
The airplane is equipped with an M-8 pyrotechnic flare pistol mounted on a bracket attached to the fuselage at the left side of the pilot's seat. It is fired through a hole in the fuselage at the outer end of the mounting bracket. Six flares are stowed in a canvas container just to the left of the pilot's seat. To insert a flare in pistol, pull on the lower handle above the barrel and break it in the same manner as an ordinary revolver. When the upper handle on the barrel is pulled, the pistol is released from the bracket.

Section 4

Contents

ALL CHARTS AND INFORMATION FOR THIS SECTION
WILL BE ISSUED AS SOON AS AVAILABLE.

Section 5



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SECTION 5

Special Ferrying Equipment

AUXILIARY FUEL SYSTEM

Description

General By the addition of two separate auxiliary tanks the total fuel capacity of the P-51A Airplane may be increased to 480 gallons. This does not alter the basic fuel system, as the additional tanks, which are droppable, are secured to the airplane by means of the wing bomb racks and are merely attached to fuel lines already provided. The auxiliary fuel system interconnects to the main fuel system just aft of the fuel strainer on the firewall. The tanks, lines, and units of the fuel system have been prepared for the use of aromatic fuels.

Ferrying Tanks The droppable ferrying tanks are constructed of wood and have a fuel capacity of 150 U.S. gallons (125 Imperial gallons) each. They are installed on the bomb racks by means of two shackle fittings, and the tank fuel line is connected to the wing outlet by means of a rubber hose and a straight nipple which is installed in the underside of the wing forward of the bomb rack. Access to the fuel line within the tank is gained by the removal of the access door, which contains the filler cap. A vent line extends along the top of the tank, from the front to the rear. The filler cap is at the front and top of the tank, and the drain plug is on the bottom of the tank.

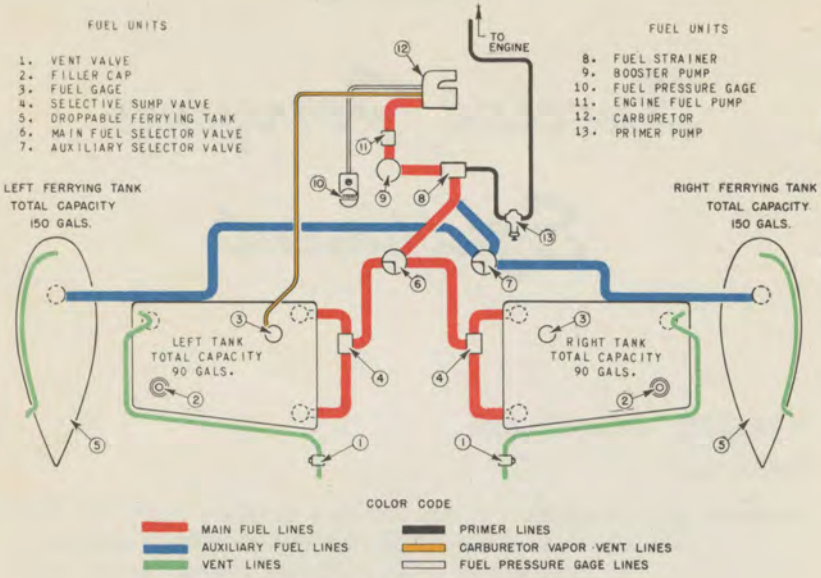


Fig. 82 FUEL SYSTEM LINE DIAGRAM

Operating Instructions

Take-off Turn the main fuel tank selector valve to the **left** position. Desired fuel valve settings should always be determined by click and feel, and not solely by dependence upon the position of the control handle pointers. Be sure the booster pump is **on** and operating properly. Test flights have shown that an unusual condition exists when the landing gear of the P-51A equipped with long-range ferrying tanks is raised or lowered. With the gear in the down position, the airflow between the landing gear fairing and the ferrying tanks creates a side pressure of sufficient force to cause the landing gear down-lockpins to bind. Therefore, to retract the landing gear under these conditions, the pilot must first pull up on the landing gear handle and then **yaw the airplane from side to side** in order to relieve this air pressure sufficiently to permit the down-lockpins to be released.

WARNING: **Do not under any circumstances remove the lock bar from the flap control handle and attempt to lower the flaps over 20° when the droppable ferrying tanks are installed, as serious structural damage to the airplane would result. Neither the tanks nor the flaps are designed to withstand the hydraulic pressure that would be placed upon them if an attempt were made to lower the flaps fully.**

In Flight Turn the main fuel selector valve to the **off** position and quickly turn the auxiliary system selector valve to either the **left** or **right** position. Alternate between both ferrying tanks in consuming the fuel, to prevent excessive wing heaviness. When the entire auxiliary supply of fuel has been consumed, turn the auxiliary selector valve to **off,** and turn the main fuel system selector valve to the **right** or **left** position. Then continue to alternate between left and right main tanks.

Do not exceed 250 IAS with ferry tanks installed.

Note: The pilot must keep in mind that it requires approximately ten seconds for the fuel from the second ferrying tank to reach the engine after the fuel from the other ferrying tank has been depleted.

Landing A landing must never be attempted while the engine is operating on fuel from the ferrying tanks. Make sure that the auxiliary selector valve is **off** and the main selector valve is in the **left** or **right** position, as the engine will not function if either selector valve is set on an empty tank. Be sure the booster pump is **on.** As a result of thorough flight tests, it has been discovered that, when the landing gear is lowered, side pressure between the landing gear fairing and the ferrying tanks will prevent the gear from fully lowering into the required position to

enable the down-lockpins to engage. Therefore, to lower the landing gear under these conditions, the pilot must first push down on the landing gear handle and then **yaw the airplane from side to side** until the down-lockpins are engaged.

IMPORTANT: **In case a forced landing on water is necessary, tanks should be dropped prior to landing if time permits. They should not be used for flotation purposes.**

Assembly and Installation

Ferrying Tanks The procedure for installation of the long-range ferrying tanks given below should be followed very carefully to assure proper functioning of the system.

Preinstallation Procedure—Before installing the tank, make the following preinstallation inspection:

1. Thoroughly test bomb racks for operation, both electrically and manually, as fully explained in Paragraph entitled **Preloading Inspection** under **BOMBING EQUIPMENT** in Section 3.
2. Inspect the tank for possible damage. The right and left tanks are identical except for the fuel line fitting and the rear end of the vent line. Install the tanks so that the fitting will be bent slightly outboard, and the vent line outlet will be on the outboard side when the tank is installed.
3. Inspect the vent line to be sure it is properly installed; inspect the access doors for proper installation.
4. Inspect the flaps to see that they are in the full **up** position.

Fig. 83 FLAP CONTROL STOP

Raise the flap handle lock bar to a horizontal position and see that the peg on the bar is engaged in the hole on the quadrant housing. This lock bar stops the flap control handle at 20° to ensure that the pilot does not damage the flaps or the ferrying tanks by lowering the flaps more than the tank installation permits.

Installation—The following instructions should be read carefully before any attempt is made to install the ferrying tanks.

Note: The numbers 1, 2, 3, etc., preceding each instruction item below, correspond to those shown in Figure 84.

1. Open the bomb rack support hooks while the bomb control handle in the cockpit is being held in the **salvo** position. Then return the control handle to the **lock** position.
2. Remove the plug from the wing fuel line outlet and install a nipple. The nipple provided has no bead.
3. Install the fuel hose on the tank with two clamps.
4. Screw the four sway brace adjustment bolts down into the sway brackets as far as possible.
5. Three men, two at the front and one at the rear of the tank, can now raise the tank until the lugs are both in position in the V slots in the bomb rack. Then bump the lugs on the tank against the upper portion of the rack support hooks; the hooks will snap shut and lock the rack. Check the rack through the inspection holes in the rack to be sure it is positively locked.
6. Tilt the tank until the dimension from the upper edge of the tank to the under surface of the wing opposite the rear outboard sway brace bolt is approximately 4¼ inches, and the dimension opposite the rear inboard sway brace bolt is approximately 1¾ inches. Raise the two rear sway brace bolts until the top enters the hole in the wing pad and the shoulder of the stud rests against the wing pad. This adjustment will make a gap between the side of the tank and the landing gear fairing; the closest point between the two is approximately one inch. Check the tank to eliminate any side play in the rear studs before raising the front adjustment bolts. Raise the two front adjustment bolts until the heads of the bolts touch the dimpled portion of the front wing pads. All four sway brace bolts must not be more than finger-tight against the wing pads. Additional tightening will only preload the two main shackle fittings on the tank and might cause possible failure. Lock each adjustment bolt with the locknut.

7. The fuel hose may now be connected to the nipple in the wing. Apply light grease, Spec. VV-L-791-2, or equivalent, to the nipple before attaching the hose. Use only one clamp to hold the hose on the nipple.
8. Make certain that the drain plug on the bottom of the tank is installed properly and safety wired. Do not tighten the drain plug excessively, as this will crack the plastic threaded insert in the boss.
9. Fill the tank to the proper capacity of 150 U.S. gallons (125 Imperial gallons) and install the filler neck cap.

Note: If the tank is permitted to stand for several hours before flight, drain out a slight amount of fuel through the drain plug to remove any water or sediment which may have collected. Reinstall the drain plug and safety properly.

Installing Tank Fairing—After the ferrying tank is hung, adjusted, and filled, install the wood fairing as follows:

1. Place the front fairing around the tank, locating the ¾-inch hole over the peg at the upper front end of the tank. Engage the clevis bolts in the brackets on top of the tank, install the wing nuts on clevis bolts, and tighten the wing nuts and lock with safety wire.
2. Raise the wooden handle off the peg screw on the tail fairing and turn handle forward so that the steel strap is extended. Loosen the two screws on each side of the tail fairing which hold the adjustable hinge point brackets. Then engage one end of the coil spring in the slotted hole on the steel strap, and install the tail fairing on the tank, engaging the forward end of the coil spring in the slotted hole in the bracket on the top of the tank.
3. Install the bolts through the adjustable hinge point brackets into the rear holes on the sides of the tank. Shift the fairing around until it fits snugly against the flap and within ¼ inch around the rear end of the tank. Tighten the hinge bracket screws only enough to hold the bracket temporarily, and then raise and lower the tail fairing to check the operation.
4. When proper operation has been obtained, tighten the hinge bracket screws as tightly as possible. This will cause the protruding metal teeth on the bracket to bite into the wood fairing so as to prevent the hinge bracket from slipping. Then raise the tail fairing to the up position, tighten the pivot bolts snugly, and then back them off one turn to permit easy movement of the fairing.

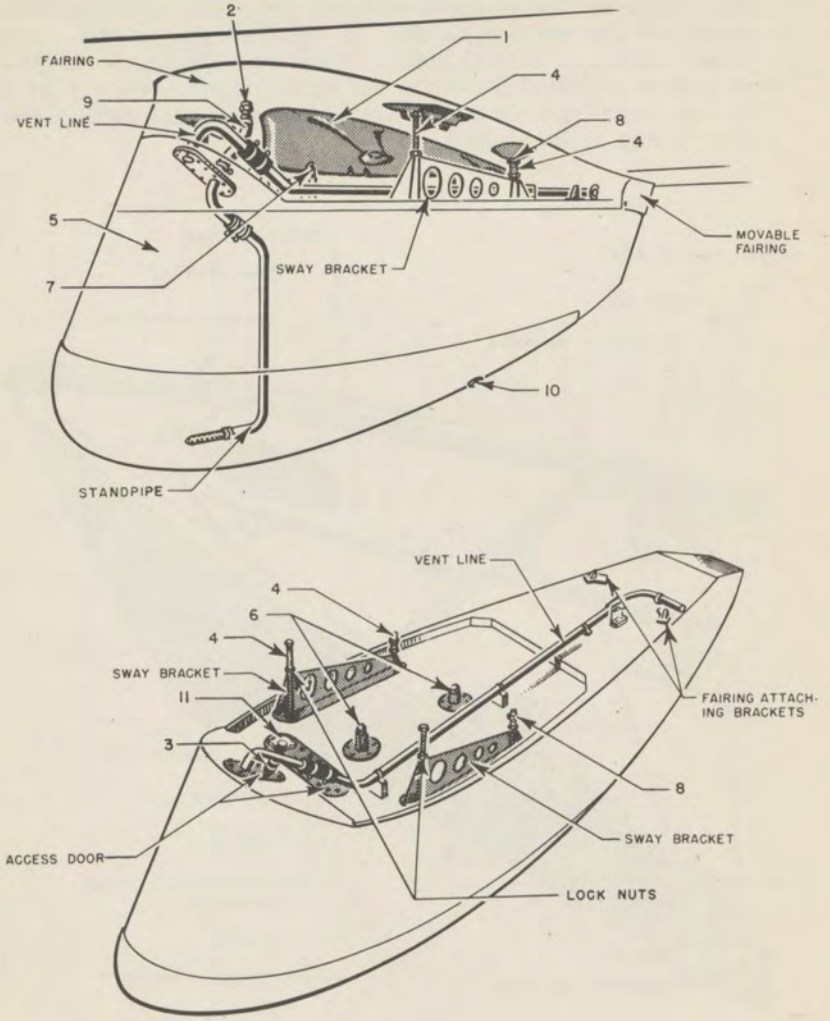


Fig. 84 FERRYING TANK INSTALLATION DIAGRAM

5. Safety wire the heads of the pivot bolts and the hinge bracket screws together. Then lower the tail fairing into the down position. Hold the fairing down with one hand and with the other hand pull the wooden handle, on top of the tail fairing, back to put tension on the coil spring. Snap the handle over the peg to lock in position. Raise the tail fairing slowly—do not let it fly up. Install screws in the slotted holes on each side of the front fairing at the aft end.

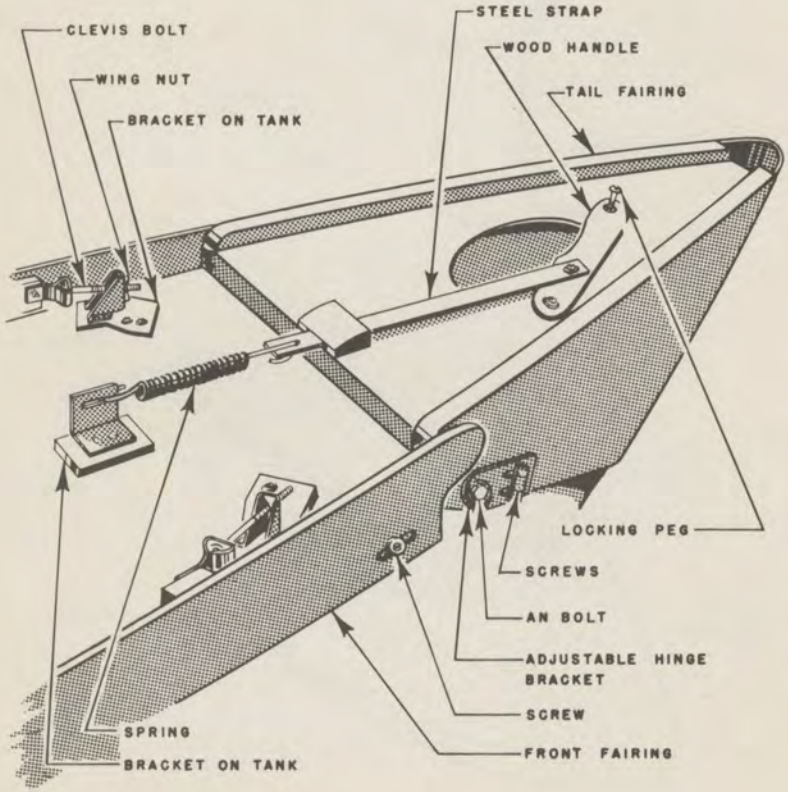


Fig. 85 FAIRING INSTALLATION

Removal and Disassembly

Ferrying Tanks Drain both ferrying tanks completely before removal. To remove the fairing, lower the tail fairing and release the tension on the coil spring. Remove the hinge bolts on the tail fairing and then remove the screws and the wing nuts holding the front fairing to the tank. When removing the droppable tank while the airplane is on the ground, have available two racks or stands or some other means of support to set the tanks on. Seven men are required to remove the droppable tanks, one at the bomb release control and three to hold each tank when it drops. The tanks are released by placing the bomb control handle in the **salvo** position.

WARNING: **Remember both tanks will drop simultaneously when released, so be sure that the proper number of men are under each tank to support its weight when dropped.**

FERRYING RADIO

Description

General On P-51A Airplanes equipped with the SCR-522 radio command set, which is of the ultra-high-frequency type, a separate receiver must be used for the reception of beacon signals, weather broadcasts, and airport communication. This additional set is a Model 438 Detrola 6-tube receiver, designed to give good sensitivity and ample selectivity even though the normal high-voltage power supply has been eliminated. All electrical power required is obtained directly from the airplane's 24-volt power system. On airplanes equipped with the SCR-274-N radio command set, no additional receiver is required.

Operation

Operation of the receiver is a simple matter. The hexagonal control knob is an on-off switch and also controls the volume. The round knob is the frequency control; the frequency range is plainly

Fig. 86 DETROLA 438 RECEIVER

marked on the face of the receiver. When the pilot desires to use the receiver he need only turn it on, as the output is fed into the regular radio output system. The headphones are connected to the set through the CD495 connector jack.

Installation

Receiver The mounting bracket and receiver are installed as an integral unit. Four self-threading screws are used to attach the mounting bracket to the floor of the cockpit. (See Figure 86.)

Power Supply The wire on the back side of the receiver should be routed in the most convenient way to the detonator switch junction box, where connection is made to the positive side of the push button at the same point where wire number 573 connects.

Combination Headphone and Microphone Jack and Receiver Plug The wires for the CD495 combination headphone and microphone connector and for the receiver output plug (PL55) are routed into the detonator switch junction box and are connected as follows: black wire and blue wire to T —; white wire and red wire to T +; green wire to M —; and yellow wire to M +. The PL55 connector is plugged into the headphone jack of the 438 receiver.

Antenna The antenna wire is plugged into the side of the receiver and is routed aft to and then up the overturn structure to connect to the IN84 lead-in insulator. The antenna wire need follow no fixed route since the design of the receiver permits widely varying antenna capacities.

Removal

When removing the Detrola receiver, the power supply wire,

antenna wire, and two plugs are considered part of the equipment to be removed. The procedure is the reverse of installation.

PROPELLER ANTI-ICER TANKS FOR FERRYING

Description

General For ferrying purposes, a temporary propeller anti-icer tank with a capacity of 2.9 U.S. gallons (2.4 Imperial gallons) is installed in the aft ammunition box in the left-hand wing. The fluid flows from this tank to the filter on the anti-icer pump bracket, where it enters the main system. The lines are temporarily installed, and at various points throughout the wing are attached to the wing ribs with friction tape and safety wire. The switch for controlling the system is located on the upper right corner of the pilot's switch box. At the conclusion of the ferrying flight, the tank and the lines should be removed from the airplane.

Fig. 87 PROPELLER ANTI-ICER FERRYING TANKS

Operation.

The propeller anti-icer system is operated by pushing the switch on the pilot's switch panel to the **on** position.

Removal

First drain the system by disconnecting the outlet lines from the anti-icer pump, installing flexible hoses to the outlets, and running the free ends of the hoses into a suitable container. Push the control switch to the **on** position. When the system has been drained, push the switch to **off.** Disconnect the flexible hoses and reinstall the outlet lines. Disconnect the temporary feed line from the filter and install the main system line, which is taped to the temporary line when the ferrying tanks are being used. Then remove the temporary lines from the airplane by disconnecting them and cutting the supporting tape and wire. Be sure to remove all the tape and wire. Open the left-hand wing ammunition box access door, remove the

lines connected to the tank, disconnect the bonding braids from the wing structure, and lift out the ammunition box. Working through the access hole in the bottom of the ammunition box, remove the hose connecting the tanks. Lift out the tanks, replace the ammunition box in the wing, and then install the feed rollers that are tied to the feed chute on the ammunition box. Replace the ammunition box cover.

Note: The temporary anti-icer tank should always be removed before the airplane goes into combat.

LOOSE EQUIPMENT

Loading

When loaded for ferrying as shown below, the P-51A Airplane will have take-off horizontal CG (wheels down) at 28.2% M.A.C. With all fuel consumed and ferrying tanks dropped, the horizontal CG (wheels down) will be at 25.4% M.A.C. The items listed are to be loaded in the airplane for long-range ferrying, and should be stowed as follows:

General	**Weight**
Nominal Weight Empty (Including Fuel and Oil Trapped in System)	**Pounds** **6500**
Pilot and Parachute	200
Fuel—180 Gal. in Wing Tanks	1080
300 Gal. in Droppable Tanks	1800
Oil—13 Gal.	98
Propeller Anti-icer Fluid—2.9 Gal.	20
Armament—4 Wing Guns and Accessories	273
Optical Gun Sight Installation	4
2 Wing Bomb Racks	23
Droppable Fuel Tanks Installation	220

Special stowage provisions are built into the airplane for the following items:

Pyrotechnic Pistol	2
Mooring Kit	11
Starter Handcrank and Extension	4
Data Case	2
External Power Connection Adapter	1
First-aid Kit	1
Gun Charging Hooks	1

The following items are stowed in wing ammunition boxes:

2	Tanks for Propeller Anti-icer Fluid	7
1	Kit—Engine Tools (Allison)	7
1	Set Propeller Tools	19
	Engine Hoist Sling	5
1	Kit—Armorer's Tool Roll	4
	Miscellaneous Small Items	2
	Engine and Cockpit Covers	16
	Sway Brace Adapters for Combat Fuel Tanks	10

The following items are lashed in gun compartments:

1	Kit—NAA Special Tools	24
	Wheel Well Liners	6
	Dust Excluders	3
	Emergency Spare Parts (S. O. No. 2110)	4

The following items are stowed on top of battery case:

	Instruction Books Technical Orders Diagrams	14

The following items are stowed in radio compartment:

	Dust Excluders for Exhaust Stacks	10

Total—Ferrying Gross Weight **10,371**

Notes

Section 6

"That's the new inspector the government sent out."

Contents

SECTION 6

Servicing & Preflight Inspection

SERVICING

Fuel System

Filling Main Fuel Tanks Before filling the main fuel tanks, make a general examination of the fuel system for obvious leaks. Drain a small amount of fuel from the tanks by means of the drain cocks, two located at the forward end of the radiator scoop and one in the fuel strainer at the bottom of the firewall. This serves to remove any water which may have accumulated in the tank.

CAUTION: **The airplane must be grounded before filling the tanks.** The two main fuel tanks are filled individually through the filler necks provided on the upper surface of the respective wing sections.

The maximum fuel capacity of both tanks is 180 U.S. gallons (150 Imperial gallons). The fuel gages are accurate only when the airplane is in the level flight position. Replenish the fuel tanks when necessary, and see that the filler caps are properly secured. The fuel to be used is 100 octane in accordance with Spec. AN-VV-F-781, Amend. No. 5.

Filling Ferrying Tanks Fill ferrying tanks to a capacity of 150 U.S. gallons

(125 Imperial gallons) each through the filler neck between the leading edge of the wing and tank. No gages are provided. A drain plug is located on the bottom of each tank.

Oil System

Filling System The oil filler neck is accessible through a small dzus-fastened door on the left side of the upper engine cowling. The full capacity of the oil system is 18 U.S. gallons (15 Imperial gallons), Spec. AN-VV-O-446, Grade 1120. In replenishing the tank when foam is present, care should be exercised to ensure a proper reading of the oil level. If for any reason the oil system has previously been drained, fill the oil tank to overflowing; this procedure will require approximately 12 to 13 gallons. Run the engine for one or two minutes between 1000 and 1200 RPM. **These figures should be closely adhered to, as running the engine above the specified time or speed could cause serious internal damage to the engine.** Stop the engine and again fill the tank to overflowing. Approximately five more gallons of oil should be required to fill the system to capacity. Tighten and safety the filler cap, wipe off any spilled oil, and replace the access door.

Coolant System

Filling System Access to the coolant tanks is gained by the removal of a dzus-fastened door on the left side of the engine nose cowling directly aft of the propeller spinner. When replenishing, fill slowly to overflowing capacity. If the system is dry, fill with a measured amount of 19 U.S. gallons (15.8 Imperial gallons), AAF Spec. AN-E-2. The system will not take the full 19 gallons on first filling and it will be necessary to run up the engine for not more than two to three minutes. Running the engine any longer will tend only to cause the coolant liquid to foam, thus preventing the addition of the remainder of the liquid required to fill the system to capacity. Stop the engine and add the remaining fluid. Tighten and safety the filler plug, wipe off any liquid spilled during filling, and secure the access door.

Hydraulic System

Filling System The total capacity of the hydraulic system for this airplane is approximately 3.75 U.S. gallons (3.12 Imperial gallons). The fluid used in the hydraulic system is a mineral oil with a petroleum base, AN-VV-O-366A (red fluid). **In handling the hydraulic oil, every precaution must be taken to prevent**

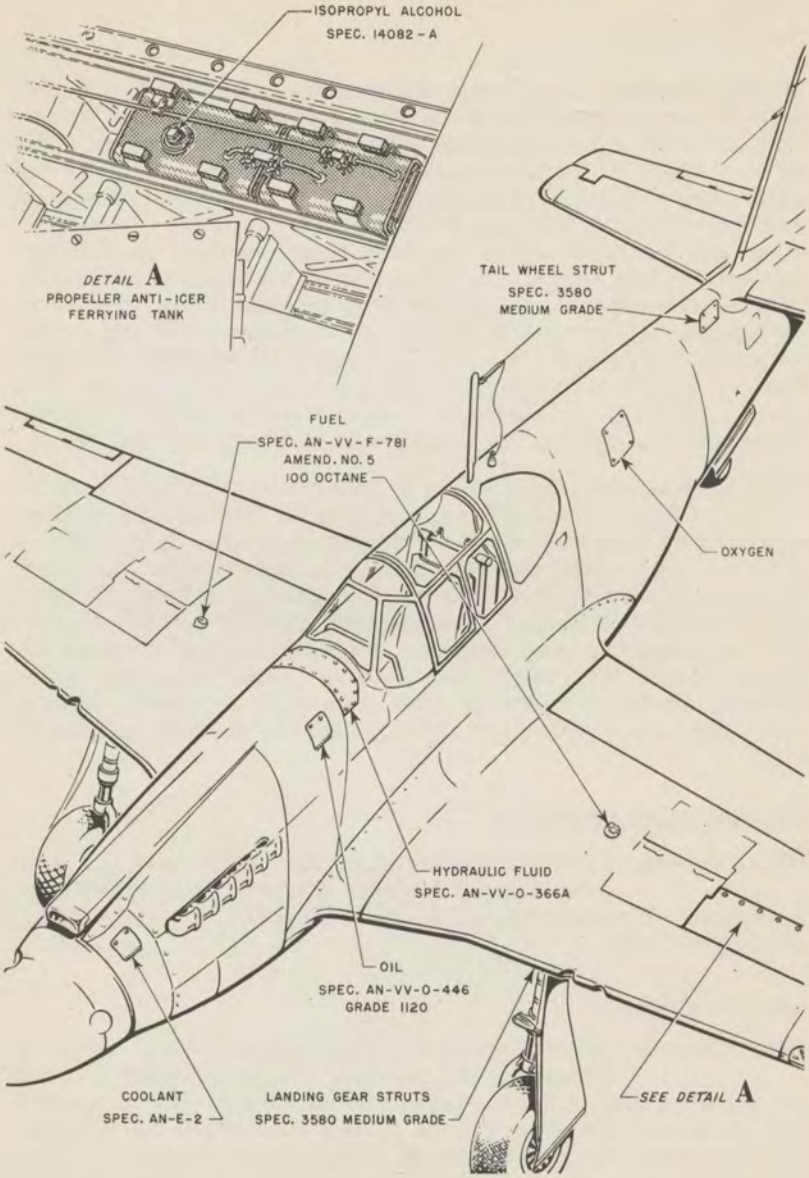


Fig. 88 SERVICING POINTS

its contamination. The storage containers must be kept sealed, and all handling equipment must be kept clean and designated for use only in handling hydraulic fluid. Do not expose hydraulic oil to the air for periods longer than is absolutely necessary, as the oil will absorb dust and grit, and in certain localities, this becomes a serious menace. Fluid that has been exposed to dust and grit, or has been in use previously, should be filtered to remove sludge, metal flakes, and grit, before using. The most simple equipment for filtering hydraulic oil consists of a ribbed glass or metal funnel of approximately one gallon capacity, a sheet of commercial filter paper, and a container to support the funnel and hold the filtered oil. The filter paper is folded into a funnel shape and placed in the funnel. The filtered oil should be placed in clean containers, properly marked to identify the contents, and kept sealed until required for use.

Refilling Reservoir Exhaust the system pressure by operating the wing flaps, and then fill the reservoir to overflowing with hydraulic oil. The reservoir fluid capacity is 1.74 U.S. gallons (1.45 Imperial gallons). Access to the reservoir filler neck is readily gained by removing the dzus-fastened coverplate immediately forward of the cockpit windshield. When filling the reservoir, it is recommended that a suitable receptacle be placed under the reservoir drain line, which bottoms at the lower left center of the firewall. Clean the reservoir filler neck strainer at each refilling and make sure the filler cap and dip stick are correctly secured in place.

Propeller Anti-icer System

Filling System Fill the propeller anti-icing system ferrying tank, located in the left-hand wing rear ammunition box, to capacity. The tank holds 2.9 U.S. gallons (2.4 Imperial gallons) of anti-icer fluid.

Oxygen System

Filling System Access to the oxygen system filler valve is gained by the removal of dzus-fastened door on the upper left side of the fuselage aft of the cockpit. The filler valve is located aft of the door. Fill the system to a normal full pressure of 365 lbs./sq. in. **Before take-off,** make certain that the cylinder pressure gage on the instrument panel shows a sufficient oxygen supply.

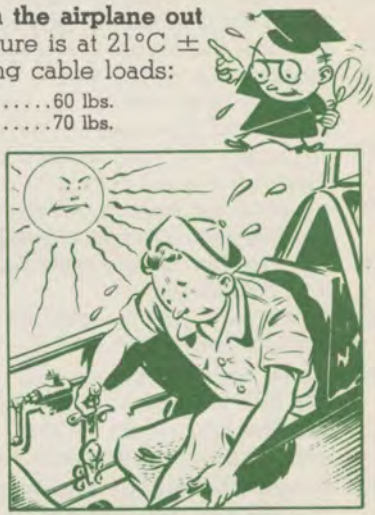
PREFLIGHT INSPECTION

The following inspections should be made prior to a long-range flight:

1. **Check the cable tensions with the airplane out of the sun,** when the temperature is at 21°C ± 3° (70°F ± 5°), to the following cable loads:

   Rudder Cable.....60 lbs.
   Elevator Cable.....70 lbs.
   Aileron Cable.....70 lbs.
   All Trim Tab Cables..20 lbs. (no slack)

   A tension tolerance of plus or minus 5 pounds is permissible.



2. Inspect the turnbuckles to see that they are properly secured. Turnbuckles are considered to be in safety if not more than three threads are exposed on either end.
3. Inspect the fuel lines and units for leaks, general condition, and security of attachment.
4. Inspect the auxiliary ferry tanks for security of attachment and stability. Ascertain that the tank fillets are secure.
5. Inspect the oil lines and units for leaks, general condition, and security of attachment.
6. Inspect the coolant lines and units for leaks, general condition, and security of attachment.
7. Inspect the hydraulic lines and units for general condition and security of attachment. Check for leaks.
8. Turn the hydraulic Purolator handle clockwise one or more complete revolutions.
9. Inspect the propeller anti-icer system for general condition and security of attachment. Check for leaks.
10. Inspect the main shock struts, lock mechanism, and the wheel well for cleanliness.
11. Examine the tail wheel unit, lock mechanism, and entire tail wheel compartment for cleanliness.
12. Ascertain that the pitot tube sock has been removed, and that the air inlet hole is open.

13. See that the upper surface of the wing, particularly at the leading edge, is cleaned of all dirt, fuel, and oil. **This is a necessary precaution to prevent premature stalling.**
14. Examine the contents of the first-aid kit for completeness and see that it is correctly stowed.
15. See that the signal pistol is properly loaded and installed.
16. Inspect the entire pilot's compartment for cleanliness, and security of all parts. See that there are no loose objects which might foul the control cables or control rods.
17. Ascertain that the surface control lock is secure in the unlocked (forward) position.
18. Operate the aileron, elevator, and rudder trim tab controls at the pedestal to ensure freedom of movement.
19. Operate the control stick and rudder pedals to ensure full and free movement.
20. Make sure that the sliding sections of the cockpit enclosure operate freely and lock securely.
21. Close and lock the cockpit enclosure from the inside. Inspect the two latches to make sure that they latch securely. See that the four hooks on the inside of the roof of the enclosure are secure on their respective pins.
22. Inspect the cockpit enclosure emergency release handle and the release mechanism to ascertain that it has not been released. See that the safety wire on the release handle and the safety wires at the aft ends of the two hinge rods have not been broken.
23. Visually inspect the safety harness and replace it if there are any indications of defects or deterioration. Check all attaching parts and fittings for security of fastening. Inspect the latching device for free operation, and check for bent or damaged parts. Check the date the harness was last tested; if the required period is past, determine whether the harness should be replaced. Check the operation of the harness spring-loaded release and see that it engages properly when locked. Lubricate the lock mechanism as necessary.
24. The oxygen equipment must be checked for completeness and for proper operation. Turn off the regulator handle and depress the diaphragm button, which is accessible through the hole in the cover. A noticeable stream of oxygen should pass through the elbow, indicating that the oxygen is flowing freely. Release the button and open the emergency valve to make sure that it is in operating condition.

25. Remove and clean the two airspeed line moisture trap sumps located in the left wheel well.
26. Inspect the instrument lines for leaks, tightness, flexibility, and anchorage.
27. Check the lamps on the instrument panel and replace any weak or broken lamps.
28. Inspect the oxygen mask for general condition.
29. Inspect the instruments for correct and discernible operation markings on the coverglasses.
30. Check the turn indicator and the bank-and-turn indicator for discolored liquids and free action of balls. A careful inspection should be made to see that there is no fluid leakage.
31. Inspect the altimeter setting knob, pointers, and reference markers for proper operation.
32. Inspect the altimeter for synchronism of barometric scale and reference markers. Check for zero setting error.
33. Check the reading of the manifold pressure gage against the station altimeter or barometer. If the reading differs more than 0.4 in. Hg from that of station barometer, replace the instrument.
34. Check the pointers of the engine gage unit for tolerances. At zero, the tolerance for the fuel pressure gage is $\pm$ 0.2 pounds and the tolerance for the oil pressure gage is $\pm$ 5.0 pounds. The tolerance for the thermometer is $\pm$ 3° of the existing engine temperature. If excessive errors exist, replace the unit with a spare gage from stock.
35. Inspect the compass for dirty or discolored damping liquid, leaks, or insufficient liquid as evidenced by bubbles. Check the instrument for evidence of unbalanced card element. See that the proper compensation data is recorded on the correction card. Examine the compass for broken coverglass and damaged external parts.
36. See that the compass light operates properly.
37. Visually inspect the tachometer for indications of oil inside the coverglass.
38. Inspect the clock for proper winding, setting, and running operation.
39. Clean all the instrument coverglasses with a clean cloth.
40. Inspect the caging mechanism of the flight indicator and the turn indicator for correct operation.

41. Before the engine is started, inspect the following instruments for correct zero settings:

    Bank-and-Turn Indicator
    Airspeed Indicator
    Suction Gage
    Tachometer
    Rate-of-Climb Indicator

42. Test the specific gravity of each battery cell with a hydrometer, returning the electrolyte to the cell from which removed. In case the gravity is 1.200 or lower, battery should be replaced with one fully charged.
43. Add distilled water to the battery when necessary, and ascertain the proper level with a self-leveling syringe.

    CAUTION: **Care should be taken to prevent spilling of the electrolyte from the hydrometer while taking battery readings. If any electrolyte is accidentally spilled, immediately wipe it away and wash the area with a sodium bicarbonate solution.**

44. Inspect the cement around the frames of the running, formation, and upper recognition lights for possible water leakage. If leakage has occurred, remove the old cement and check the light sockets for corrosion.
45. Turn the ignition switch to **bat** and operate the landing light switch, thereby checking the battery and the battery switching circuit.
46. Test the navigation lights, identification lights, cockpit lights, instrument lights, and landing lights by operating the respective switch and rheostat controls.
47. Ascertain that the radio equipment is in proper working order by tuning in on a station within the radio's frequency range. Check for ignition interference with the engine running.
48. The plate current of the radio equipment should be checked to see that excessive amperage is not being drawn by the plate circuits of the tubes.
49. With the transmitter in operation, the modulation should be checked by speaking into the microphone and observing the antenna current ammeter. The pointer of this meter will indicate a slight increase of current if the output is properly modulated.
50. The remote contactor should be checked by ensuring that during the red segment the special channel is operating, and

during the white segment the normal channel is operating. The rotation time of one minute should also be checked.

51. See that the propeller is properly installed and that all exposed screws, bolts, and pins are tight and safetied.
52. The exterior of all parts of the propeller should be examined for cracks, bends, nicks, and other damage. The entire leading edge, trailing edge, and tip portion of each blade should be carefully watched for development of cracks. A magnifying glass will facilitate this work. When in doubt as to the extent or seriousness of apparent cracks, aluminum alloy blades should be given a local etching. Watch especially for longitudinal cracks.
53. Visually inspect the condition of all flexible conduits running to the propeller governor unit at points where possible damage may occur.
54. Visually inspect the condition and security of the propeller governor Arens control. Inspect the cockpit control lever to determine that it has at least ⅛-inch spring-back from the full forward position as an assurance that the governor control is fully against the stop, which is set for take-off RPM.
55. Check the propeller hub and retaining nut for looseness on the shaft. If repeated tightening of the propeller hub retaining nut is necessary to maintain proper tightness, the propeller should be removed and the cause ascertained.
56. Lubricate the propeller hub with lubricant, Spec. AAF 3581, Grade AA, applying a grease gun to the zerk fitting located on the speed reducer housing just forward of the hub face until the hub is completely filled. This will be indicated by a solid flow of grease from the relief fitting.
57. Check the oil level in the speed reducer. This may be done by removing the filler plug located near the front of the housing, and rotating the propeller until the plug opening is approximately 20° below the horizontal plane when the airplane is at a ground angle of approximately 12°, and approximately 8° below the horizontal plane when the airplane is level. The oil in the speed reducer should then be at the plug opening. If the oil is not at the plug opening, completely fill the gear assembly at this point, using lubricant Spec. AAF 3563.
58. See that all exposed surfaces of the propeller are thoroughly coated with clean engine oil. The propeller should be washed

thoroughly with fresh water, and dried before being coated with oil.

59. Inspect the propeller spinner for general condition and security of attachment.
60. Wash the engine completely, taking care that no cleaning fluid enters the generator, starter, or any other electrical equipment.
61. Drain the regulator unit, air chamber, fuel chambers, and fuel control unit of the carburetor by means of the plugs in the bottom.
62. Inspect the fuel intake system for broken studs. Check the lines for leaks or damage.
63. Check the exhaust manifolds and studs for looseness.
64. Remove the magnetic oil drain plug on the engine and inspect for accumulation of sediment. Remove and clean the oil screen of the reduction gear oil pump.
65. Inspect the carburetor air scoop duct for general condition and cleanliness. See that the screen in the forward end of the duct is clean.
66. Clean and inspect the carburetor fuel strainer, which is located on the right side of the carburetor.
67. Remove the screen from the end of the fuel strainer mounted on the firewall, and clean the screen with gasoline. Ascertain that the interior of the strainer is clean before installing the screen.
68. Remove and clean the Cuno oil strainer. Whenever the Cuno strainer is removed for cleaning, the inside of the sediment chamber should also be cleaned.
69. See that all drain plugs on the oil system are properly installed, tightened, and safetied.
70. Inspect for evidence that the engine is throwing oil.
71. Inspect all drain plugs and access doors on the coolant system for proper installation, and see that the plugs are safetied properly.
72. Inspect the carburetor and fuel line connections for fuel leakage, paying particular attention to drain plugs, passage plugs, and parting surfaces between the regulator castings.
73. Inspect all safety wiring on the carburetor for security.
74. Examine all throttle and mixture control rods, linkage, and bellcranks for general condition and security of attachment. See that all locknuts are tight.

75. Check the fuel intake system lines for security of attachment. Inspect for leaking gaskets or hose connections.
76. Inspect the exhaust stack flanges for security.
77. Inspect the high-tension ignition leads for evidence of burning as the result of leaks in the exhaust system.
78. Examine the engine-driven accessories for general condition and security of attachment.
79. Inspect the control quadrant in the cockpit for general condition and security. Check the friction control for proper functioning.
80. Inspect the throttle stop located just below the quadrant to see whether the safety wire is broken. **A broken safety wire on the stop indicates that an excessive strain has been placed on the motor.**
81. Check the throttle and mixture control levers at the quadrant for ⅛-inch spring-back.
82. Check the fuel quantity gages for correct functioning and inspect for visible defects and security of attachment.

    Note: The fuel gages are accurate only when the airplane is in the level flight position.

83. Operate the throttle and mixture control rods, before starting the engine, to see that they are free.
84. The engine should always be warmed up until proper lubrication and engine operation for the take-off and flight are assured.
85. As soon as the engine has started, the oil gage should be watched for pressure. **If in 30 seconds the oil pressure gage does not indicate pressure of 60 lbs./sq. in., the engine should be shut down and an investigation made to determine the cause.**
86. Warm up the engine at approximately 1200 RPM. Check the oil temperature gage for a minimum of 20°C and a maximum of 95°C; otherwise, continue to warm the engine until the oil temperature gage shows a definite increase and the oil pressure gage remains steady between 60 and 70 lbs./sq. in. when the throttle is opened. This indicates that the oil is circulating properly.
87. Check the radiator temperature for a minimum of 85°C and a maximum of 125°C. Open the scoop as necessary.
88. During the engine warm-up, the functioning of all the tanks should be tested by switching the fuel valve to each tank for

a period sufficient to ensure that the fuel from the tank has an opportunity to flow to the engine. Proper performance of the engine during this test will indicate, as far as possible, that the entire fuel system is free from water and dirt and is functioning properly in all fuel valve positions. **The fuel selector valve position must be determined by click and feel, and not entirely by the settings indicated on the dial.** See that the connecting linkage does not bind.

89. To check the constant speed operation, place the selector switch on **auto constant speed** and place the governor control lever in take-off position. Open the throttle until the engine turns approximately 2300 RPM and pull the governor control lever back until a reduction of not more than 200 RPM is noted. Return the control again to take-off position. The engine should resume its original RPM.

90. Check the operation of the propeller limit switches by changing the pitch with the manual switch in both directions until the limit switches operate.

91. Check for full range and free operation of the propeller controls. **Do not operate the blade angle controls any more than is absolutely necessary when the engine is not running. Prolonged operation of the electric motor while the slip rings are stationary will result in excessive wear and pitting.**

92. Check the hydraulic system by operating the flaps and the radiator air scoop.

93. Check the brakes for proper operation while warming up the engine. See that the brakes do not feel spongy (an indication of air in the lines), and see that the left and right pedal pressures are equal.

94. Check the fuel pressure gage to see that it maintains a pressure of 12 to 16 lbs./sq. in.

95. With the engine operating at 1000 RPM, adjust the vacuum pump relief valve so that the suction gage registers 3.75 in. Hg (minimum). Increase the RPM to the maximum RPM obtainable on the ground, and note the suction gage reading. This indication should not be more than 4.25 in. Hg (maximum). If proper adjustment cannot be made within these limits, check the suction relief valve for cleanliness of the screen, and also check for a sticky valve or loose adjustment.

96. During the engine warm-up period, inspect all instruments for excessive pointer oscillation.

97. Check all instruments for readings consistent with engine conditions.

98. Inspect the manifold pressure gage for a reading consistent with engine behavior. Check for excessive pressure.

99. With the engine turning at 1150 RPM or better, turn on either the pitot heater or landing light. The ammeter should show an increase when this is done.

100. Set the propeller control in **auto constant speed** position for take-off at 3000 RPM. Open the throttle control to obtain 2400 RPM and note the manifold pressure. With this fixed throttle and manifold pressure setting, vary the engine speed from 2400 RPM to 2200 RPM by manually increasing the propeller pitch. The manifold pressure should remain constant within 1 in. Hg.

101. Following the engine warm-up, the throttle should be opened to the position corresponding to take-off for not over 30 seconds. **Prolonged running of the engine on the ground at or near take-off throttle position should be avoided.** The limits of 2200 RPM and 30 in. Hg MP for ground operation will provide a sufficient range of power and speed adequate to check the magnetos, spark plugs, and propeller control.

102. Check the ignition system by running the engine on each magneto separately while propeller selector switch is in fixed pitch. The loss of RPM in running on either magneto alone should not exceed 80 when the engine is warm and operating properly. A loss of over 100 RPM on either magneto generally indicates defective ignition or defective spark plugs.

103. Check the **off** position of the ignition switch to assure the proper connection of the ground wires. This check should be made at the end of the engine warm-up period with the propeller in full low-pitch and the engine turning over approximately 700 RPM. The switch should be turned to the **off** position momentarily to note whether or not the engine stops firing, and immediately returned to **both** position. Two or three seconds is ample time for the switch to remain in the **off** position.

WARNING: **If the engine does not cease firing when the switches are placed in the off position, it will be necessary to stop the engine by turning the fuel to off. After the engine stops, do not touch the propeller until the difficulty has been found and corrected, as the engine may start or kick over, causing death or serious injury.**

104. Check all fairings, access doors, and fillets for security of attachment and general condition.

105. Ascertain that all loose equipment is securely stowed in its proper place.

106. Inspect the engine cowling panels for general condition, correct fit, and security.

107. With the airplane fully loaded and ready for flight, inspect the main shock absorber struts and the tail wheel shock absorber strut for proper inflation and obvious fluid leaks.

108. Inspect the tires for proper inflation. The tires should be inflated until the deflection marks on the sidewall are just in contact with the supporting surface. Check tires for damage.

109. Refill the fuel, oil, cooling, hydraulic, anti-icer, and oxygen systems.

110. Clean the entire windshield, enclosure, and rear windows thoroughly.

Section 7

Contents

ALL CHARTS AND INFORMATION FOR THIS SECTION
WILL BE ISSUED AS SOON AS AVAILABLE.

Section 8


KG CALLING TOWER - YOU'RE COMING IN EXCEPTIONALLY CLEAR—
WHAT IS MY POSITION!

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Notes

GLOSSARY

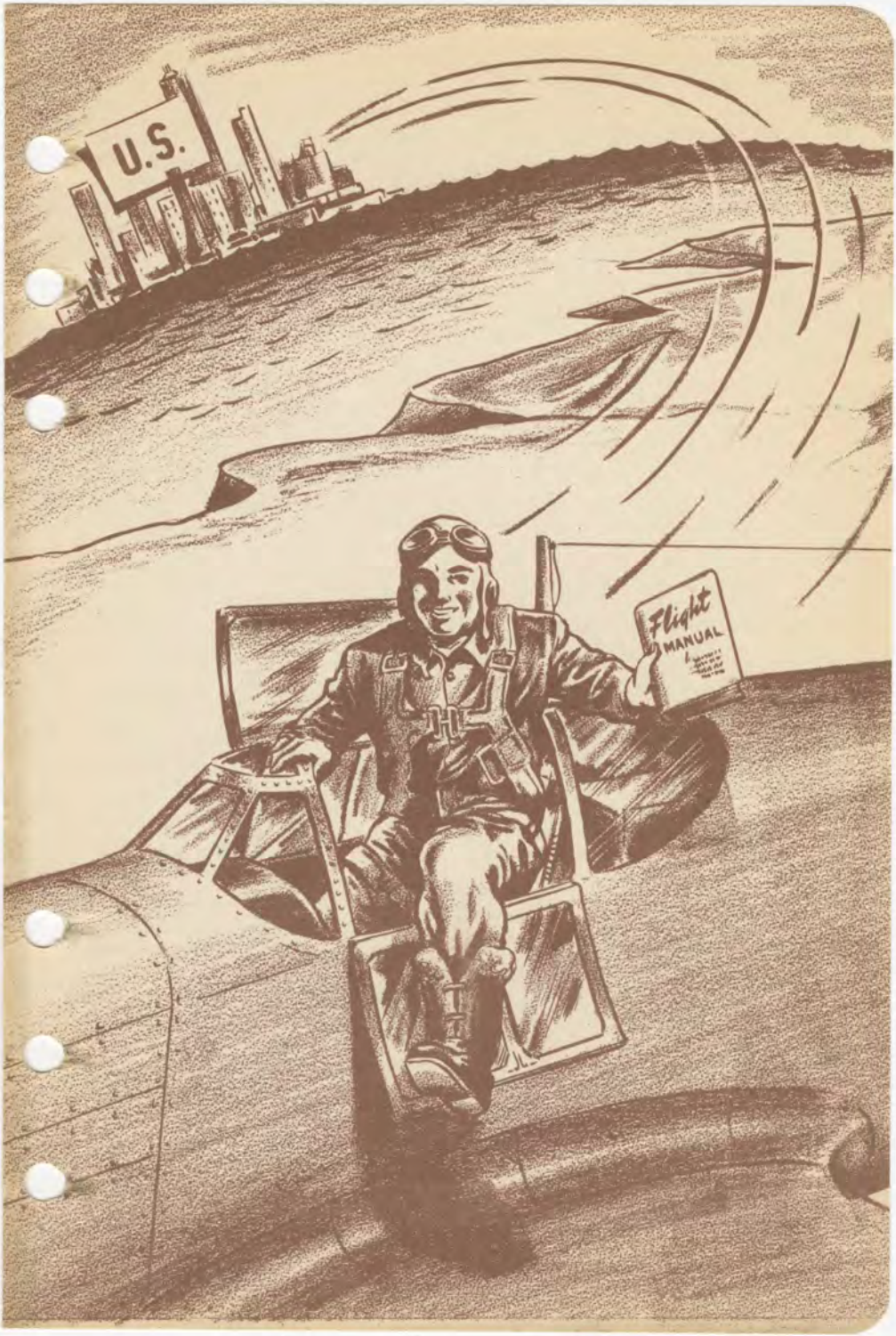
AMERICAN TERMINOLOGY	BRITISH TERMINOLOGY
1. Accumulator	Pressure Reservoir
2. Air Filter	Air Cleaner
3. Airfoil	Aerofoil
4. Airplane	Aeroplane
5. Antenna	Aerial
6. Armor	Armour
7. Battery	Accumulator
8. Caliber	Calibre
9. Carburetor	Carburettor
10. Center	Centre
11. Cockpit Enclosure	Cockpit Hood
12. Control Stick	Control Column
13. Empennage	Tail Unit
14. Engine (Power Plant)	Aero-Engine
15. Firewall	Fireproof Bulkhead
16. Gasoline	Petrol
17. Horizontal Stabilizer	Tail Plane
18. Indicated Airspeed	Air-Speed-Indicator Reading
19. Land	Alight
20. Landing Gear	Undercarriage
21. Left	Port

22. Left Wing ..... Port Main Plane
23. Lines ..... Pipes
24. Maneuver ..... Manoeuvre
25. Manifold Pressure ..... Boost
26. Mooring Rings ..... Picketing Rings
27. Propeller ..... Propellor
28. Radio ..... Wireless
29. Radio Mast ..... Rod Aerial
30. Right ..... Starboard
31. Right Wing ..... Starboard Main Plane
32. Shock Strut ..... Oleo Leg
33. Signal Flare ..... Signal Star
34. Surface Control Lock ..... Locking Gear
35. Surface Controls ..... Flying Controls
36. Trim Tab ..... Trimming Tab
37. Vertical Stabilizer ..... Fin
38. Windshield ..... Windscreen
39. Wing ..... Main Plane
40. Wing Tips ..... Plane Tips

AMERICAN-BRITISH METRIC UNITS

The following general table of conversions may be used where calculations are necessary:

Multiply	By	To Obtain
U. S. Gallons (gal.)	0.833	(Imp. gal.) Imperial Gallons
U. S. Gallons	3.785	(l) Liters
Miles per hour (m.p.h.)	1.609	(KmPH) Kilometers per Hour
Miles per hour	0.8684	Knots
Miles	1.609	(Km) Kilometers
Miles	0.8684	Nautical Miles
Feet (ft.)	0.3048	(M) Meters
Inches (in.)	2.54	(cm) Centimeters
Pounds (lb.)	0.4536	(Kg) Kilograms
Pounds per sq. in. (lbs./sq. in.)	0.0703	(Kg/sq.cm) Kilograms per Square Centimeter
Inches of Mercury (in.Hg)	2.54	(cm Hg) Centimeters of Mercury
Horse Power (h.p.)	1.014	(m.h.p.) Metric Horse Power
Degrees Centigrade (°C)+17.8	1.8	(°F) Degrees Fahrenheit


U.S.
Flight
MANUAL

Notes