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INFORMATION REPORT INFORMATION REPORT

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CENTRAL INTELLIGENCE AGENCY

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[redacted] English-language manuals on the Soviet aircraft MIG-21FL [redacted] 50X1-HUM

Attachment 1: Aircraft MIG-21FL, Service Manual, Book I, Airframe and Power Plant, consisting of 328 pages and 15 insets.

Attachment 2: Aircraft MIG-21FL, Service Manual, Book II, Armament, containing 140 pages. 50X1-HUM

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Air/AFNEIBA Air/FTD Army/FSTC Navy/STIC								

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INFORMATION REPORT INFORMATION REPORT

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AIRCRAFT MIG-21FL
SERVICE MANUAL
Book I
AIRFRAME AND POWER PLANT

SECRET

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AIRCRAFT МиГ–21ФЛ

SERVICE MANUAL

BOOK I

AIRFRAME AND POWER PLANT

S-E-C-R-E-T

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In servicing the aircraft make use of the following books of the Service Manual:

Book I: Airframe and Power Plant

Book II: Armament

Book III: Electrical, Radio and Oxygen Equipment and Instruments

The book contains 328 pages. Besides, there are fifteen Insets: Inset 1 to face page 18, Inset 2 to face page 26, Inset 3 to face page 38, Inset 4 to face page 74, Inset 5 to follow Inset 4, Inset 6 to face page 82, Inset 7 to face page 172, Inset 8 to face page 202, Inset 9 to face page 220, Inset 10 to face page 246, Inset 11 to follow Inset 10, Inset 12 to face page 272, Inset 13 to face page 320, Inset 14 to face page 324 and Inset 15 to follow Inset 14.

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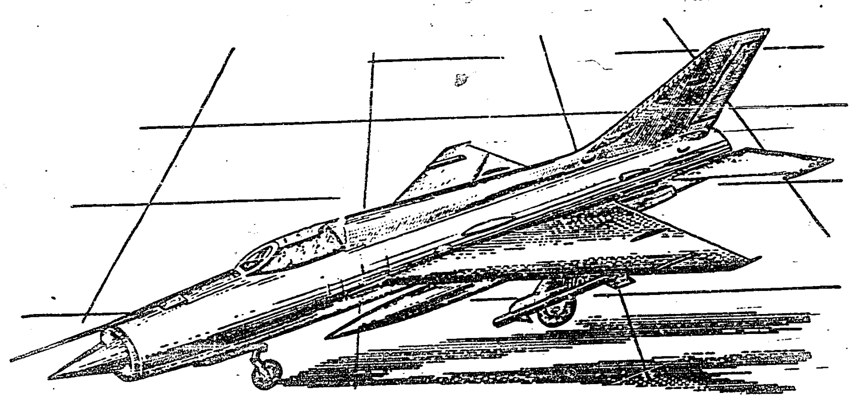

FIG.1. GENERAL VIEW OF AIRCRAFT [illegible]

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POOR ORIGINAL

INTRODUCTION

The multipurpose front-line interceptor МиГ-21Ф is a single-seat all-weather high-performance fighter.

The aircraft is designed to perform combat flights at altitudes of 20 km. and supersonic speed exceeding 2M.

The aircraft is powered by a turbojet engine, type Р11Ф2-300, which features an axial-flow two-spool compressor and an afterburner.

The aircraft is provided with an effective control system and possesses a high degree of stability. The aircraft being equipped with a roll stabilization autopilot, type КАП-2, the piloting of the aircraft at night or under bad-weather conditions is greatly facilitated.

Due to distribution of overloads in flight at high altitudes, the aircraft possesses great manoeuvrability indispensable for a modern interceptor fighter.

The aircraft makes it possible to perform aerobatics, its behaviour as well as stability and controllability during aerobatic performances being quite satisfactory.

The takeoff and landing characteristics of the aircraft are so as to allow the second-class and grass airfields to be used. To use the aircraft on a grass airfield, the wheels with cross-country tyres are to be mounted.

The stable operation of the engine under the conditions of engine acceleration and throttling up to the critical altitude, reliable control of afterburning, use of the adjustable cone with a follow-up system, and sufficient thrust-to-weight ratio ensure high fighting performance of the aircraft. The aircraft is equipped with missiles, rockets and bombs so that it can be employed as an interceptor, a front-line fighter or an aircraft intended to accomplish some other combat missions.

The aircraft is provided with radar, radio and instrument equipment which ensures long-range detection of the enemy, reception of control commands from a command post situated at a long distance off and reliable engagement of targets within the range of 5 to 7 km.

Good observation from the cockpit, automatic control of air supply and temperature in the cockpit, compact panoramic layout of the instruments and warning red lights, all these ensure convenient control of the aircraft in flight.

The aircraft is simple in operation and can therefore be readily mastered both by flight and maintenance personnel after the respective training.

The flight and maintenance personnel must always be aware of the fact that the use of a modern fighter operated at highly supersonic speeds requires a sound knowledge of the aircraft and its engine, adequate understanding of operation and proper maintenance of the aircraft systems, and sufficient experience in all kinds of operations performed in the course of pre-flight, preliminary and starting-line

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preparation of the aircraft which ensure reliable functioning of all aircraft systems during flight.

Described below are the main features of design of aircraft МиГ-21Ф.

The aircraft is an all-metal centre plane with a triangle wing and sweptback empennage which forms the controlled stabiliser. The fuselage consists of the nose and tail parts jointed together along frame No. 28 which makes the removal and mounting of the engine more convenient.

The nose and tail parts of the fuselage are fitted with a considerable number of hatches to provide an easy access to the aircraft and engine units in the course of use and maintenance of the aircraft.

The front portion of the air intake is fitted with an adjustable cone designed to minimise the total loss of engine power when the in-coming air flow is slowed down and to achieve optimum conditions for gas flow.

The cone is controlled by a follow-up system incorporating automatic equipment to provide automatic extension and retraction of the cone depending on the degree of compression achieved in the compressor. Apart from this, an additional correction for the cone extension is introduced in response to the stabiliser deflection at definite angles of attack.

To prevent surge effects inside the air intake when the engine is throttled during the flight or when the aircraft executes a motion in a wide angle of attack, the aircraft is fitted with automatically controlled anti-surge shutters coupled to the engine control lever and to the stabiliser control system. The anti-surge shutters are arranged on the fuselage behind the nose air intake.

In case the automatic control system fails, the cone and anti-surge shutters can be controlled manually.

At the engine inlet two additional intake shutters (take-off shutters) are installed in parallel on both sides of the fuselage. The operation of the shutters is based on the difference in pressures inside and outside the air intake due to which an additional air intake is provided for the engine in taking off.

Installed on the aircraft is a two-shaft turbojet engine which consists of an axial six-stage twin-rotor compressor, ten cannular combustion chambers assembled in a common housing, two-stage axial gas turbine, afterburner and variable jet nozzle, fuel system and automatic engine control system. The engine employs an independent oil system and an automatic starting system.

The two-shaft engine features an axial compressor which is divided into two independent spools, each driven by a separate turbine. The spool of three initial stages which forms the low-pressure compressor is driven by the second turbine, i.e. by the low-pressure turbine, while the three final stages which form the high-pressure compressor, are rotated by the first turbine, i.e. by the high-pressure turbine.

The low-pressure compressor turbine compose the low-pressure rotor, whereas the high-pressure compressor and turbine form the high-pressure rotor. The main advantage of the split-compressor engine is that its rotors are not coupled mechanically; this ensures high stability in compressor operation under off-design conditions.

When changes occur in the engine operating conditions (such as speed and altitude of flight, outside air temperature and engine control lever position), the axial speed of the air inside the compressor stages changes accordingly. Consequently, the aerodynamic loads on the two spools of the split-compressor engine are redistributed (i.e., the torques will increase at one spool and decrease at the other) so that the ratio between the speeds of the rotors varies automatically.

Self-adjustment of the rotor speed brings about stability in operation of both stages irrespective of changes in axial speeds of the air fed through the compressor line in different modes of its operation which is actually the main advantage of the split-compressor engine.

Mounted on the fuselage are three air brakes. The left-hand tail portion of the fuselage houses a container for the drag chute.

The aircraft has a triangle wing whose leading-edge sweepback angle is 57°. The wing trailing edge and the fuselage axis form an angle of 90°.

The wing carries the ailerons and take-off shutters. Arranged inside each wing are two pressurised fuel tank compartments.

The fuel system comprises six tanks installed inside the fuselage, one saddle tank, four wing tank compartments having a total capacity of 2910 lit., and one streamlined drop tank of 490 lit. The fuel consumption system is automatic and needs not be controlled by the pilot during flight. The sequence of fuel consumption provides the best possible centering of the aircraft in various modes of flight.

The hydraulic system falls into a booster system and a main system functioning independently. The pressure in each system is built up by a variable-capacity pump, type НП-34-1Т. The maximum operating pressure is 210 kg/cm². The main hydraulic system is employed to actuate the landing gear, wing flaps, air brakes, anti-surge shutters, air intake cone, adjustable jet nozzle of the engine and autopilot КАП-2 (pressure interlock) and one chamber of stabiliser booster БУ-51МС.

The booster hydraulic system delivers pressure to two aileron boosters БУ-45А, one of the two chambers of stabiliser booster БУ-51МС. and autopilot КАП-2 (pressure interlock).

In case the booster system fails, the main system duplicates it to actuate the aileron boosters.

The capacity of a single operable chamber of the stabiliser booster is quite sufficient to continue the flight till landing when one of the hydraulic systems fails. In case the engine stops and cannot be restarted in flight while the engine autorotation speed is normal, the aircraft can be landed owing to the pressure of the working fluid built up by the hydraulic pumps driven by autorotations and emergency pumping unit НП-27Т.

When the engine is jammed or its autorotation speed is low, the pressure required for landing is delivered by pumping unit НП-27Т which gets automatically engaged. The pumping unit is powered by the aircraft storage battery, as well as by the hydraulic accumulators, provided the booster hydraulic system is functioning normally.

The ailerons are controlled through a mechanical linkage composed of rods and bell-cranks. The aileron effect in the triangle wing being exceptionally high in flights at low altitude and high speed, the aileron control system is provided with a non-linear mechanism intended to change the control-stick-to-booster БУ-45А transmission ratio. The transmission ratio non-linear change mechanism facilitates aileron control with minor displacements of the control stick from the neutral position when the ailerons boosters are disengaged, and provides sufficient lateral controllability of the aircraft at high speeds when the boosters are engaged.

The artificial feel mechanism included into the aileron control linkage is designed to simulate the effort applied to the control stick by the ailerons when the boosters are engaged.

Owing to the roll stabilization autopilot, type КАП-2, included into the aileron control system, the aircraft lateral control characteristics have been greatly improved and the pilot's activities at night and under bad-weather conditions have been considerably facilitated. The autopilot employs the principle of measuring the angular velocity and roll angle which are electrically converted into the corrected travel of the ailerons within ±5.5°.

The autopilot is employed in two duties: damping and stabilisation.

In the damping duty the autopilot suppresses the aircraft lateral oscillations caused by external perturbation at a sustained angle of roll or when changing from one roll angle to another. The autopilot responds to the aircraft roll angular velocity and thereby largely facilitates the pilotage.

In the damping duty the autopilot is employed in conjugation with the aircraft manual control system.

In the stabilisation duty the autopilot ensures:

(a) zero roll of the aircraft during flight;

(b) returning the aircraft to zero roll angle from whatever position;

(c) control of the roll angle in response to the control stick application within 50 to 70 mm, right or left, from the neutral position.

The stabiliser is controlled by the aircraft control stick by virtue of irreversibly coupled two-chamber booster БУ-51МС.

The stabiliser control system employs an automatic controller, type АРУ-3В, used for automatic changing of the control-stick-to-stabiliser transmission ratio and, simultaneously, the control-stick-to-feel-mechanism transmission ratio depending on the indicated speed and altitude of flight, so as to provide for natural feel under various flight conditions.

The feel mechanism is employed to simulate the effort applied to the control stick while it is displaced from the neutral position.

Apart from this, the stabiliser control system is fitted with a trimming effect mechanism used to accomplish in-flight longitudinal trimming of the aircraft in response to the existing pressures. The switch of the mechanism is located on the control stick.

The aircraft is equipped with a tricycle landing gear retracted in flight. The nose strut assembled in the fuselage nose portion is retracted forward. The nose strut is fitted with a damper to suppress shimmies.

The L.G. main struts are arranged in the wings. During retraction the wheel axles are turned off by a special gear, the wheels are drawn into the fuselage and the struts are folded into the wing.

The L.G. main struts are provided with wheels КТ-92, 800x200, and the nose strut carries wheel КТ-38, 500x180.

In order to prevent skidding the wheels are provided with an automatic releasing system.

The emergency brake system provides braking of the main wheels only.

To reduce the landing run, the aircraft is fitted with a drag chute.

The air system consists of the main and emergency systems functioning independently.

The main system is designed to perform the following functions: braking of the L.G. wheels, lifting and sealing of the canopy, releasing and disconnection of the drag chute, emergency jettison and release of the canopy time-delay lock, cutting-in of the de-icer system and control of the pressure-operated valves of the front fuselage compartment cooling system.

The emergency air system ensures:

(a) emergency extension of the landing gear;

(b) emergency braking of the landing gear main wheels.

The air supplied to the pressurised cabin is entrained at the engine compressor outlet. The cabin altitude and ventilation are controlled by the АРД-57В regulator valve. The cabin is sealed by a rubber hose. The pre-set temperature of the air inside the cabin is maintained automatically. To ventilate and heat the cabin on the ground, a ground heater can be employed.

In order to provide normal conditions for the pilot when in flights at high altitude, the aircraft is fitted with oxygen supply system ККО-3 including anti-g suit ВКК-4 and pressure helmet ГШ-4М or face mask КМ-30М.

The system of seat ejection canopy which can practically be employed regardless of the aircraft flight speed, is designed to rescue the pilot in cases of emergency.

The aircraft is equipped with a liquid (alcohol) canopy de-icer system.

Employed as a permanent electric power supply of the aircraft is starter generator ГСР-СТ-12000ВТ mounted on the engine.

When the engine is started, the generator operates as an electric starter to speed up the engine. Apart from this, the engine can independently be started from the aircraft storage batteries.

Two silver-zinc batteries, type 15СЦС-45, engaged in parallel with the generator serve as a reserve source of D.C. current.

The 115 V A.C. current is supplied by an A.C. generator, type СГО-8.

The aircraft instrumentation designed to ensure the flights under various weather conditions includes directional system КСИ, artificial horizon АГИ-1, airspeed indicator КУС, altimeter ВД-28, course and altitude deviation indicator and artificial horizon duplicate ДА-200.

The aircraft radio equipment comprises receive-transmit radio set РСИУ-5Т, radio compass АРК-10, marker beacon receiver МРП-56П, responder СРО-2 and long-range radar Р-1Л.

GENERAL

1. To meet the requirements for proper maintenance of the aircraft and to prevent damage of its units and systems, the following conditions should be observed:

(a) the design and operating principle of all aircraft systems and units will be adequately studied;

(b) the aircraft maintenance instructions given in the present Manual will be followed closely;

(c) the aircraft maintenance will be allowed to the personnel who have undergone special training and passed the respective tests.

2. The present Service Manual consists of separate chapters which contain general information pertaining to design of various systems of the aircraft as well as the instructions on operation and maintenance of the systems.

3. Preliminary and pre-flight preparations of the aircraft, as well as preparation of the aircraft for a repeated flight, towing and scheduled maintenance should be accomplished in compliance with the Inspection and Maintenance Guide (for the given aircraft) published as a separate issue.

In the course of maintenance of the aircraft as well as during all kinds of work and inspection, safety precautions specified in the Inspection and Maintenance Guide should be observed.

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4. The engine, and separate units and instruments of the aircraft should be handled and maintained in compliance with the respective instructions accompanying them.

5. The tools and appliances used in aircraft maintenance should always be in good condition and appropriately marked.

After the maintenance work is over, use the Inventory List to check the availability of tools so as to avoid leaving them inside the aircraft.

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Chapter II

FUELING AND CHARGING OF AIRCRAFT SYSTEMS

1. FUEL SERVICING

The aircraft uses kerosene, grade T-1 (State Standard ГОСТ 4138-49), or kerosene, grade TC-1 (State Standard ГОСТ 7149-54). In the course of operation the aircraft can be refueled with either of the above fuels, mixing being permissible.

Prior to fueling, the storage battery should be switched off and the aircraft and the fuel servicing truck should be earthed.

The aircraft must be fueled only from a fuel servicing truck equipped with filter covers of special design.

Procedure of Fuel Servicing

1. Fill all the fuel tanks located in the fuselage and wings through the filler neck of saddle fuel tank No. 7.

Wait some minutes to see if more fuel is to be added and refuel, if necessary.

2. Fill the drop tank through its rear filler neck.

After fueling, see that the level of fuel in tank No. 7 and in the drop tank is 20 to 30 mm below the lower edge of the filler necks in summer and 10 to 20 mm in winter.

After fueling close the filler necks tightly. When closing the drop tank neck, drive the cross member into the neck body slits as far as it will go and screw up the filler neck cover.

3. Use a setting knob to adjust the flow meter pointer in a position indicating the total amount of fuel in the tanks (3360 lit., with the drop tank filled, or 2870 lit., without the drop tank).

2. FUEL DRAINING

The fuel contained in the fuselage tanks is drained through the drain cock installed in the engine fuel pipeline.

To drain the fuel, proceed as follows:

1. Remove the plug of the drain cock.
2. Connect the suction hose of the fuel servicing truck to the drain cock.
3. Open the cock with a wrench.
4. Open the saddle tank filler neck.
5. Couple to the ground electric power supply.
6. Earth the aircraft and the container into which the fuel is to be drained.
7. Engage the pump of the 2nd (service) group of tanks and the pump of the group of tanks to be drained.

Observe light panel T-107 to see the end of drainage; in this case the inscriptions of the respective groups of tanks will be illuminated.

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The entire fuel system of the aircraft (including the wing tanks) can also be drained through the common drain cock; for this purpose a pressure not above 0.3 kg/cm^2 must be built up in the wing tanks by feeding compressed air from a ground air bottle through a special arrangement.

To this end, remove the plug from the wing tank pressurization line T-piece located above tank No. 3 on the right side of the recess and couple the air delivery hose.

If necessary, the fuel can be drained from the wing tanks alone by opening the drain plugs of each fuel tank with a special wrench. In this case only part of fuel (about 600 lit.) will be drained from the 1st group of tanks, provided the fuel system is completely filled.

CAUTION. To prevent damage of the fuel system, never employ non-standard equipment for pressurising the wing fuel tanks.

The drop tank is emptied into the fuel servicing truck through a hose with a special snout dipped into the tank through the filler neck located on the front compartment.

After draining the fuel, cut off and lock the drain cock and close it with the plug. Close the fuel tank filler necks.

3. OIL SERVICING

To provide lubrication and cooling of the engine bearings, oil МК-8 (State Standard ГОСТ 6457-53) with additive, type НОКОН, 0.6 per cent in weight, is used.

The oil tank installed on the engine is filled by means of an oil servicing truck.

The procedure of oil filling is the following:

1. Open the hatch situated under the wing on the left side of the fuselage.
2. Drive out the plug with the measuring rod, rub the rod off with a clean cloth and measure the level of oil in the tank.
3. Remove the oil tank filler neck plug and fill in the oil up to the level of 11 ± 0.5 lit.
4. After filling, close the filler neck and measuring rod plugs, lock them with wire and close the hatch.

CAUTION. 1. Never add oil into the engine to avoid penetration of smoke and vapours into the cockpit.

2. Measure the oil level with the measuring rod, at least 10 to 15 min. after the engine has stopped.

4. OIL DRAINING

The oil system is drained through special drain cocks installed on the left side of the fuel-oil unit, below, behind frame No. 22 and on the right side of the accessories box, below, near frame No. 25. For draining, the oil tank filler neck must be opened.

5. CHARGING OF HYDRAULIC SYSTEM

The hydraulic system is filled with oil, type АМГ-10. The two hydraulic systems of the aircraft are charged through the charging connections. The charging connections are located in the recesses housing the aircraft connections, one on each side.

Apart from the charging connection, the right-hand recess houses a connection to attach the hydraulic reservoir pressurization hose.

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Instead of the filler necks, the hydraulic reservoir is fitted with glass gauges to check up filling.

The system is filled or refilled at a pressure of 3 to 4 kg/cm^2 delivered from a special charging unit.

The procedure of charging the system is the following:

1. To reduce the pressure in the hydraulic systems to zero, pull the control stick backward and push it forward, and see that the air brakes and wing flaps are retracted.

2. Open the access doors of the hydraulic reservoir glass gauges and aircraft connections.

3. Remove the plugs from the charging connections, rub all dirt off the connections and couple the ground pump. Prior to coupling, thoroughly wash the snouts of charging hoses in gasoline.

4. Refill both compartments of the hydraulic reservoir with oil AMT-10 bleeding the air from the hydraulic system by means of the bleed valve button. Observe the glass gauges to determine the level of oil in the reservoir compartments.

5. Disconnect the hoses of the charging unit, stop the connections with plugs and close the access doors.

The procedure of complete charging of the system is the following:

1. Check the pressure in all hydraulic accumulators and recharge them with distilled nitrogen to obtain a pressure of 50^{+5} kg/cm^2, if necessary.

2. Lift the aircraft with the aircraft jacks till the wheels are clear off the ground.

3. Open the access doors of the hydraulic reservoir glass gauges and aircraft connections.

4. Remove the plugs from the charging connections, rub all dirt off the connections and couple the charging unit hoses. Prior to coupling, thorougly wash the charging hose snout with gasoline.

5. Charge the two compartments of the hydraulic reservoir with oil AMT-10 till the level is as high as indicated by the mark lines on the glass gauges. Meanwhile bleed the air from the hydraulic system by means of the bleed valve button.

6. Disengage the charging unit hoses, remove the plugs from the ground pump connections, couple the ground pumps to both hydraulic systems and couple the pressurization hose to the pressurization pipe connection situated at the right side.

7. Couple to a ground electric power supply.

8. Switch on the storage battery and circuit breakers of the landing gear, wing flaps, air brakes and cone, and turn on switch AILERON BOOSTER.

9. Turn the L.G. control valve handle into position EXTENDED and depress button EXTENDED on the wing flap control panel.

10. Switch on the hydraulic pumps of the ground charging unit, cut in the hydraulic reservoir air pressurization, and build up a pressure of 180 to 215_{-12} kg/cm^2.

Note: When adjusting any of the hydraulic systems, DO NOT FAIL to engage the ground hydraulic unit to pressurize the hydraulic reservoir.

11. To pump the hydraulic system through by means of the ground hydraulic pumps, make 20 complete shifts of the control stick backward and forward, left and right.

12. Recharge the hydraulic reservoir with oil and pump through the system once again by completing 10 to 12 extensions and retractions of the L.G., wing flaps, air brakes, cone and anti-surge shutters, and changing the control stick from one extreme position into another 20 times.

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Depress button BOOSTER SYSTEM CUT OFF and shift the control stick in the extreme backward, forward, left and right positions 8 or 10 times.

Set the L.G. into the extended position and set the air brakes, wing flaps, cone and anti-surge shutters into the retracted position.

13. To pump the fluid through the engine flap control system, change the flaps 20 times in succession from the augmented position into the MAXIMUM rating position and back by switching on and off circuit breaker AFTERBURNING.

14. Disconnect the ground hydraulic pumps and reduce the pressure in the system to zero by changing the aircraft control stick from one position into another as has been indicated above.

15. Turn on switch PUMPING UNIT and keeping the control stick in position, operate the pumping unit to build up a pressure of 172 to 195 kg/cm^2 in the booster system (so that the pumping unit gets disengaged). Turn off the pumping unit switch and reduce the pressure in the system to zero.

16. Make sure that the oil in the hydraulic reservoir is level with the reference lines of the glass gauges, with the L.G. extended and the air brakes, wing flaps, anti-surge shutters and cone retracted.

In case the level of oil in the reservoir is above the reference lines, drain the excess oil through the suction connections used for coupling to the ground pumps by depressing the check valves and the bleed valve button simultaneously.

Note: When the engine is started, the hydraulic accumulators are filled with fluid so that the fluid level falls below the reference lines on the glass gauges. In this case no recharging of the hydraulic system is required since the level of fluid is normally checked when the pressure in the hydraulic system is zero.

6. DRAINING OIL AMГ-10 FROM HYDRAULIC SYSTEM

To drain oil AMГ-10 from the hydraulic system, the following procedure is to be observed:

1. Jack up the aircraft.
2. Couple to the ground electric power supply.
3. Switch on the circuit breakers of the L.G., wing flaps, air brakes and cone, and turn on switch AILERON BOOSTER.
4. Connect the ground hydraulic pump to the main hydraulic system and build up a pressure of 180 to 215_{-12} kg/cm^2.
5. Retract the landing gear and extend the air brakes and wing flaps. Set the L.G. control valve in position NEUTRAL.
6. Switch off the pump and reduce the pressure in the main hydraulic system to zero by changing the control stick from one position into another.
7. Disconnect the ground hydraulic pump delivery hose from the aircraft valve connection and place it into the container to drain the fluid.
8. Turning the cock handle smoothly, engage the emergency system to extend the landing gear.
9. Disconnect the pipe installed in the extension line between the L.G. cylinders and hydraulic lock and bleed the air from the L.G. cylinders.
10. If the hydraulic reservoir is pressurised, switch on the ground pump and drain oil AMГ-10 from the hydraulic reservoir of the main system.
11. In case the pressure in the system is zero, retract the air brakes and wing flaps manually so as to force oil AMГ-10 into the hydraulic reservoir. Switch on the ground pump and drain oil AMГ-10 from the hydraulic reservoir.

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12. Couple the ground hydraulic pump suction hose to the booster system connection, build up a pressure in the hydraulic reservoir, switch on the pump and drain oil АМГ-10 from the booster system.

Note: If oil АМГ-10 is to be drained for washing the hydraulic system, disjoint the aircraft, disassemble and remove the hydraulic reservoir and flush the reservoir and the system according to the instructions given in Chapter III "Maintenance of Aircraft Hydraulic System".

7. AIR CHARGING

1. Prior to charging the aircraft systems with air, check that the L.G. emergency extension valves situated inside the cockpit are cut off. Then remove the plug from the aircraft charging connection.

2. Blow the hose with compressed air and couple the aircraft charging connection situated in the right-wing L.G. well to the airfield air bottle.

3. Open the aircraft system valve, the emergency air bottle charging valve and the airfield air bottle cock.

4. When the pressure in the main system air bottles and the emergency air bottles reaches 110 to 130 kg/cm^2, cut off the aircraft system valve and the emergency system charging valve.

To check pressure, read off the indications of the two-pointer pressure gauge on the right-hand console in the cockpit.

5. Turn off the airfield air bottle cock.

6. Make one or two turns to screw off the nut connecting the charging hose to the airfield air bottle and bleed the air from the hose.

7. Disconnect the charging hose from the aircraft connection and stop the connection with the plug.

8. FILLING DE-ICER SYSTEM WITH ALCOHOL

To fill the de-icer system, open the cover of the hatch housing the de-icer reservoir and set it vertically.

Fill the system with 96 per cent rectified ethyl alcohol (State Standard ГОСТ 5962-51) through the reservoir filler neck. The quantity of alcohol filled into the reservoir should not exceed 4.5 litres.

To check the filling of the reservoir use a measuring rod. After filling close the filler neck tightly, lock it and attach a seal.

Place the hatch cover into position and fix the locks.

9. CHARGING PILOT'S OXYGEN SYSTEM

The aircraft oxygen system bottles are charged with live oxygen only.

The procedure of charging is the following:

1. Open the cover of the aircraft charging connection hatch and screw off the connection plug. The charging connection is located in the left-wing L.G. well.

2. Connect the pipe from the airfield oxygen charging truck bottles to the charging connection.

3. Check if cock КВ-2МС situated in the cockpit is cut off.

4. Open the airfield oxygen cock and charge the aircraft bottles with oxygen.

When the ambient air temperature is +15°C, charge the aircraft bottles until the pressure is 150 kg/cm^2. In case the temperature differs from that indicated above, fill the aircraft bottles until the pressure is equal to that listed in Table 1.

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Table 1

Oxygen Pressure in Aircraft Bottles at Various Temperatures of Ambient Air

Temperature, °C	Oxygen pressure in aircraft bottles, kg/cm²	Temperature, °C	Oxygen pressure in aircraft bottles, kg/cm²
+35	160	-5	140
+30	157	-10	138
+25	155	-15	136
+20	152	-20	134
+15	150	-25	131
+10	148	-30	128
+5	145	-35	126
0	143	-40	124
		-45	121

5. On charging the aircraft bottles, cut off the airfield oxygen bottle cock and disconnect the pipe from the aircraft charging connection.

6. Open cock KB-2MU in the cockpit and read the pressure off indicator [illegible]-10.

7. Screw the plug on the aircraft charging connection.

10. CHARGING ENGINE OXYGEN SUPPLY SYSTEM

This system is also charged with live oxygen to a pressure of 150 kg/cm².

The procedure of charging is the following:

1. Couple the pipe of the oxygen charging truck to the aircraft connection which is also arranged in the left-wing L.G. well.

2. Open the cock of the charging truck and charge the system. Read off the high pressure gauge located near the aircraft charging connection in the left-wing L.G. well.

See that engine oxygen supply system cock KB-2MC arranged inside the cockpit is cut off.

3. After charging the system, cut off the cock of the oxygen charging truck, disconnect the oxygen charging truck pipe and screw the plug onto the aircraft charging connection.

__Note__: In charging the engine oxygen supply system, refer to Table 1 showing oxygen pressure against the temperature of ambient air.

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Chapter II
FUEL SYSTEM

1. GENERAL

The aircraft fuel system is intended to supply the engine with fuel in all possible modes of flight and to ensure starting of the engine on the ground and in the air.

The total capacity of the fuel system less the drop tank is 2910 lit.

The capacity of usable fuel is 2870 lit., and 3350 lit. with the drop tank suspended.

The fuel system comprises:

1. Six rubberized bag tanks packed into metal containers in the nose part of the fuselage between frames Nos 11 and 28, their total capacities being:

230 lit. – tank No. 1;

930 lit. – tank No. 2;

340 lit. – tank No. 3 (upper and lower parts);

175 lit. – tank No. 4;

245 lit. – tank No. 5 (right and left halves);

245 lit. – tank No. 6 (right and left halves).

2. One metal tank No. 7 installed on the top of the fuselage behind the canopy so that it forms a continuation of the canopy and superstructure outline.

The cross-section of the tank is of a horseshoe shape. Situated inside of the horseshoe hollow (between the rims) are the aircraft control rods, bunched conductors and pipelines of the fuel and hydraulic systems.

The total capacity of the tank amounts to 170 lit.

3. Four riveted metal tank compartments located inside the right and left wings. The total capacities of the tank compartments are:

180 lit., per each front (right and left) tank compartment;

110 lit., per each rear (right and left) tank compartment.

4. One outboard (drop) tank attached to the fuselage belly to the pylon near frame No. 16.

The capacity of the drop fuel tank is 490 lit.

5. Electric pumps mounted on tanks Nos 2, 3 and 4 are fitted with pipelines and non-return valves used to transfer the fuel to the service tank and supply it to the engine.

6. A drain pipeline and a tanks pressurization pipeline (delivering air from the engine compressor) to force the fuel from the wing tank compartments and drop tank and to ensure stable operation of the pumps at high altitudes.

7. A control pipeline equipped with a special valve, drain valve and float valve which regulate the sequence of fuel consumption automatically and thereby provide an adequate trim of the aircraft during flight, take-off and landing.

8. A system which controls the fuel quantity and sequence and pump operation.

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The tanks installed in the aircraft fuel system (Fig. 1A) are subdivided into three groups described below. The 1st group of tanks comprises saddle tank No. 7, tanks Nos 1 and 2, and the wing tank compartments.

The fuel contained in the tanks is delivered by an electric pump (unit 495A-2) mounted on tank No. 2. The fuel stored in tanks Nos 1 and 7 is delivered by gravity through a pipeline into tank No. 2, whereas the fuel stored in the wing tank compartments is forced through a pipeline and is also delivered into tank No. 2 via special valve 38. The fuel stored in the wing tank compartments is forced by compressed air supplied from the engine compressor into the wing rear tank compartments via the pressurization pipeline. The fuel contained in tank No. 2 and the fuel delivered into the tank from other tanks are transferred into the service group of tanks (tank No. 3) by means of a pump.

In order to prevent fuel return and air bubbles in the pump mounted on tank No. 3 (service tank), non-return valve 36 with a baffle is installed in the point of connection of the pipeline and tank No. 3 after completing fuel consumption from the wing tank compartments.

To ensure the fuel sequence in case the pump fails, tank No. 2 is connected to the service group of tanks through another pipeline of a larger diameter so that the fuel can be consumed from the 1st group of tanks, provided the engine is operated at ratings not higher than nominal. The pipeline connecting the two groups of tanks is equipped with non-return valves 35 and 36 intended to avoid the flow of fuel from the service tank into the 1st group.

The 2nd group of tanks (service group) comprises the upper and lower parts of tank No. 3.

The fuel which is delivered to the service tank from other tanks is further transferred by electric pump 22 (unit 495A-2) installed on the lower part of tank No. 3. From the service tank the fuel is supplied to the engine booster pump through a pipeline fitted with shut-off valve 19 and fuel flow meter pickup.

In case the service group pump fails, the engine can still be operated at ratings not higher than nominal. The 3rd group of tanks (tail group) comprises tanks Nos 4, 5 and 6.

The fuel from the 3rd group of tanks is transferred by means of electric pump 22 (unit 495A-2) installed on tank No. 4, while the fuel stored in tanks Nos 5 and 6 is transferred by gravity to tank No. 4.

Pumped from tank No. 4 the fuel passes through a pipeline and flows into the upper part of tank No. 2 via float non-return valve 5 which admits the fuel from tank No. 4 when the level of fuel in tank No. 2 drops a certain distance down.

To ensure fuel supply from the 3rd group of tanks, in case the pump fails, tank No. 4 is connected to the lower part of tank No. 3 through another pipeline of a greater diameter, so as to provide fuel consumption, when the engine is operated at ratings not higher than nominal.

In order to avoid fuel flow from the service tank into the 3rd group of tanks, the pipeline connecting the two groups is fitted with non-return valve 35.

Apart from this, an outboard tank jettisoned during flight can be attached to the fuselage belly to a pylon. The fuel from the outboard tank is forced by compressed air (delivered from the engine compressor) into tank No. 2 through special valve 38 installed in the fuel supply line of the wing tank compartments.

The above sequence of fuel consumption provides definite trim of the aircraft during flight. The fuel sequence is controlled automatically by float valves 1 and 9 installed in tanks Nos 7 and 2 and actuated in response to fuel level variations.

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INSET 1

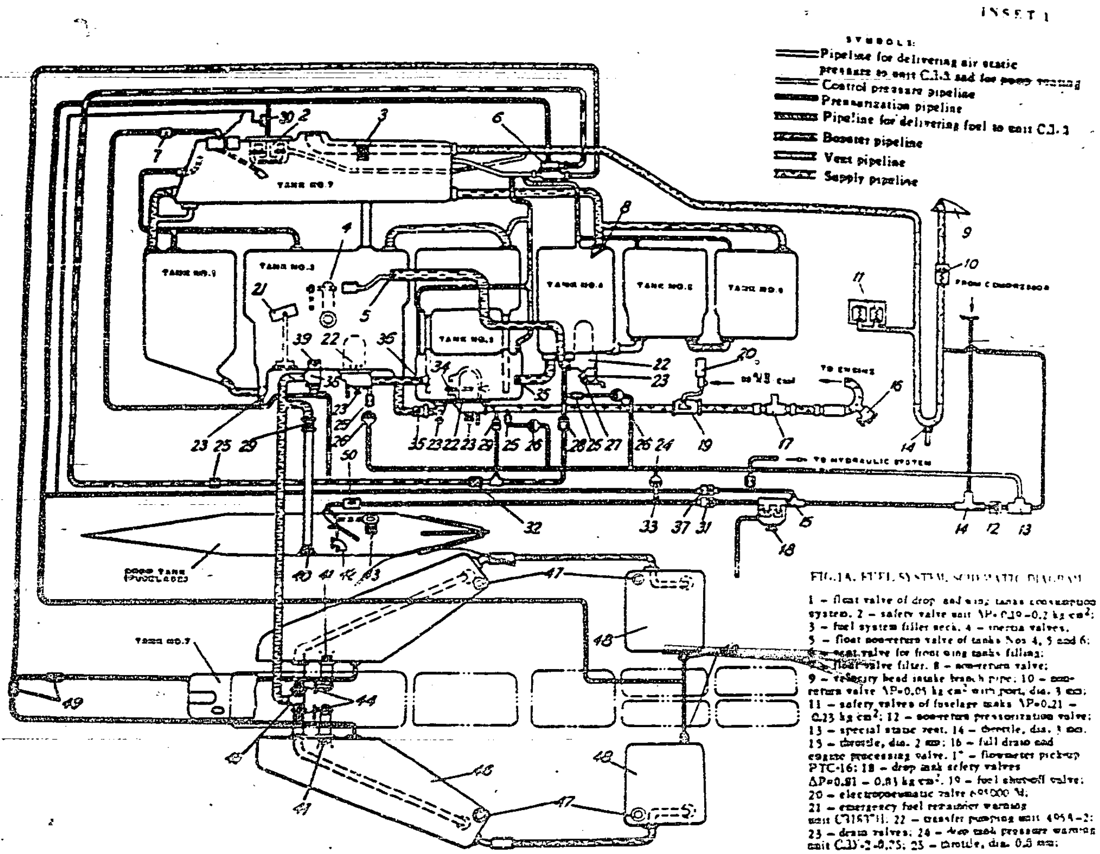

FIG.1A. FUEL SYSTEM SCHEMATIC DIAGRAM

1 – float valve of drop and wing tanks consumption system. 2 – safety valve unit $\Delta P = 0.19 - 0.2$ kg cm²; 3 – fuel system filler neck. 4 – inertia valves. 5 – float non-return valve of tanks Nos 4, 5 and 6; 6 – vent valve for front wing tanks filling; 7 – float valve filter. 8 – non-return valve; 9 – velocity head intake branch pipe; 10 – non-return valve $\Delta P = 0.05$ kg cm² with port, dia. 3 mm; 11 – safety valves of fuselage tanks $\Delta P = 0.21 - 0.23$ kg cm²; 12 – non-return pressurization valve; 13 – special static vent. 14 – throttle, dia. 3 mm. 15 – throttle, dia. 2 mm; 16 – full drain and engine processing valve. 17 – flowmeter pickup PTC-16; 18 – drop tank safety valves $\Delta P = 0.81 - 0.85$ kg cm². 19 – fuel shutoff valve; 20 – electropneumatic valve 695000 M; 21 – emergency fuel remainder warning unit C71STH; 22 – transfer pumping unit 495A-2; 23 – drain valves; 24 – drop tank pressure warning unit CJY-2-0.25; 25 – throttle, dia. 0.5 mm; 26 – pressure warning unit CJ-2; 27 – drain pipe with funnel; 28 – non-return valve with throttle, dia. 0.8 mm; 29 – non-return valve; 30 – throttle, dia. 2.1 mm; 31 – non-return valve; 32 – control pressure gauze filter; 33 – throttle, dia. 1 mm; 34 – negative g valve; 35 – branch pipe with non-return valve; 36 – non-return valve; 37 – non-return valve; 38 – special valve; 39 – non-return valve; 40 – drop tank drain plug with gauze filter; 41 – non-return valve; 42 – non-return valve in drop tank; 43 – drop tank filler neck; 44 – wing tanks gauze filter; 45 – non-return valves; 46 – front wing tanks; 47 – wing tanks drain plugs; 48 – rear wing tank compartments; 49 – throttle, dia. 7 mm; 50 – vacuum valve with non-return valve.

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Float valve 1 installed in tank No. 7 is actuated by the fuel control pressure so that it opens special valve 38 mounted on tank No. 2 and cuts off vent valve 6; these valves in turn control fuel consumption from the drop tank and wing tank compartments.

The fuel control pressure is built up by the pumps of unit 495A-2 installed on tanks Nos 3 and 4. If any of the pumps fails, the serviceable pump will be able to build up the control pressure alone. For this purpose each control pressure line is interlocked by non-return valves 28 and 29.

To release the control pressure after the flight, non-return valve 28 installed in the line connected to the pump of tank No. 4 is provided with a throttle orifice, dia. 0.8 mm.

Float valve 5 in tank No. 2 controls fuel transfer from the 3rd group of tanks (tanks Nos 4, 5 and 6) to tank No. 2.

Installed on tank No. 2 in the drop fuel tank line is special valve 38 intended to provide proper sequence of fuel consumption from the drop tank; the valve is opened by float valve 1 which is mounted on tank No. 7 and closed by a spring (for special valve operation see Fig. 2). The special valve is opened due to the fuel pressure exerted on the diaphragm for which purpose it is connected through a control pipeline to the delivery lines of 495A-2 pumps installed on service tank No. 3 and tank No. 4.

To ensure reliable operation of the diaphragm, a throttle, dia. 0.7 mm, with a protective gauze is installed at the control pressure inlet of the special valve. The special valve control pressure outlet (drain) connection is coupled through a pipeline to connection 26 of float valve 1 (Fig. 1A) which is similarly fitted with protective gauze 7 to prevent clogging of the float valve orifice.

When the float is up (is floating), the float valve orifice is open and when the float is down, the orifice is closed.

The control pressure is built up in the special valve when any pump (either that of service tank No. 3 or that of tank No. 4) is engaged and the orifice of connection 26 of float valve 1 is closed. In this case the special valve is open.

As the level of fuel in tank No. 7 rises, the float moves upward (comes to the surface), opens the orifice in the float valve connection and releases the control pressure into the tank. The spring closes the special valve to shut off fuel flow from the drop tank till the next drop of the fuel level in tank No. 7.

Apart from the above-mentioned protective gauzes used to prevent clogging of the special valve throttle and float valve orifice, the control pressure line is fitted with filter 32 installed at the pumps outlets to remove the dirt.

From the wing tank compartments the fuel is transferred under pressure to tank No. 2 through the same special valve 38. The fuel is first consumed from the drop tank and then from the wing tank compartments. This sequence of fuel consumption is governed by the difference of excess pressures in the drop tank (0.78 to 0.85 kg/cm^2) and in the wing tank compartments (0.38 to 0.43 kg/cm^2). Inasmuch as compressed air delivered from the engine compressor outlet is fed into the wing tank compartments, a pressure of about 0.17 to 0.2 kg/cm^2 in excess of the pressure built up in the fuselage tanks is maintained in the wing tank compartments due to operation of safety valves (Fig. 3) installed in tank No. 7 (Fig. 1, Ref. 2).

Since the fuel from the wing tank compartments passes through special valve 38, the drop tank fuel supply line is fitted with non-return valve 29 to prevent fuel flow back into the drop tank.

In order to avoid fuel flow from the right-hand wing compartments into the left-hand ones and vice versa, the pipeline is provided with non-return valves 45 fitted with protective gauzes 40.

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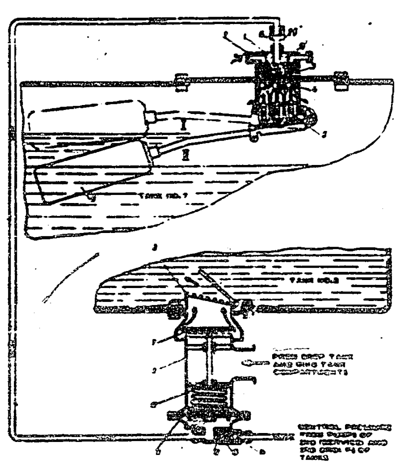

FIG.2. FUEL SYSTEM SPECIAL VALVE. FUNCTIONAL DIAGRAM

1 – float valve; 2 – plug; 3 – spring; 4 – ball valve; 5 – rod; 6 – float; 7 – valve disc; 8 – non-return valve; 9 – special valve; 10 – spring; 11 – diaphragm; 12 – throttle, dia. 0.7 mm; 13 – protective cover; 14 – ball valve; 15 – protective gauze.

I – level of fuel in tank No.7 which causes ball valve "[illegible]" to open and special valve of tank No.2 to close.

II – level of fuel in tank No.7 which causes ball valve "[illegible]" to close and special valve in tank No.2 to open.

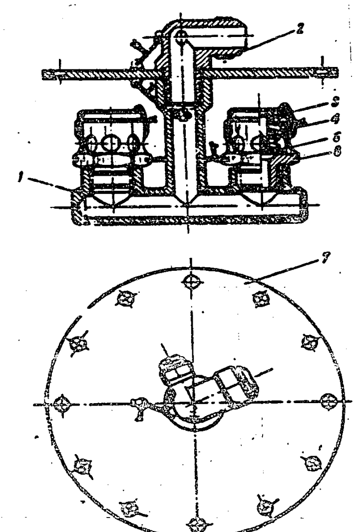

FIG.3. SAFETY VALVE UNIT

1 – body; 2 – connection; 3 – cover; 4 – spring; 5 – valve; 6 – body; 7 – plate.

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To prevent fuel flow from tank No. 2 into the wing tank compartments (through the charging pipeline) caused due to transverse g-load on the aircraft, inertia valves 4 are installed in the charging pipes.

To prevent fuel flow from the wing tank compartments into tank No. 2 through the charging pipeline (which may disturb the fuel sequence), the charging pipeline is fitted with non-return valves 41 installed at the inlet of the front wing tank compartments.

To prevent fuel flow from tank No. 4 into tank No. 7 caused by negative loads, the line connecting the above tanks is provided with non-return valve 8.

The beginning of fuel consumption from the 3rd group of tanks is governed by the level of fuel in the upper part of tank No. 2; for this purpose tank No. 2 is provided with float valve 5 which opens as soon as the fuel reaches a certain level to give way to fuel flow.

All tanks, except the drop tank, are fueled through the filler neck of tank No. 7. Tanks Nos 1, 2, 3, 4, 5 and 6 and wing tank compartments are filled by gravity through the pipeline interconnecting the tanks.

The air expelled from the fuel tanks during filling is displaced as follows:

(a) the air expelled from the fuselage tanks passes through the vent pipeline connected to the upper (front and rear) parts of tank No. 7;

(b) the air expelled from the front and rear tank compartments passes through the pipeline connected to vent valve 6 which is installed on top behind tank No. 7 (the vent valve is shown in Fig. 4);

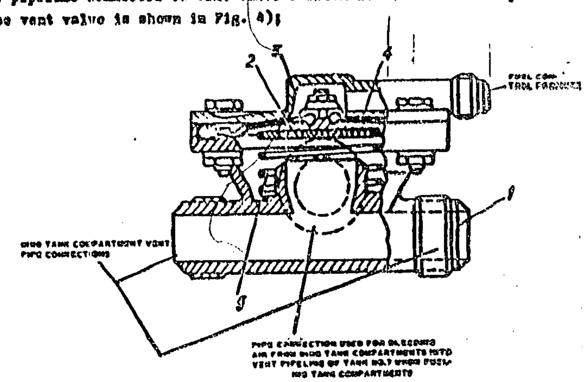

FIG. 4. VENT VALVE FOR WING TANK FILLING

1 – body; 2 – valve; 3 – cover; 4 – diaphragm; 5 – spring.

(c) the air expelled from tank No. 7 passes through the tank filler neck and is exhausted into the atmosphere.

During filling, the wing tank compartment vent valve is open (the control pressure is zero) to release air into tank No. 7 and vent pipeline.

The drop tank is fueled through the filler neck on the rear compartment of the tank.

The fuel drained from the fuselage tanks and wing tank compartments passes the drain valve located on the engine fuel supply pipeline. The fuel draining is effected by engaging the pumps of the 1st, 2nd and 3rd groups of tanks, with arrange-

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ment 76-9320-00 used to build up excess air pressure in the wing tank compartments. The fuel contained in the wing tank compartments can also be drained through drain plugs 47 fitted on each compartment.

The drop tank is emptied by pumping the fuel into the fuel servicing truck through a special hose to be dipped into the tank through the filler neck on top of the tank front compartment.

To drain the fuel deposit (condensate) from the fuel system, the lowest points of the pipeline and pumps are fitted with drain valves 23.

The drop tank is provided with drain plugs made in the front and rear compartments for draining the fuel deposit.

During fuel supply in flight the tanks are vented through the pipeline whose intake pipe is led outboard and is arranged opposite to flight to preclude high rarefaction in the fuel tanks in case the aircraft dives from high altitude with the engine throttled.

Besides, the vent pipeline, drop tank and rear wing tank compartments are fed with compressed air to provide normal operation of the fuel pumps at high-altitude flights and to achieve reliable fuel consumption from the drop tank and wing tank compartments.

The air for pressurization purposes is supplied from engine compressor final stage and is routed in the following ways:

1. To pressurize the fuselage tanks, the air passes through a throttle, dia. 3 mm, and non-return valve 12 into the vent pipeline situated in the tail portion of the fuselage.

In order that the air should not escape through the vent intake pipeline, the vent pipeline is fitted with non-return valve 10 and a throttle, dia 3 mm.

To maintain the pressurization value at 0.21 to 0.23 kg/cm², the vent pipeline (installed in the tail portion of the fuselage on the right-hand side) is provided with two spring-loaded safety valves 11 intended to relieve excessive air pressure into the atmosphere.

2. To pressurise the drop tank, the air passes through a throttle, dia. 2 mm, and non-return valve 31 to the tank connection via the pipeline. In order to maintain the designed pressurisation value, the pipeline carries a box housing two safety valves 18 calibrated to respond to the excess pressure of 0.51 to 0.63 kg/cm². The excess air pressure is relieved into the atmosphere. Non-return valve 31 is intended to prevent escape of the compressed air from the drop tank pressurisation line. The valve is installed behind the throttle, dia. 2 mm, and safety valves.

In order to avoid rarefaction in the drop tank when the aircraft dives from high altitudes with the engine throttled, the pressurisation pipeline (passing over the tank pylon) is equipped with special vacuum valve 50 which opens when the rarefaction inside the drop tank reaches 0.03 kg/cm².

3. To pressurise the wing tank compartments, the air passes through non-return valve 37 interlocking the wing tank compartment pressurisation system from other consumers of compressed air, and throttle 30, dia. 2.1 mm, and further on to the pipe connections arranged on the rear wing tank compartments.

To maintain the excess pressure large enough to allow fuel consumption from the compartments, the portion of the pressurisation pipeline located behind the throttle, dia. 2 mm, is connected to vent valve 2 installed in tank No. 7 which is fitted with two safety valves calibrated for excess pressure of 0.13 to 0.2 kg/cm² (with the engine running, the pressure built up in the wing tank compartments is 0.12 to 0.2 kg/cm²). The air pressure exceeding the indicated one is relieved into the fuselage tank vent pipeline.

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The pressure delivered into the wing tank compartments is controlled by vent valve 6 which cuts off the free flow of air into the fuselage tank vent pipeline.

The streamlined drop tank is suspended from a detachable pylon of special design and is fixed to the fuselage belly by means of rack БДЗ-56Б and an eye-bolt (Fig. 5).

Mounted on top of the tank are front and rear racks 4 and 8 used to attach the tank to the pylon. The tank is tightened to the pylon by eye-bolt 6 passing through the tank.

The tank is dropped electrically by means of a button installed on the aircraft control stick. When the button is depressed, the rack arm is tossed which causes firing of charge-operated release gun 25 with a tappet resting against stop 5 in the tank.

In order to obtain the required initial pressure upon the tappet, special washer 6 made of АМгАМ-Л1,8 material is used. When the gun is fired, the washer is cut away so that piston 4 and the tappet are simultaneously disconnected from the pylon. Each drop tank is provided with a charge-driven piston, tappet, special washer, fixing nut, stop and attachment bolt.

The drop tank is divided into two pressurised compartments, front and rear. The tank is fueled through filler neck 11 located on the rear compartment.

The front compartment is filled with fuel through a pipe connection fitted with non-return valve 10 to prevent flow of fuel from the front compartment into the rear one when the fuel is pumped out of the rear compartment. The valve is installed on the pressure bulkhead.

When fueling the tank, the air contained in the front compartment is exhausted through the port in the bulkhead connected to the filler neck via a pipe. When the filler neck cover is seated in its place, the pipe mouth, through which the air escapes from the front compartment during fueling, is closed as well so that the atmospheric air can penetrate into the front compartment through the rear compartment only.

The fuel consumption from the drop tank is forced by compressed air supplied from the engine compressor at 0.78 to 0.83 kg/cm^2. From the drop tank the fuel is delivered into tank No. 2 through the special valve. The fuel is first transferred from the rear compartment and then from the front one.

To achieve the above sequence, the tank is equipped with intake pipe connection 3 installed in the front part of the tank so that its pipe passes downwards to the tank bottom, while pressurization pipe connection 7 is coupled through the pressure bulkhead to the rear compartment of the tank. With the drop tank suspended the telescopic joint having a seal packing couples pipe connections 3 and 7 to the respective connections of the pylon which in turn are coupled to the fuel system pipeline arranged in the fuselage.

As the drop tank is attached to the fuselage belly near the third air brake, the pylon is fitted with limit switch 29 designed to discontinue the air brake hydraulic valve control circuit and thereby prevent air brake extension in the case of suspended drop tank.

The fuel sequence is controlled by the following devices:

1. Fuel flow meter РТС-16А4 installed in the pipeline between the fuel tanks and the engine to indicate the quantity of fuel in the tanks in terms of the cockpit fuel indicator readings.

2. The pressure warning unit installed at the outlets of pumps of the 1st, 2nd and 3rd groups of tanks and in the drop tank pressurization line to produce a light signal on light panel Т-10У and on the central board of the cockpit instru-

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ment panel. The signal light provides information about expenditure of fuel from a tank and at the same time warns the pilot about cutting off (or failure) of pumps or a pressure drop in the drop tank pressurisation line.

3. Emergency fuel remainder warning unit installed in tank No. 2 to produce a light signal on light panel T-10/ when the fuel reserve in the tanks is 500±50 lit.

To strain the fuel filled into the system, the following filters are employed:

(a) fuel servicing truck filters and filters installed in the filler necks which prevent foreign matter from getting into the tanks when fueling;

(b) low- and high-pressure fuel filters installed in the engine fuel line, and gauzes fitted in the drop tank suction pipe and in the non-return valve unit of the wing tank compartment fuel delivery line; these filters provide filtering during fuel consumption. To ensure proper engine operation during negative g flights, tank No. 3 (its lower part) is fitted with a negative g valve which ensures flights under negative g conditions at all ratings (except the augmented one) for the time interval of 15 sec., and at the augmented rating, for the time interval of 5 sec.

To shut off fuel supply to the engine in case of fire or when the engine is to be stopped because of the unserviceable engine controls, the fuel pipeline is fitted with a shut-off valve installed at the engine inlet and remotely controlled from the cockpit through an electropneumatic drive. The shut-off valve can also be closed manually to stop the fuel contained in the tanks when dismantling the engine. The remote control provides only the closure of the valve; during the flight the valve cannot be possibly opened.

The engine is started with the working fuel, i.e. with kerosene, for which purpose it is provided with an independent starting system.

To achieve reliable ignition of fuel when starting the engine in flight, the engine starting equipment is provided with an oxygen supply system.

Fuel Sequence

The sequence of fuel consumption from the tanks is controlled automatically and needs not be checked by the pilot whose mission goes as far as switching on all fuel pumps before starting the engine. Described below is sequence of fuel consumption (shown in Fig. 5).

(a) Fuel Sequence with Drop Tank Attached

I - The fuel is transferred from tank No. 7 until the float of valve 26 (the float valve in tank No. 7) moves down to a certain level so that the float shuts off the port of valve 26 and the control pressure opens the special valve installed in tank No. 2.

II - Compressed air is first fed to force the fuel from the drop tank rear compartment and then from the front compartment.

Note: The rate of fuel consumption from the drop tank can be 11,500 lit/hr.

III - Compressed air is first fed to force the fuel from the rear wing tank compartments and then from the front wing tank compartments.

Note: The rate of fuel consumption from the wing tank compartments can reach 5500 lit/hr (maximum).

IV - The fuel from tank No. 7 is delivered by gravity through the pipeline to tanks Nos 1 and 2 and is pumped from tanks Nos 1 and 2 by the 495A-2 pump (till the valve float in tank No. 2 goes a certain distance down).

V - The fuel from tanks Nos 4, 5 and 6 is sent by the 495A-2 pump at a rate of about 14,000 lit/hr (maximum).

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VI, VII – The fuel from tanks Nos 1 and 2 is completely transferred by the 495A-2 pump; when the float of warning unit C31637H reaches a certain level, the emergency fuel remainder warning lamp lights up.

VIII – The fuel from tank No. 3 (the service group) is sent by the 495A-2 pump at the rate of engine fuel consumption.

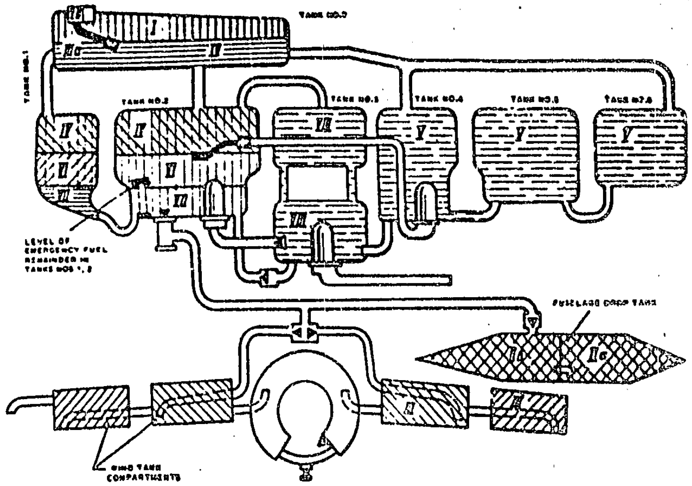

FIG.5. DIAGRAM OF FUEL CONSUMPTION

Notes: 1. The above sequence of fuel consumption relates to a level flight with the engine operating at the maximum rating. In the case of an augmented engine rating the rate of fuel consumption is increased by delivering the fuel from tanks Nos 1 and 2 and from tanks Nos 3, 4, 5 and 6 simultaneously.
2. The above rates of fuel consumption are maximum and given for the augmented engine rating.
3. Prior to beginning fuel transfer from the drop tank, about 40 lit. of fuel are first delivered from tank No. 7.
4. When the engine is operated at an augmented power rating, a part of fuel is additionally fed from tank No. 7 since the rate of fuel transfer from the drop tank is not sufficient.

(b) Fuel Sequence with Drop Tank Removed

The sequence of fuel consumption is the same as in the case when the drop tank is used.

2. USE OF DROP TANK
(Fig. 6)

General

1. The aircraft is employed both with the drop tank or without it.

In case the drop tank is removed, the aircraft can be employed both with the pylon attached or without it.

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If the pylon is removed, the fuel pipeline in the fuselage should be fitted with a special stop to prevent dirt from getting into the pipeline. Insert plug ШР-4 with cover 74-7202-3711 into electric connector No. 102 and fit electric connector No. 114 with cover Н1168-24-Б also to prevent fouling and to provide extension of the third air brake.

If the pylon is not removed, proceed as follows:

(a) plug the fuel pipeline socket arranged on the pylon;

(b) cover the pylon with a fairing and fix it with bolts to the pylon lower portion; after this check if the fairing is fitted tightly to the pylon (local gaps up to 1 mm wide are permissible).

2. When installing a new drop tank (received at the airfield depot) or a drop tank already used on some other aircraft, test the tank for releasing by depressing the button on the control stick (meanwhile support the tank by hands at both ends). See to it that the charge-operated gun is unloaded and special duralumin washer 6 (Fig. 7) is not fitted when installing the charge-operated tappet and the stop into the cylinder.

It is allowed to jettison the tank by disengaging the rack support arm mechanically by means of opening the hatch on the right-hand side of the pylon inscribed RELEASE and depressing the electromagnet axle sector tooth which should cause the tank to drop and the spring mechanism to operate simultaneously.

3. If during the day the aircraft is to perform flights with and without the drop tank, it is allowed not to test the tank jettisoning, the operation of the rack and spring mechanism or interlocking of the air brakes when installing the tank on that very day.

4. Similarly, if during the day the aircraft is to perform flights with and without the drop tank, the charge-operated gun may not be unloaded when preparing the aircraft for the flight without the drop tank. In this case, the following should be done prior to removing the tank:

(a) open the access door to reach the charge-operated gun;

(b) fit the gun bolt with a locking pin available in the ground accessory kit;

(c) disconnect the gun from the spring mechanism by driving out the pin interlocking the plug and the firing cotter;

(d) remove the locking pin from the charge-operated gun bolt and replace it with the pin driven out of the plug and firing pin;

(e) set the access door in place, remove the drop tank and leave the БДЗ-56Б rack in its lower position.

Note: To attach the drop tank with the charge-operated gun loaded, proceed in the reverse order and observe the safety precautions.

5. Checking and maintenance of the pylon mechanisms should be accomplished in compliance with the instructions given in Book II.

Attachment of Drop Tank to Aircraft

To attach the drop tank to the aircraft, observe the following priority:

1. Prior to attaching the drop tank, make sure that the pylon has been properly installed on the fuselage as specified in Section "Pylon Attachment" (See Book II) and that the drop tank is in good condition and all its parts are available. To do it, proceed as follows:

(a) remove the plug from the fuel suction pipe branch and from the pressurization pipe connection and make sure that the branch and connection are clean;

(b) inspect the front and rear supports of the tank for reliable nut attachment at the tank bottom and for the absence of axial play;

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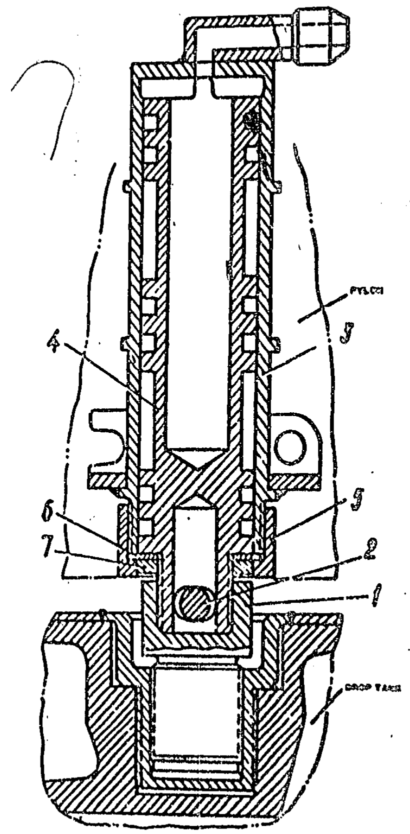

FIG.7. DROP TANK CHARGE-OPERATED TAPPET ATTACHMENT
1 – tappet seat; 2 – stud; 3 – cylinder; 4 – rod and tappet; 5 – union nut; 6 – washer; 7 – spring nut.

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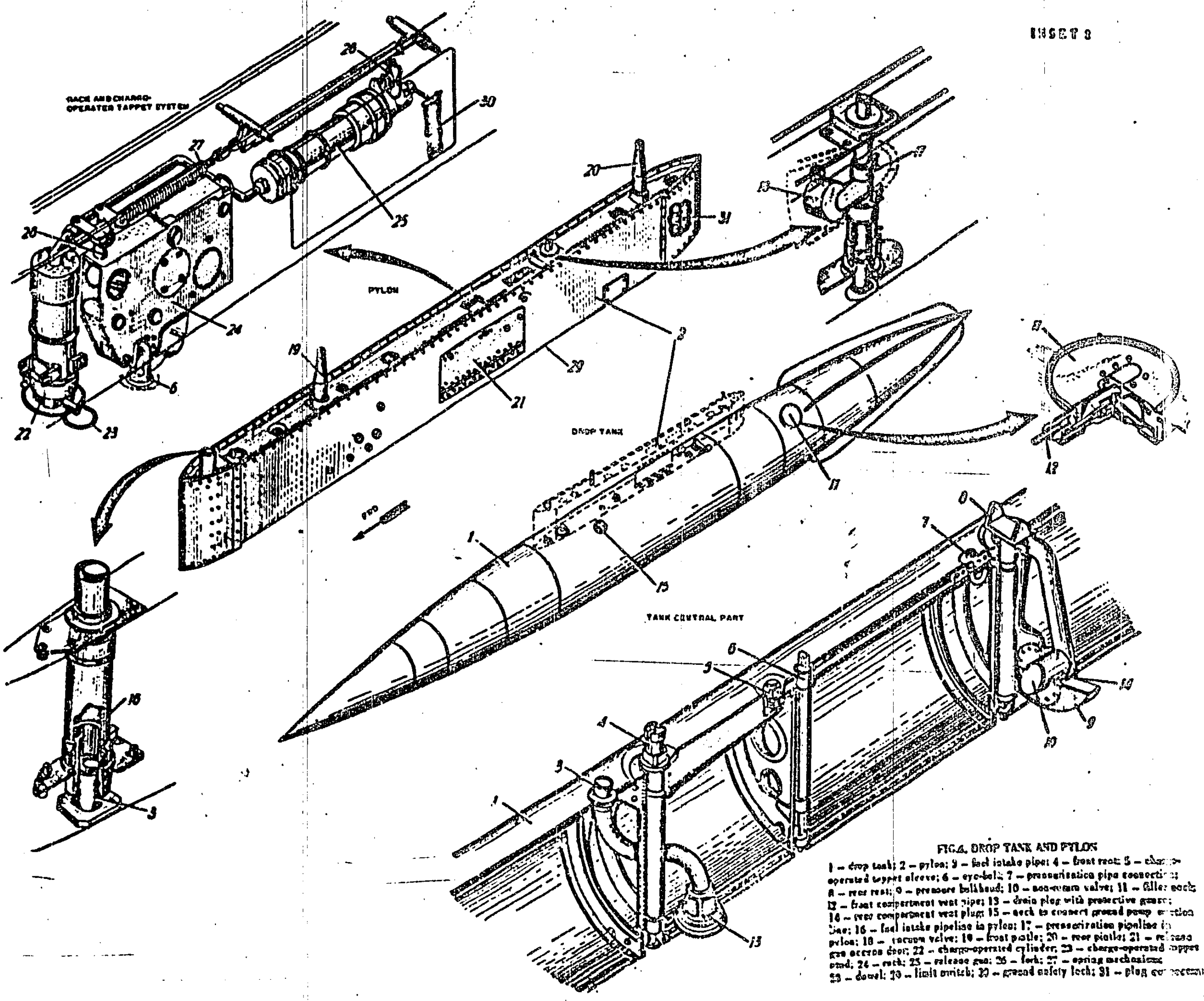

FIG.4. DROP TANK AND PYLON

1 – drop tank; 2 – pylon; 3 – fuel intake pipe; 4 – front rest; 5 – charge-operated tappet sleeve; 6 – eye-bolt; 7 – pressurization pipe connection; 8 – rear rest; 9 – pressure bulkhead; 10 – non-return valve; 11 – filler neck; 12 – front compartment vent pipe; 13 – drain plug with protective guard; 14 – rear compartment vent plug; 15 – neck to connect ground pump suction line; 16 – fuel intake pipeline in pylon; 17 – pressurization pipeline in pylon; 18 – vacuum valve; 19 – front pintle; 20 – rear pintle; 21 – release gun access door; 22 – charge-operated cylinder; 23 – charge-operated tappet stud; 24 – rack; 25 – release gun; 26 – fork; 27 – spring mechanism; 28 – dowel; 29 – limit switch; 30 – ground safety lock; 31 – plug connector

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(c) make sure that the charge-operated tappet stop is driven all the way into the socket on the tank;

(d) remove the rear compartment filler neck cover, see that the tank is not fouled and install the cover in place;

(e) turn out the drain plug from the front compartment, make sure that the filter gauze is not clogged, install the plug in place and lock it with wire, and ascertain the integrity of locking of the drain plug on the rear compartment;

(f) remove the tank attachment eye-bolt and make sure that it is intact;

(g) open the front compartment filler neck cover, take out the assembled charge-operated tappet, piston, washer and pressing nut (to be installed on the pylon) and check if they are not fouled.

Note: If the tank has been slushed or fouled from the inside, wash the tank with pure kerosene.

2. Remove the fairing from the lower portion of the pylon and check the operation of the БДЗ-56E rack. To do this, proceed as follows:

(a) unload the charge-operated gun in case it is loaded, set the gun bolt in its place, cock the spring mechanism and couple its plug to the bolt pin. Do not install the ground safety pin;

CAUTION. Checking the rack operation while the charge-operated gun is loaded is strictly prohibited.

(b) couple a ground storage battery to the aircraft mains;

(c) turn on switch BATTERY, AIRCRAFT-GROUND situated on the right-hand console and switch on circuit breaker TANK RELEASE;

(d) cock the rack support arm and suspend the eye-bolt from it by pressing the eye-bolt against the lock stop and driving the eye into the support arm mouth;

(e) through the peephole on the left-hand side of the pylon and through access door RELEASE on the right-hand side of the pylon check to see that the support arm is reliably fixed as is shown on the reference plate on the pylon;

(f) depress button TANK RELEASE on the aircraft control stick and make sure that the support arm has been released, the eye-bolt has dropped out and the spring mechanism has operated simultaneously so that the cotter has been driven out of the gun bolt and the bolt firing pin has been released.

After checking operation of the rack, cock the spring mechanism and the rack support arm again.

3. To check the interlocking of the third air brake, proceed as follows:

(a) couple the main hydraulic system to a ground hydraulic pump and build up a pressure;

(b) switch on circuit breaker AIR BRAKES situated on the right-hand side of the cockpit;

(c) depress the limit switch on the pylon by the hand so that the warning lamp TANK SUSPENDED lights up on the instrument panel central board;

(d) the technician working in the cockpit must set the engine control lever slide into the position of air brake extension and make sure that two side air brakes have extended whereas the third air brake has remained retracted;

(e) lower the rod of the limit switch arranged on the pylon and see that warning lamp TANK SUSPENDED has come off and the third air brake has been let down.

4. Retract the air brakes, stop the ground hydraulic pump, turn off switch BATTERY, AIRCRAFT-GROUND, cut out all circuit breakers switched on for checking, and disconnect the ground electric power supply from the aircraft mains.

5. Screw off the union nut from the charge-operated tappet actuating cylinder installed on the pylon, remove the plug (in case it has been previously installed),

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insert the assembled charge-operated group of the piston, tappet, duralumin washer screwed on the piston with a nut as far as it will go into the tappet cylinder and fix the group with the union nut (Fig. 7). Make sure that there is no plug on the pylon fuel pipeline and start fastening the drop tank.

6. Install the eye-bolt into the tank without fixing it with nuts. Place the tank under the pylon, drive the eye-bolt from the tank seat and hang it on the clamp support arm. Drive the attachment bolt from the charge-operated tappet support installed on the tank.

7. Lift the tank and fit the front and rear stops as well as the pipeline connections and charge-operated tappet stop in the respective places on the pylon.

Screw the steel washer onto the eye-bolt from below, screw on the nut, drive the nut home with special box wrench 76-9424-00 and fix it with a lock nut (Fig. 8).

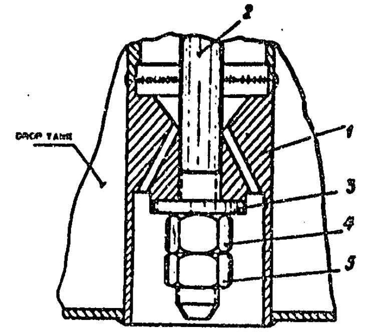

FIG. 8. DROP TANK EYE-BOLT ATTACHMENT
1 – attachment tube; 2 – eye-bolt; 3 – washer [illegible]-4-14-35; 4 – nut 1411C14; 5 – locknut 1411C14.

Make sure that the eye of the eye-bolt is fixed on the support arm without cocking.

CAUTION. 1. When screwing on the nuts with the special wrench, never apply any levers to increase the effort on the wrench.

2. Never use eye-bolts with stripped threads or washers and nuts affected by corrosion, burrs and nicks or fouled with grease or dirt.

8. Connect the charge-operated tappet with the stop on the tank by turning the stop with a wrench until the hole in the stop is aligned with the tappet hole, and insert the attachment bolt.

9. Check the tank for reliable attachment by pushing its front part sideways. Ascertain the presence of clearances between the tank and the edges of the pylon, no contact between them being permissible.

10. Load the charge-operated gun with the ПК-3М-1 squib in compliance with the instructions given in Book II and install a ground locking pin with a red flag.

Removing Drop Tank from Aircraft

To remove the drop tank from the aircraft, proceed as follows:

1. Pump the fuel from the tank into the fuel servicing truck.

2. Unload the charge-operated gun as specified in Book II. To release the spring mechanism, do not connect the plug with the firing cotter or with the bracketed eye-piece leaving the locking pin in the plug.

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Note: If the tank is to be removed from the aircraft for more than one day, the charge-operated gun should be unloaded, and the spring mechanism and the БДЗ-56Е rack should be released.

3. Drive the locking pin from the charge-operated tappet stop (Fig. 7).

4. Supporting the tank by the hands, disengage the support arm mechanically by depressing the rack electromagnet axle sector tooth or the respective button in the cockpit.

5. Remove the drop tank and see that the БДЗ-56Е rack is released.

Note: To prevent fouling of the removed tank, stop all its pipe connections with plugs. Slush the tank when placing it for a long-term storage. Store the tanks premises well protected against moisture.

Measures to Be Taken after Jettisoning the Tank

After dropping the tank during the flight, carry out the following maintenance operations:

1. Open the access door in the pylon and remove the charge-operated gun, disassemble and clean the gun, clean and examine all parts of the tank charge-operated tappet according to the instructions given in Book II.

2. Make an external inspection of the pylon to see whether it has not been damaged.

3. Examine the БДЗ-56Е rack and check its operation.

4. Check the pylon for reliable attachment to the fuselage.

5. After inspecting and cleaning the pylon, rack and charge-operated group, attach a new drop tank according to the instructions listed above.

3. CHECKING PERFORMANCE OF FUEL SYSTEM

(Pre-Flight Preparation)

Check the operation of the fuel system with the fuel tanks filled and the ground power supply connected using the following procedures

1. Turn on starboard switch BATTERY, AIRCRAFT - GROUND.

2. Switch on starboard circuit breaker ЭЦН OF HYDRAULIC SYSTEM; FUEL REMAINDER TANK WARNING and see that light panel T-10У displays the inscription SERVICE TANK and the instrument panel lower board lamp DROP TANK EMPTIED lights up.

3. In case the drop tank is attached, switch on circuit breaker TANK RELEASE arranged under a glass on the starboard and see that lamp TANK SUSPENDED lights up.

4. Switch on starboard circuit breaker PUMP OF 1ST GROUP OF TANKS and see that a respective inscription shows up and disappears on light panel T-10У of the instrument panel.

5. Switch on starboard circuit breaker PUMP OF 3RD GROUP TANKS and see that a respective inscription goes on at light panel T-10У and disappears after the pump is switched on.

6. Switch on starboard circuit breaker SERVICE PUMP and see that a respective inscription goes on and disappears on light panel T-10У.

After checking, switch off all circuit breakers and the storage battery.

After the drop tank has been attached and fueled, the pressure has been built up and the engine started, instrument panel lower board warning lamp DROP TANK EMPTIED should come off.

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4. MAINTENANCE OF FUEL SYSTEM AND CHECKING IT FOR AIRTIGHTNESS

In the course of aircraft operation perform the following:

1. Check the fuel system connections and units for airtightness.

2. Eliminate leakage by tightening loose union nuts and hose clamps.

If the special valve cover is leaky, replace the valve; do not try to stop leakage by tightening the valve cover.

3. If leakage persists despite tightening of the nuts and clamps, detect the cause of leakage by disassembling the joints and checking the condition of parts. Repair or replace the parts, if necessary. Stripped or fouled threads of pipe connections, dents and cracks in pipes or damage of flexible hoses are impermissible.

4. Keep the drain pipes outgoing from the fuselage skin always clean. In winter time, see to it that the pipe outlets and safety valves recess installed under a gauze near frame No. 29 on the starboard are free from ice and snow.

5. When fueling the system, take care not to overfill the tanks. Tighten the filler neck cover by hand as far as it will go and close the access door.

6. If the filler neck cover or rubber-sealed joints leak, replace the damaged rubber gaskets by new ones taken from the spares set.

7. In winter time give special care to the quality of fuel, since at low temperature the fuel filter may get clogged with ice.

8. If the drain pipe of the pump leaks, replace it.

Testing Fuel System Tightness

Testing the fuel system for tightness is made with the fuel tanks completely filled and an excess pressure of 0.3 kg/cm^2 built up in the system by means of special testing equipment. Conduct the test in the following order:

1. Remove the drop tank with the pylon and use special plugs to stop the fuel pipeline and the pressurization pipeline of the fuselage. The system may also be tested with the pylon installed.

2. Fill the fuel tanks with kerosene completely and tighten the cover of the ground testing equipment securely.

3. Using the lower access door, close the shut-off fuel cock, having unlocked the cock lever.

4. Remove two safety valves of the fuselage tank pressurization system located in the starboard fuselage tail section recess closed with a metal gauze; plug the holes.

5. Use a rubber plug to stop the pipe connected to the airtight box housing the drop tank pressurization system safety valves.

6. Open the access door on the left-hand side of the fuselage between frames Nos 25 and 28 and disconnect the engine air intake pipe from the cross branch connections; stop the branch connections.

7. Use a rubber plug to stop the vent pipe passing from the vent (circular) pipeline outboard at frame No. 29 (fuselage bottom).

8. Use a special plug to stop the vent pipe branch on the superstructure behind frame No. 28A.

9. Engage ground installation 76-9861-150 to build up an air pressure of 0.3 kg/cm^2 and maintain it in the system for 15 min.

No pressure drop or kerosene leakage is permissible.

10. Restore the system, open and lock the shut-off cock.

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IMPORTANT. See to it that two safety valves used in the fuselage tank pressurization system (See Point 4) are installed instead of the plugs.

With the engine control lever set against stop CUTOFF, engage all pumps of the fuel system for 5 min. No leakage of kerosene from the pipeline or drain system is permissible.

5. CHECKING PRESSURE IN FUEL SYSTEM AND HYDRAULIC RESERVOIRS

To check the pressure value, observe the following priority:

1. Fill the tanks and check the level of fuel in the hydraulic reservoirs.

2. Install special covers fitted with pressure gauges in the place of the filler neck cover of tank No. 7, drop tank filler neck cover and booster system hydraulic reservoir filler neck cover.

3. To measure the pressure in the wing tank compartments, connect a pressure gauge instead of the plug installed in the T-piece of the wing tank compartment pressurization pipeline. The T-piece is installed in the right-hand part of the recess, above fuel tank No. 5.

4. Start the engine and accelerate it to obtain a speed of 70 to 80 per cent. Maintain the above rating for the time interval required to charge the tanks with air and see that the drop tank fuel consumption warning lamp comes off.

5. Check the pressure value against the pressure gauges. See that the pressure in tank No. 7 is within 0.21 to 0.23 kg/cm^2, the pressure in the drop tank is within 0.78 to 0.83 kg/cm^2 and the pressure in the hydraulic reservoir is within 1.6 to 2.55 kg/cm^2.

The pressure in the wing tank compartments must keep equal to that in the fuselage tanks till the moment when the whole amount of fuel contained in the drop tank and some 50 to 100 lit. of fuel contained in the fuselage tanks have been consumed; after this the pressure in the wing tank compartments should rise and vary to exceed the pressure in the fuselage tanks by a value of 0.12 to 0.19 kg/cm^2, but it must never exceed the pressure in the fuselage tanks by more than 0.2 kg/cm^2.

To avoid expenditure of large amounts of fuel (i.e., the fuel contained in the drop tank plus 50 to 100 lit. from the fuselage tanks), it is advisable to take the pressure check of the wing tank compartments without the drop tank engaged.

In case the above-mentioned pressure in the tanks cannot be obtained, find the leaky point in the system and eliminate the fault.

6. Make sure that the desired pressure value is maintained, reduce the engine speed to the idling rating, and maintain it for 1 min. to see that the pressure built up in tank No. 7 does not drop below 0.17 kg/cm^2.

7. 15 min. after stopping the engine, make another check to see that the pressure is within 1.6 to 2.55 kg/cm^2 with the hydraulic reservoir filler neck cover retained in its place.

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Chapter III

MAINTENANCE OF AIRCRAFT HYDRAULIC SYSTEM

1. GENERAL

The aircraft hydraulic system consists of two independent systems: main and booster (Fig. 9).

The main hydraulic system is intended for extension and retraction of the landing gear, wing flaps and air brakes, for control of the engine nozzle flaps, anti-surge shutters and air intake cone, for automatic braking of the wheels when retracting the landing gear, and for actuating one chamber of the stabilizer booster. It is also employed as a system duplicating aileron control booster БУ-45А in case the booster hydraulic system fails.

The booster hydraulic system is designed to actuate the aileron boosters and one chamber of the stabilizer booster.

The sources of hydraulic energy for the main and booster systems are variable displacement piston rotary pumps НП-34-1Т installed in each system, and having an operating pressure range from 180 to 215_{-12} kg/cm^2; the pumps are employed in combination with the hydraulic accumulators.

With the operating pressure in the hydraulic system equal to 180 kg/cm^2 and maximum pump speed of 4000 r.p.m., the pump capacity is a maximum and equals at least 34 lit/min.

When the operating pressure built up in the hydraulic system is 215_{-12} kg/cm^2, the pump capacity is a minimum irrespective of the pump speed, and the pressure is consumed to compensate for the system internal leakage and for cooling the pump through the external circulation return line.

When the hydraulic pressure is 175_{-3} kg/cm^2 and the pump speed is close to the engine autorotation speed during landing, the pump capacity is over 2.5 lit/min. The pump capacity depends on the pressure in the hydraulic system and is controlled automatically by a regulator included into the pump system.

The hydraulic accumulators installed in the systems are designed to ensure sufficient response of the hydraulic system, i.e. to restore instantaneous large losses in hydraulic energy of the system.

The hydraulic accumulators are at the same time used to supply stabilizer booster БУ-51МС during landing with the engine jammed or operating on autorotations and emergency pumping unit НП-27Т engaged. Besides, the hydraulic accumulators are used to damp the pressure fluctuations.

Each hydraulic system is fitted with two hydraulic accumulators, one of these is of a spherical-diaphragm type, while the other is of a cylindrical-piston type (Figs 10 and 11). The gas cavities of the hydraulic accumulators are filled with nitrogen. In order to preserve the energy of the hydraulic accumulators when booster system pump НП-34-1Т fails, the spherical hydraulic accumulator is separated from the pump by a non-return valve, while the cylindrical hydraulic accu-

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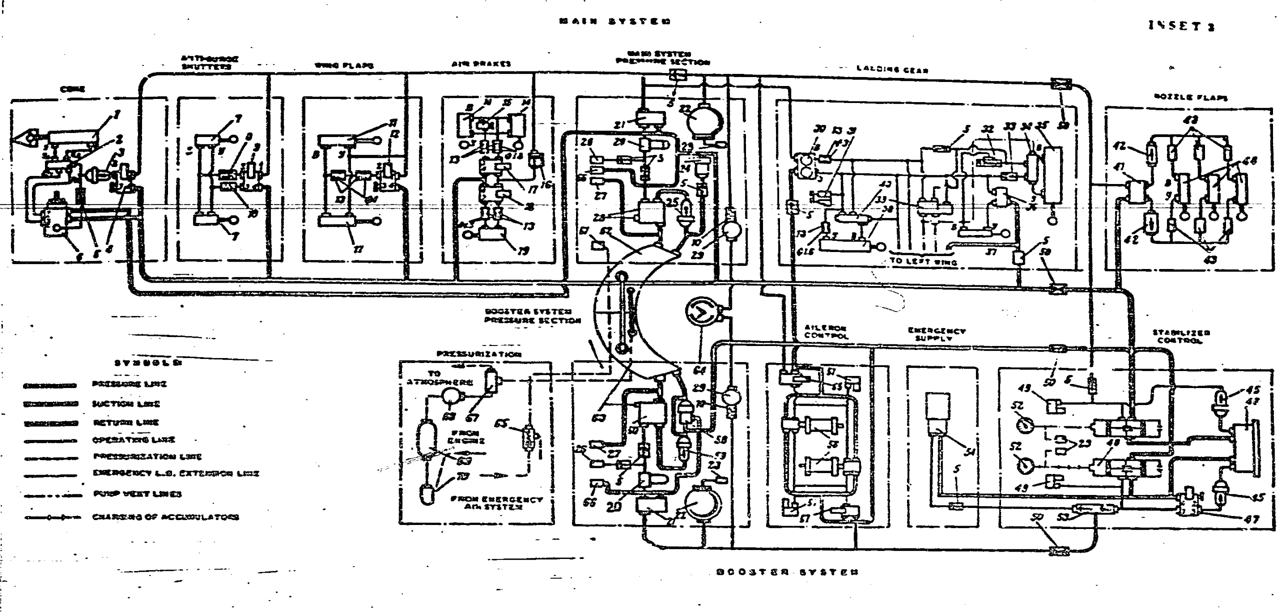

FIG.9. KEY DIAGRAM OF HYDRAULIC SYSTEM

1 – cone cylinder; 2 – cone cylinder hydrolock; 3 – 11ПФ-15-1 filter; 4 – ГА-184У cone valve; 5 – check valve; 6 – АУ-35-1 control unit; 7 – anti-surge shutters cylinder; 8 – differential throttle; 9 – ГА-184У flaps valve; 10 – throttle; 11 – wing flaps cylinder; 12 – wing flaps valve ГА-184У; 13 – throttle; 14 – side air brake cylinder; 15 – cross-feed valve; 16 – check valve with thermovalve; 17 – side air brake valve ГА-184У; 18 – ventral air brake valve ГА-184У; 19 – ventral air brake cylinder; 20 – ФГ-11/1СП fine filter; 21 – ГА-186М safety valve; 22 – spherical hydraulic accumulator; 23 – charging valve 642500; 24 – main system return-line fine filter; 25 – main pump circulating line filter 11ФГ-4СП; 26 – aircraft valve (pressure); 27 – aircraft valve (suction); 28 – main system pump НП34-1Т; 29 – pressure gauge pick-up 2ДП-50/250; 30 – L.G. valve ГА-142/1; 31 – automatic brake cylinder; 32 – emergency valve; 33 – one-way throttle; 34 – L.G. main strut actuating cylinder hydrolock; 35 – L.G. main strut actuating cylinder; 36 – sequence valve; 37 – L.G. main strut wheel door cylinder; 38 – L.G. nose strut actuating cylinder; 39 – L.G. main strut up-lock cylinder; 40 – L.G. nose strut actuating cylinder hydrolock; 41 – nozzle flaps valve ГА-164М; 42 – ГА-173 metering unit; 43 – synchronizing valves; 44 – after burner flaps ring cylinders; 45 – 11ГФ4СП fine filter; 46 – stabilizer booster БУ-51МС; 47 – ГА-184У valve for disconnecting БУ-51МС booster from booster system; 48 – cylindrical hydraulic accumulator; 49 – ГА-135Т/32 pressure-sensitive relay; 50 – disconnect valve; 51 – pressure-sensitive relay ГА-135/21 for pressure interlocking of autopilot КАП-2; 52 – cylindrical accumulator air pressure gauge МВ-250М; 53 – dual check valve; 54 – НП-27Т emergency pumping unit; 55 – ГА-190Б valve for disconnecting БУ-45А booster from main system; 56 – БУ-45А aileron booster; 57 – ГА-190Б valve for disconnecting БУ-45А booster from booster system; 58 – booster system return line gauze filter; 59 – booster pump circulating line filter 11ГФ4СП; 60 – booster system pump НП34-1Т; 61 – release valve; 62 – hydraulic reservoir main system compartment; 63 – hydraulic reservoir booster system compartment; 64 – УК2-250А pressure gauge indicator; 65 – vent valve; 66 – filling valve; 67 – pressurization valve; 68 – reducer e826004; 69 – pressurization unit; 70 – sump.

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mulator is fitted with a non-return valve separating it from the whole system, except booster БУ-51МС.

For the same purpose all points consuming the hydraulic energy in the main system, except the boosters and nozzle flap control system, are similarly separated from the hydraulic accumulators by means of a non-return valve. Thus, an increased expenditure and drop of pressure in the main system caused due to engagement of the air brakes, wing flaps, cone or some other elements do not affect the booster operation; in case the booster system fails, the energy stored in the hydraulic accumulators will be given off to supply the boosters alone.

The hydraulic system is provided with a common hydraulic reservoir divided by a pressurized bulkhead into two independent compartments for the main and booster systems (Fig. 12). To ensure high-altitude operation of the hydraulic system and to prevent cavitation in the pumps, an excess pressure of 1.6 to 2.55 kg/cm^2 is built up at the pump inlet. The air to pressurize the hydraulic reservoirs is taken at the compressor outlet and fed into a unit which consists of a container of 1.3 lit. capacity, non-return valve and dust filter. At a low altitude, when the engine speed is maximum, a pressure of 8 to 12 kg/cm^2 is produced at the compressor outlet. The pressurization unit maintains the pressure throughout the flight no matter what altitude or engine power rating may be, and compensates for air leakage from the pressurization system caused by occasional disturbances in tightness of the hydraulic system which may occur during the flight. The air delivered from the unit is fed through reducer 682600A to the air cavities of the hydraulic reservoir at a pressure of 1.6 to 2.55 kg/cm^2. Installed at 682600A reducer outlet are two non-return valves designed to prevent fluid АМГ-10 from getting into the reducer and pressurization system. Besides, the pressurization system is fitted with a safety valve intended to protect the hydraulic reservoir against damage due to sharp pressure rises caused during emergency L.G. extension.

Apart from this, the pressurization system is fitted with a release valve which is at the same time used as a pipe connection for coupling to a ground pump.

Since the hydraulic system is pressure-filled, no filler necks are provided on the hydraulic reservoir. Fitted into the reservoir are transparent pipes used to check the level of fluid in the reservoir compartments. To achieve reliable operation of the pumps under negative-g conditions, the hydraulic reservoir compartments are separated with horizontal bulkheads which form the cells for feeding the pumps under negative-g conditions.

To inspect, clean and wash the inner surfaces of the hydraulic reservoir it is provided with access hatches designed as bases of the drain pipe connections. The two reservoir compartments are interconnected through a pipe used to prevent overfilling of either compartment in case the working fluid flows from one system into the other through the aileron booster slide-valve change-over devices.

The flow of the working fluid through the aileron booster change-over valves becomes very intensive when the pressure in one system is zero while in the other system it is still present, or when the boosters are being changed-over from one system to another. Such cases may happen on the ground when one of the systems operates from a ground hydraulic pump, or during the flight when one pump fails.

In order to avoid pressure rises in the systems when the pump capacity regulator fails, the main and booster systems are fitted with safety valves ГА-186М (Fig. 13). When the pressure jumps up to 240^{+5} kg/cm^2, the valve bypasses the working fluid to the return line and thereby maintains the pressure in the system within 260 kg/cm^2.

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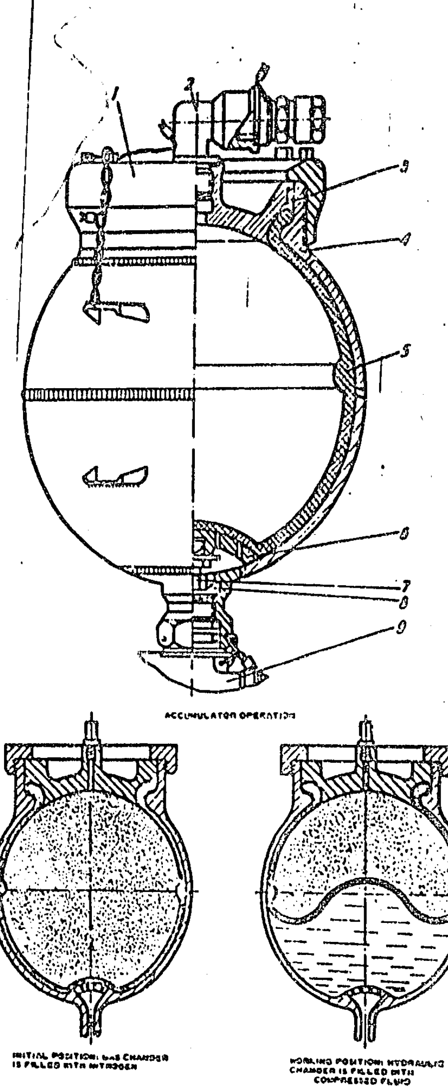

FIG.10. SPHERICAL HYDRAULIC ACCUMULATOR
1 – nut; 2 – charging valve with angle; 3 – cover; 4 – body; 5 – diaphragm; 6 – head; 7 – screw; 8 – nut; 9 – collector.

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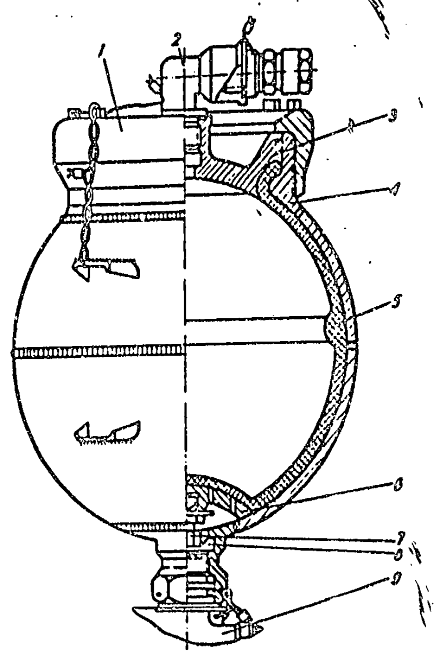
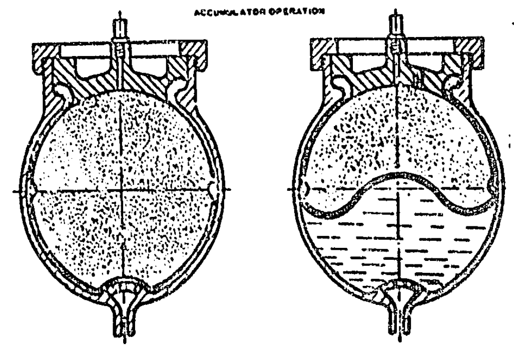


ACCUMULATOR OPERATION



INITIAL POSITION: GAS CHAMBER IS FILLED WITH NITROGEN

WORKING POSITION: HYDRAULIC CHAMBER IS FILLED WITH COMPRESSED FLUID

FIG.10. SPHERICAL HYDRAULIC ACCUMULATOR
1 – nut; 2 – charging valve with nozzle; 3 – cover; 4 – body; 5 – diaphragm; 6 – bead; 7 – screw; 8 – nut; 9 – collector.

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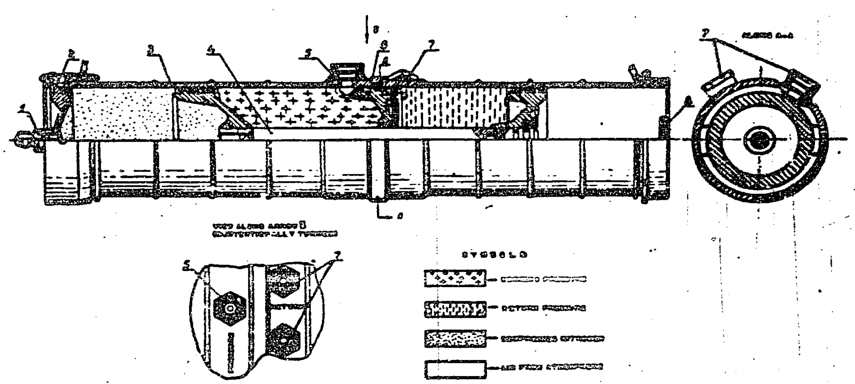

FIG.11. CYLINDRICAL HYDRAULIC ACCUMULATOR

1 – [illegible] 2 – cover 3 – [illegible] 4 – [illegible] 5 – [illegible] line pipe connection 6 – [illegible] 7 – [illegible] pipe connection 8 – [illegible]

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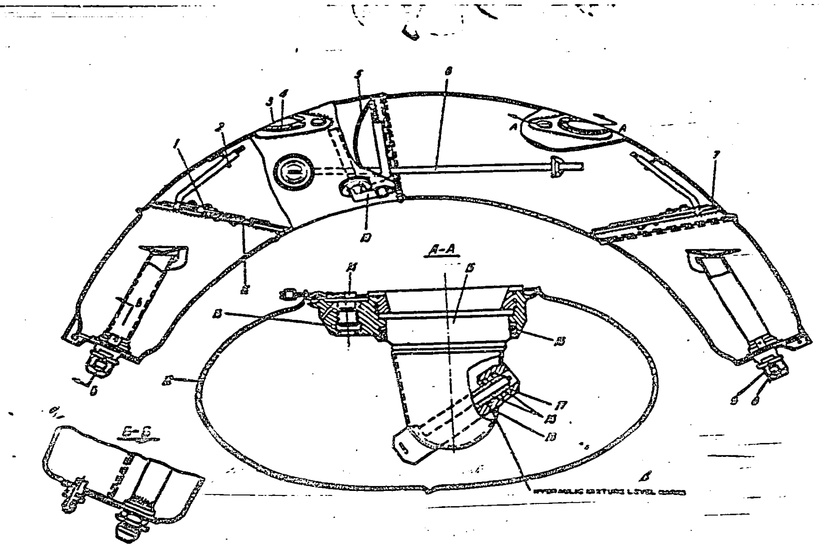

FIG.12. HYDRAULIC RESERVOIR

1 – valve with strong spring; 2 – vent pipe; 3 – [illegible]; 4 – nut; 5 – pressure bulkhead; 6 – connecting pipe; 7 – separating bulkhead; 8 – drain connection; 9 – suction connection; 10 – pressurization connection; 11 – valve with weak spring; 12 – reservoir body; 13 – filler neck body; 14 – plug; 15 – sleeve; 16 – packing ring; 17 – gauge glass; 18 – gauge glass housing.

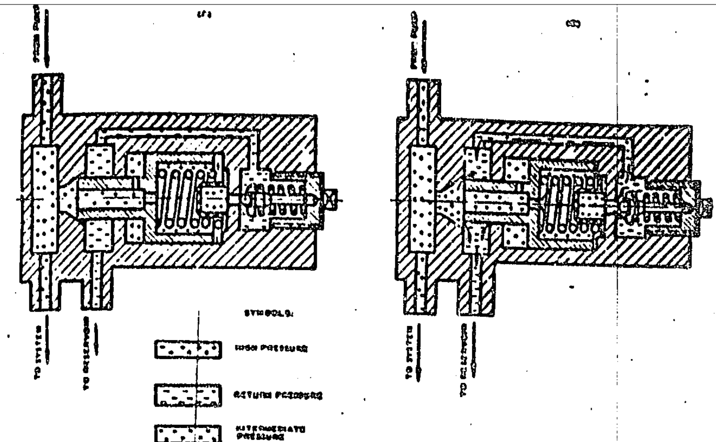

FIG. 18. SAFETY VALVE ГА-186М
(a) normal operating pressure 180 to 215_{-15} kg/cm^2; (b) pressure exceeding 215^{+15} kg/cm^2

The booster hydraulic system is intended to supply the hydraulic energy to the aircraft control system. In order to increase the service life of the aircraft control system and to achieve its maximum reliability in operation, the main hydraulic system is arranged so as to duplicate the aileron boosters supply and to feed one chamber of the stabilizer booster.

When landing with the engine jammed or autorotating, the stabilizer booster is fed from emergency pumping unit НП-27Т and from the hydraulic accumulators.

In the case of normal operation of both hydraulic systems, the aileron boosters permanently employ the booster system, while the working fluid from the main system is kept constantly under pressure at the БУ-45А booster change-over valves. When the pressure built up in the booster system drops to a value approximately twice as small as the pressure in the main system, the aileron boosters are automatically changed over to the main system supply through the operation of the change-over valves mounted inside the heads of boosters БУ-45А. As the pressure in the booster system increases to a value exceeding half the pressure produced in the main system, the aileron boosters are automatically disconnected from the main system and are changed over to the booster hydraulic system supply.

When boosters БУ-45А are cut off or a simultaneous pressure drop occurs in both systems, the ailerons can be controlled manually. In these cases the actuating cylinder cavity cross-feed valves and the booster distributing slide valve locking mechanism are caused to operate during pressure decrease when a pressure difference of 5 ± 1 kg/cm^2 is produced in the booster between the pressure and return lines. As a result of engagement of the mechanisms mentioned above, the boosters operate as rigid elements so that the slide valve play is arrested and

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the cross feed of the actuating cylinder cavities does not produce additional efforts when the ailerons are controlled manually.

Stabiliser two-chamber booster БУ-51МС permanently employs both main and booster hydraulic systems.

When a pressure drop occurs in the booster or main system, booster БУ-51МС keeps on operating on one chamber supplied either from the booster or main system depending upon which of these has failed. In such cases the capacity of one chamber of booster БУ-51МС is sufficient to exercise stabiliser control at the final stage of flight and landing.

In order to prevent deformation of the booster БУ-51МС rod caused by aerodynamic forces produced due to a simultaneous drop of pressure in both hydraulic systems, non-return valves are installed in the main and booster system pressure lines and in the booster body.

Emergency pumping unit НП-27Т arranged in the booster system is engaged automatically in case the pressure in the booster system drops. Automatic engagement and disengagement of the pumping unit is controlled by pressure switch ГА-135Т/32.

When the pressure produced in the system drops to 165^{+10}_{-5} kg/cm^2, the pumping unit gets engaged; and when the pressure built up in the system by pump НП-34-1Т or by pumping unit НП-27Т increases to a value up to 195 kg/cm^2, the pumping unit gets disengaged. The difference between the pressures at which the pumping unit gets engaged and disengaged must not be less than 12 kg/cm^2.

If the pumping unit is to be switched on and off manually for checking the aircraft on the ground, or if it is to be switched off in the course of flight when booster system pump НП-34-1Т is out of operation, make use of circuit breaker PUMPING UNIT arranged on the right-hand console.

Pumping unit НП-27Т is used to supply the stabiliser control system in cases of emergency landing listed below:

1. When the engine stops during flight and cannot be restarted, pumps НП-34-1Т provide reliable operation of the aircraft control system at the final stage of flight till landing, if the engine autorotation speed is normal. In this case a decrease in the aircraft speed during landing and reduction of the engine autorotation speed, as well as an increased movement of the control stick at landing, cause a decrease of pressure in the hydraulic systems; as a result pumping unit НП-27Т may get switched on some 15 or 20 sec. before the wheels touch the ground.

2. When the engine jams during flight or its autorotation speed is not normal, i.e. less than 15 per cent of the high-pressure rotor speed, the capacity of pumps НП-34-1Т is either zero or too low to provide normal operation of the system.

Therefore, the pressure in the main system reduces to zero, the pressure in the booster system reducing till the engagement of the pumping unit. Stabiliser booster БУ-51МС is supplied from pumping unit НП-27Т and from two hydraulic accumulators of the booster system.

An emergency landing such as that described in Items 1 and 2 can safely be accomplished, provided the booster system is functioning normally, i.e. when the condition of the hydraulic system is good enough to maintain the normal pressure. In such cases, the Flying Instructions should be closely followed so as to achieve minimum expenditure of the working fluid. If landing is to be performed with the

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engine jammed and pumping unit НШ-27Т operating throughout the final stage of flight and landing, the electric power must also be economised which is achieved through automatic disconnection from the aircraft mains of all powerful consumers and other consumers mentioned in the Flying Instructions.

Under normal operating conditions the aileron boosters and the stabiliser booster are permanently engaged. If a necessity arises, aileron boosters БУ-45А can be disengaged from the hydraulic system with the help of hydroelectric valves ГА-190Б (Fig. 14). One of the valves disconnects the boosters from the booster system and the other disconnects them from the main system. Both valves are controlled by a common switch arranged in the cockpit. Stabiliser booster БУ-51МС cannot be disconnected from the system.

To check operation of the boosters on the ground separately from the booster and main systems, valve ГА-184У is employed to disconnect one chamber of stabiliser booster БУ-51МС from the booster system. The other chamber is not disconnected from the main system.

Aileron boosters БУ-45А are disconnected from the booster system with the help of valve ГА-190Б used for this purpose. When checking, the two valves are switched off by depressing a push-button arranged on the right-hand console; the valves remain cut-off as long as the button is depressed.

The pressure produced in the hydraulic systems is controlled by an electric remote-reading pressure gauge whose two-pointer indicator is arranged in the cockpit, while the pick-ups are installed in the systems.

Apart from the above pressure gauges, both hydraulic systems are equipped with a light warning system comprising two red lamps arranged on light panel Т-107 to illuminate the inscriptions NO PRESSURE IN BOOSTER SYSTEM and NO PRESSURE IN MAIN SYSTEM. The warning lamps are switched on by pressure switch ГА-135Т/32 when the pressure in the systems drops to 165^{+10}_{-5} kg/cm^2. The light warning circuit of the booster system is also connected to pressure switch ГА-135Т/32 used to engage and disengage pumping unit НШ-27Т.

The light warning circuit of the main system is controlled by another pressure switch ГА-135Т/32.

As the pressure produced in the systems increases to a value within 195 kg/cm^2, the warning lamps are switched off.

When checking the aircraft on the ground, it should be borne in mind that, while releasing pressure by the aileron boosters, the pressure drop warning lamps will light up at a pressure less than 165^{+10}_{-5} kg/cm^2 as indicated by the pressure gauge installed in the cockpit. This is explained by the fact that signal pressure switches ГА-135Т/32 are installed in the tail portion of the fuselage and are separated by the non-return valves from that portion of the system where the aileron boosters and pressure pick-ups are installed. Consequently, the pressure built up in the portion fitted with pressure switches ГА-135Т/32 reduces at a lower rate and causes a time lag in switching on the warning lamps. If the pressure produced in the systems is released through the stabiliser booster, the warning lamps will light up when the pressure is 165^{+10}_{-5} kg/cm^2.

In servicing the system it should not be forgotten that the non-return valve installed in the main system at the inlet of the spherical hydraulic accumulator disconnects the accumulator from all consumers except the boosters and engine nozzle flap control system; at the same time the valve separates the cockpit pressure gauge pick-up from all the consumers of hydraulic energy. Consequently, the cockpit pressure gauge does not indicate the pressure in the L.G., wing flaps,

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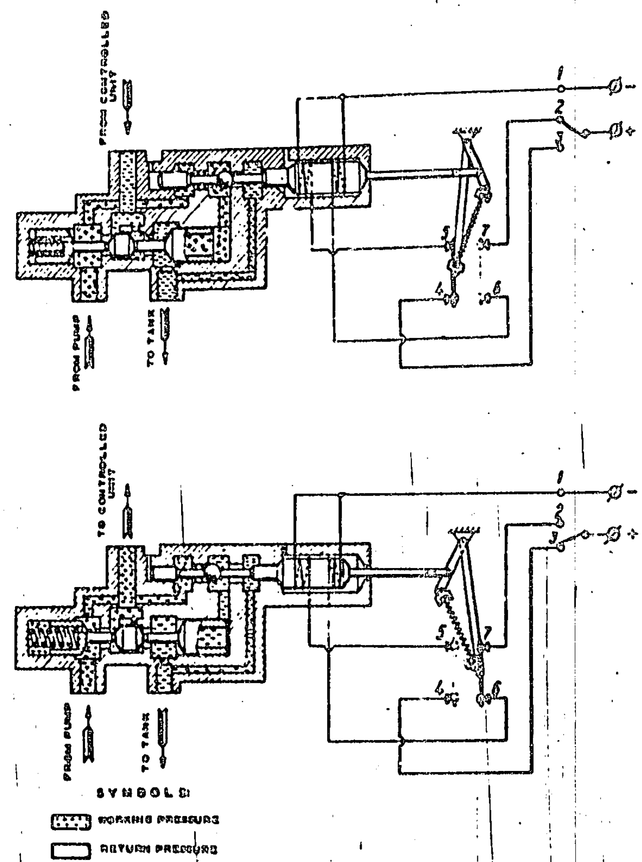

FIG.14. AILERON BOOSTER CUT-OFF VALVE ГА-100B

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air brakes, cone and anti-surge shutters control systems, when the engine is stopped or the ground hydraulic pump is switched off. Hence, the pressure built up in the main system can be released only through booster БУ-51МС.

The main system units are controlled with the help of the remote control electrohydraulic valves.

Employed as the L.G. retraction-extension distributing device is three-position valve ГА-142/1 (Fig. 15).

When the valve is cut off, its distributing slide is set into the neutral position. If the pressure is zero or if the valve pressure is low, the valve distributing slide is driven by the springs into the neutral position, no matter whether the valve electromagnets are energized or not. As the slide valve is set into the neutral position, the pressure line is cut off by the valve and both L.G. actuating lines are connected to the return line.

When the valve is switched on, one of the two electromagnets is energized so that the slide set into the extreme position connects one of the L.G. actuating lines to the pressure line, and the other, to the return line.

The valve body carries two buttons intended for mechanical (manual) control of the valve. The buttons are used to adjust the L.G. system on the ground when the ground electric power supply is not connected to the aircraft mains.

Installed in the return line at the inlet of valve ГА-142/1 is the non-return valve used to protect the L.G. retraction-extension actuating lines against return pressures caused during operation of the air brakes, wing flaps and other units, when the L.G. cock is in the neutral position.

The systems controlling the air intake cone, anti-surge shutters, wing flaps and air brakes are fitted with electrovalves ГА-184У (Fig. 16).

Two-position valves ГА-184У are employed to control delivery of compressed fuel supplied to either of the two cavities of the system cylinders. The valve distributing slide is kept in one position by a spring and in the other, by the pressure applied. When the pressure drops or if the electromagnet is de-energized, the spring drives the slide into the original position.

The engine nozzle flaps are controlled by special electrohydraulic valve ГА-164М/1 (Fig. 17).

The electric signals fed to the valve are governed by the engine control lever.

When the engine control lever is within the sector limited by position CUT-OFF and the position of 66 per cent high-pressure rotor speed, the engine nozzle flaps are opened completely. When the lever is within the sector limited by the position of 66 per cent high-pressure rotor speed and position MINIMUM AFTERBURNING the flaps are opened partially.

When the lever is within the sector limited by MINIMUM AFTERBURNING and FULL AFTERBURNING positions, the engine nozzle is controlled by an electric follow-up system which uses a feedback coupling. The feedback potentiometer is installed in one of the nozzle flap control cylinders. When the electric signal is removed, valve ГА-164М/1 is set into the neutral position so that the distributing slides cut off the lines connected to the cylinder cavities and the cylinder cavities are shut by the valve hydraulic locks. Temperature expansion of the working fluid trapped in the cavities is released by the thermovalves incorporated in valve ГА-164М/1.

To reduce high temperatures of the working fluid, the pipelines connected to the nozzle flap control cylinders are protected with a jacket of special design

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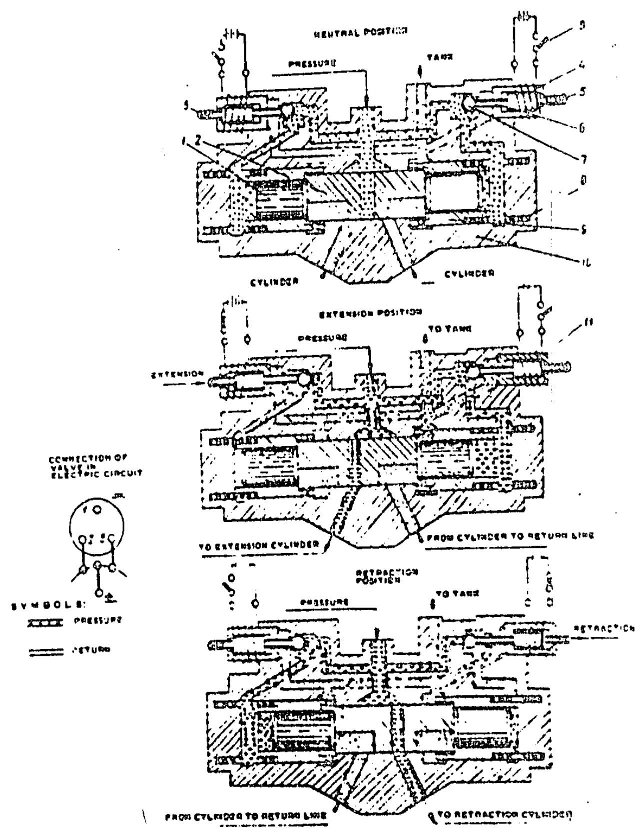

FIG.15. L.G. CONTROL VALVE ГА-142 Т

1 – slide; 2 – distributing slide valve; 3 – changeover switch; 4 – electromagnet coil; 5 – manual control button; 6 – control slide valve; 7 – ball valve; 8 – spring; 9 – bushing; 10 – body; 11 – electromagnet.

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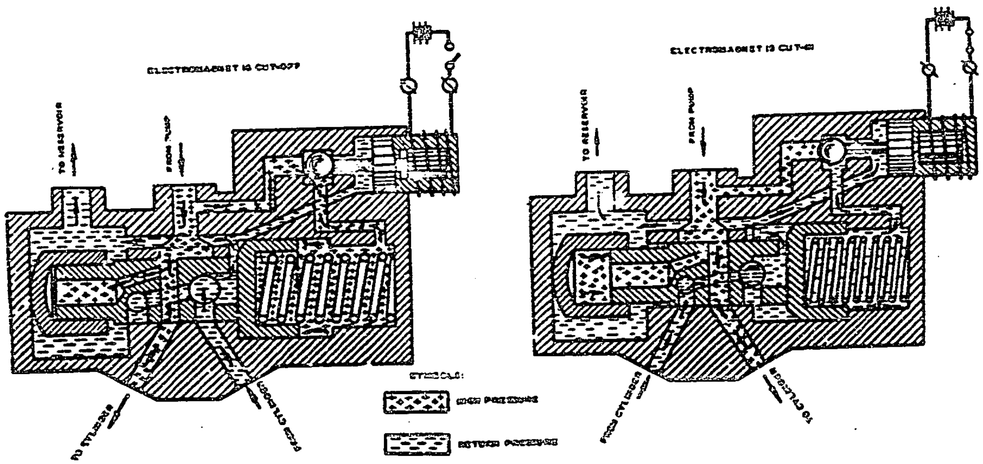

FIG.14. VALVE PA-104V

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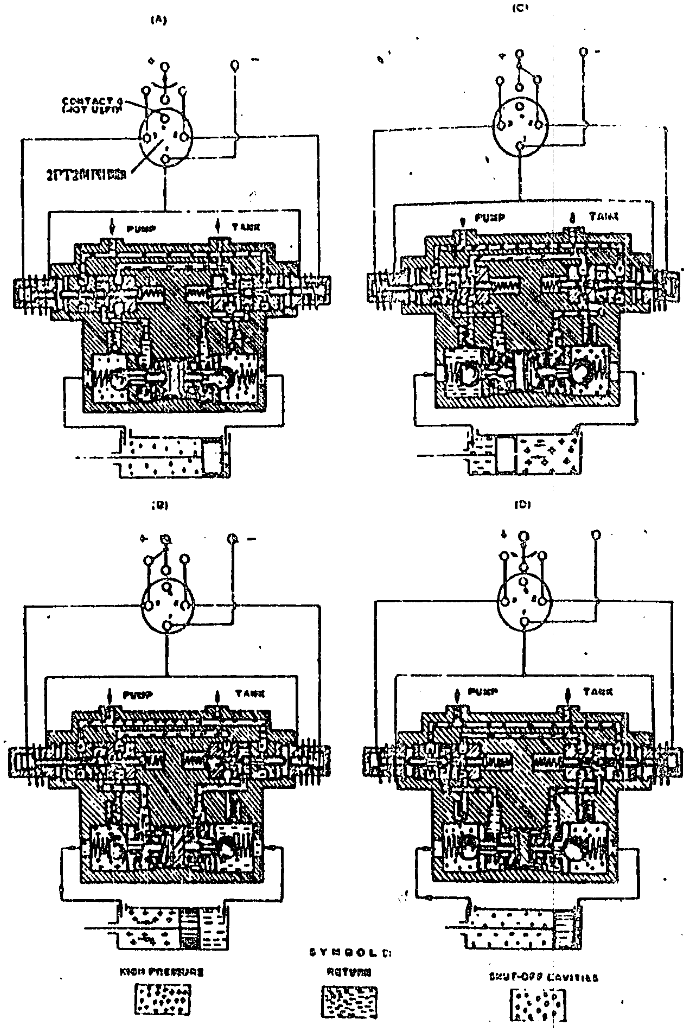

FIG.17. VALVE (A-164?)

(a) Electromagnets are de-energized. Fluid delivery to cylinder is cut off. Cylinder cavities are closed.

(b) Left-hand electromagnet is energized. Fluid is delivered to cylinder left-hand cavity. Right-hand cavity is connected to return line.

(c) Right-hand electromagnet is energized. Fluid is delivered to cylinder right-hand cavity. Left-hand cavity is connected to return line.

(d) Electromagnets are de-energized. Pressure in cylinder (left-hand cavity) is above operating value. Thermal valve operates.

installed in the vicinity of the afterburner, and cooled by a flow of air. The pipelines located between frame No. 30 and tail cone joint are arranged as a moving loop to respond to heat expansion of the engine afterburner.

During flight the air intake cone is controlled automatically. Extension and retraction of the cone depend upon the degree of compression produced by the engine compressor and are adjusted in response to the stabilizer deflection. The cone control system hydraulic section comprises valve ГА-184У, electrohydraulic control unit АУ-35-1, hydrolock, filter, non-return valve and actuating cylinder.

When the system is engaged, valve ГА-184У is energized so that it connects unit АУ-35-1 and hydrolock to the pressure line. Acted upon by the control pressure, the hydrolock opens and connects the actuating cylinder cavities to unit АУ-35-1.

One of the operating pipe connections of valve ГА-184У is not used, and the return line of the cone units is coupled directly to the system and not to the valve.

Electrohydraulic unit АУ-35-1 (Fig. 18) receives the electrical signals from the control system and converts them into the hydraulic signals to control the unit slide valve. The slide is caused to displace and connects one cylinder cavity to the pressure line and the other, to the return line due to which the cone is caused either to extend or retract.

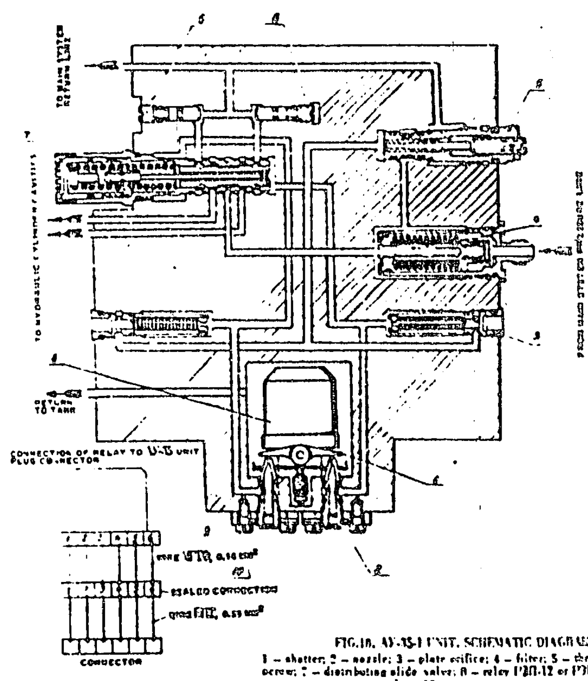

FIG. 18. АУ-35-1 UNIT. SCHEMATIC DIAGRAM

1 – shutter; 2 – nozzle; 3 – plate orifice; 4 – filter; 5 – throttle; 6 – adjusting screw; 7 – distributing slide valve; 8 – relay РЗП-12 or РЗП-12А; 9 – locking plate; 10 – screw.

When the system is de-energised, valve ГА-184У is cut off which leads to a release of control pressure applied to the hydrolock.

Irrespective of the operating condition of the electric system, a pressure drop in the main system leads to a drop of the control pressure acting upon the hydrolock. In either case the hydrolock is set into the closed position and cuts off the lines connected to the cylinder cavities. As a result, the cone is fixed in the position it occupied when the electric or hydraulic system ceased its operation. The hydrolock is closed when the pressure in the system drops down to 35 kg/cm^2, and is opened when the pressure increases up to 70 kg/cm^2.

Temperature expansion of the working fluid trapped in the cylinder cavities is released by the thermovalve fitted into the hydrolock assembly.

In order to prevent cone yielding prior to hydrolock closing when the hydraulic system fails the pressure line is fitted with the non-return valve installed at the inlet of unit АУ-35-1.

Apart from the automatic control, in case of necessity, the cone can be controlled manually by means of a setting knob installed in the cockpit on the cone position indicator.

The aircraft is equipped with float wing flaps. The flaps are deflected through the same angle in positions TAKE OFF and LANDING, the deflection angle depending upon the dynamic pressure exerted upon the flaps.

A specific feature of this design lies in the fact that the hydraulic pressure is supplied to cavity CYLINDER RETRACTION incessantly, i.e. bypassing valve ГА-184У both when the wing flaps are let up or down. During extension the hydraulic pressure is delivered to cavity EXTENSION through valve ГА-184У.

To effect extension of the wing flaps, the working surface area of the piston in cavity EXTENSION is made larger than that of cavity RETRACTION by a value equal to the rod cross-sectional area.

To control the air brakes, two valves, type ГА-184У, are employed.

When the air brakes are let down, both valves are energized and when the air brakes are let up, the valves are de-energized so that their slides acted upon by the springs are set into position RETRACTION. The air brakes are retained in the retracted or extended position by the pressure applied. When no electric current is supplied, the pressure causes the air brakes to retract. If the pressure in the hydraulic system drops, the air brakes are caused to move up due to dynamic pressure exerted upon them. In order to prevent the suction effect upon the air brakes caused when the pressure in the system is zero, as well as to compensate for the temperature expansion of fluid trapped in the retraction cavities, the pressure line has at its inlet a non-return valve and a thermovalve housed in a common body.

The thermovalve is calibrated to open at a pressure exceeding that of the pressure line by 25 kg/cm^2. When the drop fuel tank is attached, the push-action limit switch cuts off lower air brake valve ГА-184У.

To ensure safe operation of the maintenance personnel in the side air brake bays, the extension and retraction lines of the air brakes are cross-fed through the manual control valve. When performing maintenance work in the air brake bays, the manual control valve must be opened and a cotter pin installed on the valve rod. Prior to flight, the valve must be closed.

The air bypass anti-surge shutters installed in the air intake duct are operated automatically during flight. The shutters open at $M > 1.35$ in response to the electric signal applied to them by the M-relay, through the operation of limit switch КВ-9А connected to the stabiliser control system; the limit switch is caused to operate when the stabiliser travels through a pre-determined angle, as well as when the afterburner is disengaged and the engine control lever is set into a position between MAXIMUM and IDLING. The shutters can also be controlled manually by means of a switch installed in the cockpit.

The hydraulic section of the shutters control system comprises valve ГА-184У, throttles and actuating cylinders. As an electric signal is applied to its terminals, the valve opens and bypasses the compressed fluid to the actuating cylinders to open the shutters. When the signal is removed from the valve terminals, the shutters are caused to close. The shutters are retained open or closed by the fluid pressure. The time required for opening and closing the shutters is controlled by the throttles fitted into the extension and retraction lines.

Table 2

List of Throttles Installed in Hydraulic System

No.	Place of installation	Orifice dia., mm
1	Pipe connection 2 (extension) of L.G. valve ГА-142/1	3
2	L.G. nose strut retraction line, in cross pipe connected to actuating cylinder through pipe	1.6
3	Pipe connection RETRACTION of air brake valve ГА-184У	1.8
4	Pipe connection EXTENSION of air brake valve ГА-184У	1.8
5	Pipe connection RETRACTION of lower air brake flap valve ГА-184У	1.5
6	Pipe connection EXTENSION of lower air brake valve ГА-184У	1.5
7	Pipe connection EXTENSION of wing flap valve ГА-184У	1
8	Wing flap extension line, on pipe connection of T-piece connected to valve ГА-184У through pipe	1

In order to protect the units fitted with slide-valve couples, the hydraulic system is provided with a number of filters. The filters installed in the booster are distributed as follows:

(a) filter ФГ11/1СН installed at the outlet of pump НП-34-1Т;

(b) filter 11ГФ4СН installed at the input of booster БУ-51МС;

(c) gauze filter installed in the return line connected to the reservoir;

(d) filter 11ГФ4СН installed at the pump outlet connected to the return line.

The filters installed in the main system are distributed as follows:

(a) filter 76-5505-270 installed at the inlet of the reservoir in the common return line;

(b) filter 11ГФ4СН installed at the pump outlet connected to the return line;

(c) filter ФГ11/1СН installed at the outlet of pump НП-34-1Т;

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(d) filter 11Г94СН installed at the inlet of the БУ-51МС booster chambers;

(e) gauze filter 11Г94-БТ installed in the pressure line at inlet of one system unit АУ-35-1.

Each filter, type 11Г94СН or ФГ11/1СН, consists of a set of fine and coarse filtering elements arranged in a common body. The rate of filtering of a fine element constitutes 10 to 12 μ, and that of a coarse element is 80 μ.

<u>Note</u>: Filter ФГ11/1СН uses filtering element 340044А, filter 11Г94СН employs filtering element 340042А, and filter 75-5505-270 is fitted with filtering element 340045А.

The by-pass valve arranged inside the filter body will open when the fine filtering element is clogged and the pressure differential is increased at the filter inlet and outlet, so that the working fluid will be bypassed through the coarse filtering element only.

In order to reduce the pressure in the main system return line when the hydraulic units are engaged, a number of throttles listed in Table 2 are fitted into the system.

2. HYDRAULIC SYTEM BASIC SPECIFICATIONS
(Two Systems)

1. Working fluid .... АМГ-10 (State Standard ГОСТ 6794-53)
2. Total amount of fluid in both systems and reservoir .... 36 lit.
3. Total capacity of main system hydraulic reservoir ...... 10.5 lit.
4. Total capacity of booster system hydraulic reservoir ... 8 lit.
5. Maximum working pressure built up by pump at zero capacity at the end of service life:
   (a) working fluid at 20 ±5°C .... 215_{-12} kg/cm²
   (b) working fluid at 100 ±3°C .... 190 kg/cm²
6. Pump operating pressure range within which pump capacity varies from maximum to zero .... from 180 to 215_{-12} kg/cm²
7. Pump capacity at a pressure of 180 kg/cm² at the end of service life:
   (a) when pump speed is 4000 r.p.m. .... not below 34 lit/min.
   (b) when pump speed is 500 r.p.m., pressure is 175_{-3} kg/cm² and working fluid temperature is 75 ±3°C .... not below 2.5 lit/min.
8. Safety valve is calibrated to open at a pressure of ... 240^{+5} kg/cm²
9. Nitrogen pressure in hydraulic accumulator gas cavity at zero pressure in hydraulic system .... 50^{+5} kg/cm²
10. Quantity of fluid in spherical hydraulic accumulator at a pressure in system 215_{-12} kg/cm² .... 1.25 lit.
11. Quantity of fluid in cylindrical hydraulic accumulator at a pressure in system 215_{-12} kg/cm² .... 0.03 lit.

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12. Pressure in hydraulic reservoir pressurisation system (in hydraulic reservoir) .... 1.6 to 2.35 kg/cm²
13. Hydraulic reservoir pressurisation system safety valve is calibrated to open at a pressure of .... 2.8 ±0.3 kg/cm²
14. L.G. nose and main strut hydrolock thermovalves are calibrated to open at a pressure of .... 275 ±15 kg/cm²
15. Air brake actuating cylinder thermovalve is calibrated to respond to a pressure differential of .... 35^{+5} kg/cm²
16. Capacity of pumping unit НП-27Т at a pressure of 215_{-12} kg/cm², working fluid temperature of +90°C and voltage of 20 V at the end of service life .... not below 0.9 lit/min.
17. Pressure switch ГА-135Т/32 to signal a pressure drop in main and booster systems and engagement of pumping unit НП-27Т is calibrated to respond to the following pressures:
    (a) engagement of pressure drop warning system and pumping unit .... 165^{+10}_{-5} kg/cm²
    (b) disengagement of pressure drop warning system and pumping unit .... not above 195 kg/cm²
    (c) difference in pressures required to cut switch on and off .... not below 12 kg/cm²

3. INSTRUCTIONS ON KEEPING HYDRAULIC SYSTEM CLEAN

General

1. In servicing and maintaining the aircraft hydraulic system, mind that the system uses units (pumps, boosters, etc.) fitted with the slide-valve couples having small clearances. Reliable operation of the above units greatly depends upon purity of the working fluid.

2. When replacing units, disjointing hydraulic system pipelines, or carrying out scheduled maintenance, take care to keep off dust, sand, soot or moisture from the unprotected parts of the system. For this purpose carry out the above operations in a closed room or protect the operating position with canvas and by other improvised means.

Never carry out the above-mentioned maintenance in the vicinity of the testing grounds where the aircraft engines are checked.

3. In demounting units, disjointing pipelines and carrying out scheduled maintenance use clean tools and accessories only.

4. To avoid spilling of the working fluid over units, communication lines of aircraft systems or the airframe members located near the place where demounting or disjointing is performed, make use of drip pans, funnels, and cellophane or vinyl chloride sheet guards.

5. For wiping unprotected pipe connections and inner surfaces of the units, use only clean cloths washed in pure gasoline and wrung out.

CAUTION. For wiping use only lintless material (to use cotton, rags, cotton waste etc. is impermissible).

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Measures Taken to Keep Aircraft Clean when Replacing Hydraulic System Units

1. Prior to demounting a unit, take care to wipe thoroughly the ends of pipes connected to the unit to be removed and the unit proper, as well as all structural members situated nearby.

2. Remove the attachment parts of the unit and pipes, and wipe them clean before disassembling the pipes and demounting the unit.

3. After demounting the unit, seal the open pipe mouths and unit pipe connections with clean plugs in case a new unit is not to be installed immediately.

Unslush and wash the new unit in compliance with the corresponding maintenance instructions. When installing the unit, take care to prevent dirt from getting into the system.

4. On mounting a new unit, check the whole mounting region for tightness, using the operating pressure, and wipe the surface thoroughly of any signs of working fluid.

5. Prior to demounting a unit, the working fluid can either be drained from the system or not, depending upon the position of the unit in the system, the number of pipes connected to the unit, a necessity to remove the pipes together with the unit, etc. In case the unit is separated from the system by a shut-off valve, do not use the non-return valves to drain the working fluid. If removal of the unit leads to a considerable flow-out of the working fluid, it is better practice to drain the fluid beforehand from the entire system or from that portion of the system where the unit is installed.

6. After replacement of a unit, pump the system through to expell the air, and refill the system with working fluid.

Measures Taken to Keep Aircraft Clean when Disjointing Fuselage

1. Prior to disjointing the aircraft, thoroughly wipe the connections of the hydraulic pipes.

2. After disjointing, seal the open service connections and pipes with clean plugs.

3. Prior to disjointing, wipe thoroughly all connections and surfaces around them.

4. Use special plugs to stop the detachable valves of the "Argus" type.

Measures Taken to Keep Aircraft Clean when Filling and Refilling Hydraulic System

1. The working fluid to be charged into the hydraulic system must be stored in special containers with lead seals affixed.

2. For transference of the working fluid from the special containers into the servicing truck reservoir, use a closed room or otherwise take the required measures to prevent pollution of the working fluid during filling.

3. Prior to charging the working fluid, wash with pure gasoline and thoroughly wipe out the aircraft charging connection and the servicing cart hose encut.

After charging, remove the traces of fluid thoroughly from the aircraft charging connection, and then plug and lock the connection with wire.

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Measures Taken to Keep Aircraft Clean when Carrying Out Scheduled Maintenance

1. When removing fine filters from the pressure and return lines for washing and checking, proceed as follows:

(a) thoroughly wipe the filter body and the ends of pipes connected to the filter;

(b) screw off the body from the sump filter, remove the fine filtering element, drain the deposit from the body and wash the filter body in gasoline.

Wash the coarse filter in gasoline, install the fine filtering element already washed and checked up, assemble the filter body and wipe it out thoroughly.

Note: If, for some reason, washing and checking of the fine filtering element cannot be accomplished immediately, wrap the coarse filter with cellophane or temporarily install the filter body in its place without the fine filtering element;

(c) when handling a direct-flow filter, remove the whole filter and stop the open pipes disconnected from the filter with clean plugs. In washing filter 11ТФ-4Б-1 follow the corresponding Manufacturer's instructions.

Wash the coarse filter and replace the clean fine filtering element only with the filter removed. Wipe the filter thoroughly after installing it into the system.

2. When washing the gauze filter installed in the booster system return line, observe the following priority:

(a) prior to removing, wipe the filter body and the ends of pipes connected to it;

(b) remove the filter and stop the open pipes with clean plugs;

(c) disassemble the gauze filter and wash it in pure gasoline;

(d) assemble and install the clean filter into the system and wipe the dirt all about the place.

3. When examining and washing the gauze filters installed in boosters БУ-45А and БУ-51МС, proceed as follows:

(a) prior to removing the gauze filter, wipe the booster body housing the filter;

(b) take out the gauze filter and wash it. Be sure to close the place of the filter inside the booster with a clean plug or a piece of cellophane;

(c) after washing and installing the gauze filter, thoroughly wipe the booster body.

Measures Taken to Keep Aircraft Clean when Connecting Ground Pump

1. Prior to connecting a ground pump, wash the aircraft pipe connections and hose snout with pure gasoline.

2. The ground pump disengaged, wipe thoroughly the aircraft pipe connections and hose snouts, and close them with respective plugs.

4. CHECKING OPERATION OF PUMPING UNIT НП-27Т

To check the pumping unit operation, observe the following priority:

1. Connect the aircraft to the ground power supply and couple the ground hydraulic pump to the booster system pipe connections arranged on the port side.

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2. Switch on circuit breakers inscribed BOOSTER SYSTEM CUT OUT, HYDRAULIC SYSTEM WARNING, and ЗДМ OF HYDRAULIC SYSTEM, FUEL REMAINDER, TANK WARNING situated on the right-hand console.

3. Turn on the switch inscribed BATTERY, AIRCRAFT – GROUND located on the right-hand console and see that two warning lamps NO PRESSURE IN BOOSTER SYSTEM and NO PRESSURE IN MAIN SYSTEM light up on the instrument panel.

4. Switch on the ground hydraulic pump and build up a pressure in the booster system. Check the pressure against the pressure gauge installed in the cockpit. When a pressure within 195 kg/cm^2 is produced, warning lamp NO PRESSURE IN BOOSTER SYSTEM will come off, whereas warning lamp NO PRESSURE IN MAIN SYSTEM will continue to glow.

5. Switch on the right-hand console circuit breaker PUMPING UNIT.

6. Disengage the ground hydraulic pump, pull backward and push forward the aircraft control stick slowly to release the pressure from the hydraulic system. Check the automatic engagement of the pumping unit.

As the pressure drops down to 165^{+10}_{-5} kg/cm^2, make sure that warning lamp NO PRESSURE IN BOOSTER SYSTEM lights up and the pumping unit is switched on automatically.

Check the engagement of the pumping unit by listening to the noise produced by the electric motor and pump.

7. Turn switch AILERON BOOSTER situated in the upper left part of the instrument panel to switch off the aileron boosters, and disengage the pumping unit by turning off circuit breaker PUMPING UNIT situated on the right-hand console.

Shift the aircraft control stick to reduce the pressure in the system down to 100 kg/cm^2, then stop shifting and switch on the pumping unit again. Check the pressure increase caused due to operation of the pumping unit.

While the control stick is stationary and the aileron boosters are disengaged, estimate the time required to increase the pressure in the system from 130 to 170 kg/cm^2 and make sure that it does not exceed 7 sec. In case the time interval exceeds 7 sec., the hydraulic system and its units are not airtight, or the capacity of pumping unit НП-27Т has diminished.

8. When a pressure up to 195 kg/cm^2 is achieved, see that the pumping unit switches off. Check the difference in pressures produced at the instants of engagement and disengagement of the pumping unit. Make sure that the difference does not exceed 12 kg/cm^2. Check the disengagement of the pumping unit by listening to cessation of noise produced by the electric motor and pump, and by noting the end of the pressure increase indicated by the cockpit pressure gauge.

On accomplishing the check indicated in Items 7 and 8, switch on the aileron boosters and turn off all circuit breakers and switches.

<u>Note</u>: When checking the pumping unit on the ground, see to it that the total operating time of the pumping unit does not exceed 3 min. so as to prolong the service life of the pumping unit electric motor.

<u>CAUTION</u>. In order to guarantee normal engagement and disengagement of pumping unit НП-27Т as well as normal indication of the hydraulic system pressure drop after replacing hydroelectric switches Гд-135/32 in the booster or hydraulic system, it is necessary that the switches to be installed should be selected according to their calibration indicated in the Certificates:

(a) switching-on pressure should be 165^{+10}_{-5} kg/cm^2;

(b) switching-off pressure should be within 195 kg/cm^2.

The difference between the switching-on and switching-off pressures must not be less than 12 kg/cm².

The calibration data are listed in the pressure switch Certificates.

5. CHECKING CAPACITY OF PUMPS НП-34-1Т

(Performed with the engine running during pre-flight preparation)

1. Check the pressure of nitrogen indicated by the pressure gauges installed in the cylindrical hydraulic accumulators of the main and booster systems and make sure that the pressure is 50^{+5} kg/cm². Meanwhile, the pressure in both hydraulic systems must be zero.

2. Check the air brakes for tight pressing. Mind that no loose air brakes are allowed when the pumps are being checked. To eliminate looseness of the air brakes, open the cross-feed valve, press the air brakes closely to the fuselage by the hands, and close the cross-feed valve again.

3. Switch off aileron boosters БУ-45А and the cone control system so as to avoid leakage of the working fluid through the boosters and cone unit АУ-55-1 during checking of the pumps. For this, turn switches AILERON BOOSTER and CONE CONTROL to the off position.

4. Start the engine. As the engine speed increases watch the pressure gauge to check the rate of increase in pressure produced in both systems.

By the instant when the high-pressure rotor gains 25 per cent speed, the pressure gauge should indicate a pressure increase from zero to at least 195 kg/cm² in both systems, while the control stick is stationary.

<u>Note</u>: In summer time, when the ambient air temperature is 25° and higher, it is permissible that prior to the repeated flight the normal operating pressure of 195 kg/cm² in the considerably warmed-up hydraulic system should drop down to a pressure of 183 kg/cm².

5. When checking engine operation, obtain a 50 per cent speed of the high-pressure rotor after running the engine at maximum speed. Switch on aileron boosters БУ-45А.

When a stable engine speed equal to 50 per cent speed of the high-pressure rotor is obtained, displace the control stick from one extreme position into another, shifting it along the diagonal of the cockpit at a maximum possible speed.

While shifting the control stick, watch the pressure gauge indications to check the booster system pressure, and see that it should not drop below 180 kg/cm². In case the pressure thus checked corresponds to the above value, the booster system and its pump НП-34-1Т are considered to be in good condition.

6. While running the engine at the same speed, check pump НП-34-1Т of the main hydraulic system. To do this, depress the right-hand console button BOOSTER SYSTEM CUT OUT. Keeping the button depressed, shift the control stick as described in Item 5. Make sure that the main system pressure does not drop below 180 kg/cm².

In case the pressure corresponds to the above value, the main system and its pump НП-34-1Т are considered to be in good condition.

<u>Notes</u>: 1. In summer time, when the ambient air temperature is 25° and higher, it is permissible that prior to the repeated flight the operating pressure in the considerably warmed-up hydraulic system should drop down to 165 kg/cm² as compared to the pressure value of 180 kg/cm² specified above under Items 5 and 6.

It is possible, that in this case the signal light indicating a pressure drop in the hydraulic system may light up for some short time.

2. For the sake of simplicity, checking of the pump operation specified under Items 5 and 6 may be carried out with the engine operating in the IDLING mode.
If under these conditions the pumps display some abnormalities in operation, the final check of their operation must be made at 50 per cent speed of the high-pressure rotor.

CAUTION. 1. No flying is allowable, unless the requirements stated in Items 4, 5 and 6 have been satisfied.

2. After the pump check is completed, switch on the cone control system before flight by turning on switch CONE CONTR.

Note: To simplify checking described in Items 5 and 6, the check can be carried out with the engine operating in the IDLING mode.
If in this case the pumps operate abnormally, check up pump operation again at a 50 per cent speed of the high-pressure rotor.

6. DETECTING CAUSE OF HYDRAULIC PUMP ABNORMAL OPERATION

If the checks of the hydraulic pumps have shown that their capacities do not correspond to the ratings listed in Section 5, try to find out the cause of trouble.

The possible causes of decrease in pump capacity may be:

(a) breakdown of the pumps resulting in zero capacity;

(b) leakage of the hydraulic reservoir pressurization system or insufficient pressurization;

(c) external leaks in the hydraulic system;

(d) internal leaks in the hydraulic system.

To detect the cause of trouble in the hydraulic system which has resulted in a decrease of pump capacity, strictly observe the fixed priority indicated below:

1. The engine running, check the hydraulic reservoir pressurization value.

In case the value is below 1.6 kg/cm^2, check the tightness of the pressurization system according to the instructions given in Section "Checking Tightness of Hydraulic Reservoir Pressurization System". Restore tightness of the system, if necessary.

In case the pressurization system proves to be airtight though the pressurization value is below the rating, replace the pressurization system reducer, and check the non-return valves and other units.

Make another check of the hydraulic reservoir pressurization value and the pump serviceability.

If the pressurization value has increased up to 1.6 - 2.35 kg/cm^2, and the pumps performances correspond to the requirements given in the Instructions, the hydraulic system and pumps are considered to be in good condition.

2. Check the hydraulic systems for external leaks (See Section "Checking Hydraulic System for Tightness"). In case of external leakage of the hydraulic system, remove the trouble and check the operation of the hydraulic pumps. The airtightness restored, and the pumps operating normally, the hydraulic systems are considered to be in good condition.

3. Check the hydraulic systems for internal leakage (See Section "Checking Hydraulic System for Tightness"). In case of internal leakage of the hydraulic system, determine the faulty unit and replace it.

After the internal leaks have been removed, make another check of the pump operation. If the pumps operate normally, the hydraulic system is considered to be in good condition.

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4. In case the hydraulic reservoir pressurization value is normal and no external or internal leakage is present, while the capacity of the pumps is low, the cause of trouble lies in the pumps. Replace the pumps, and check operation of the newly installed pumps. If the pump capacity obtained during checking corresponds to the rated data given in the Instructions, the hydraulic systems are considered to be good.

7. CHECKING HYDRAULIC SYSTEM FOR TIGHTNESS

The tightness of the hydraulic system is checked in the following cases:

(a) when carrying out scheduled maintenance;

(b) when the operation of the hydraulic pumps is found to be abnormal in the course of pre-flight preparation;

(c) when the units or pipelines of the hydraulic system are replaced or when separate portions of the hydraulic system are dismounted or assembled.

Checking of the system for tightness comprises checks for external and internal leakage of the system. Described below is the procedure for making the above-mentioned checks.

Checking Hydraulic System Pipelines and Units for External Leakage

The main and booster hydraulic systems should be checked separately.

Prior to checking perform the following:

1. Open the fuselage, wing and fin hatches to examine the hydraulic system units and pipelines.

2. Check the pressure of nitrogen contained in the gas chambers of hydraulic accumulators of the two hydraulic systems and see that it is equal to 50^{+5} kg/cm^2. Recharge the hydraulic accumulators, if necessary.

3. Close the fuel shut-off valve to prevent fuel flow into the engine due to shifting of the engine control lever. After checking the tightness of the hydraulic system and setting the engine control lever into position CUTOFF, open the shut-off fuel valve initially closed.

When checking the booster system for external leakage, observe the following priority:

1. Connect the aircraft to the ground electric power supply and couple the ground hydraulic pump to the booster system pipe connections. Turn on the circuit breakers and switches to engage the hydraulic system.

2. Operate the ground hydraulic pump to produce a pressure of 215_{-12} kg/cm^2 in the hydraulic system and estimate the pressure by the cockpit pressure gauge. Switch on the aileron boosters and set the control stick into the neutral position.

3. The pump operating, maintain the pressure in the system for 10 to 15 min. Open the access doors to inspect the condition of system units and joints located between the pump and boosters both in the pressure and return lines.

No leakage is permissible.

4. Turn on switch PUMPING UNIT, disengage the aileron boosters and switch off the ground hydraulic pump.

5. Pull the stick backward and push it forward and release the pressure in the booster hydraulic system to obtain 165^{+10}_{-5} kg/cm^2. At this pressure pumping unit НП-27Т must get engaged. Stop shifting the stick and see that the pressure increases till it becomes not more than 195 kg/cm^2 when the pumping unit is disengaged.

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All in all, operate the pumping unit for not more than 3 min. and examine its separate assemblies and joints for external leakage. No leakage in pipeline joints or assemblies is permissible.

Switch off the pumping unit and reduce the pressure to zero by shifting the control stick.

In order to check the main hydraulic system for external leakage, proceed as follows:

1. Jack up the aircraft.

2. Connect the main system to the ground hydraulic pump and obtain a pressure of 215_{-12} kg/cm^2 indicated by the cockpit pressure gauge.

3. Open the access doors to inspect for external leakage of the pipeline joints and units installed in the following portions of the hydraulic systems:

(a) L.G. extension and retraction system with the valve set in three positions: NEUTRAL, RETRACTED, and EXTENDED;

(b) wing flaps system, with the valve set in two positions: RETRACTED and EXTENDED;

(c) the air brake system with the valve set in two positions: EXTENDED and RETRACTED;

(d) anti-surge shutter control system with the valve set in two positions: OPEN, and CLOSED;

(e) cone control system set in two positions: EXTENDED and RETRACTED;

(f) engine nozzle flap control system in two positions: MAXIMUM and FULL AFTERBURNING;

(g) pressure and return lines of aileron boosters БУ-45А and stabilizer booster БУ-51МС.

Note: The cone should be extended and retracted, and the anti-surge shutters opened and closed manually. After checking, the switches should be set into position AUTOMATIC.

Keep the hydraulic system under pressure for less than 10 min. in each position of the valves.

Inspect from outside the following portions of the pressure and return lines "pump - valves", "valves - cylinders" and "pump - boosters".

No leakage in pipeline joints or units is permissible.

Checking Hydraulic System for Internal Leakage

The internal leakage of the main and booster hydraulic systems should be checked separately. Each system is checked for internal leaks by noting the time of pressure drop in the system with the ground hydraulic pump switched off. Prior to checking both hydraulic systems for internal leaks, the following operations should be performed:

1. Check the level of the working fluid contained in both compartments of the hydraulic reservoir. If necessary, refill the reservoir with oil АМГ-10.

2. Check the pressure of nitrogen in the gas chambers of the hydraulic accumulators of both systems and see that it is 50^{+3} kg/cm^2. If necessary, recharge the hydraulic accumulators.

3. Remove the non-return valve installed in the main hydraulic system pressure line at the inlet of the spherical hydraulic accumulator.

To substitute for the removed non-return valve, install service adapter 74-7801-1050, to be found in the tools kit, delivery set 1:4. The adapter has an internal diameter equal to that in the given pipeline portion.

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4. Jack up the aircraft.

Check the main and booster systems for internal leaks separately according to instructions given below.

Main Hydraulic System

1. Connect the aircraft to the ground electric power supply and couple the main system connections to the ground hydraulic pump.

Switch on the ground hydraulic pump and build up a pressure of 213_{-12} kg/cm^2 in the main system. The pressure in the booster system should be zero.

2. In order to heat up the working fluid and units and to expell the air from the system, engage the hydraulic system units as follows: make 10 to 12 cycles to retract and extend the landing gear, wing flaps, air brakes, cone, anti-surge shutters and engine nozzle flaps; make 20 to 30 complete shifts of the control stick in the forward and backward directions at a maximum possible speed.

3. When the operating pressure is obtained in the system, set the hydraulic system valves into the following positions:

(a) aileron booster valve in position OFF;
(b) cone valve in position OFF;
(c) landing gear valve in position NEUTRAL;
(d) wing flap valve in position RETRACTED;
(e) anti-surge shutter valve in position CLOSED;
(f) air brake valve in position RETRACTED.

Make sure that the air brake cross-feed valve is shut off, the engine nozzle flap valve is in the neutral position and the engine control lever is in a position between the stops MINIMUM AFTERBURNING and FULL AFTERBURNING.

4. Maintain the system under pressure for 1 to 2 min. Switch off the ground hydraulic pump, do not shift the control stick, watch the cockpit pressure gauge to evaluate the time over which the pressure drops from 180 to 150 kg/cm^2, and make sure that it is not less than 10 sec.

5. Check the time of pressure drop in the system by setting the valves in some other positions than those listed in Item 3, but do not change over the aileron booster valves or the cone valve which must be cut off. Make sure that the time of pressure drop from 180 to 150 kg/cm^2 is not less than 10 sec. irrespective of the positions of the valves.

6. Switch on the ground hydraulic pump and as soon as the system develops the operating pressure, set the valves in the positions listed in Item 3.

Switch on the aileron boosters and make 20 to 30 complete shifts of the control stick moving it from right to left at a maximum possible speed. Then, set the control stick in the neutral position.

7. At the operating pressure in the system switch off the ground hydraulic pump, and keeping the control stick stationary, measure the time over which the pressure drops from 180 to 150 kg/cm^2 with the aileron boosters switched on; the time must not be less than 5 sec. Shift the control stick to relieve the pressure from the hydraulic system.

Note: No internal leakage check of the hydraulic system is to be made when the cone valve is turned on, since under normal conditions cone control system unit AY-55-1 constantly delivers 3 to 4 lit/min. of the working fluid from the pressure line to the return line rendering the above check impracticable.

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8. In case the check proves that the internal tightness of the main system is normal, set the system in the operating conditions, i.e. replace adapter 74-7801-105C used for checking the hydraulic system, and install the non-return valve in the pressure line at the inlet of the spherical hydraulic accumulator.

The non-return valve should be arranged so as to direct the arrow on its body along the flow of the working fluid through the pipeline, i.e. to direct the arrow towards the spherical hydraulic accumulator. On installing the valve, apply a pressure to check if its connection to the pipeline is airtight.

If the check has shown the presence of internal leakage in the main system, take measures to restore airtightness of the system. After this, substitute the non-return valve for the adapter.

Booster Hydraulic System

1. Couple the booster system to the ground hydraulic pump and build up the operating pressure. Meanwhile, the pressure in the main system should be zero.

2. Switch on the aileron boosters and shift the control stick forward, backward, left and right at a maximum possible speed over an interval of 2 to 3 min.

3. Stop shifting the control stick and set it in the neutral position. As the operating pressure is achieved, switch off the ground hydraulic pump and make sure that the time over which the pressure in the system drops from 180 to 150 kg/cm^2 is not less than 9 sec.

4. Switch on the ground hydraulic pump and build up the operating pressure in the system, switch off the aileron boosters, switch off the ground hydraulic pump, and keeping the control stick stationary, make sure that the time of pressure drop from 180 to 150 kg/cm^2 is not less than 35 sec., the aileron boosters being not engaged.

Release the pressure in the hydraulic system by shifting the control stick.

Notes: 1. To prevent the valve slides from getting loose, switch all the electrohydraulic valves from one position into another only at the operating pressure in the hydraulic system.
2. If the time of pressure drop does not correspond to the ratings indicated above, find out the cause and remove the trouble.
3. The time of pressure drop measured during the internal leakage of the hydraulic system is specified for the aircraft in service, the leakage values being taken at the end of the guaranteed service life of the units.

8. DETECTING CAUSE OF INTERNAL LEAKAGE

If checking of the hydraulic system for internal leakage proves that the time of pressure drop in either the booster or the main system is below the rated value, find out the faulty unit of excessive internal leakage and replace it with a new one. Given below are the methods for detection of faulty units in the booster and main hydraulic systems.

Booster Hydraulic System

1. When the internal leakage check of the booster hydraulic system (made as described in the previous Section) has shown that the time of pressure drop is normal when the aileron boosters are switched off, and below the rated value when the aileron boosters are switched on, it means that there is leakage in aileron boosters БУ-45А.

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Replacing boosters БУ-45А in succession, find out the faulty booster and install a new one instead.

2. To check the hydraulic system in the tail portion of the fuselage for internal leakage, proceed as follows:

(a) make sure that circuit breaker PUMPING UNIT is switched on. Operate the ground hydraulic pump to build up the operating pressure in the booster hydraulic system;

(b) with the aileron boosters switched on, pump through the booster hydraulic system by shifting the control stick forward, backward, left and right at a maximum possible speed for 2 to 3 min.;

(c) stop shifting the stick and switch off the ground hydraulic pump as soon as the pressure in the system is normal. Shifting the control stick right and left, i.e. making only the aileron boosters operate, release the pressure from the booster system arranged in the fuselage nose portion till the pressure is zero. Check the pressure by the cockpit pressure gauge. Stop shifting the stick;

(d) while proceeding as described in Item c, note the time over which the pressure in the fuselage tail portion of the system drops from 180 to 150 kg/cm^2 and make sure that it is not less than 15 sec. (check the pressure by the pressure gauge of the booster system cylindrical hydraulic accumulator);

(e) in case the pressure built up in the fuselage tail portion of the hydraulic system decreases quicker than required, disengage stabilizer booster БУ-51МС from the hydraulic system. To do this, depress and keep so the cockpit button inscribed BOOSTER SYSTEM CUT OUT. Once again measure the time of pressure drop from 180 to 150 kg/cm^2 and make sure that it is not less than 4 min. Release the button. In case the checking thus performed renders positive results while the results of checking performed as described in Section "Booster Hydraulic System", Item 4, are negative, this is an indication of excessive internal leakage in the stabilizer booster. In this case, replace booster БУ-51МС;

(f) if the time of pressure drop in the fuselage tail part of the hydraulic system is less than 4 min., make a successive replacement of the units (stabilizer booster shut-off valve ГА-184У, cylindrical hydraulic accumulator, and non-return valve installed in a twin body), find out the faulty unit and install a new one instead.

> Note: Leaky non-return valve cannot be the cause of internal leakage of the booster system; therefore the faulty valve must be replaced and the troubleshooting must be continued.

3. To check for internal leakage the booster hydraulic system arranged in the fuselage nose portion proceed as follows:

(a) split the detachable valve installed in the pressure line between the fuselage nose and tail portions;

CAUTION. In order to prevent damage caused by pressure upon the cylindrical hydraulic accumulator of the booster system when the stabilizer booster is supplied from the main system, never disconnect the detachable valve installed in the return line;

(b) build up the operating pressure in the hydraulic system. With the aileron boosters engaged, pump the system through by shifting the control stick left and right for 1 min. Set the stick into the neutral position and switch off the aileron boosters. When a pressure of 215_{-12} kg/cm^2 is obtained in the hydraulic system, switch off the ground hydraulic pump, and make sure that the

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time of pressure drop from 180 to 150 kg/cm^2 as indicated by the cockpit pressure gauge is not less than 2.5 min.;

(c) if the time of pressure drop happens to be less than 2.5 min., make successive replacement of the units (the aileron booster shut-off valve, safety valve ГА-186M and non-return valves installed near the pump and in the ground hydraulic pump line), find the faulty unit and replace it with a new one.

4. In case separate checks have shown that the time of pressure drop in the fuselage nose and tail portions of the booster system is normal, while the booster system as a whole is not airtight, the cause of trouble, as an exception, may lie in the internal leaks of two non-return valves of the pumping unit. One of these is installed inside the dual non-return valve body arranged near the cylindrical hydraulic accumulator, while the other valve is installed in the pumping unit pressure line. Replace the non-return valves.

<u>Note</u>: When the pressure in the booster hydraulic system is not zero, leakage in the pumping unit non-return valves can be detected by the rotation of the disk on the pump shaft as observed through the peephole in the НШ-27Т body. In this case, replace the valves.

5. After checking and removing the internal leakage of the booster hydraulic system, joint the detachable valve installed in the pressure line between the fuselage nose and tail portions and check the entire system for internal leaks.

Main Hydraulic System

To prepare the main hydraulic system for the internal leakage check, install adapter 74-7801-105C instead of the non-return valve arranged near the spherical hydraulic accumulator, jack up the aircraft and couple to the ground power supply and hydraulic pump.

1. When checking the fuselage tail portion of the hydraulic system for internal leakage, proceed as follows:

(a) use the ground hydraulic pump to build up the working pressure in the system and pump the system through by shifting the control stick forward and backward 20 to 30 times at a maximum possible speed;

(b) while the control stick is stationary and the pressure built up in the system is 215_{-12} kg/cm^2, switch off the ground hydraulic pump and operate the air brakes to reduce the pressure to zero in the hydraulic system section arranged in the fuselage nose portion, watching the readings of the cockpit pressure gauge;

(c) while proceeding as described in Item b, measure the time of pressure drop from 180 to 150 kg/cm^2 caused in the fuselage tail section of the system when the control stick is stationary; the measured time must not be less than 15 sec.; check the pressure by the cylindrical hydraulic accumulator pressure gauge.

If the pressure drops at a higher rate, it is indicative of excessive internal leaks in stabilizer booster БУ-51МС, non-return valve or cylindrical hydraulic accumulator. In this case measure the internal leakage in booster БУ-51МС as follows:

(a) reduce the pressure in the hydraulic system fuselage tail section to zero by shifting the control stick forward and backward;

(b) release the pressure from the hydraulic reservoir pressurization system;

(c) disconnect the main hydraulic system return pipe from booster БУ-51МС, plug it up, keeping the booster return pipe connection unsealed;

(d) build up the operating pressure in the hydraulic system and place a measuring vessel under the booster return pipe connection;

(e) keeping the control stick stationary, make sure that the rate of leakage through the booster does not exceed 230^{+30} cm^3/min. If the leakage proceeds at a higher rate, replace the booster.

In case the booster is in good condition, restore the hydraulic system, and make successive replacements of the units installed in the given sector of the system (i.e., the non-return valve and cylindrical hydraulic accumulator) to find the faulty unit. Replace the faulty unit with a new one.

Note: Leaky non-return valve cannot be the cause of internal leakage of the main hydraulic system. In this case, replace the valve and perform further checking of the system.

2. When checking the fuselage nose portion of the hydraulic system for internal leakage, proceed as follows:

(a) uncouple the detachable valve installed in the main hydraulic system pressure line between the fuselage nose and tail portions;

CAUTION. During the check never uncouple the detachable valve installed in the return line, to avoid damage to the cylindrical hydraulic accumulator by the pressure when the booster is supplied from the booster system.

(b) engage the ground hydraulic pump and, with the aileron boosters switched on, pump through the hydraulic system by making 20 to 30 shifts of the control stick right and left at a maximum possible speed;

(c) when a pressure of 215_{-12} kg/cm^2 is produced in the hydraulic system, disengage the ground hydraulic pump, and observing the cockpit pressure gauge, measure the time of pressure drop from 180 to 150 kg/cm^2 while the control stick is stationary; make sure that the measured time is not less than 35 sec.

3. If the above separate checks have shown that the time of pressure drop in the fuselage tail and nose sections of the hydraulic system is normal, leakage in the main hydraulic system as a whole may be caused by internal leakage of the engine nozzle flap control units.

In this case joint the detachable valve installed in the pressure line between the fuselage nose and tail portions, disconnect the nozzle cylinder fluid delivery pipes from valve ГА-164М/1 and plug the pipes. Make another check of the internal leakage in the entire main hydraulic system according to the instructions given in the previous section. In case the internal leakage persists, replace the nozzle flap control valve.

In case the nozzle flap control valve is airtight, make successive replacement of the nozzle cylinders to determine the faulty cylinder and replace it with a new one.

4. If the internal leakage check of the fuselage nose portion of the hydraulic system has proved that the time of pressure drop is less than 35 sec., take up the following steps (in this case do not joint the detachable valve installed in the pressure line between the fuselage nose and tail portions):

(a) cut off successively the pressure pipelines from the electrohydraulic valves arranged in the fuselage nose portion and find the leaky section of the hydraulic system. Cut off the pipeline up to the valve.

Cut off the sections of the hydraulic system, observing the following priority:

(1) cone control system valve;
(2) anti-surge shutter control valve;
(3) L.G. control valve;
(4) wing flap control valve;

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(5) two air brake control valves.

To detect the leaky sections of the system, proceed as follows:

(1) disconnect and plug the working fluid pressure pipeline connected to the valve;

(2) check the hydraulic system for internal leakage starting from the fuselage nose portion as indicated above.

In case the time of pressure drop in the fuselage nose portion of the hydraulic system increases after a certain section of the system with a valve has been cut off, this is indicative of internal leaks in the disconnected section.

Note: Minor increases in time of pressure drop (of 1 to 2 sec.) which might occur during the check cannot be used as a basis for estimation of tightness of the section being disconnected.

After the faulty section of the hydraulic system has been detected, make successive replacements of the units composing the given section so as to spot the faulty place; follow each replacement by an internal leakage check and replace the leaky unit with a new one;

(b) if the above checks carried out according to Item a have proved that all sections and units are tight, replace in succession the safety valve and non-return valve installed near the pump, find out the faulty unit and replace it.

5. The internal leaks in the hydraulic system removed, engage all units of the system and pump the system through. After this remove and examine all filters.

Notes: 1. In the course of operation the hydraulic system may happen to leak after a certain unit has been replaced. The cause of trouble must not be necessarily ascribed to the new unit, since excessive internal leaks of the newly installed unit may be normal with respect to those of the unit removed.
In this case make sure whether the new unit is in good condition and then detect the faulty unit of the hydraulic system using the procedure indicated above.
2. In checking the hydraulic system for tightness follow the requirements specified in Section "Instructions on Keeping Hydraulic System Clean" so as to avoid fouling of the system.
3. Tightness test completed, restore the main hydraulic system, i.e. substitute the non-return valve for adapter 74-7801-1050 in the pressure line at the spherical hydraulic accumulator inlet as directed in Section 7.

9. MAINTENANCE OF HYDRAULIC SYSTEM AFTER L.G. EMERGENCY EXTENSION

After the emergency system has been used to extend the landing gear, perform the following operations:

1. Cut off and lock the emergency valve.

2. Release air from the L.G. emergency extension system by disconnecting the AMT-10 fluid delivery pipes, used to feed the main and nose struts, at the sections between the hydrolocks and cylinders as well as the pipes coupling the L.G. doors emergency valve to the extension line. After releasing the air, connect the pipes and lock the joints.

3. Couple the ground hydraulic pump and make 10 to 12 cycles to retract and extend the L.G. so as to release the air from the hydraulic system and to check tightness of the joints.

4. After removing the trouble which has entailed the employment of the emergency system, make sure that the landing gear uplocks are in good condition.

After emergency extension NEVER retract the L.G. before the air is released from the actuating cylinder system, NEVER open the emergency valve, unless necessary, and NEVER leave it unlocked.

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10. WASHING OF HYDRAULIC SYSTEM

General

1. When washing the main and booster hydraulic systems, make use of a special complete filter set available in the group set of SPTAA (Filters 6П1/1СН, 11П4СН, 76-5505-270 and the booster system gauze filter).

2. See that the ground equipment such as the hydraulic pumps, pump hoses, and filling accessories (like funnels, buckets and various containers used when washing and adjusting the hydraulic system), is clean enough to avoid pollution of working fluid АМГ-10 charged into the hydraulic system; for this, prior to use wash the above equipment with pure fluid АМГ-10.

3. When the aircraft are operated under conditions of heavy-dust airfields which leads to excessive fouling of the hydraulic system, wash the hydraulic system as often as the senior engineer officer of the unit commands, i.e. at time intervals much shorter than those set out by the Inspection and Maintenance Guide.

Hydraulic System Washing Procedure

1. Drain working fluid АМГ-10 from both hydraulic systems as prescribed in Section "Draining Oil АМГ-10 from Hydraulic System".

2. Prepare the engine jet nozzle flap control system for adjustment on the ground with the engine cut off as prescribed in Section "Power Plant Control". Jack up the aircraft.

3. Remove all the filters installed in both hydraulic systems including the gauze filter fitted into the booster system return line.

4. Install new filters of a similar type to be found in the set specially used for washing the hydraulic system.

Note: Prior to installing the new filters in the hydraulic system, stop their safety valves.

5. Remove, wipe and wash in pure gasoline the gauze filters installed at the inlets of boosters БУ-51МС and БУ-45А, and then fit them back into their places.

6. Wash the throttles, dampers, coarse filters and filter bodies in pure gasoline and dry them up.

7. Remove the hydraulic reservoir from the aircraft, wash its cavities with pure gasoline 3 or 4 times, shaking and turning the reservoir over.

Continue washing until the gasoline poured from the reservoir is absolutely clean and is not polluted with dirt or working fluid АМГ-10.

Dry the reservoir and install it into the aircraft.

8. Fill both the hydraulic systems fully with the working fluid.

9. Couple to the ground hydraulic pump and the hydraulic reservoir pressurization system to the main hydraulic system (the fuselage starboard).

10. Couple the ground hydraulic pump with the hydraulic reservoir pressurization AIRCRAFT - GROUND and turn on all circuit breakers and switches to engage the aircraft control system, L.G., wing flaps, air brakes, air intake cone and anti-surge shutters.

11. Build up the operating pressure in the main system, engage the aileron boosters and pump the system through for 5 to 6 min. by shifting the control stick forward and backward, right and left at a maximum possible speed. Make sure that the АРУ-3В switch is set in position IDLING.

12. To pump working fluid АМГ-10 through other units of the main system, make 10 to 12 cycles to retract and extend the landing gear, wing flaps, air

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brakes, air intake cone, anti-surge shutters and engine jet nozzle flaps. Switch off the ground hydraulic pump and relieve the pressure.

13. Couple the ground hydraulic pump to the booster system (the fuselage port-side).

14. Build up the operating pressure in the booster system, switch on the aileron boosters and pump the system through for 5 to 6 min. proceeding as specified in Item 11.

15. As soon as the working pressure is built up in the system, switch off the aileron boosters and ground hydraulic pump, and switch on the pumping unit by engaging switch PUMPING UNIT.

Shifting the control stick forward and backward release the pressure from the system and see that the pumping unit is engaged.

Continue shifting the control stick so as to operate the pumping unit for not more than 3 min. during engagement or disengagement. Turn off the switch to disengage the pumping unit.

16. Reduce the pressure built up in the hydraulic system to zero by shifting the control stick.

17. Drain working fluid AMГ-10 from both hydraulic systems as prescribed in Section "Draining Oil AMГ-10 from Hydraulic System".

18. Remove all filters used for washing, disassemble them and check for cleanliness.

CAUTION. 1. In case any dirt, sand or the like have been detected in the ground hydraulic pump filters, wash the filter elements in gasoline and dry them up.

2. In case any dirt has been detected in the filters used for washing, wash the respective hydraulic system again.

3. Wash and check the fine filtering elements, taken from the special set, as instructed in Section "Washing of Filters".

19. Check the cleanliness of the gauze filters installed at the inlets of boosters БУ-51МС and БУ-45А and wash the filters in pure gasoline.

20. After washing the two hydraulic systems, install all operating filters in their proper places having washed and checked their fine filtering elements. Check the joints for external leaks and lock the joints with wire.

CAUTION. After washing the hydraulic system, make sure that the washed and checked up fine filtering elements are installed in all organic filters of the system.

21. Charge both hydraulic systems with clean working fluid as prescribed in Section "Charging Hydraulic System with Oil AMГ-10".

22. Enter the respective notes about washing and adjustment of the hydraulic system into the aircraft Service Log.

II. CHARGING OF, AND CHECKING THE PRESSURE IN, HYDRAULIC ACCUMULATORS

The gas chambers of the spherical and cylindrical hydraulic accumulators installed in the booster and main systems of the aircraft are charged with commercial nitrogen at a pressure of 30^{+5} kg/cm^2 after the pressure in the hydraulic systems has been released completely. To charge the spherical hydraulic accumulators, proceed as follows:

1. Release the pressure from the hydraulic systems.

2. Remove the plug of the hydraulic accumulator charging connection and couple it to arrangement 76-7604-250A equipped with a pressure gauge. Prior to this, screw out the arrangement rod as far as it will go.

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3. Couple the airfield nitrogen pressure bottle hose to the arrangement connection.

4. Open the airfield nitrogen pressure bottle cock.

5. Open the shut-off valve of the hydraulic accumulator charging connection, screw in the arrangement rod and charge the accumulator gas chamber with nitrogen to obtain a pressure of 50^{+5} kg/cm^2. Screw out the arrangement rod.

6. Shut off the airfield nitrogen pressure bottle cock, disconnect the hose, remove the arrangement and stop the accumulator charging connection with a plug.

Stop the charging connection used for coupling to the airfield nitrogen bottle with a plug and check the pressure of nitrogen contained in the spherical hydraulic accumulators by the charging arrangement pressure gauge.

To charge the cylindrical hydraulic accumulators, proceed as follows:

1. Release the pressure from the hydraulic systems to zero.

2. Remove the plug from the hydraulic accumulator charging connection and couple it to arrangement 76-7802-250A.

3. Couple the arrangement to the airfield nitrogen pressure bottle hose and open the bottle cock.

4. Open the shut-off valve of the hydraulic accumulator charging connection and simultaneously shift the aircraft control stick slowly backward and forward a small distance to cause the БУ-51МС booster slide valve to travel and working fluid АМГ-10 to return from the accumulator hydraulic cavity, as the gas chamber is being filled with nitrogen.

5. When the pressure of nitrogen charged into the hydraulic accumulator reaches 50^{+5} kg/cm^2, shut off the airfield nitrogen pressure bottle and continue shifting the control stick to make sure that the pressure built up in the hydraulic accumulator does not drop.

If a certain drop of pressure is observed, open the bottle cock again and recharge the hydraulic accumulator to obtain normal pressure. The above operations completed, charging is considered finished.

6. Remove the charging arrangement and stop the hydraulic accumulator charging connection with a plug.

To check the pressure produced in the cylindrical hydraulic accumulators, observe the reading of the pressure gauges installed directly at the accumulators.

12. CHECKING TIGHTNESS OF CYLINDRICAL HYDRAULIC ACCUMULATORS

When the tightness of the hydraulic accumulators is to be checked separately from the aircraft hydraulic system, apply the operating pressure to the pressure pipe connection (as indicated on the reference plates on the body) after making sure that the hydraulic accumulator return connections are open.

CAUTION. If the return pipe connections are shut off, the delivery of pressure to the pressure chamber will increase the pressure in the return cavity of the hydraulic accumulator beyond the tolerated value.

The tightness of the cylindrical accumulator return cavity is checked for 3 min. at a pressure of 8 ± 2 kg/cm^2, and at a temperature of 25 ± 5°C.

For possible alterations in the test parameters of the hydraulic accumulators see the respective Certificate.

When 100-hour scheduled maintenance operations are performed on the aircraft and each time when working fluid АМГ-10 is changed in the hydraulic systems, check the cylindrical accumulators for internal leakage and observe the following priority:

[redacted]

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1. Remove the cylindrical hydraulic accumulators from the aircraft after reducing the nitrogen pressure to zero.

2. Open the hydraulic accumulator gas cavity pipe connection and turn the accumulator upside down so that working fluid АМГ-10 that has penetrated into the accumulator should pour out through the open pipe connection into the measuring vessel. Similarly drain the working fluid from the hydraulic accumulator cavity connected to the atmosphere.

3. In case the quantity of fluid АМГ-10 drained from the accumulator gas cavity exceeds 50 cm^3, replace the hydraulic accumulator since its piston sealing cups are a great deal leaky.

4. Install the hydraulic accumulators in the aircraft and charge them with nitrogen.

13. DRAINING CONDENSATE FROM HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM MOISTURE TRAP

Installed in the hydraulic reservoir pressurization line at the pressurization unit inlet is a moisture trap intended to accumulate condensate. The moisture trap is arranged in the L.G. main strut wheel well.

To prepare the system for draining, check whether the drain hole of the cump is clean, and remove fouling and ice.

14. USE OF GROUND HYDRAULIC INSTALLATION УПГ-250

In order to adjust and check the aircraft hydraulic system on the ground, the aircraft in use employ hydraulic installation УПГ-250. When checking and adjusting the main or the booster system separately, one of the pumps of the installation is employed.

When the main and booster systems are checked together, two pumps, separately coupled to the main and booster system pipe connections, are engaged.

To pressurise the aircraft hydraulic reservoir, the УПГ-250 air system is employed.

The УПГ-250 hydraulic pumps have a constant delivery which depends upon the driving motor speed only.

The pressure produced in the aircraft hydraulic system when installation УПГ-250 is connected to the system, can be adjusted by means of the adjustment screw of pressure regulator ГА-198 arranged on the installation.

The predetermined pressure built up in the aircraft hydraulic system can be adjusted only in case no pressure is consumed by the hydraulic system, i.e. when the aircraft hydraulic system units are inoperative.

In order to avoid the system pressure fluctuation and vibration of units, the aircraft hydraulic system must not be checked with the help of hydraulic installation УПГ-250 if the expenditure of fluid delivered by the pumps is less than 27 to 30 lit/min. (the engine speed less than 1500 r.p.m.).

To adjust the aircraft hydraulic system on the ground, installation ЭГУ with pumps НШ-34 may be employed.

15. USE OF BOOSTERS БУ-49А AND БУ-51МС

The admissible leaks of working fluid АМГ-10 forced out during actuating rod movement in the course of employment of boosters БУ-49А and БУ-51МС, are listed in the following Table:

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Booster type	Admissible leaks of fluid forced out around actuating rod per one hour operation, cm³
БУ-51МС	3
БУ-45А	4

Note: Permissible external leakage of fluid when the aircraft is parked is up to 2 cm³ per calendar day.

16. CHECKING TIGHTNESS OF HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM

The tightness of the hydraulic reservoir pressurization system can be checked either simultaneously with checking the fuel supply pressurization system, while the engine is running, or separately, when the engine is cut off.

When checking, observe the following priority:

1. Check the level of working fluid АМГ-10 contained in the main and booster system compartments of the hydraulic reservoir. If necessary, refill the reservoir to obtain the required level.

2. Connect a reference pressure gauge to the pressurization system T-piece.

3. With the engine running, perform the following:

(a) after starting the engine, accelerate it to 100 per cent speed of the high-pressure rotor;

(b) check the pressurization value indicated by the reference pressure gauge and make sure that it is 1.6 to 2.55 kg/cm²;

(c) stop the engine and make sure that within 15 min. the pressurization value does not drop below the normal value indicated above.

Note: While maintaining the pressure in the system, an increase in pressurization value up to 2.8 to 3.0 kg/cm² may occur due to internal leakage of the hydraulic system.

4. With the engine cut off, perform the following:

(a) disconnect the pressurization system pipeline near the sump located in the main strut wheel bay at the pressurization unit inlet;

(b) couple the pipe to a hose with an adapter combined with the pneu charging arrangement;

(c) couple the arrangement to the airfield compressed air bottle, and keeping the reducer valve closed open the bottle cock, then slowly open the reducer valve and produce a pressure of 10 kg/cm² at the reducer outlet;

(d) make sure that the pressure indicated by the pressure gauge is equal to 1.6 to 2.55 kg/cm², close the reducer valve and maintain the system under the above pressure for 15 min. (no pressure drop as indicated by the pressure gauge is permissible);

(e) after checking, restore the system.

5. If the check proves that the system is leaky, spot the place of air leakage, remove the trouble and check the system again.

6. To check the pressurization system safety valve for correct calibration, proceed as follows:

(a) couple the arrangement and airfield compressed-air bottle to the ground pressurization pipe connection arranged in the aircraft;

(b) keeping the reducer valve shut, open the air bottle cock; after this open the reducer valve slowly and build up a pressure of 2.0 ±0.3 kg/cm² in the system.

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Make sure that at this pressure the safety valve opens and the air is released
from the vent pipe. Stop checking and remove the arrangement.

17. USE OF HYDRAULIC SYSTEM FILTERS FITTED WITH FINE FILTERING ELEMENTS MANUFACTURED FROM TWILL-WOVEN NICKEL GAUZE

When in service, the hydraulic system employs filters manufactured from twill-
woven nickel gauze. During scheduled maintenance these filters are washed and
installed back into the system. To wash the hydraulic system, a set of nickel gauze
filters is used. These are washed similarly as the service filter elements.

Washing and Measuring Residual Fouling of Filter Elements Manufactured from Twill-Woven Nickel Gauze

The metal filter elements made of twill-woven gauze require frequent washing in the course of their employment.

The method of washing the filter elements recommended by the given instructions provides for removing all mechanical admixtures from the filter surface. The degree of filter cleanness is estimated in terms of flow resistance produced by the filter element after washing. For this purpose immerse the filter element into the working fluid by means of a special test arrangement (Fig. 19) and measure the time during which the filter element gets filled with fluid.

It is evident that the time of filling the element with fluid will depend on the degree of cleanness of the filter gauze.

Methods of Washing

In order to wash the dirty filter elements, fill a trough with pure aircraft gasoline, type Б-70, and use a stiff hair brush. The length of brush hair should exceed the depth of the filter crimp.

For washing, regularly immerse the filter element into gasoline and make 2 to 3 applications of the brush along each crimp moving the brush in one direction. Fill the trough with pure gasoline instead of dirty one and continue washing until the filled quantity of pure gasoline remains clean. Make a final check of the clean filter element to estimate the residual fouling by means of the test arrangement.

Methods of Determination of Filter Element Residual Fouling and Short Description of Test Arrangement

The arrangement used for determination of residual fouling of filter elements after washing consists of head 4, handle 2, float 5, set of replaceable adapters 7 and plugs 10. Head 4 is threaded at both ends.

Screwed upon one end is handle 2, and the other end is used to attach adapters 7 used for close fitting of the filter elements under test. The arrangement is supplied with replaceable adapters, plugs and rubber packing rings.

Head 4 has a flange to indicate the required depth for immersing the arrangement with the filter element into the working fluid.

Arranged inside head 4 is float 5 to whose red reference button 1 is attached; the position of the reference button is checked through a peephole at the butt end of handle 2.

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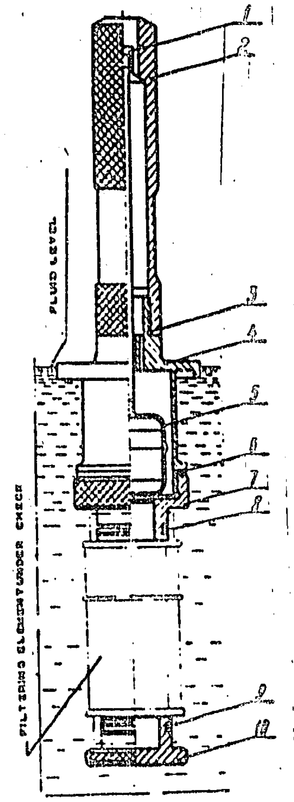

FIG.19. ARRANGEMENT TO DETERMINE FILTER ELEMENT RESIDUAL FOULING

1 – reference button; 2 – handle; 3 – gasket; 4 – body; 5 – float; 6 – gasket; 7 – adapter; 8 – gasket; 9 – gasket; 10 – plug.

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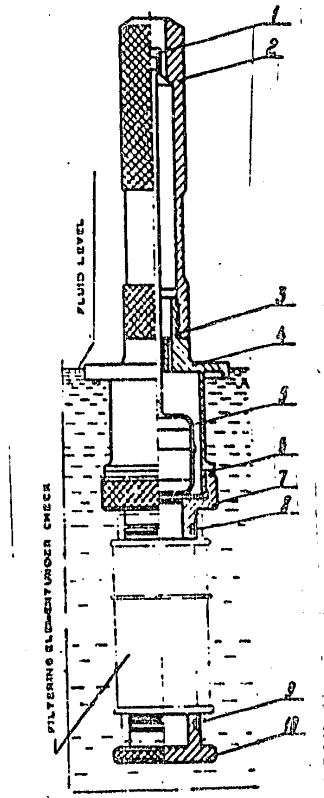

FIG.19. ARRANGEMENT TO DETERMINE FILTER ELEMENT RESIDUAL FOULING

1 – reference button; 2 – handle; 3 – gasket; 4 – head; 5 – float; 6 – gasket; 7 – adapter; 8 – gasket; 9 – gasket; 10 – plug.

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To take measurements by means of the arrangement, a clean container, working fluid АМГ-10 and stopwatch are required. The measuring procedure is the following:

1. On the arrangement install adapter 7 of an appropriate size to fit the filter under test.

2. Attach the tested filter element to the adapter.

3. Fill the container with pure oil АМГ-10 which has already been twice strained through the filter element gauze. See to it that the level of the filled oil covers the whole length of the filter element plus 50 to 60 mm and that the temperature of fluid is +20 $\pm 5^{\circ}$C.

4. Immerse the filter element into the fluid, take it out and let the fluid drip down. This is required to form the surface tension film inside the gauze so as to obtain more stable results of measurements.

5. Install rubber ring 9 and close the filter element lower port with plug 10.

6. Prepare the stopwatch. Grip handle 2 so as to shut off the butt end hole with the thumb, and immerse the arrangement into the oil as deep as to touch the surface with the reference flange of head 4.

7. Remove the thumb to open the butt end hole of handle 2 and start the stopwatch simultaneously. As a result, the fluid will start flowing into the filter causing the float with the reference button to travel upwards.

8. As soon as reference button 1 reaches the upper butt end of handle 2, stop the stopwatch.

9. Make sure that the time of filling the element with fluid does not exceed 15 sec. which stands for maximum permissible residual fouling of the filter element. In case the time of filling is equal to, or less than, 15 sec., the filter element is considered sufficiently clean and good for further service. Otherwise, wash and check the filter again.

10. To obtain more accurate results, it is advisable to make three measurements of the filling time of the filter being tested and take the arithmetic mean.

11. Take the arrangement out of the fluid and drain it by removing plug 10. Remove the filter element from the arrangement.

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Chapter IV
AIR SYSTEM

1. GENERAL

The aircraft air system (Fig. 20) consists of the main and emergency air systems functioning independently.

The main air system is intended for:

(1) braking the L.G. wheels;

(2) closing the fuel shut-off valve;

(3) lifting, sealing, emergency jettisoning of the canopy and release of the canopy time-delay lock;

(4) doors control and dropping the drag chute;

(5) cutting-in the canopy de-icer system;

(6) control of the fuselage nose pressurized compartment cooling system pneumatic valves;

(7) blowing off radio set РСИУ-5.

The emergency air system ensures:

(1) emergency L.G. extension;

(2) emergency braking of the L.G. main strut wheels.

The air system is charged from the airfield air bottles through the common charging connection situated in the right-wing L.G. well.

Air System Basic Specifications

1. Total capacity of 9 air bottles .... 16.3 lit.
2. Capacity of 5 main air bottles (three spherical bottles, 2 lit. each, and two L.G. strut bottles, 2.2 lit. each) .. 10.4 lit.
3. Pressure in main system air bottles .... 110 to 130 kg/cm^2
4. Capacity of 2 emergency air bottles (1.3 lit. each) ...... 2.6 lit.
5. Pressure in emergency system air bottles .... 110 to 130 kg/cm^2
6. Pressure in brake system of L.G. nose strut wheel KT-38 .. $9.5^{+0.5}$ kg/cm^2
7. Pressure in brake system of L.G. main strut wheels KT-92 at the section before pressure amplifiers УП-24/2 .... $9.5^{+0.5}$ kg/cm^2
8. Pressure in brake system of L.G. main strut wheels KT-92 at the section after pressure amplifiers УП-24/2 .... 19^{+1} kg/cm^2
9. Pressure in emergency brake system of L.G. main strut wheels KT-92 .... 17.5 ± 0.5 kg/cm^2
10. Capacity of canopy emergency tossing air bottle .... 2 lit.
11. Pressure in canopy emergency tossing air bottle .... 110 to 130 kg/cm^2
12. Pressure delivered to fuel system shut-off valve, canopy lifting system, drag chute control system, fuselage compartments cooling valve and to blowing system of radio set РСИУ-5 .... 50 kg/cm^2
13. Pressure in de-icer system .... 3 kg/cm^2

14. Pressure in canopy sealing system .... 1.3 kg/cm²
15. Pressure to be produced at the outlet of valve ПУ-7 when automatic wheel brake cylinder is engaged during L.G. retraction .... not less than 3 to 4 kg/cm²
16. Pressure in drag chute air bottle of 1.3 lit. capacity ....150 kg/cm²

L.G. Brake System

The L.G. brake system (Fig. 21) is intended for braking the main and nose wheels.

To brake the wheels, it is necessary to press the brake lever on the aircraft control stick.

The nose wheel brake can be applied by the handle of valve УП-33/1 arranged on the instrument panel. When landing, the pilot applies the brake to reduce the landing run, and releases it during taxiing.

In order to achieve effective wheel braking during landing (to reduce the landing run), the system uses an automatic brake control which is switched on by circuit breaker AUTOMATIC WHEEL BRAKING arranged on the left-hand console. The automatic wheel braking also largely reduces wear-out of the tyres.

The automatic wheel braking excludes skidding during braking. If any main wheel starts skidding, it is released simultaneously with the nose strut wheel. In case the nose wheel starts skidding, its brakes will get released alone, the main wheels remaining braked.

The air delivered to the nose wheel brake from the high-pressure line of 110 to 130 kg/cm² is supplied through reducer ПВ-50Н and through reducing valve ПУ-7 so that the pressure drops to $9.5^{+0.5}$ kg/cm². From valve ПУ-7 and through valve УП-33/1 and electromagnetic servovalve УП-53/1 the pressure is applied to the L.G. nose wheel brake.

Installed in the L.G. main wheel brake air supply line are two pressure amplifiers УП-24/2 arranged at the outlet of differential valve ПУ-8 in the wheel wells on the fuselage sides.

The pressure amplifiers are used to achieve high speed in applying and releasing the wheel brakes and to reduce the air pressure delivered to the brake down to a value of 19^{+1} kg/cm².

The air supplied from valve ПУ-7 (through differential valve ПУ-8) has a control function to open the amplifier reducer; the air supplied to pressure amplifier УП-24/2 from the air system at 50 kg/cm² is reduced to a value of 19^{+1} kg/cm² and then fed to the disc brakes of wheels КТ-92 through electromagnetic servovalves УП-53/1.

If the main L.G. brake system fails (breaking of the cable running to valve ПУ-7, zero pressure in the main air system, etc.), the L.G. wheels can be braked through the emergency system by turning the handle of emergency braking valve УП-25/2 installed on the left-hand side above the instrument panel.

During emergency wheel braking, the air supplied from the emergency system air bottles through reducer ПВ-50Н, emergency braking valve УП-25/2 and emergency valve 563600М is delivered only to the main wheel brakes, the nose wheel brake being bypassed. Valve УП-25/2 gets open in response to gradual increase of pressure applied to the valve handle.

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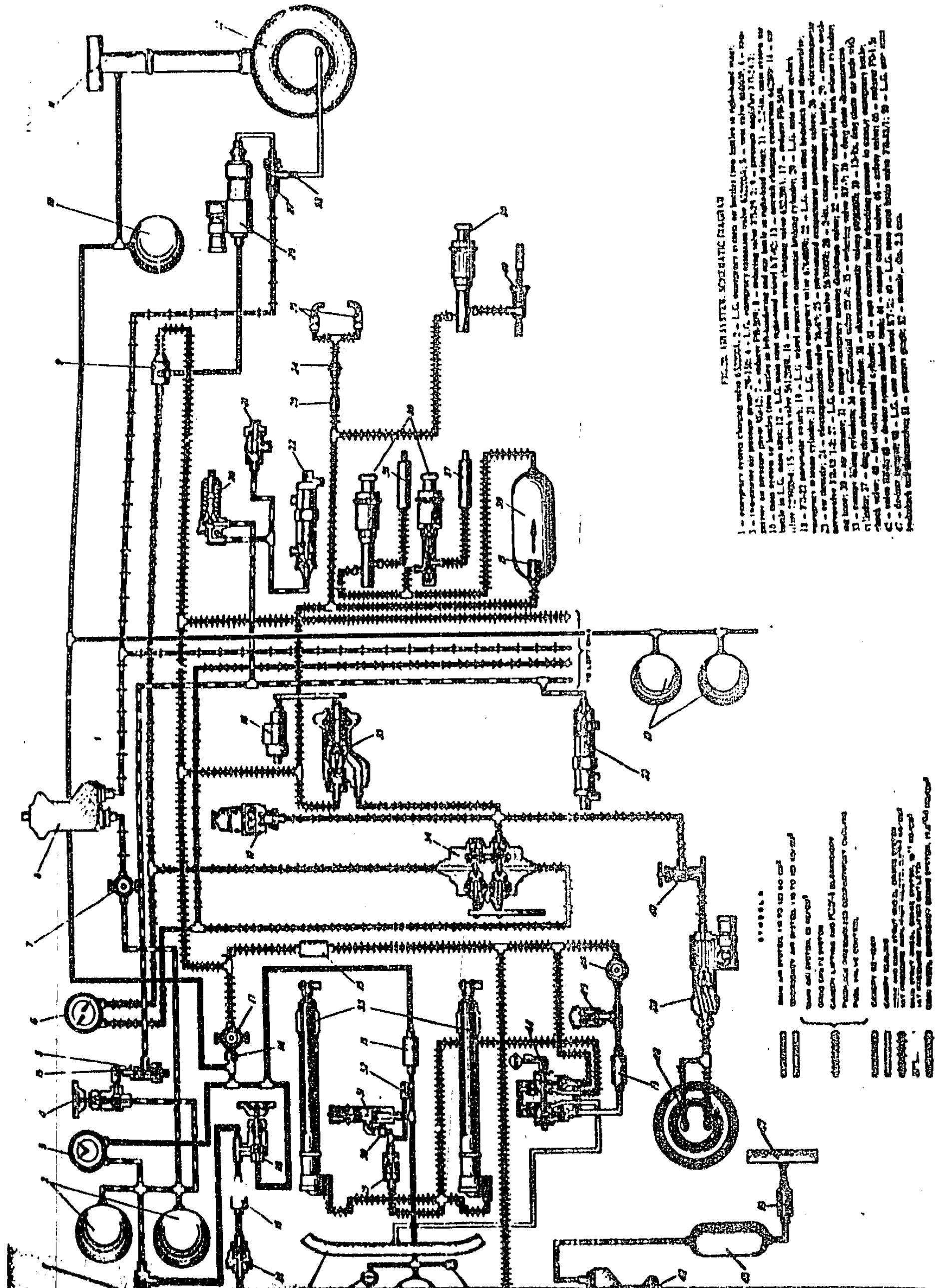

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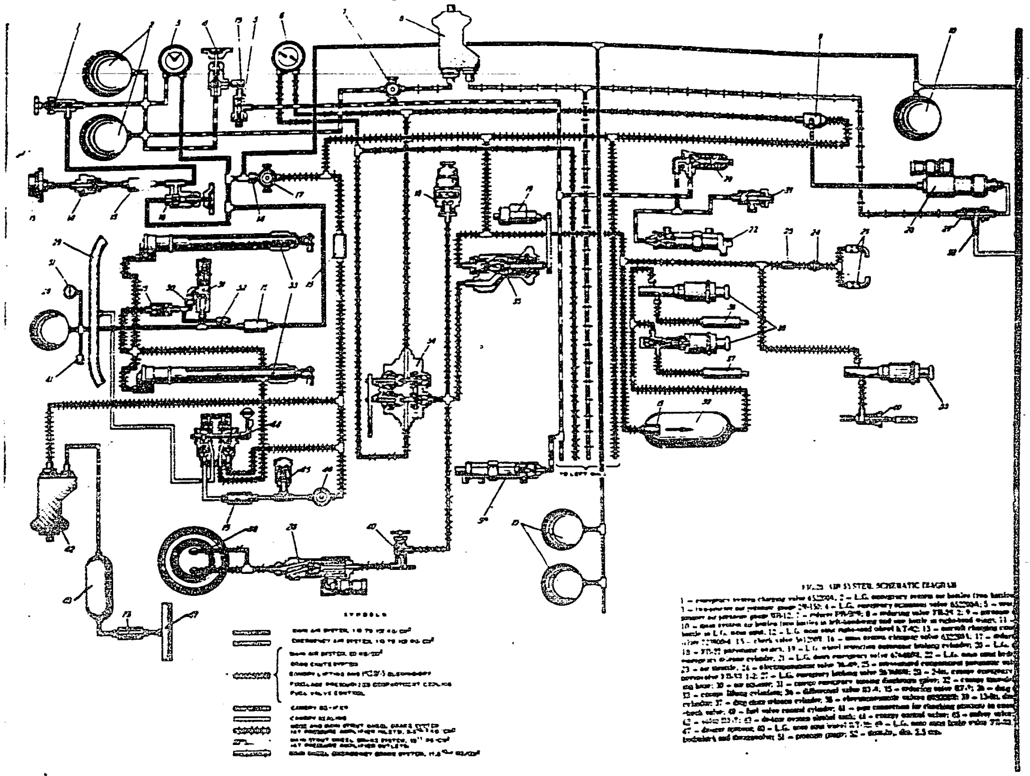

AIR SYSTEM SCHEMATIC DIAGRAM

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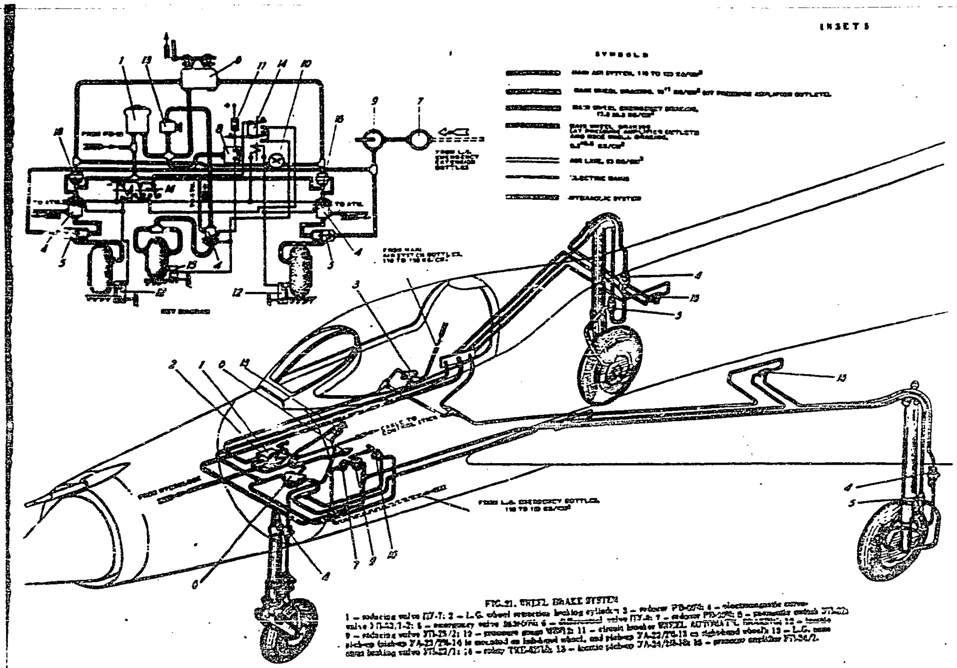

FIG. 21. WHEEL BRAKE SYSTEM

1 — reducing valve [illegible]; 2 — L.G. wheel retraction locking cylinder; 3 — [illegible]; 4 — electromagnetic [illegible] valve [illegible]; 5 — emergency valve [illegible]; 6 — [illegible] valve [illegible]; 7 — [illegible]; 8 — pneumatic switch [illegible]; 9 — reducing valve [illegible]; 10 — pressure gauge [illegible]; 11 — circuit breaker WHEEL AUTOMATIC [illegible]; 12 — [illegible]; 13 — L.G. nose [illegible]; 14 — [illegible]; 15 — [illegible]; 16 — pressure amplifier [illegible]

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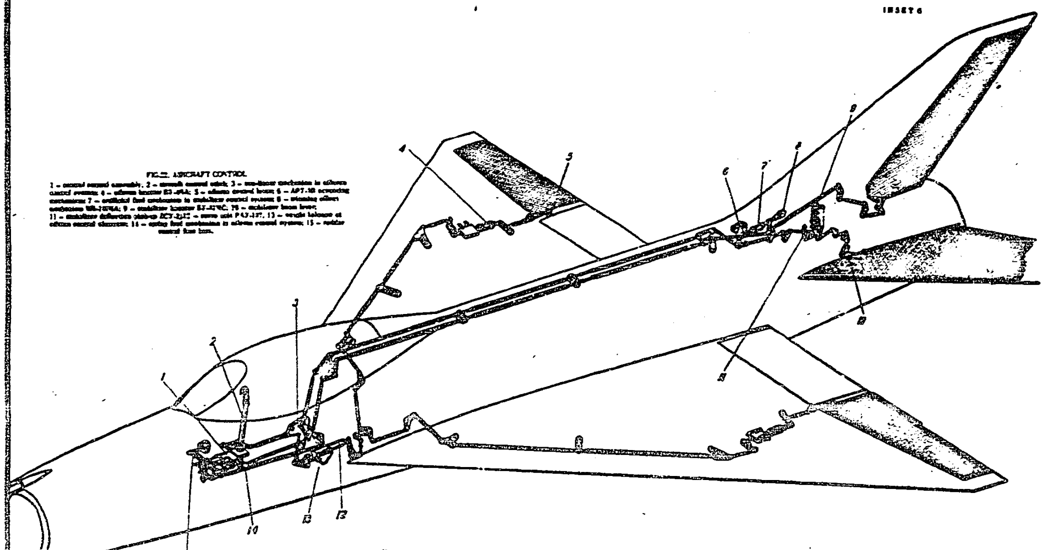

FIG.[illegible] AIRCRAFT CONTROL

1 – [illegible] 2 – [illegible] 3 – [illegible] 4 – [illegible] 5 – [illegible] 6 – APT-[illegible] 7 – [illegible] 8 – [illegible] 9 – [illegible] 10 – [illegible] 11 – [illegible] 13 – [illegible] 14 – [illegible] 15 – [illegible]

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It should be borne in mind that the emergency wheel braking is not as effective as the main braking.

Use of Brake System

The automatic wheel braking system is switched on and off by means of circuit breaker AUTOMATIC WHEEL BRAKING arranged in the cockpit on the left-hand console.

To employ automatic braking during landing run, the brake lever on the aircraft control stick should be pressed as far as it will go. If the automatic wheel braking system is switched off for the purpose of economical expenditure of the compressed air, it is advisable that the braking should be performed by smoothly pressing the brake lever so that it could reach the rest just the instant the aircraft stops.

Note: It should not be forgotten that during automatic braking the rate of air consumption increases.

In the course of landing run, it is possible to change over from manual to automatic wheel braking and vice versa.

For changing over from manual to automatic braking, switch on circuit breaker AUTOMATIC WHEEL BRAKING without releasing the brake lever.

For changing over from automatic to manual braking, first release the brake lever (to avoid tyre slip-off), and then switch off circuit breaker AUTOMATIC WHEEL BRAKING. After this perform manual brake control.

Use of Nose Wheel Brake System

The nose wheel brake system is switched on by the handle of УП-33/1 valve NOSE WHEEL BRAKING arranged in the left-hand upper part of the instrument panel by setting the valve handle into position ON.

The nose wheel is braked by the common brake lever on the aircraft control stick simultaneously with the braking of the main wheels. Brake application can be controlled either manually or automatically.

L.G. Main Wheel Emergency Braking

The L.G. main wheel emergency braking is resorted to in case the brake system cable is damaged, valves ПУ-7, ПУ-8 or pressure amplifiers УП-24/2 fail, or when the pressure in the main air system bottles is zero.

To effect emergency braking of the wheels, open the emergency braking valve УП-25/2 located in the cockpit in the left-hand part above the instrument panel by pulling backward the handle inscribed EMERGENCY BRAKING (having broken the locking wire). As a result, the air from the L.G. emergency air bottles is fed at a pressure of 110 - 130 kg/cm^2 to emergency valve 563600М through reducer РВ-50М and reducing valve УП-25/2. After this the air passes through the pipeline to the brakes of L.G. main wheels КТ-92. As the handle is smoothly turned, the pressure gradually increases from 0 to 17.5 $\pm$0.5 kg/cm^2. To release the wheels, close reducing valve УП-25/2 by setting handle EMERGENCY BRAKING smoothly in the initial position. Emergency braking is effected due to a smooth increase of pressure in the wheel brakes up to the value of 17.5 $\pm$0.5 kg/cm^2 (as emergency braking valve УП-25/2 is opened). With handle EMERGENCY BRAKING pulled backward all the way to the stop, the effort applied to the handle amounts to 8 kg.

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Fuel System Shut-Off Valve Control

In case a fire occurs during flight, the shut-off valve is closed by the control cylinder which is supplied with compressed air at 50 kg/cm^2 through electropneumatic valve 695000М from the air system.

When the electropneumatic valve is switched on, the cylinder is actuated to shut off the valve.

Lifting, Sealing and Emergency Jettisoning of Canopy

The canopy is lifted by the air delivered from the main air system at a pressure of 50 kg/cm^2. The air supplied through the canopy control valve is fed to the canopy lifting cylinder and opens the canopy.

To seal the canopy, the compressed air delivered at 50 kg/cm^2 from the main air system through reducer РВ-1.5, safety valve and check valve is supplied to the canopy control valve and then to the canopy sealing hose.

Emergency tossing of the canopy is performed by the air delivered at a pressure of 110 - 130 kg/cm^2 from a separate air bottle of 2 lit. capacity. When the system is charged, the air fed to the air bottle at a pressure of 110 - 130 kg/cm^2 is supplied through a pipeline and a check valve from the main air system. To measure the pressure in the canopy tossing air bottle, a special pipe connection is used. During jettisoning the air from the air bottle is fed through a diaphragm valve to the actuating cylinders which toss up the canopy.

To release the canopy time-delay lock in case of an emergency jettison of the canopy, the air is delivered at a pressure of 110 - 130 kg/cm^2 from the bottle to the canopy time-delay lock release cylinder.

Doors Control and Disconnection of Drag Chute

From the main air system the air is delivered through reducer РВ-50М and check valve to the drag chute release and disconnection air bottle; the air bottle feeds the air through electropneumatic valves 695000Ш separately to the drag chute door opening cylinder and to the drag chute disconnection cylinder.

As the electropneumatic valves are actuated, the drag chute discharge or disconnection cylinders are caused to operate.

Canopy De-Icer System

To engage the canopy de-icer system, the air delivered at a pressure of 50 kg/cm^2 from the main system is fed through reducing valve ПУ-7 and is further supplied at a pressure of 3 kg/cm^2 to the alcohol tank.

From the alcohol tank the alcohol is pressed through the sprayer onto the canopy windshield.

Control of Fuselage Pressurized Compartment and РСИУ-3 Set Cooling Pneumatic Valves

The air delivered from the main air system at a pressure of 50 kg/cm^2 is fed through electropneumatic valve 3К-69 to special pneumatic valves so that when the aircraft speed is $M \geqslant 1.35$, the valves are cut off automatically and the pressurized compartments and radio set РСИУ-3 are no longer cooled.

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L.G. Emergency Extension

To extend the landing gear on emergency, the air delivered at a pressure of 110 to 130 kg/cm^2 is supplied from the emergency air system bottles.

After the L.G. emergency extension valve is opened, the air supplied from the bottles is distributed as follows:

(a) through the hydrolock to the nose strut extension cylinder for extending the strut;

(b) to the L.G. main strut uplock emergency release cylinders, to the wheel door actuating cylinders through the emergency valves, and to the main strut extension cylinders through the hydrolocks, so that the main struts are extended.

2. CHECKING L.G. EMERGENCY EXTENSION SYSTEM OPERATION
(Performed during ground check)

To check the L.G. emergency extension, proceed as follows:

1. Lift the aircraft by the wing and nose jacks till the wheels are clear off the ground.

2. Connect the ground electric power supply and a hydraulic pump to the main hydraulic system, and retract the landing gear.

3. Observe the pressure gauge to make sure that the air pressure in the emergency system is not less than 110 kg/cm^2, and reduce the hydraulic pressure to zero.

4. Make sure that the L.G. retraction and extension valve handle is set in position NEUTRAL.

5. Open the L.G. emergency valve arranged on the right-hand console in the cockpit.

6. See that the red warning lights come off and the mechanical indicator at the nose strut starts to extend, and thereby make sure that the L.G. uplocks are released.

7. After the green warning lights have gone on and the L.G. nose strut mechanical indicator has fully extended to indicate the L.G. extension, close the L.G. valve.

<u>Note</u>: To facilitate opening of the L.G. emergency extension valve during flight, see to it that the collapsible handle should be turned towards the inside of the cockpit normally to the aircraft fore-and-aft axis or displaced from this position somewhat forward (so as to fit the collapsible handle and valve axle in the desired position).

8. Release the air from the L.G. retraction cylinders as has been explained in Chapter III, Section 9, and restore the system.

<u>Note</u>: After the L.G. has been extended completely, the cockpit pressure gauge 2M-150 should indicate the pressure in the system not less than 38 kg/cm^2.

3. CHECKING AND ADJUSTMENT OF L.G. WHEEL BRAKE SYSTEM
Checking Manual Brake System Operation

By means of two-pointer pressure gauge 2M-150 make sure that the air charged into the main air system is at 110 to 130 kg/cm^2 and proceed as follows:

1. Check that the pressure in the main brake system indicated by two-pointer gauge MB-12 is $9.5^{+0.5}$ kg/cm^2 when the nose wheel braking valve is cut in, the foot bars are in the neutral position and ПУ-7 lever arranged on the control stick is

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pressed down completely. Difference of 0.5 kg/cm^2 in readings of the right and left pointers is permissible.

2. Check application and release of the wheel brakes by completely pressing and releasing the brake lever several times, meanwhile watching two-pointer pressure gauge MB-12 to see that the pressure is increased to $9.5^{+0.5}$ kg/cm^2 or reduced to zero.

3. Check application and release of the brakes of the main wheels separately by pressing the brake lever completely down. Slowly shifting the foot bars right and left, make sure by two-pointer pressure gauge MB-12 that the pressure is applied to the brake of one wheel and not applied to that of the other.

Checking Pressure in KT-92 Wheel Brakes

To check pressure in the KT-92 wheel brakes, operation of pressure amplifiers УП-24/2 and emergency valves 563600M, proceed as follows:

1. Disconnect the hose of wheel KT-92 and connect the hose to pressure gauge MB-30 or MB-60.

2. Press down the aircraft control stick brake lever as far as it will go and make sure that the pressure gauge indicates 19^{+1} kg/cm^2. Release the brake lever and see that the pressure gauge indicates zero pressure.

3. Open emergency braking valve УП-25/2 by pulling backward handle EMERGENCY BRAKING after tearing off the locking wire; make sure that the pressure gauge indicates 17.9 $\pm$0.5 kg/cm^2.

Check the brakes of the right and left wheels in turn. After the above check is over, connect the hose back at its place and lock it and valve handle EMERGENCY BRAKING with wire.

Checking Automatic Braking

To check that the automatic braking is normal, proceed as follows:

1. Jack up the aircraft.

2. Disconnect the YA-23 automatic braking pick-up connector (arranged on the right and left main wheels KT-92).

3. Couple the ground electric power supply and switch on the automatic wheel braking circuit breaker.

4. Engage valve УП-53/1 to brake nose wheel KT-38.

5. Press down the brake lever and see that the pressure produced in the brake system is not less than 4 to 5 kg/cm^2.

6. Couple the terminals of the YA-23 pick-up connector on the right or left main wheel KT-92. As the terminals are coupled, two valves УП-53/1 of the main wheel being checked and of the nose wheel should operate. Valves УП-53/1 will bleed the air and the wheels will get released. As the terminals are uncoupled, wheels will get braked again.

Check the right and left wheels in turn.

7. Couple the УП-23 pick-up connector of the main wheel being checked and uncouple the YA-24 pick-up connector of the nose wheel.

8. When pressing the control stick brake lever, couple the terminals of the nose wheel YA-24 pick-up connector and see that nose wheel valve УП-53/1 operates and the nose wheel gets released (the main wheels remaining braked).

As the terminals are uncoupled, the nose wheel must get braked again.

9. Couple the electric connector of pick-up YA-23.

10. Check that the brakes of the three L.G. wheels are applied and released simultaneously and that the time taken to apply the brakes is within 2 sec.

Note: Listen to the noise produced by the air bled from valve УП-53/1 to check that the wheel brakes are released while the absence of noise indicates that the wheels are braked. Noise is also heard when the wheel is rotated by hand.

11. Jack down the aircraft.

Adjustment of Brake Control System

In order to adjust the brake control system when a necessity rises, proceed as follows:

1. Press down the brake lever completely and make sure that two-pointer pressure gauge МВ-12 indicates a pressure of $9^{+0.5}$ kg/cm^2.

2. In case the pressure exceeds the above-mentioned value, unlock the adjustment bolt of the ПУ-7 lever and drive it into the lever till the pressure gauge indicates a pressure of $9^{+0.5}$ kg/cm^2 with the brake lever is pressed down completely. After this lock the adjustment bolt on the ПУ-7 lever.

3. In case the pressure is less than the value mentioned above, drive the ПУ-7 lever adjustment bolt out so that the pressure gauge should indicate $9^{+0.5}$ kg/cm^2 when the brake lever is completely pressed down. After this lock the ПУ-7 lever adjustment bolt.

4. Check the position of the adjustment bolt of the automatic wheel brake cylinder (engaged during retraction of the landing gear). See that the clearance between the bolt and ПУ-7 valve control lever should be equal to 0.5 to 1.0 mm, otherwise readjust the bolt.

5. Retract the landing gear and check the L.G. wheel automatic braking. Make sure that the pressure in the brakes is 3 to 4 kg/cm^2 when the L.G. valve handle is set into position RETRACTED. After the L.G. valve is set in the neutral position, see that the pressure in the brakes drops to zero within the interval not above 1 min.

4. CHECKING AIR SYSTEM TIGHTNESS

The air system should be checked section by section in the following order:

Checking Tightness between Main Air Bottles and Points of Consumption

Charge the main air system to produce a pressure of 110 to 130 kg/cm^2. Close all valves. The permissible bleeding of the air should not exceed 5 kg/cm^2 per 2 hours.

Check the tightness by main system pressure gauge 2М-150.

Checking Tightness of Brake System

With the main system charged to 110 - 130 kg/cm^2, the valves closed, and none wheel brakes applied, press down the brake lever to obtain a pressure of $9.5^{+0.5}$ kg/cm^2 in the brake system (observe the indications of two-pointer pressure gauge МВ-12). See if valve ПУ-8 is now in either extreme position (check both positions).

The permissible pressure drop for half an hour is 2.5 kg/cm^2 (in each position of valve ПУ-8). When checking, observe the indications of main system pressure gauge 2М-150.

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10. Check that the brakes of the three L.G. wheels are applied and released simultaneously and that the time taken to apply the brakes is within 2 sec.

Note: Listen to the noise produced by the air bled from valve УП-53/1 to check that the wheel brakes are released while the absence of noise indicates that the wheels are braked. Noise is also heard when the wheel is rotated by hand.

11. Jack down the aircraft.

Adjustment of Brake Control System

In order to adjust the brake control system when a necessity rises, proceed as follows:

1. Press down the brake lever completely and make sure that two-pointer pressure gauge МВ-12 indicates a pressure of $9^{+0.5}$ kg/cm^2.

2. In case the pressure exceeds the above-mentioned value, unlock the adjustment bolt of the ПУ-7 lever and drive it into the lever till the pressure gauge indicates a pressure of $9^{+0.5}$ kg/cm^2 with the brake lever is pressed down completely. After this lock the adjustment bolt on the ПУ-7 lever.

3. In case the pressure is less than the value mentioned above, drive the ПУ-7 lever adjustment bolt out so that the pressure gauge should indicate $9^{+0.5}$ kg/cm^2 when the brake lever is completely pressed down. After this lock the ПУ-7 lever adjustment bolt.

4. Check the position of the adjustment bolt of the automatic wheel brake cylinder (engaged during retraction of the landing gear). See that the clearance between the bolt and ПУ-7 valve control lever should be equal to 0.5 to 1.0 mm, otherwise readjust the bolt.

5. Retract the landing gear and check the L.G. wheel automatic braking. Make sure that the pressure in the brakes is 3 to 4 kg/cm^2 when the L.G. valve handle is set into position RETRACTED. After the L.G. valve is set in the neutral position, see that the pressure in the brakes drops to zero within the interval not above 1 min.

4. CHECKING AIR SYSTEM TIGHTNESS

The air system should be checked section by section in the following order:

Checking Tightness between Main Air Bottles and Points of Consumption

Charge the main air system to produce a pressure of 110 to 130 kg/cm^2. Close all valves. The permissible bleeding of the air should not exceed 5 kg/cm^2 per 2 hours.

Check the tightness by main system pressure gauge 2М-150.

Checking Tightness of Brake System

With the main system charged to 110 - 130 kg/cm^2, the valves closed, and nose wheel brakes applied, press down the brake lever to obtain a pressure of $9.5^{+0.5}$ kg/cm^2 in the brake system (observe the indications of two-pointer pressure gauge МВ-12). See if valve ПУ-8 is now in either extreme position (check both positions).

The permissible pressure drop for half an hour is 2.5 kg/cm^2 (in each position of valve ПУ-8). When checking, observe the indications of main system pressure gauge 2М-150.

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Checking Tightness of L.G. Emergency System

Charge the L.G. emergency bottles to obtain a pressure of 110 - 130 kg/cm^2. Make sure that the emergency extension valves and emergency system charging valves are closed. No pressure drop in the section between the emergency bottles and the valves is permissible over an interval of 2 hours. When checking, make use of emergency system pressure gauge 2M-150.

Checking Tightness of Emergency Brake System

Charge the L.G. emergency system bottles to obtain a pressure of 110 - 130 kg/cm^2. See that all emergency system valves are closed.

Open the emergency braking valve and maintain this state for 30 min. The pressure drop in the system must not exceed 3 kg/cm^2 within 30 min. When checking, make use of emergency system pressure gauge 2M-150.

CAUTION. No flights are permissible with the pressure in the L.G. emergency system below 110 kg/cm^2.

Checking Cooling Control System of Fuselage Pressurized Compartments and Radio Set PCIY-5

1. Couple to the ground electric power supply.
2. Check the operation (closing) of the fuselage pressurized compartment cooling system pneumatic valves by depressing button IMITATING MP-1.35 OPERATION on the right-hand console after having switched on cockpit circuit breaker CONE AND SHUTTERS CONTROL.
3. After electropneumatic valves ЭК-69 are actuated, make sure that the systems function normally.

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Chapter V
AIRCRAFT CONTROL SYSTEM

1. GENERAL

The aircraft control system (Fig. 22) comprises the stabilizer, ailerons, rudder and air brake control systems.

Stabilizer Control

The stabilizer control system (Fig. 23) employs the linkage of rigid rods and bell-cranks and irreversibly connected two-chamber hydraulic booster БУ-51МС. The efforts applied to the aircraft control stick are simulated by the spring feel mechanism.

To remove the efforts upon the aircraft control stick, a trimming effect mechanism (pilot's trim) is employed. In order to remove the pushing or pulling efforts, the button is shifted either in the forward backward so that the pilot's trim electrical mechanism is engaged to alter the pull of the feel mechanism springs which in their turn relieve the aircraft control stick.

The working fluid supplied to two-chamber booster БУ-51МС is delivered from both the booster and the main hydraulic systems simultaneously.

In case any of the two hydraulic systems fails, booster БУ-51МС will continue its operation on one of the chambers depending on which of the systems has remained serviceable.

The booster hydraulic system includes emergency pumping unit НП-27Т intended to maintain such pressure in the booster system as to effect landing in case hydraulic pump НП-34-1Т fails or the engine stops.

In order to make the efforts upon the stick feel natural depending on the speed and altitude of flight, the system employs automatic controller, type АРУ-3В.

The specific features of controller АРУ-3В are the following (Fig. 24):

1. When the altitude is within 4500 $\pm$650 m., the adjustment is governed by the aircraft speed alone. Thus, if the indicated speed is less than 455^{+120}_{-85} km/hr or more than 992^{+58}_{-55} km/hr, the control stick-to-feel mechanism transmission ratio and the control stick-to-stabilizer transmission ratio are constant values and correspond to minimum and maximum efforts upon the control stick or to maximum and minimum stabilizer deflection angles.

2. When the altitude is from 4500 $\pm$650 m. to $10{,}000_{-700}$ m., the automatic system responds both to dynamic pressure and to the altitude flight. Altitude correction introduced ensures the required stability and controllability of the aircraft when Mach-numbers increase and the stabilizer effect decreases.

As the altitude increases, the range of response of the automatic system to the dynamic pressure decreases. The loads upon the control stick diminish, while the stabilizer deflection caused by a 1-deg. shift of the control stick increases.

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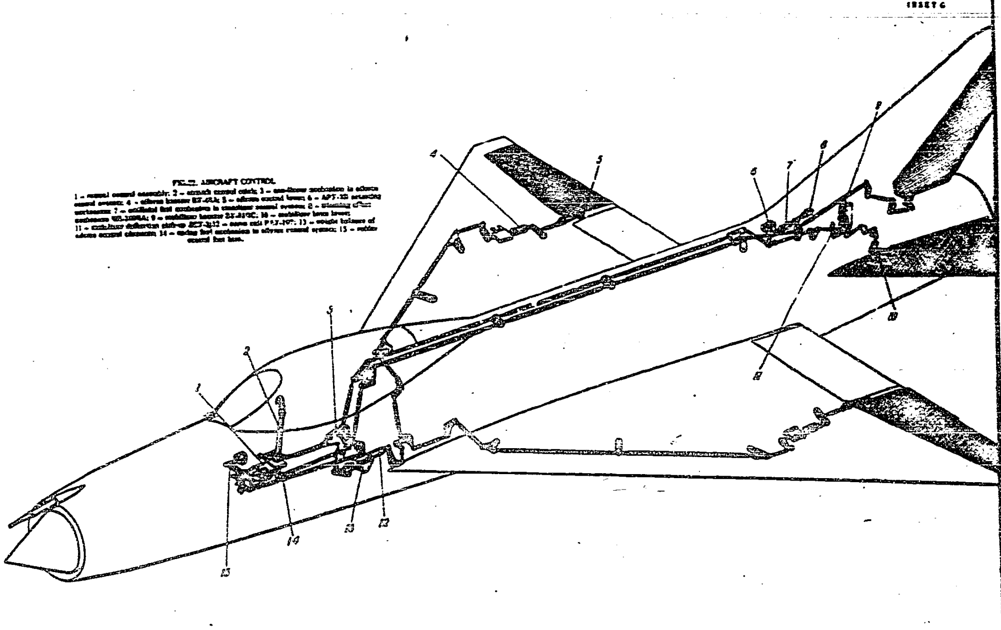

FIG. ... AIRCRAFT CONTROL

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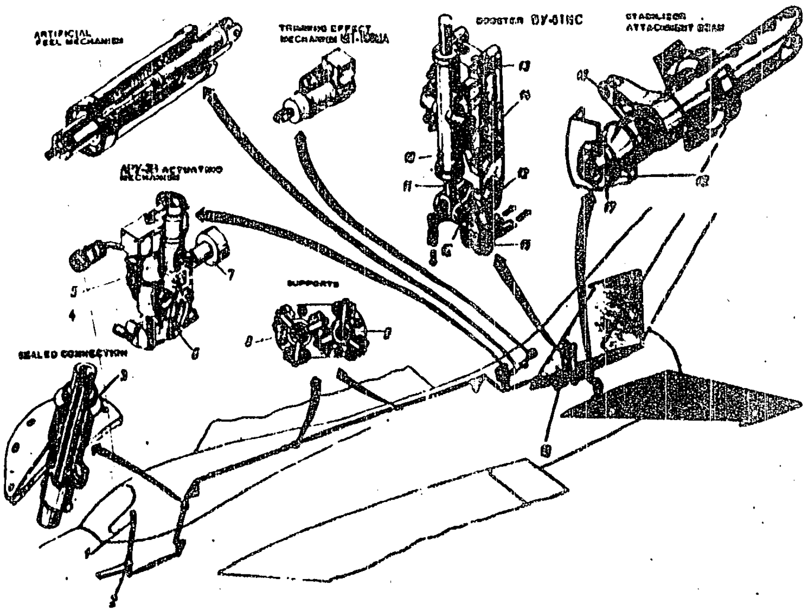

FIG.23. STABILIZER CONTROL SYSTEM

1 – aircraft control stick; 2 – control control assembly; 3 – stabilizer control sealed joint; 4 – autopilot transmission ratio corrector KIП-2; 5 – electric mechanism MT-100MA; 6 – APY-3B rod; 7 – artificial feel mechanism; 8 – stabilizer control rod; 9 – rudder control rod; 10 – booster cylinder; 11 – rod; 12 – oil fittings 13 – filter; 16 – bracket; 15 – bell-crank; 16 – stabilizer beam lever; 17 – bearing; 18 – stabilizer deflection signalling pick-up ACY-2.

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3. No matter what may be the aircraft speed when the altitude exceeds $10{,}000_{-700}$ m. or whatever the altitude may be when the indicated speed is less than 455^{+120}_{-45} km/hr, the APY-3B actuating mechanism rod engages the bigger arm so that the stick-to-feel mechanism transmission ratio and stick-to-stabilizer transmission ratio correspond to the minimum load on the stick and to maximum angles of stabilizer deflection.

4. The controller operation is followed by the indicator arranged on the instrument panel left part and by signal light STABILIZER FOR LANDING installed on panel T-4 (Fig. 24).

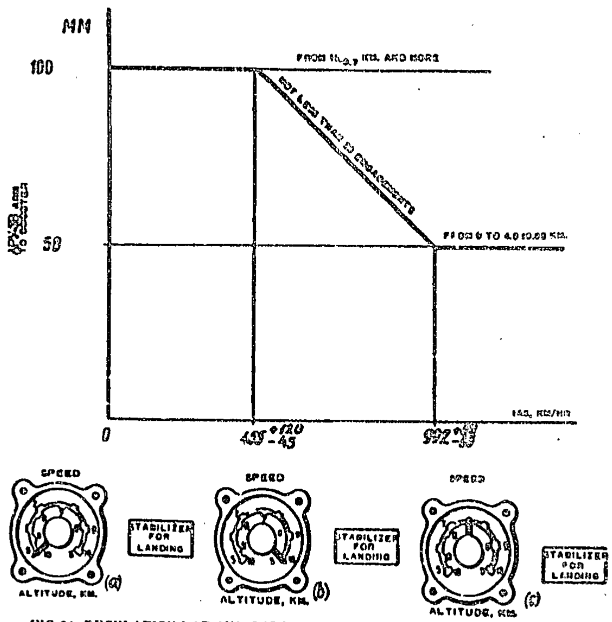

FIG.24. REGULATION LAW AND CHECKING INSTRUMENTS OF CONTROLLER APY-3B

(a) flight at IAS < 410 km/hr at all altitudes; flight at IAS > 410 km/hr at altitude equal to, or in access of, 10 km. in landing approach. Pointer is on left stop, signal light on panel T-4 is on;

(b) flight at IAS > 937 km/hr at altitudes up to 5 km. Pointer is on right stop, signal light on panel T-4 is dead;

(c) flight at IAS ~ 750 km/hr at altitude of 7 km. Pointer is in central position, signal light on panel T-4 is dead.

When the indicated speed is 455^{+120}_{-45} km/hr or less (at all altitudes), as well as when the altitude is $10{,}000_{-700}$ m. or more (irrespective of the speed) and when landing, the controller rod should engage the bigger arm, and on light panel T-4 signal light STABILIZER FOR LANDING must go on.

5. Controller APY-3B operates independently and responds to dynamic and static pressures in the pitot-static tube system.

The controller does not perform the pre-determined control program continuously, but follows it intermittently, by repeated activations. The number of activations within the dynamic pressure and altitude control range has been selected so as to cause minimum effect on the pilot during flight and to reduce the controller relay operation to a minimum intensive rating.

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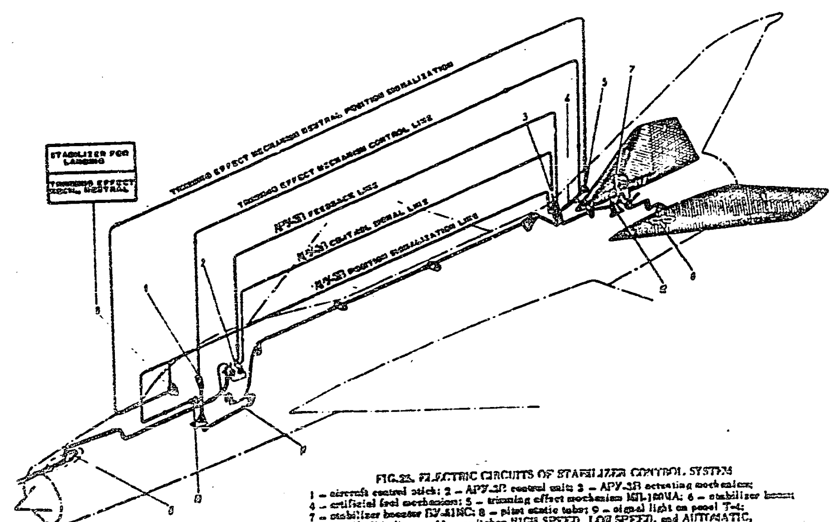

FIG.23. ELECTRIC CIRCUITS OF STABILIZER CONTROL SYSTEM

1 – aircraft control stick; 2 – APY-3П control unit; 3 – APY-3П actuating mechanism; 4 – artificial feel mechanism; 5 – trimming effect mechanism МП-100МА; 6 – stabilizer boost; 7 – stabilizer booster БУ-51МС; 8 – pitot static tube; 9 – signal light on panel T-4; 10 – APY-3П indicator; 11 – switches HIGH SPEED, LOW SPEED, and AUTOMATIC, MANUAL; 12 – stabilizer deflection signalling pick-up ДСУ-2.

6. In case the control unit fails, the pilot can regulate the controller manually by means of cockpit switch AUTOMATIC, MANUAL.

7. The electrical couplings employed by the stabilizer control system are the following (Fig. 25):

(a) automatic control of the APY-3B mechanism from the control unit (switched on throughout the flight);

(b) manual control of the APY-3B mechanism employed by the pilot in case the automatic control fails;

(c) control of the pilot's trim effected by the button arranged on the aircraft control stick (switched on throughout the flight);

(d) operation of three microswitches KB-9A of pick-up ДСУ-2 in response to stabilizer deflection angles (See Chapter VI, "Power Plant Control System").

Aileron Control

The ailerons are controlled through a linkage of rigid rods and bell-cranks and two irreversibly coupled boosters БУ-45А (Fig. 26). The working fluid supply of the boosters is duplicated so that in case the booster hydraulic system pressure drops, the boosters are automatically changed over from the booster to the main hydraulic system. The change-over is effected by special valves built into the heads of boosters БУ-451. When the operating pressure is produced in any of the hydraulic systems, the boosters respond to aerodynamic forces, but when the pressure in a hydraulic system is zero, the boosters are used as rigid links, and the effects of aerodynamic forces acting on the ailerons are overcome by the pilot. When the boosters are engaged, the efforts produced by the ailerons on the aircraft control stick are simulated by the spring feel mechanism.

In order to facilitate the lateral control of the aircraft as well as to achieve maximum safety of flight under bad-weather conditions and at night, the aileron control system is equipped with a single-axis (roll) autopilot, type КАП-2.

The principle of operation utilized in the autopilot is based on the measurements of the roll angular velocity and present roll angle by the sensitive elements (such as the roll rate gyro and transmitting gyro of artificial horizon) with a subsequent sending of the respective voltage signals to relay and amplifier unit РУБ-1КМ where the signals are summed up and amplified. The autopilot elements are interacting according to the block diagram shown in Fig. 27.

A control signal formed by unit РУБ-1КМ is fed to servo unit РАУ-107 which functions as an extendible rod of the aileron control linkage. When the РАУ-107 electromotor rotates, it acts upon the actuating rod through a reduction gear and causes the rod to displace. The displacement of the actuating rod is transmitted through the linkage of rods and bell-cranks to boosters БУ-45А which shift the ailerons depending upon the angular velocity and roll angle. Each roll angle and angular velocity involve an absolutely definite deflection of the ailerons governed by the transmission ratios in roll angle (i_x) and angular velocity (μ_x). The transmission ratio values are set by the resistors mounted in relay box КВ-1А.

The angular velocity transmission ratio (μ_x) is corrected with respect to the dynamic pressure and flight altitude by transmission ratio corrector КПС-2 in accordance with the controller APY-3B regulation law.

Servo unit РАУ-107 shifts the ailerons through $\pm 5.5^{\circ}$ when the actuating rod makes a full travel (± 15 mm), the complete deflection of the ailerons caused by shifting the control stick amounting to $\pm 20^{\circ}$. Thus, when the autopilot is engaged,

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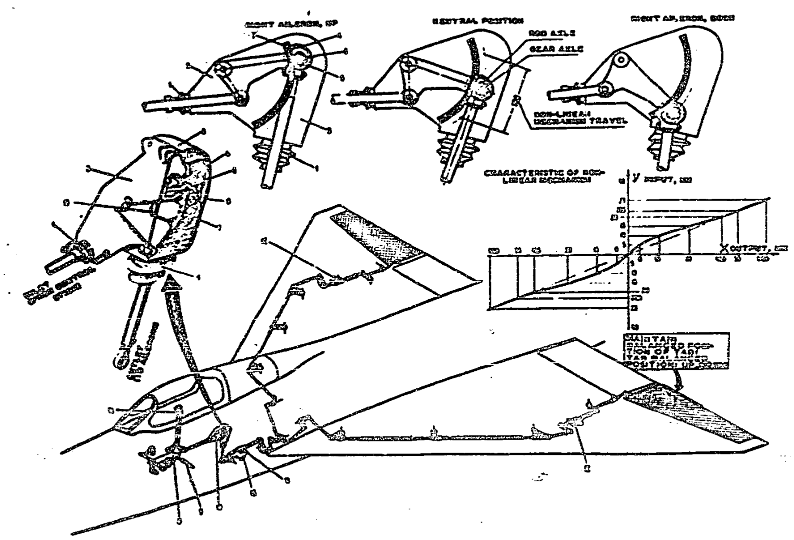

FIG. [illegible] AILERON CONTROL SYSTEM

1 – [illegible]; 2 – body; 3 – jacket; 4 – universal joint; 5 – bell-crank; 6 – gear; 7 – toothed sector; 8 – aircraft control [illegible] assembly; 9 – aileron control system artificial feel mechanism; 10 – non-linear mechanism; 11 – servo unit PAY-107; 12 – boosters [illegible]; 13 – weight balance; 14 – aircraft control [illegible]; 15 – place of installation of [illegible] to stop non-linear mechanism in neutral position.

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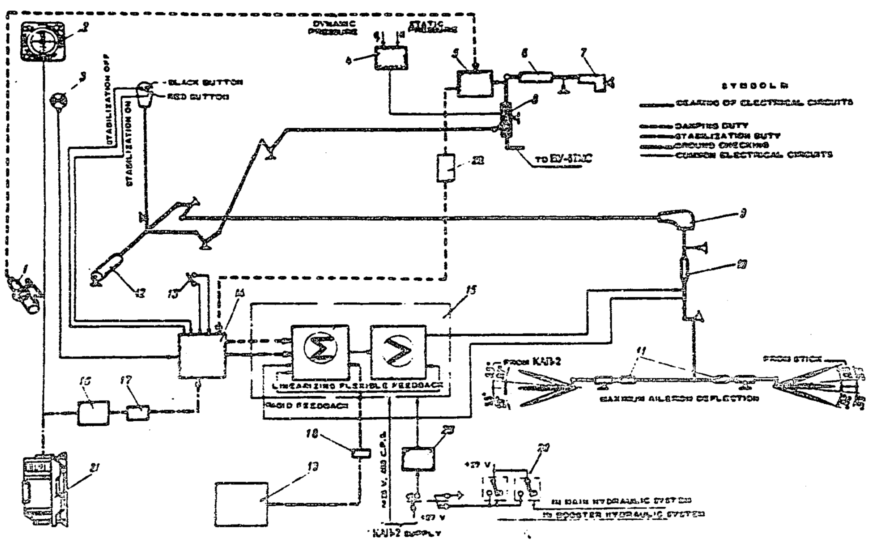

FIG.27. AUTOPILOT KAП-2 IN AILERON CONTROL SYSTEM. BLOCK DIAGRAM

1 — ДУС-А angular velocity pick-up; 2 — АГД-1 flight indicator; 3 — stabilization duty signal light AUTOPILOT ON; 4 — АПУ-3В control unit; 5 — transmission ratio corrector АРУ-2; 6 — stabilizer control system artificial feel mechanism; 7 — trimming effect mechanism МП-100МА; 8 — АПЗ-3В actuating mechanism; 9 — aileron control system non-linear mechanism; 10 — servo unit РАЗ-18; 11 — aileron boosters БУ-45А; 12 — aileron control system artificial feel mechanism; 13 — damping duty switch ROLL DAMPER; 14 — relay box КР-14; 15 — relay and amplifier unit РУБ-1КМ; 16 — phase-sensitive rectifier ФВЛ; 17 — roll angle transmission ratio (i_γ) adjustment potentiometer installed inside relay box КР-14; 18 — aircraft test connector; 19 — autopilot ground test set ПКА-1; 20 — autopilot hydraulic pressure interlocking relay ГА-135 21; 21 — АГД-1 transmitting gyro; 22 — two angular velocity transmission ratio (i_{ω}) adjustment potentiometers installed inside relay box КР-14; 23 — interference filter ФП-110.

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only 27.5 per cent of the complete deflection of the ailerons are utilized to achieve safety in flight if the autopilot fails.

In order to avoid damage of servo unit PAY-107 in case boosters БУ-49А are inoperative (when the load upon the PAY-107 electric motor exceeds the normal rating), the autopilot employs pressure interlocking of the hydraulic systems. For this purpose the booster and main systems are fitted with pressure switches ТА-135/21. Each system uses one pressure switch installed at the outlet of valves ГА-190Б used to disconnect the boosters. Each of the above switches responds to a pressure drop below 70 kg/cm^2 in the hydraulic system where it is installed and cuts off its circuit through which the autopilot is fed with direct current and cuts it in when the pressure increases above 90 kg/cm^2.

The autopilot operates in the damping and stabilization duties.

In the damping duty the autopilot damps lateral oscillations of the aircraft regardless of the pilot's activities and responds to the aircraft rolling velocity both when a definite roll angle is set by the pilot and when changing over from one roll angle to another. Owing to this, the pilotage is greatly facilitated since the scope of shifts of the aircraft control stick required to maintain the desired roll is considerably limited.

In the stabilization duty the autopilot ensures:

(a) a roll-free flight requiring no pilot's activities, i.e. zero roll stabilization when the control stick is shifted laterally into the neutral position. The regulation law ensures zero roll of the aircraft to an accuracy of 0.5 to 1°;

(b) automatic bringing of the aircraft to zero roll (to the "horizon") from any initial angle (including the inverted flight), by shifting the aircraft control stick laterally into the neutral position. The average rate of zeroing the aircraft roll is 20 to 50 deg/sec;

(c) aircraft roll control within the range of approx. ±35° in response to the control stick position which corresponds to a lateral linear displacement of the stick through 50 to 70 mm from the neutral position. In this case the pilot sets the desired roll within ±35° by shifting the stick into a required position and leaving it therein after the roll has been obtained. As the stick is returned into the neutral position, the aircraft is set into the zero roll position. Shown in Fig. 28 are the operating sectors of the aircraft control stick. When the control stick is displaced through a length exceeding 50 to 70 mm, normal angular velocity control of the aircraft will be maintained and servo unit PAY-107 will be employed as a rigid control rod.

In the damping duty, the autopilot is switched on and off by switch ROLL DAMPER installed on the left-hand console.

To switch the stabilization on and off, the aircraft control stick carries two buttons (arranged right and left of the trimming effect mechanism button). The right button is used for switching the stabilization on and the left one is used for switching it off.

When the stabilization is on, this is indicated by signal light AUTOPILOT ON going on at the white band of the instrument panel. As the stabilization is switched on, the damping mode is started automatically, if it has not been previously engaged.

Installed in front of autopilot servo unit PAY-107 is the control stick-to-aileron non-linear transmission mechanism used to provide:

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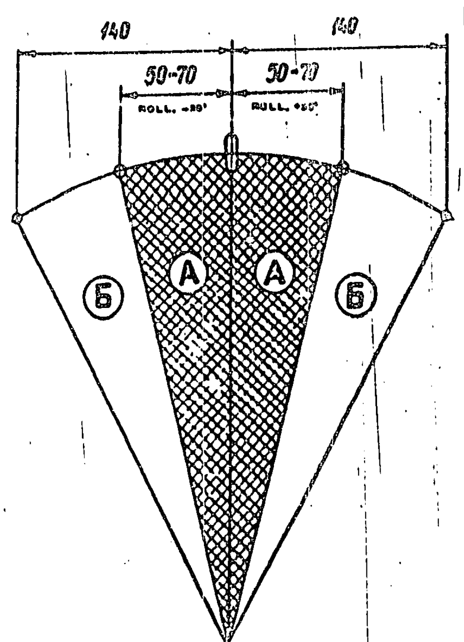

FIG.28. AUTOPILOT CONTROL SECTORS WHEN IN STABILIZATION DUTY

A – roll sector maintained in response to control stick application (each position of control stick corresponds to a definite roll angle within the range of ±35°).
Б – angular velocity control sector (aircraft regular control sector).

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(a) an increase of the control stick travel from the neutral position by 2 to 2.5 times to obtain the required aileron displacement; in this case the roll sensitivity of the aircraft will be reduced (within 1/3 of the aileron deflection range), when the autopilot is disengaged during flight;

(b) an easier control of the ailerons in case boosters БУ-45А are disengaged.

Rudder Control

The rudder is controlled by the foot bars connected to it through a linkage of rigid rods (Fig. 29).

The aerodynamic forces upon the rudder are picked up by the pilot.

Air Brake Control

In order to decrease the aircraft speed in various modes of flight, the fuselage is fitted with three air brakes.

In case a drop tank is attached, the lower air brake is interlocked and is not extended.

The air brakes have an electrohydraulic control (Fig. 30). The side air brakes are controlled by an electrohydraulic valve, type ГА-184У and the lower air brake is controlled by another valve of this type.

The side air brakes are extended through 25°, while the lower air brake travels through 40°.

In the up or down positions the air brakes are kept by the compressed working fluid delivered from the main hydraulic system.

The air brakes are controlled with the help of a slide arranged on the engine control lever grip. As the slide is pulled forward, the air brakes are retracted and when the slide is displaced in an opposite direction, the air brakes are extended.

2. CHECKING STABILIZER CONTROL

Described below are the following checking operations:

(a) checking of trimming effect mechanism operation carried out during pre-flight and preliminary preparation of the aircraft;

(b) simplified checking of АРУ-3В controller operation (at zero pressure in the hydraulic systems) carried out during preliminary preparation of the instrumentation;

(c) checking of АРУ-3В controller operation (with the pressure built up in one of the hydraulic systems) carried out in the course of scheduled maintenance.

Checking Trimming Effect Mechanism during Pre-Flight and Preliminary Preparations

To check the trimming effect mechanism while the engine is running and the ground hydraulic pump is engaged, observe the following priority:

1. Switch on the right-hand console circuit breaker TRIMMING EFFECT MECHANISM and circuit breaker CHECK. LIGHT PANEL; PITCH TRIM WARNING; SPEEDOBAROGRAPH and make sure that signal light TRIM. EFFECT MECH., NEUTRAL of the panel goes on.

2. Press the control stick button forward and then backward. As the button is depressed, see that the released control stick travels backward and forward respectively (the directions in which the button and stick are displaced must coincide).

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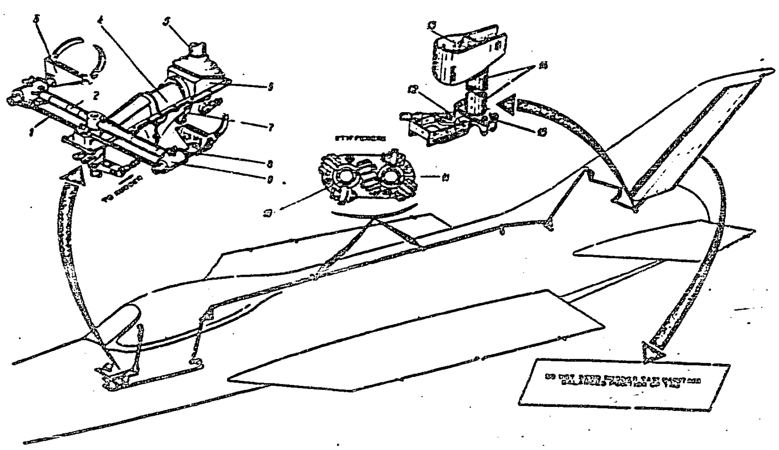

FIG.23. RUDDER CONTROL SYSTEM
1 – rods 2 – pipes 3 – foot bar; 4 – bracket; 5 – control stick; 6 – box; 7 – aileron control lever; 8 – pilot's height foot bar locking screw; 9 – side brackets; 10 – stiffener (guide) of stabilizer control rods 11 – stiffener (guide) of rudder control rods 12 – bell-crank; 13 – rudder; 14 – axle; 15 – rudder lever axle.

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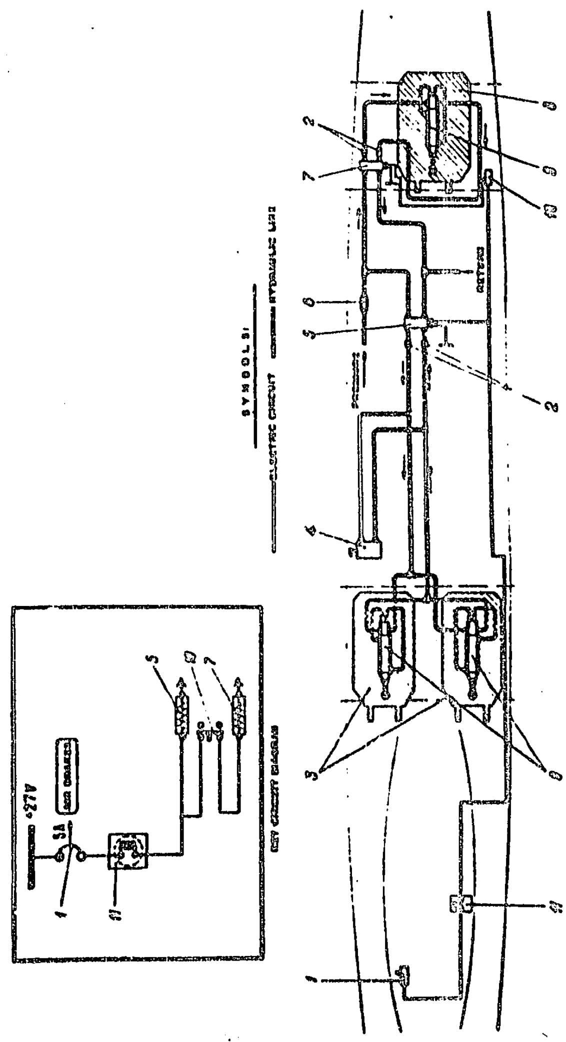

FIG.33. AIR BRAKES CONTROL SYSTEM

1 – circuit breaker AIR BRAKES; 2 – throttles; 3 – front air brakes; 4 – cross-feed valve; 5 – front air brake extension valve ГА-184У; 6 – check valve with thermovalve; 7 – rear air brake extension valve ГА-184У; 8 – rear air brakes; 9 – air brake cylinders; 10 – limit switch ВК-2А used for interlocking rear air brake when drop tank is attached; 11 – switch КЗ-6 on throttle control lever.

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3. When the trimming effect mechanism button is depressed, see that signal light TRIM. EFFECT MECH., NEUTRAL comes off.

4. After checking, set the trimming effect mechanism into the neutral position so that signal light TRIM. EFFECT MECH., NEUTRAL illuminates.

To determine the neutral position of the trimming effect mechanism, press the button rearward bringing it from the forward position.

Simplified Checking of APY-3B Controller Operation (at Zero Pressure in Hydraulic Systems) Carried Out during Preliminary Preparation

Functioning of controller APY-3B is checked during preliminary preparation of the aircraft when the pressure in the hydraulic systems is zero. In this case, the aircraft control stick should be set close to its neutral position and left without any hand pressure applied as during this check it is the control stick and not the stabilizer leading edge which is caused to shift. The above operations should be performed simultaneously with checking the aircraft instrumentation associated with aneroid instruments.

When checking, observe the following priority:

1. Couple the ground electric power supply to the aircraft.
2. Turn on right-hand console switch BATTERY, AIRCRAFT - GROUND.
3. Make sure that circuit breakers APY AUTOMATIC CONTROL and CHECK. LIGHT PANEL; PITCH TRIM WARNING; SPEEDOBAROGRAPH are switched on. See that signal light STABILIZER FOR LANDING illuminates and the controller indicator pointer is set on the left stop of the scale.
4. Make sure whether the selector switch of controller APY-3B is set in position AUTOMATIC and safety-wired.
5. Connect tester KUY-3 (or testing equipment П[illegible]-APY or УИАП) to the dynamic line hole of the pitot-static tube.
6. Build up an excess pressure in the pitot-static tube dynamic line, increase the pressure gradually (within 60 to 90 sec.) and note the reading of the controller indicator velocity scale (outside numbers) to make sure that its indications are approximately equal to the readings of tester KUY-3 and the aircraft speed indicator within the indicated speed range of 410 to 1030 km/hr.

As the pressure corresponding to about 410 km/hr of the indicated air speed is obtained, check if signal light STABILIZER FOR LANDING comes off on light panel T-4, the controller indicator pointer starts to displace in a clockwise direction.

With further increase of pressure to a value corresponding to about 992^{+38}_{-55} km/hr of the indicated speed (due to decrease of the APY-3B mechanism arm), check that the aircraft control stick displaces somewhat forward. Make sure that the controller indicator pointer takes the extreme right position at IAS more than 992^{+38}_{-55} km/hr.

7. Smoothly reduce the pressure in the pitot-static tube dynamic line and see that the indicator pointer and the control stick start moving back into their initial positions, i.e., pointer starts travelling to the left and the control stick, backward.

When the pressure drops to a value corresponding to a speed less than 410 km/hr, see that signal light STABILIZER FOR LANDING goes on.

After checking, remove the tester.

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Checking АРУ-3В Controller Operation (with Pressure Built Up in One Hydraulic System) during Scheduled Maintenance

Checking of АРУ-3В mechanism operation is performed in two stages:

(a) checking the automatic control of the mechanism depending on changes in speed and altitude;

(b) checking the manual control of the mechanism.

To check up the controller, testing equipment ППУ-АРУ is commonly employed. If testing equipment ППУ-АРУ or УМАП is not available, two testers ППУ-3 may be used.

Checking Controller АРУ-3В by Testing Equipment ППУ-АРУ (or УМАП)

To check operation of controller АРУ-3В in respect of the speed with the altitude correction introduced, build up the working pressure in one hydraulic system, and release the aircraft control stick; for this purpose proceed in the following order:

1. Connect the ground hydraulic pump.

2. Couple to the ground electric power supply.

Make sure that the power supply voltage is 27 V ±10%.

3. Turn on the right-hand console switch BATTERY, AIRCRAFT - GROUND.

4. Make sure that circuit breakers АРУ AUTOMATIC CONTROL and CHECK. LIGHT PANEL; PITCH TRIM WARNING; SPEEDOBAROGRAPH are switched on.

5. Check if the controller selector switch is set in position AUTOMATIC and the dynamic line change-over valve is in position PITOT-STATIC TUBE.

6. Connect the aircraft mains to testing equipment ППУ-АРУ by means of bunched conductor No. 5 coupled to socket PORTABLE LIGHT.

7. Fit the pitot-static tube with a special snout and use rubberised hoses to connect the respective static and dynamic pressure pipe connections of the snout and ППУ-АРУ testing equipment. Couple connection Д of the cabin altitude and pressure differential gauge to connection STATIC - II of testing equipment ППУ-АРУ.

8. Set valve "I-II" of ППУ-АРУ in position "I" and valve PRESSURE - VACUUM in position PRESSURE. Make sure that the rest of the valves are cut off.

9. Build up the operating pressure in the hydraulic system, and keep switches CIRCUIT BREAKER and PUMP of the test device turned on for 10 to 15 sec. Smoothly open valve DYNAMIC and slowly (for the interval of 60 to 90 sec.) change the pressure in the ДРД-106 dynamic cavity (maintaining the atmospheric pressure in the static cavities of the ДРД-106 and ДРД-126 pick-ups). Varying the pressure, bring out a change in the indicated air speed from 410 to 1050 km/hr and check the adjustment of the follow-up system. As a pressure corresponding to an indicated air speed of about 410 km/hr is produced, see that panel signal light STABILIZER FOR LANDING comes off and that the controller indicator pointer starts moving clockwise. When a pressure corresponding to an indicated air speed of about 1050 km/hr is built up, close valve DYNAMIC.

To check whether the adjustment is good, determine the number of activations of electric mechanism МП-100МА which must amount to 20 to 50, at one-sense pressure variations (Fig. 31). While the pressure increases, follow the controller

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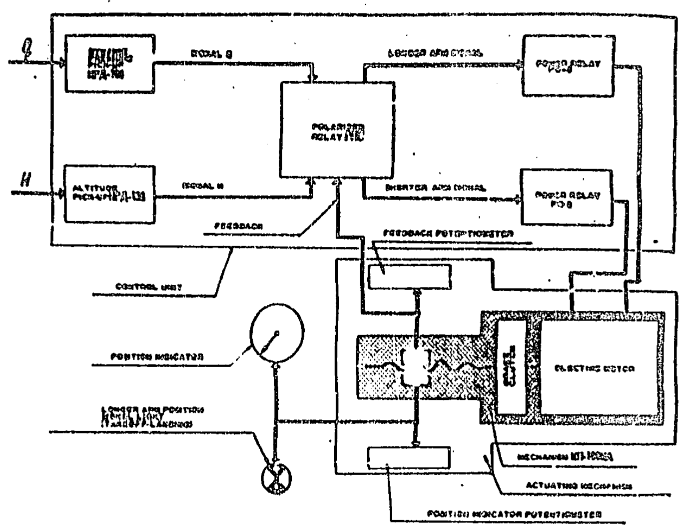

FIG.31. APZ-19 CONTROLLER COMPONENTS INTERACTION DIAGRAM

indicator speed scale (outside numbers) and see that its readings are about equal to those of two-pointer speed indicator КУС-2000 and of the aircraft speed indicator. Check that the controller actuating rod starts its retraction from the "longer arm" of 100 mm at the speed of 455^{+120}_{-35} km/hr and completes its retraction stroke at the speed of 992^{+58}_{-55} km/hr.

10. Check if the length of the controller shorter arm is 50 mm. Take measurements at the reference lines made on the rod and controller actuating rod body.

11. Check accuracy of altitude corrections. While "climbing", see to it that the preset speed does not change. In the case of a change in the indicated air speed when the vacuum is produced, release the excess pressure from the НПЛ-10С dynamic cavity through valve PRESSURE DIFFERENTIAL (or valve "H" of testing equipment УКАП).

12. Set valve PRESSURE - VACUUM in position VACUUM, switch on the testing equipment pump, smoothly open valve STATIC - I and observe the readings of the altimeter and cabin altitude and pressure differential gauge to check that the "climbing" proceeds evenly. To avoid off-scale pointer readings on the gauge pressure differential scale, open valve STATIC - II gently so as to keep the pressure difference within the predetermined limits.

As an altitude of 9300 to 10,000 m. is achieved, see that the actuating rod is driven into its longer arm position (100 mm), signal light STABILIZER FOR LANDING illuminates on the instrument panel and the controller indicator pointer is set in the extreme left-hand position.

Cut off valve STATIC - I. Make sure that the number of activations of the controller electric motor is 20 to 50 while a one-sense change of the static pressure from 4500 ± 650 m. to $10{,}000_{-700}$ m. proceeds at a ground speed of 992^{+58}_{-55} km/hr.

13. Set valve PRESSURE - VACUUM in position PRESSURE and turn valve inscribed STATIC - I to "descend" to 4500 ± 650 m. See if the controller actuating rod travels into the shorter arm position. Make sure that the controller indicator readings (altitude scale, inside numbers) correspond approximately to the aircraft altimeter readings within the altitude range from $10{,}000_{-700}$ m. to 4500 ± 650 m. While descending, maintain a constant indicated air speed (so that it should not decrease) by turning valve DYNAMIC and regularly switching on the КПУ-АРУ testing equipment pump.

14. After "descending", reduce the speed by setting valve PRESSURE - VACUUM in position VACUUM; then, turning valve DYNAMIC, achieve even decrease of speed. Make sure that the controller rod travels into the longer arm position and signal light STABILIZER FOR LANDING goes on at light panel Т-4.

Note: It should not be forgotten that the automatic transmission ratio controller is adjusted under the standard atmospheric conditions, and the readings of its indicator altitude scale can differ from the readings of the aircraft altimeter.

Checking Controller АРУ-3В by Means of Two Testers КПУ-3

1. Couple to the ground hydraulic pump and produce the operating pressure.
2. Couple to the ground electric power supply.
3. Make sure that circuit breakers АРУ AUTOMATIC CONTROL and CHECK. LIGHT PANEL; PITCH TRIM WARNING; SPEEDOBAROGRAPH are switched on and that the controller selector switch is in position AUTOMATIC.

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4. Couple one tester KIIY-3 to the pitot-static tube dynamic hole and connect the other directly to the APY-3B control unit inside the cockpit. Prior to coupling the tester for measuring the static pressure, remove the seal from the detachable pipe connection installed near the APY-3B control unit, detach the pipe connection and use adapter 76-7702-170 to connect the KIIY-3 hose to that of the MPA-126 pick-up.

5. Make sure that the pitot-static tube dynamic line change-over valve installed on the left-hand console is set in operating position PITOT-STATIC TUBE.

6. Switch on the storage battery and see that signal light STABILIZER FOR LANDING goes on.

7. Build up an excess pressure in the dynamic line and increase it gradually to obtain a value corresponding to an indicated air speed of 1050 km/hr. See that the controller actuating rod moves into position HIGH SPEED (signal light STABILIZER FOR LANDING should come off at IAS more than 410 km/hr).

Produce a vacuum in the static line and increase it gradually to a value corresponding to an altitude of 9300 to 10,000 m. See that the controller rod travels into position LOW SPEED when the above altitude range is achieved. As the vacuum is reduced to a value corresponding to an altitude of 4300 ±650 m., see that the controller rod travels into position HIGH SPEED. Make sure that the controller indicator altitude scale reading is correct.

After checking, disconnect testers KIIY-3, remove adapter 76-7702-170, joint the detachable connection, check the system for tightness and affix a seal to the pipe connection joint.

Checking APY-3B Manual Control

1. Unlock the controller selector switch arranged on the instrument panel and change it over from position AUTOMATIC to position MANUAL.

2. Connect the ground hydraulic pump and electric power supply to the aircraft, switch on circuit breaker APY MANUAL CONTROL and switch BATTERY, AIRCRAFT - GROUND

3. Set the trimming effect mechanism into the neutral position.

4. Change the controller switch from the neutral position to position HIGH SPEED until the controller operates completely, i.e. until the controller rod is changed over from the longer to shorter arm, and see that instrument panel signal light STABILIZER FOR LANDING comes off on the light panel and that the controller indicator pointer travels into the extreme right position.

CAUTION. To avoid damage of the electric motor, shift the controller manually in short steps.

5. Shift the aircraft control stick to the extreme forward and backward positions and make sure that the stick is heavily loaded by the feel spring.

6. Shift the controller switch from the neutral position into position LOW SPEED until the controller is activated completely, i.e. until its rod is changed over from the shorter to longer arm, and see that signal light STABILIZER FOR LANDING goes on and the controller indicator pointer travels into the extreme left position.

7. Shift the control stick forward and backward and make sure that the stick is lightly loaded. After checking, set the controller selector switch in position AUTOMATIC and lock it with brass wire, dia. 0.25 mm.

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3. ADJUSTMENT OF STABILIZER CONTROL SYSTEM

The stabilizer control system is adjusted each time the stabilizer control gets disabled in the course of use of the aircraft (during repair of the controls), and also when replacing the stabilizer, controller APY-3B, booster BV-31EU, spring feel mechanism, or trimming effect mechanism UM-100MA.

Note: If the stabilizer has been replaced, level the aircraft prior to adjustment of the aircraft controls.

Longitudinal control adjustment entails the following operations:

1. Adjustment of stabilizer and control stick deflection angles.
2. Adjustment of the stabilizer drift when changing the controller from position LOW SPEED to position HIGH SPEED.
3. Adjustment of the trimming effect mechanism neutral position.
4. Final adjustment of the aircraft longitudinal control after a balancing flight.

The adjustments are made with the ground hydraulic pump and electric power supply connected to the aircraft. Carry out the adjustments for the left half of the stabilizer in accordance with the Levelling Diagram.

Adjustment of Stabilizer and Control Stick Displacement Angles

To adjust the stabilizer and control stick travel angles, proceed as follows:

1. Make sure that circuit breakers APY AUTOMATIC CONTROL, APY MANUAL CONTROL, and CHECK. LIGHT PANEL; PITCH TRIM WARNING; SPEEDOBAROGRAPH are switched on.

2. Make sure that the controller rod is in position LOW SPEED (signal light STABILIZER FOR LANDING must glow and the controller indicator pointer must be set at the left-hand stop).

3. Pull the control stick backward and push it forward and make sure whether the control stick adjustment bolts come against the stops so that a clearance for additional travel is made in all hinged joints, bell-cranks and system units.

4. Pull the control stick backward from the extreme forward position and set the stabilizer in the zero position, i.e. align points 54 and 55 (See the Levelling Diagram). Points 54 and 55 on the stabilizer left side being aligned, see that the permissible misalignment of the respective points on the stabilizer right side does not exceed ± 2 mm.

Note: If necessary, adjust the stabilizer misalignment by means of rod 6 (Fig. 32).

As the stabilizer is set in the above-mentioned position, shift the control stick at a distance of $K = 250 \pm 3$ mm away from the instrument panel to point F punched on the control stick 605 mm away from its axis of rotation (Fig. 33).

When adjusting the stabilizer and control stick deflection angles (after replacement of the stabilizer or the fuselage tail portion, or after repair of the stabilizer controls), it is allowed to screw in or out the lugs of the rods located in the recess near frame No. 28 or behind the seat near frame No. 11. It should be borne in mind, however, that the rod lugs must not be screwed out to emerge over the reference holes in the sleeve.

Besides, make sure that the locking pin of the stabilizer rod lug does not press against the sealing joint sleeve located near frame No. 12.

It should not be forgotten that after readjustment of the stabilizer controls, it is necessary to check and adjust the stabilizer drift, the neutral position of the trimming effect mechanism and ECY-2 unit for the stabilizer deflection angles.

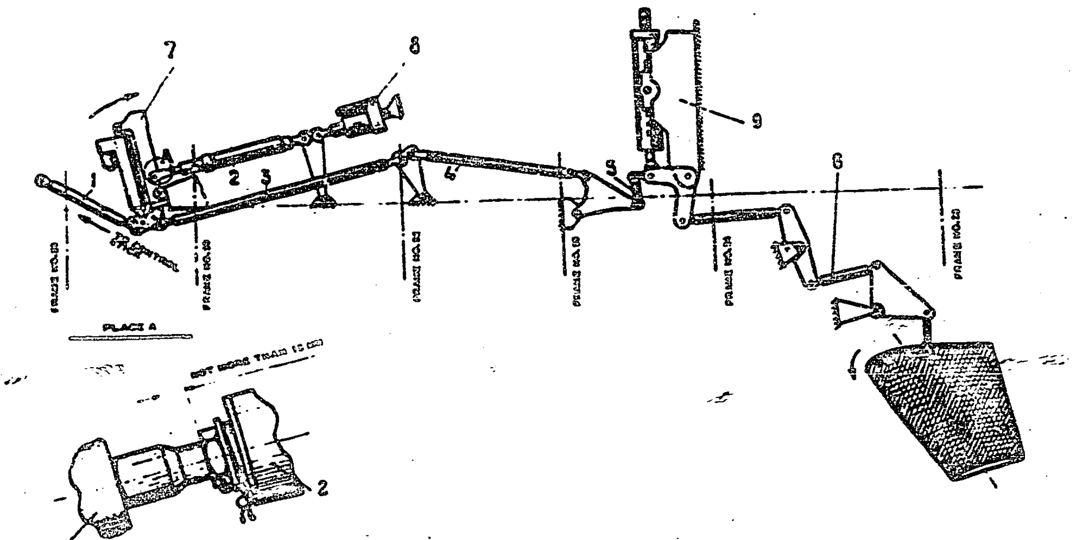

FIG.32. DIAGRAM FOR ADJUSTMENT OF STABILIZER CONTROL

1 – stabilizer control rod; 2 – artificial feel mechanism; 3 – rod; 4 – rod; 5 – rod; 6 – rod; 7 – [illegible] actuating mechanism; 8 – trimming effort mechanism [illegible]; 9 – booster [illegible].

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After adjustment of the stabilizer controls, lock the rod lugs with wire.

5. Shift the control stick into the extreme positions as far as it will go, and check the stabilizer deflection angle with the APY-3B rod set to the shorter and longer arm positions as indicated in the Levelling Diagram. To measure the angles in degrees, make use of the protractor whose scale is set normally to the stabilizer axis of rotation.

Adjustment of Stabilizer Drift

To check the stabilizer drift, see that the controller switch is changed over from position LOW SPEED to position HIGH SPEED and proceed as follows:

1. Build up the operating pressure in the hydraulic system.
2. Set the trimming effect mechanism in the neutral position and make sure that the signal light goes on.
3. Pull the control stick backward from the extreme forward position to set the stabilizer left half in the zero position, i.e. align the reference line marked on the fairing with that marked on the stabilizer. Use a special device to fix the control stick in this position.
4. Shift the controller switch from position LOW SPEED to position HIGH SPEED and see whether the controller indicator pointer has moved into the extreme right position and the stabilizer nose has moved down (so that point 55 should displace below point 54). Measure the distance between points 54 and 55 and see that it is D_{drift} = 10 to 19 mm (for balancing).

In case the measurement proves that the stabilizer drift is beyond the tolerated values, readjust the drift again.

Note: It should not be forgotten that the maladjusted stabilizer drift largely affects the aircraft longitudinal balancing.

To increase the stabilizer drift, turn the APY-3B mechanism in a clockwise direction (as viewed from the port side), and to reduce it, turn the mechanism anti-clockwise (Fig. 33).

When adjusting the stabilizer drift, proceed as follows:

(a) shift the controller switch from position HIGH SPEED into position LOW SPEED and see that signal light STABILIZER FOR LANDING goes on and the controller indicator pointer moves into the extreme left-hand position;

(b) reduce the pressure in the hydraulic system to zero to remove the stress in the joints;

(c) disconnect rods 1 and 3 (or 4) (Fig. 32);

(d) measure the tilt of the controller mechanism in the direction of flight or in the rearward direction and see that the tilt value corresponds to the value of misalignment between points 55 and 54;

(e) adjust the length of the rods indicated above and check the engagement of the adjustable rod lugs with the sleeves through the reference holes. If a lug fails to enter the sleeve as far as the reference hole, adjust the required lug length at the expense of other rod lugs which have a greater thread margin;

(f) connect the rods and tighten the rod lug locknuts;

(g) build up the operating pressure in the hydraulic system and check the stabilizer drift following the same procedure as described above.

Note: To check the stabilizer drift, the aircraft control stick must be fixed.

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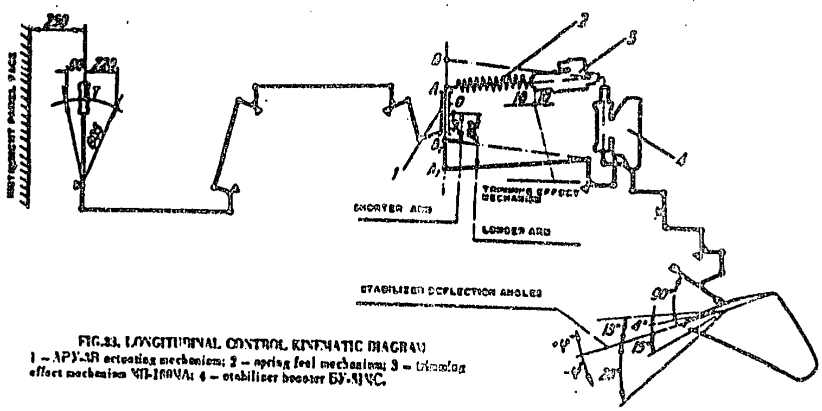

FIG.33. LONGITUDINAL CONTROL KINEMATIC DIAGRAM
1 – APУ-3B actuating mechanism; 2 – spring feel mechanism; 3 – trimming effect mechanism МП-100МА; 4 – stabilizer booster БУ-51МС.

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Adjustment of Trimming Effect Mechanism Neutral Position

Adjust the trimming effect mechanism so as to achieve coincidence of its neutral position with the pre-determined balanced position of the stabilizer governed by the previously established value of the upward deflection of the stabilizer. The value discussed is denoted by D_{mean}.

Prior to the first longitudinal balancing flight, value D_{mean} is set to be equal to 10 ± 2 mm, while the stabilizer nose is turned upwards so that point 55 is located 10 ± 2 mm above point 54.

After the first longitudinal balancing flight, the value D_{mean} is not limited, and can therefore vary depending upon the results obtained in the aircraft balancing flights.

When adjusting the neutral position of the trimming effect mechanism, observe the following priority:

1. Couple to the ground electric power supply.
2. Couple the ground hydraulic pump to the booster hydraulic system and build up the operating pressure.
3. Make sure that the controller switch is in position LOW SPEED.
4. Switch on the left-hand console circuit breaker MAXIMUM AFTERBURNING and turn on the right-hand console switch BATTERY, AIRCRAFT - GROUND. Mind that the above procedure of engagement provides for complete opening of the jet nozzle flaps when starting the engine.
5. Switch on the right-hand console circuit breaker CHECK. LIGHT PANEL; PITCH TRIM WARNING; SPEEDOBAROGRAPH and circuit breaker TRIM. EFFECT MECH.
6. Set the trimming effect mechanism into the neutral position ascertaining this by the glow of signal light TRIM. EFFECT MECH., NEUTRAL (by displacing the button first in the forward direction and then in the rearward direction).
7. Estimate stabilizer deflection value D_{mean} which corresponds to the balancing position.

To do this, proceed as follows:

(a) pull the aircraft control stick completely backward, and then let it return slowly into the neutral position, at a speed of not more than 100 mm per 10 sec. Meanwhile check the stick motion lightly so as to cause the stick to stop of itself due to friction of parts in the system;

(b) measure distance D_1 between stabilizer left half points 54 and 55;

(c) push the aircraft control stick completely forward and then let it return slowly into the neutral position;

(d) measure distance D_2 between the above points;

(e) determine the mean value of the two measurements, and see that it should correspond to $D_{mean} = \frac{D_1 + D_2}{2}$.

While finding the mean value of the two measurements, mind that value D_n has a positive sense if point 55 is settled above point 54, and a negative sense, if point 55 is settled below point 54;

(f) repeat the measurements two times and take the mean value.

In case the estimated value D_{mean} does not lie within 10 ± 2 mm, readjust the control system till the estimated value corresponds to the predetermined one.

While adjusting, mind the following:

In case value D_{mean} determined as specified in Item 7 exceeds 10 ± 2 mm, reduce D_{mean} by displacing the stabilizer nose downward. To do this, remove the

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safety wire from the locknut of the spring feel mechanism and screw off the spring feel rod from the APY-3B stem.

If value D_{mean} estimated as specified in Item 7 is less than 10 ±2 mm, increase D_{mean} by screwing the feel mechanism rod on the APY-3B stem; as a result, the stabilizer nose will move upward.

8. Check value D_{mean} in a manner described in Item 7.

If value D_{mean} does not correspond to the preset value adjusted for the first longitudinal balancing flight, readjust it till the normal value is achieved.

Value D_{mean} adjusted, fix the joint between the feel mechanism rod and APY-3B stem with a locknut, and affix a seal to it. See that the loose thread joint of the stem does not exceed 15 mm (Fig. 32).

After the trimming effect mechanism neutral position adjustment has been accomplished, the aircraft is ready for the first longitudinal balancing flight.

Final Adjustment of Aircraft Longitudinal Control after Balancing Flight

If the pilot has engaged the trimming effect mechanism control button for longitudinal balancing at $V_{long.} = 750 \pm 100$ km/hr, he must not use it after the aircraft is balanced. After landing, value D_{mean} at which the aircraft has been actually balanced should be estimated.

To accomplish the final adjustment of the trimming effect mechanism, proceed as follows:

(a) do not change the position of the trimming effect mechanism set by the pilot during the flight and determine value D_{mean} by a method analogous to that specified in Item 7, Section "Adjustment of Trimming Effect Mechanism Neutral Position";

(b) engage the aircraft control stick button to set the trimming effect mechanism into the neutral position (corresponding to the position set before the balancing flight) which is indicated by the glow of signal light TRIM. EFFECT MECH., NEUTRAL.

See that the signal light starts glowing at the moment the button is pulled rearward and after the trimming effect mechanism has been previously shifted by pushing the button forward.

On engaging the trimming effect mechanism control button, value D_{mean} determined as specified in Item a will be changed;

(c) determine D_{mean} established after the trimming effect mechanism has been moved into the neutral position indicated by the glow of signal light TRIM. EFFECT MECH., NEUTRAL;

(d) compare value D_{mean} evaluated as described in Item c with value D_{mean} determined as specified in Item a.

If value D_{mean} determined as described in Item c is less than that determined according to Item a, increase it to obtain a value equal to D_{mean} established when balancing the aircraft in flight. To do this, screw the spring feel rod on the APY-3B stem so that the stabilizer nose is caused to move upward.

If value D_{mean} determined as described in Item c exceeds that determined according to Item a, reduce the value by turning out the spring feel rod from the APY-3B stem; as a result the stabilizer nose will move downward.

Note: While adjusting, mind that an increase in decrease in value D_{mean} by 1 mm brings about a respective 10-km/hr increase or decrease in the balancing rate;

(c) after adjustment of the spring feel rod length according to Item d, make another check of value D_{mean} to see whether it corresponds to D_{mean} estimated as described in Item a and used to balance the aircraft. Enter the obtained value D_{mean} into the Aircraft Levelling Chart.

In case the aircraft is balanced in flight at a speed of $V_{long.}$ = 750 ±100 km/hr without the use of the trimming effect mechanism, readjust the stabilizer drift as specified in Section "Adjustment of Stabilizer Drift", if the pulling efforts upon the aircraft control stick exceed 4 kg when the aircraft is accelerated to 1000 to 1050 km/hr.

Note: While adjusting, mind that a 1-mm increase in the stabilizer drift causes a 3- to 4-kg decrease in the pulling efforts.

Register the stabilizer drift value thus obtained in the Aircraft Levelling Chart.

CAUTION. When adjusting the longitudinal control, never bend the stabilizer trailing edges since these are not used for adjustment of the longitudinal control.

4. CHECKING AILERON CONTROL

In checking, observe the following priority:

1. Check the aileron control with the booster switched off, for which purpose:

(a) make sure that the right-hand console circuit breaker RAH is switched off;

(b) turn off switch AILERON BOOSTER arranged on the instrument panel left-hand board;

(c) shifting the control stick into the extreme right-hand and left-hand positions, make sure that the stick travel is smooth that the stick is loaded by the spring feel efforts and booster piston friction, and that the control stick and ailerons can completely be shifted into the extreme positions.

2. Check the aileron control with the boosters switched on (for checking, engage the engine or couple to the ground hydraulic pump and the ground electric power supply).

When checking, observe the following priority:

(a) produce the operating pressure in the booster hydraulic system and turn on the right-hand console switch BATTERY, AIRCRAFT - GROUND;

(b) turn on switch AILERON BOOSTER located on the instrument panel left-hand board.

CAUTION. Do not switch on circuit breaker RAH;

(c) shift the control stick into the extreme right-hand and left-hand positions and make sure that the stick travels easily without jamming or jerks and that the efforts produced upon the stick by the spring feel mechanism are present.

If released, the control stick should return into the neutral position. To check the play of the aileron control system, apply force to the aileron trailing edge so as to shift it sharply. Check that, with the boosters switched on, there is no noise produced in the joints of the system.

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[redacted]

Final Adjustment of Lateral Control after Balancing Flight

In case the aircraft could not be balanced during the lateral balancing flight performed with the aileron boosters switched on and off as specified by the procedure described in Section "Checking Aircraft Balancing in Flight", perform the following final operations before the repeated flight:

In case the aircraft could not be balanced while in flight with the aileron boosters switched off:

Make final adjustment of the aircraft lateral control by bending the aileron left tab up or down through a length not more than 4 mm.

To eliminate the left bank when the boosters are switched off, bend the left aileron tab upward, and to eliminate the right bank, bend it down.

The direction and value of bending the tab are governed by the nature and intensity of lateral instability caused during a balancing flight; the lateral control is finally adjusted in subsequent flights.

After the direction and value of bending the tab have been completely determined, make the following inscription on the tab in red paint:

Tab balancing position:
up .... mm
down .... mm

The left aileron trailing edge tab should be adjusted so that its travel corresponds to the value specified in the Aircraft Levelling Chart.

In case the aircraft could not be balanced while in flight with the aileron boosters switched on:

Adjust the aircraft lateral control on the ground after the flight (with autopilot servo unit PAY-107 set into the neutral position) by changing the value and sense of misalignment between the left and right ailerons within a tolerance of $\pm 1^{\circ}$ (the sum misalignment estimated by points 38 and 38a may be within 16 mm).

For coarse adjustment of the misalignment, use the rod stems located in the immediate vicinity of the ailerons, whereas for fine adjustment, use the servo unit rod stem. To avoid rotation of the rod and damage to servo unit PAY-107, keep the rod in place by holding its flats.

After the adjustment, ascertain that the dimension of the aileron misalignment corresponds to the Levelling Diagram and make a checking test of the aircraft balancing in flight.

To remove the left bank of the aircraft while in flight with the boosters switched on, employ the rod stems to displace the left aileron down and the right aileron up through equal angles.

In case rolling occurs when autopilot KAП-2 is switched on:

Make the required adjustment by turning the eye-bolt of the PAY-107 rod.

A 1/2 turn of the eye-bolt brings about an aileron deflection of approx. $\pm 0.25^{\circ}$.

5. MAINTENANCE OF AUTOPILOT KAП-2

Measures of Precaution

1. Prior to switching on the autopilot supply, do not fail to switch on aileron boosters БУ-45А and produce the operating pressure in the hydraulic system.
2. Switch off the autopilot only with the aileron boosters switched on.

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3. Never switch off the autopilot by starboard circuit breaker КАП since the rod of servo unit РАУ-107 may fail to stop in the neutral position which will lead to rolling of the aircraft during flight with the control stick set in the neutral position.

4. Prior to taxiing at parking, always check whether the aileron balanced position corresponds to the neutral position of the control stick shifted laterally, to avoid taking off with the РАУ-107 servo unit rod displaced from the neutral position.

5. When taxiing and taking off, switch the damping duty on, and the stabilization duty, off.

6. Switch off the damping duty after taxiing to the parking place, when the pressure is still present in the hydraulic system; after this switch off circuit breaker КАП.

Switching Autopilot КАП-2 On and Off

(Fig. 34)

To switch autopilot КАП-2 on, proceed as follows:

1. Make sure that the aileron boosters are switched on.

2. Build up the operating pressure in the booster hydraulic system.

3. Switch on the КАП-2 supply by first switching circuit breakers GYRO TRANSM. OF HCH, КАП; CAGING АГИ and ДА-200, GYRO TRANSM. CAGING, НСН, КАП and then, after signal light CAGING GYRO TRANSM. OF HCH, КАП comes off, switch on circuit breaker КАП.

As a result, the gyro transmitter is actuated and the gyroscope of pick-up ДГ-К is started. Readiness of the autopilot for switching on a certain duty is governed by the readiness of the gyro transmitter (not less than 1.5 min. after switching).

To switch on the damping duty, turn on the left-hand console switch ROLL DAMPER.

To switch on the stabilization duty, depress the upper right-hand button arranged on the aircraft control stick and see that the instrument panel signal light AUTOPILOT ON goes on.

To disengage the autopilot, see that the pressure is present in the hydraulic system and proceed as follows:

1. Stop the stabilization by depressing the upper left-hand button (of red colour) arranged on the aircraft control stick and make sure that the instrument panel signal light AUTOPILOT ON comes off.

2. Stop the damping by shifting the left-hand console switch ROLL DAMPER into position NEUTRAL.

3. Switch off right-hand console circuit breaker КАП and then the circuit breakers used to engage the autopilot.

Checking Autopilot for Proper Functioning Mode during Preliminary Preparation

(To be done by the aircraft mechanic together with electrical technician)

When checking the autopilot for proper operation during preliminary preparation of the aircraft, make use of test set КПА-1 and observe the following priority:

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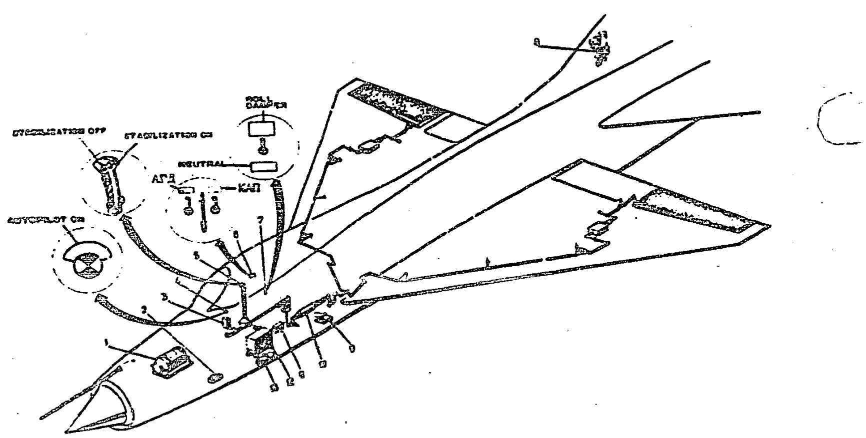

FIG.34. LAYOUT OF KAP-2 AUTOPILOT UNITS IN AIRCRAFT

1 – AP-1 [illegible] gyro; 2 – [illegible] test connector; 3 – photo-sensitive rectifier [illegible]; 4 – signal light AUTOPILOT ON (to indicate switching-on of stabilization [illegible]); 5 – aircraft control stick buttons (stabilization on and off); 6 – KAП and AП-1 circuit breakers; 7 – damping [illegible] switch; 8 – [illegible] radio converter [illegible] installed on [illegible] operating mechanism; 9 – roll [illegible] gyro [illegible]; 10 – servo unit PAS-[illegible]; 11 – interference filter [illegible]; 12 – relay and amplifier unit [illegible]; 13 – relay box [illegible].

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1. Couple to the ground D.C. supply whose voltage is not less than 27 V.

2. Connect the booster hydraulic system to the ground hydraulic pump, build up the operating pressure in the hydraulic system and make sure that the aileron boosters are switched on.

3. Remove the protective cap from the aircraft test connector arranged in the nose wheel well and couple test set ППА-1 to the connector (test set ППА-1 is shown in Fig. 39).

4. Make sure that the autopilot master switch is set in position OFF and that switches TEST - CHECK, "ω" and "γ" are set in the neutral position.

5. Turn on starboard switch BATTERY, AIRCRAFT - GROUND.

6. Switch on the right-hand console circuit breakers GYRO TRANSM. OF КСИ, КАП; CAGING АГД and ДА-200, GYRO TRANSM. CAGING, КСИ, КАП and then circuit breaker КАП.

CAUTION. Never switch on circuit breaker КАП when the pressure in the aileron boosters is zero.

7. Make sure that test set signal lights CORRECT and SUPPLY start burning. Signal light CORRECT will go on in the case of proper alternation of phases of the three-phase current of 36 V, 400 c.p.s. Signal light SUPPLY will go on in the case of proper polarity of the autopilot D.C. supply current.

8. Depress test set button SELF-MONITORING and see that all signal lights of the test set go on and the indicator sector becomes narrower. Release the button.

9. Set switch TEST - CHECK in position TEST and shift the autopilot switch into position ON.

10. To check the autopilot damping section, proceed as follows:

(a) set switch "ω" in position LEFT corresponding to the angular velocity of the aircraft at the left bank. This causes the indicator sector to spread in case the autopilot damping section operates normally (the left aileron is deflected down and the right one moves up). If the operation is not good, the indicator sector becomes narrower (the left aileron moves up and the right one travels down).

Then shift switch "ω" in the neutral position and see that the indicator sector travels into the central position while the ailerons return into the neutral balanced position;

(b) set switch "ω" in position RIGHT which corresponds to the angular velocity of the aircraft at the right bank. If the autopilot damping section operates normally, the indicator sector becomes narrower (the left aileron is deflected up while the right one is turned down).

In the case of wrong operation, the indicator sector spreads (the left aileron moves down and the right one moves up). Set switch "ω" in the neutral position and check if the indicator sector moves into the central position while the ailerons return into the neutral balanced position.

11. To check the stabilizing section of the autopilot, proceed as follows:

(a) set switch "γ" in position LEFT which corresponds to the left bank of the aircraft. If the autopilot stabilizing section operates normally, the indicator sector spreads (the left aileron travels down and the right one moves up).

In the case of wrong operation, the indicator sector becomes narrower (the left aileron moves up and the right one down). After this check the operation of the system designed to return the servo unit rod into the neutral position. To do this, switch off the autopilot by setting the test set switch in position OFF so that the indicator sector moves into the central position (the ailerons return

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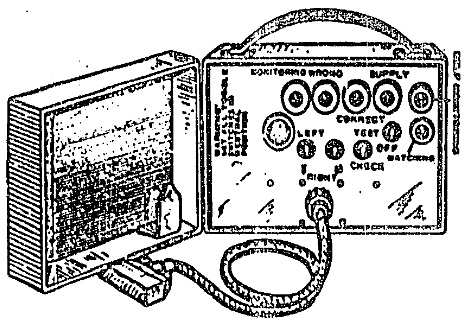

FIG.35. AUTOPILOT OPERATION GROUND TEST PANEL [illegible]-3

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into the neutral balanced position) which in turn corresponds to the neutral position of the PAY-107 servo unit rod. Set switch "Y" in the neutral position and engage the autopilot by setting the test set switch in position ON;

(b) set switch "Y" in position RIGHT which corresponds to the right bank of the aircraft. If the operation of the autopilot stabilizing section is good, the indicator sector will become narrower (the left aileron is deflected up and the right one down).

In the case of wrong operation, the indicator sector spreads (the left aileron is deflected down and the right one moves up). Switch off the autopilot by setting switch "Y" in the OFF position and check if the indicator sector travels into the central position (the ailerons return into the neutral balanced position) which corresponds to the neutral position of the PAY-107 servo unit rod. After this set switch "Y" in the neutral position.

CAUTION. Switches "-" and "Y" may be retained in position RIGHT or LEFT not more than 2 sec.

12. Set switch TEST - CHECK first in the neutral position and then in position CHECK. See if signal light CHECK illuminates to indicate that the contacts of the "ω" signal circuit relay have been closed and that the angular velocity pick-up potentiometer has been fed with the supply voltage.

13. Set switch TEST - CHECK in the neutral position and see that signal light CHECK comes off.

14. Switch off all circuit breakers used for checking and turn off the switch BATTERY, AIRCRAFT - GROUND.

15. Disconnect the test set cable from the aircraft connector, cover the connector with the cap and safety-wire the cap.

Checking Autopilot KAP-2 for Interlocking by Hydraulic System Pressure

The operation of the autopilot D.C. supply interlocking system depends upon the amount of pressure in each hydraulic system and is checked in two stages:

(a) checking the KAP-2 interlocking by the pressure in the booster system;

(b) checking the KAP-2 interlocking by the pressure in the main system.

Checking Autopilot KAP-2 for Interlocking by Booster System Pressure

While checking observe the following priority:

1. Couple to the ground electric power supply.

2. Connect the booster hydraulic system to the ground hydraulic pump.

3. Turn on the right-hand console switch BATTERY, AIRCRAFT - GROUND.

4. Build up the operating pressure in the hydraulic system to obtain 180 to 210 kg/cm^2 and then switch off the ground hydraulic pump.

5. Switch on the right-hand console circuit breaker GYRO TRANSM. OF KCH, KAP, CAGING AFI, circuit breaker ZA-200, GYRO TRANSM. CAGING, KCH, KAP and circuit breaker KAP.

6. Switch on the autopilot by depressing the right-hand upper button arranged on the aircraft control stick and see that the instrument panel signal light AUTOPILOT ON starts burning.

7. Shift the control stick smoothly right and left to reduce the booster hydraulic system pressure to 70 kg/cm^2 and make sure that signal light AUTOPILOT ON comes off as the above-mentioned pressure is obtained.

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8. Switch on the ground hydraulic pump and increase the booster system pressure to 90 kg/cm^2, then depress the upper right-hand button arranged on the control stick and see whether signal light AUTOPILOT ON starts burning as the above-mentioned pressure is produced.

9. Switch off the autopilot by depressing the left-hand upper button (of red colour) arranged on the aircraft control stick.

10. Release the booster hydraulic system pressure and disconnect the ground hydraulic pump.

Checking КАП-2 Interlocking by Main System Pressure

The only difference between the operations performed in checking the main system pressure interlocking and those performed in checking the booster system pressure interlocking lies in the place of coupling the ground hydraulic pump.

Maintenance of Servo Unit РАУ-107

During scheduled maintenance of the aircraft, charge the servo unit oil fitting with special mixture composed of 90 per cent of oil ОКБ-122-5 and 10 per cent of grease ОКБ-122-7. To do this, proceed as follows:

1. Remove servo unit РАУ-107 from the aircraft taking care not to disturb the adjustment of the servo unit rod.

2. Make sure that the servo unit rod is in the neutral position, i.e. check to see that the rod protrusion from the unit housing is within 20.5 ±1 mm.

3. Drive out the screw from the unit oil fitting and then use a grease gun to be found in the ЗПТАА set to charge 0.5 to 1 cm^2 of the above mixture.

4. Drive the screw all the way into the oil fitting and install the servo unit back into the aircraft.

Checking Autopilot КАП-2 for Proper Roll and Angular Velocity Transmission Ratios

(Check is made during scheduled maintenance or on pilot's request)

Inasmuch as servo unit РАУ-107 is installed in the control linkage and used as an extendable rod, it is necessary that the bell-crank with a weight arranged near frame No. 11 should be rigidly fixed in place by means of a special arrangement so as to achieve maximum precision in evaluating the aileron deflection angles (when checking both roll angle and angular velocity transmission ratios) set by servo unit РАУ-107.

When checking the autopilot transmission ratios, couple the aircraft to the ground electric power supply of 27 V, and to the ground hydraulic pump to produce the operating pressure in the booster hydraulic system.

Prior to checking the autopilot transmission ratios, make sure that the servo unit rod is in its neutral position.

Procedure of Checking Autopilot Roll Angle Transmission Ratio

While checking, observe the following priority:

1. Remove the transmitting gyro of artificial horizon АГД-1 from the aircraft, install it on either УШ-56 or УШ-40 turntable and then couple it to the aircraft electric connector by means of an extended connecting cable.

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Install the transmitting gyro on the turntable in a manner it is arranged in the aircraft, i.e., along the axes.

2. Turn on the right-hand console switch BATTERY, AIRCRAFT - GROUND.

3. Switch on circuit breakers GYRO TRANSM. OF КСН, НАП; CAGING АГД, circuit breaker АА-200, GYRO TRANSM. CAGING, КСН, НАП and circuit breaker НАП, all arranged on the right-hand console.

4. Set a protractor on the aileron.

5. Start the autopilot stabilization duty by depressing the right-hand upper button arranged on the control stick; ascertain the starting by the glow of instrument panel signal light AUTOPILOT ON.

6. Set on the turntable a roll angle of 20°, left and right in succession. Each roll angle must correspond to quite a definite value of aileron deflection governed by transmission ratio i_x which under normal conditions is equal to $0.15^{+0.03}_{-0.02}$ degree of aileron deflection per one-degree roll.

<u>Note</u>: In the case of instability of the supply voltages, changes in the ambient temperature from -60 to +50°C and time instability of the phase-sensitive rectifier, the transmission ratio must lie within the tolerated value of i_x = 0.146 ±0.036 degree of aileron deflection per one-degree roll.

The aileron deflection values which correspond to the indicated roll angles at the given transmission ratio are listed in Table 3.

Table 3

Roll-Angle-to-Aileron-Deflection Values

Roll angle	20°
Aileron deflection	2.6 to 3.1°

Set the above-mentioned roll, right and left (in the direction of flight) and check whether the ailerons are displaced in a correct direction by the signals fed by the АГД-1 transmitting gyro. The direction of displacement of the ailerons caused by the АГД-1 transmitting gyro signals are listed in Table 4.

Table 4

Deflection of Ailerons Produced by АГД-1 Transmitting Gyro Signals

Deflection of АГД-1 transmitting gyro	Control surface	
	left aileron	right aileron
Right roll	Up	Down
Left roll	Down	Up

7. In case the aileron deflection does not correspond to the tolerances listed in Table 3 or when the requirements specified below in Items 9 and 10 are not satisfied, reset the roll angle transmission ratio or readjust the actuating drive.

8. In case the aileron deflection does not meet the directions mentioned in Table 4, check whether the АГД-1 transmitting gyro is installed properly on the turntable.

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9. As the АГД-1 transmitting gyro is turned slowly, check the ailerons for smooth travel. When the signal is a constant or zero, make sure that the ailerons do not move.

10. In case the pilot complains of lateral oscillations of the aircraft in flight, check for proper change-over procedure of autopilot servo unit РАУ-107. To do this, stop and start again the stabilization at the transmitting gyro tilt angle of ±20°. Check if the ailerons return to the deflected position after the stabilization is started.

11. Stop the autopilot stabilization duty by the left-hand upper button on the control stick; ascertain the fact by signal light AUTOPILOT ON which must come off.

12. Check if servo unit rod is in the neutral position; for this purpose check if the control stick neutral position corresponds to the aileron balanced position.

13. Switch off all circuit breakers used for checking.

14. Remove the АГД-1 transmitting gyro from the turntable and install it into the aircraft, with the arrow on its housing turned in the direction of flight.

Procedure of Checking Autopilot Angular Velocity Transmission Ratio

In checking proceed as follows:

1. Remove the ДУС-К damping gyroscops from the aircraft and install it on the УПГ-56 or УПГ-48 turntable in a manner it is arranged in the aircraft, i.e. align the axes. Couple the ДУС-К gyroscope to the aircraft electric connector by means of an extended connecting cable.

2. Build up the operating pressure in the booster hydraulic system.

3. Turn on the right-hand console switch BATTERY, AIRCRAFT – GROUND.

4. Switch on the right-hand console circuit breaker GYRO TRANSM. OF КСИ, КАП, CAGING АГД, circuit breaker ДА-200, GYRO TRANSM. CAGING, КСИ, КАП and circuit breaker КАП.

5. Start the damping by turning the left-hand console switch ROLL DAMPER. Do not start the stabilization duty.

6. Observe the position of indicator to see if the АРУ-3В actuating rod is set in the takeoff-landing position and make sure that signal light STABILIZER FOR LANDING illuminates on light panel Т-4.

7. Set an angular velocity of 15 deg/sec., left and right, on the turntable. The given angular velocity must correspond to quite a definite deflection of the ailerons governed by angular velocity transmission ratio μ_x equal to 0.145 ±0.019 degree of aileron deflection per one deg/sec. angular velocity when controller АРУ-3В is set in the takeoff-landing position.

The aileron deflection values which correspond to the above-mentioned angular velocity at the given transmission ratio are listed in Table 9.

Table 9

Aileron Deflection at μ_x = 0.145 ±0.0019

Angular velocity	15 deg/sec.
Aileron deflection	1.95 to 2.4°

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8. Set the APV-3B selector switch in position MANUAL and depress the switch to shift the actuating mechanism rod to the shorter arm which corresponds to the HIGH SPEED mode of flight.

9. Proceed similarly to determine the value of transmission ratio set when the APV-3B rod is shifted to the shorter arm, and check if the value is equal to 0.055 $\pm$0.015 degree of aileron deflection per one deg/sec. angular velocity.

The aileron deflection values which correspond to the above-mentioned angular velocity at the given transmission ratio are listed in Table 6.

Table 6

Aileron Deflection at p_x=0.055 $\pm$0.015

Angular velocity	15 deg/sec.
Aileron deflection	0.6 to 1.05°

10. Depress the switch to shift the controller APV-3B rod into the takeoff-landing position and make sure that signal light STABILIZER FOR LANDING has gone on; then set the selector switch in position AUTOMATIC.

11. In case the aileron deflection effected at the given angular velocity does not lie within the tolerances specified in Tables 5 and 6, reset the autopilot angular velocity transmission ratios.

12. While checking the angular velocity transmission ratios, set the angular velocity on the turntable both in the right- and left-hand directions (with respect to the direction of flight) and check if the ailerons are caused to displace in the proper directions.

The aileron deflection caused by the signals fed by the DYC-K damping gyroscope is listed in Table 7.

Table 7

Aileron Deflection Produced by DYC-K Signals

Angular velocity relative to direction of flight	Control surface	
	left aileron	right aileron
Right	Up	Down
Left	Down	Up

13. In case the aileron deflection does not follow the direction indicated in Table 7, check if the DYC-K damping gyroscope has adequately been installed on the turntable.

14. Stop the damping duty by turning off switch ROLL DAMPER arranged on the left-hand console.

15. Check up the neutral position of the PAY-107 servo unit rod to see whether the control stick neutral position corresponds to the aileron balanced position.

16. Switch off the circuit breakers engaged for checking.

17. Install the DYC-K damping gyroscope back into the aircraft.

After this, inspect the condition and attachment of the autopilot units installed in the aircraft, adequate jointing of connectors to various units and proper grounding to the aircraft of units fitted with grounding wires (such as the AGK-1 transmitting gyro, PYB-1KM, PAY-107, and SH-110).

<u>Note</u>: In carrying out scheduled maintenance of the autopilot and its units, follow the Autopilot Composite Certificate as well as the КАП-2 Brief Technical Description.

6. CHECKING AND ADJUSTMENT OF RUDDER CONTROL

In servicing the aircraft, make regular checks to see whether the rudder can easily be controlled; for this purpose make sure that there is no jamming in the bell-cranks and rods and that the hinge joints are free from play.

Ascertain the absence of play in the hinge joints by the absence of knocking sound produced when the rudder trailing edge is sharply jerked by hand. No knocking in the hinge joints is permissible.

Regularly check the balanced position of the rudder tab and take care to prevent any damage of the tab when covering the fuselage tail portion with canvas or when removing the canvas from the aircraft.

While carrying out scheduled maintenance, examine the foot bar spring grips and check if all nuts and locking pins are present and that the grips do not fail to disengage (since the purpose of the grips is to release the pilot's feet during ejection).

<u>Final Adjustment of Controls after Balancing Flight</u>

If during the aircraft directional balancing flight the ЭА-200 indicator ball has displaced from the centre by a length exceeding the ball diameter, correct the directional unbalancing after the flight by means of bending the rudder tab trailing edge through a length within ± 2 mm. In the case of a turn specified in terms of displacement of the ЭА-200 indicator ball through a length of one diameter, bend the tab to about 0.5 mm.

To eliminate a turning effect caused in flights at a subsonic speed, bend off the lower portion of the tab, and to remove the turning effect caused in flights at a supersonic speed, bend off the upper portion of the tab.

To eliminate the right or left turning effects, bend the tab right or left respectively.

<u>CAUTION</u>: In the course of use of the aircraft, the gas compensator secured to the jet-pipe nozzle must never be bent or cut to remove the directional unbalancing of the aircraft.

7. CHECKING AIR BRAKE CONTROL

To check the control of the air brakes, observe the following priority:

1. Couple to the ground electric power supply.
2. Couple the main hydraulic system to the ground hydraulic pump and build up the operating pressure.
3. Switch on circuit breakers AIR BRAKES, and L.G. SIGNAL, NAVIGATION LIGHTS and turn on switch BATTERY, AIRCRAFT - GROUND.
4. Let down the air brakes by pulling the slide backwards. As the air brakes start to extend, check that the inscription AIR BRAKES EXTENDED goes on at light panel ШС-2.

Extend and retract the air brakes three times and make sure that all three air brakes are let down and up simultaneously and that their mechanisms operate reliably.

CAUTION. Never extend or retract the air brakes when the engine bay lower access doors are open, since this may cause damage to the air brakes.

Instructions on Operations Performed in Air Brake Bays

In order to prevent injuries while working in the air brake bays, closely follow the procedure described below. Prior to starting the work in the side air brake bay, proceed as follows:

1. Make sure that the pressure in the main hydraulic system is zero.
2. Open the cross-feed valve arranged in the L.G. right-hand well by pulling the valve handle backward and fixing it by means of a special safety lock.
3. Let down both side air brakes by hand.

CAUTION. When starting the work in the bays, never extend the side air brakes by the operating pressure of the main hydraulic system.

After the above operations have been completed, start the work in the side air brake bays.

After the work is over, retract the side air brakes manually and then remove the safety lock previously installed on the cross-feed valve handle. As the safety lock is removed, see that the cross-feed valve cuts off as it is caused to move down due to action of the spring.

Prior to starting the work in the ventral air brake bay, relieve the pressure in the main hydraulic system to release the bolt coupling the ventral air brake with the hydraulic cylinder rod, and drive the bolt out. After these operations have been completed, start the ventral air brake bay.

CAUTION. Never shift the disconnected air brake fully down as this may cause damage to the fuselage belly skin as well as to the skin of the air brake.

After the work is over, connect the ventral air brake flap to the hydraulic cylinder rod.

Note: To check the interlocking of the ventral air brake, when the drop tank is attached, proceed as described in Chapter "Fuel System".

8. CHECKING AIRCRAFT BALANCING IN FLIGHT

Listed below are the cases of checking the aircraft balancing:

(a) after assembling the aircraft, if it has been delivered from the plant disassembled;

(b) after replacement or repair of the control elements, such as the stabilizer, aileron, rudder or wing flap;

(c) after replacement of the engine, spring feel mechanism, controller АРУ-3В, trimming effect mechanism МП-100МА, booster БУ-45А or booster БУ-51МС;

(d) in the case of the pilot's complaints of the abnormal behaviour of the aircraft in flight.

It is the duty of the pilot that prior to the balancing flight he should familiarize himself with the Levelling Chart delivered by the Manufacturer together with the Aircraft Service Log, and that he should co-operate with the mechanic to check if the aircraft parameters correspond to the adjustment data listed in the Levelling Chart.

Mind that when switching off the autopilot by using a usual procedure, servo unit РАУ-107 is set in the neutral position to an accuracy of ± 1.5 mm which corresponds to aileron deflection within $\pm 0.55^\circ$ or ± 4 mm relative to points 33 and 38A specified in the Aircraft Levelling Diagram.

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In order to prevent effects of the above deflection on the lateral balancing, it is necessary that prior to the balancing flight servo unit PAY-107 should be set in the neutral position with a higher degree of accuracy which is achieved as follows:

(a) switch on the right-hand console circuit breaker MAII (with the aileron boosters switched on);

(b) turn on the left-hand console switch ROLL DAMPER;

(c) 2 to 3 minutes later, turn off the circuit breaker MAII and then cut off switch ROLL DAMPER.

Such procedure of switching of the autopilot provides for a greater accuracy of setting the servo unit in the neutral position and fixing it in this position by the electromagnetic locking pin.

CAUTION. 1. The above procedure for switching-off the autopilot should be used only on the ground prior to the balancing flight (to prevent the effects of rolling brought into the balancing by setting servo unit PAY-107 in the neutral position at a lower degree of precision).

2. While in flight the autopilot must be switched off in the usual order specified in the Flight Instructions; otherwise the servo unit rod affected by the angular velocity or roll signals may be caused to stop in a position leading to a one-side roll of the aircraft.

During the balancing flight, the pilot will check:

(a) longitudinal balancing;

(b) lateral balancing tested while the aileron boosters are switched on and off;

(c) directional balancing.

CAUTION. Prior to the balancing flight, the combat ammunition and drop tank should be removed from the aircraft, and the autopilot should be switched on by circuit breaker MAII.

Checking Aircraft Longitudinal Balancing

1. After a take-off, while climbing to 3000 m. at the maximum engine rating (with the L.G., wing flaps and air brakes retracted), engage the trimming effect mechanism to balance the aircraft longitudinally at IAS = 750 $\pm$100 km/hr.

2. If the aircraft balancing is normal within the above-mentioned IAS range, check the nature of changing the efforts upon the control stick while accelerating the aircraft to IAS = 1000 to 1050 km/hr at an altitude within 4000 m.; mind that the allowable pulling efforts upon the control stick are 3 to 4 kg (Fig. 36,a).

3. If the aircraft has been balanced in flight at IAS = 750 $\pm$100 km/hr without engaging the trimming effect mechanism, and signal light TRIM. EFFECT MECH., NEUTRAL has gone on at the balancing speed, while at IAS = 1000 to 1050 km/hr the pulling efforts upon the control stick have proved not to exceed 4 kg, the balancing is considered to be accomplished. In this case, no after-flight adjustment of the longitudinal control is required.

4. If the pilot has engaged the trimming effect mechanism for longitudinal balancing of the aircraft at IAS = 750 $\pm$100 km/hr, he must not use it again till the end of the flight after the aircraft has been balanced. After landing, make additional adjustment of the trimming effect mechanism to correspond to the stabilizer balanced position set by the pilot during the flight as specified in Section "Final Adjustment of Aircraft Longitudinal Control after Balancing Flight".

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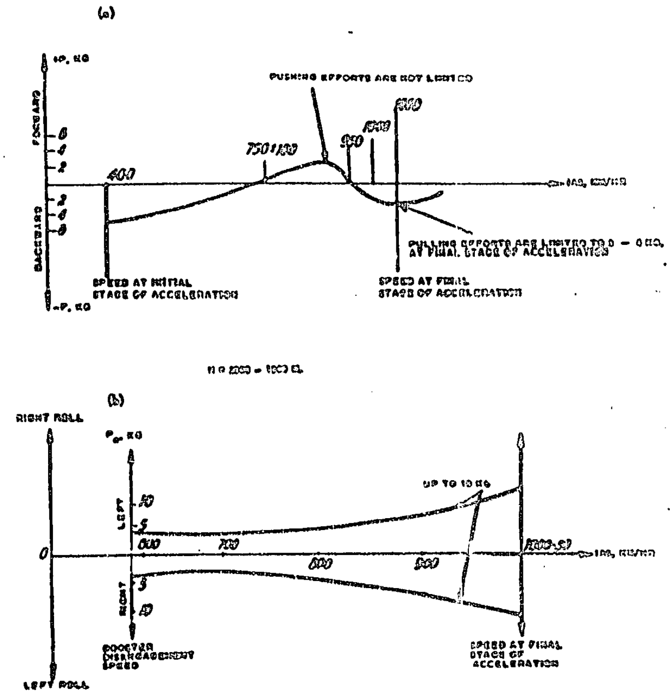

FIG.36. AIRCRAFT LEVELLING CHARTS
(a) aircraft longitudinal levelling chart
(b) aircraft lateral levelling chart.

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5. If the aircraft is normally balanced in flight at IAS = 750 ±100 km/hr, but when the aircraft is accelerated to IAS = 1000 to 1050 km/hr, the pulling efforts upon the control stick considerably exceed a tolerance of 4 kg, stop carrying out the balancing program and land the aircraft. After landing increase the stabilizer drift.

IMPORTANT: 1. The pushing efforts exerted on the control stick during longitudinal balancing are not limited.

2. The procedure of adjusting the stabilizer drift is specified in Section "Adjustment of Stabilizer Control System".

Checking Aircraft Lateral Balancing with Aileron Boosters Switched On

While checking the lateral balancing with the boosters switched on and off, do not switch on the autopilot.

1. When carrying out the lateral balancing, evaluate the aircraft lateral balancing with the aileron boosters switched on at IAS = 1000_{-50} km/hr and at an altitude of up to 4000 m.

2. If, to remove the aircraft rolling, the control stick is to be shifted through a length not more than 1/4 of its complete travel, start the program of lateral balancing of the aircraft with the aileron boosters switched off (a shift of 1/4 of the complete travel of the control stick corresponds to deflection of the ailerons through 2 to 3°).

Note: In case the directional balancing of the aircraft is not normal, the allowable displacement of the slip indicator ball is ±1 dia. If the slip is excessive, remove it by deflecting the rudder.

3. If, to remove the aircraft rolling, the control stick is to be shifted through a length exceeding 1/4 of its complete travel, readjust the aileron discrepancy after landing.

4. During the next flight with the aileron discrepancy eliminated, perform a control check of the lateral balancing with the aileron boosters switched on.

Checking Aircraft Lateral Balancing with Aileron Booster Switched Off

1. As an altitude of 3000 to 4000 m. is reached, and IAS is equal to 600 km/hr, switch off the aileron boosters, accelerate the aircraft by descending from the above altitude to achieve IAS = 1000_{-50} km/hr and when the instruments indicate the altitude of 2000 to 1500 m. and the engine is operated at the maximum rating, check the aircraft lateral balancing. Then retard the aircraft to IAS = 750 km/hr and switch on the aileron boosters.

At the initial stage of the aircraft acceleration, the efforts upon the control stick required to remove the aircraft rolling should be minimum, and as the speed increases the efforts can grow and reverse the sense (Fig. 36,b).

Maximum efforts applied to the control stick to remove rolling when the aircraft accelerates up to IAS = 1000_{-50} km/hr, must not exceed 10 kg.

2. If the efforts on the control stick exceed 10 kg, estimate the following parameters: the indicated air speed, altitude of flight, direction of roll, approximate effort on the stick and stick travel required to remove the rolling. Then retard the aircraft to IAS = 750 km/hr and switch on the aileron boosters.

3. After landing, adjust the tab leading edge of the left aileron and make sure if the aileron and wing flap trailing edges are intact and in the their proper positions.

4. After checking the lateral balancing with the boosters switched on and off, make sure that the aircraft balancing is normal with the autopilot switched on for damping.

Minor rolling and wing dipping caused when autopilot KAП-2 is switched on are removed after landing with the help of the PAY-107 rod eyebolt as is described in Section "Final Adjustment of Lateral Control after Balancing Flight".

5. Minor rolling and banking of the aircraft caused due to switching on the autopilot in flight are permissible and do not require readjustment (since they are caused by setting servo unit PAY-107 in position which is not exactly neutral but lies within a tolerance of ± 1.5 mm along the rod travel).

When the autopilot is switched off during flight, minor rolling of the aircraft may be effected due to specific features in the autopilot design; the rolling of this nature is permissible.

6. In case the aileron tab has been adjusted after a flight, check the aircraft lateral balancing with the boosters switched off when another flight is made.

Checking Aircraft Directional Balancing

1. Check the aircraft directional balancing when the aircraft is accelerated to maximum Mach-number.

When the indicated air speed is over 1000 km/hr and the Mach-number exceeds 0.95, the ЭА-200 indicator ball may displace within ± 1 of its diameter (when the foot bars are released during a straight flight without acceleration). In this case the pilot should be enabled to eliminate a turn by shifting the foot bars without applying too much effort.

2. In the case of directional instability in some mode of flight, the pilot should estimate the following parameters: the indicated air speed or Mach-number, altitude of flight, direction and value of displacement of the ЭА-200 indicator ball when the foot bars are released, and approximate amount of force applied to the foot bars to eliminate the turn. After this, land the aircraft.

3. After landing check if the position of the jet nozzle flaps in the augmented mode is correct, since a wrong position of the flaps with respect to the fuselage contour may lead to the directional unstability of the aircraft. The flaps can be driven to a wrong position as a result of improper adjustment of the rollers used to attach the afterburner, or due to deformation of the jet nozzle flaps, particularly in the region of the drag chute.

4. If the position of the nozzle flaps is correct, adjust the rudder tab to prevent turns at a subsonic speed, or install a gas compensator to prevent turns at a supersonic speed.

Make sure whether the fin lower part between the jet nozzle and lower portion of the rudder is not bent since this may cause the aircraft to turn in the direction of fin bending.

5. After adjusting the directional stability, make a control check of the directional balancing.

On some aircraft the flights with n_y from 1.5 to 2 and M-number from 2 to 2.05 (with the foot bars released), cause the slip indicator ball to displace on its own from the balance position depending on the rate of acceleration with subsequent roll and directional oscillations occurring with a period of about 3 sec.

As the lateral oscillations proceed, a greater effect is produced by the directional oscillations which cause the ball to displace through 2 to 2.5 dia. when the foot bars are released and the rolling oscillations lie within 3°, the foot bars shifting notably. To reduce the lateral oscillations, the foot bars are fixed in the neutral position.

The directional oscillations cease as soon as the engine augmented rating is switched off and the Mach-number is reduced to 1.83. When the augmented rating is stopped at high Mach-number, a turn within ±2 dia. of the ball is allowable; the turn can easily be eliminated by engaging the foot bars and is quickly damped during deceleration.

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Chapter VI

POWER PLANT CONTROL SYSTEM

1. GENERAL

The aircraft is equipped with an engine, type P1102-300, which features a controllable thrust at augmented rating. Operation of the power plant in all conditions of flight and at various engine ratings is controlled by the engine control lever, air intake (adjusted with the help of an extensible cone), anti-surge shutters and additional air intake shutter used during take-off.

The air intake cone displacement is controlled automatically depending on the compressor pressure ratio π_0 and is governed by the linear law $L_{cone} = f(\pi_0)$ corrected by the stabiliser deflection angle.

The engine thrust at the augmented rating, within the range from minimum to full augmentation, is controlled by smoothly changing the jet nozzle exit diameter by means of the flaps, which leads to a change in quantity of fuel supplied to the afterburner. With the engine thrust controlled at augmented rating, the jet nozzle flaps are regulated by an electrohydraulic follow-up system whose control element consists of an electric system which responds to shifting of the engine control lever, and whose actuating element consists of hydraulic actuating cylinders. The flaps control system employed when the engine thrust is controlled at augmented rating is intended to provide continuous and smooth change of the exit diameter depending on the position of the engine control lever.

To facilitate starting of the engine on the ground, the engine is fitted with air bypass valves installed at the outlet of the sixth stage of the compressor. Apart from this, the jet nozzle flaps are made to open completely when the engine is started.

The nozzle flaps are set in the fully open position (the exit is 673_{-10} mm) prior to starting and are retained in this position throughout the starting and after starting as long as the engine is accelerated to 66^{+2}_{-1} per cent speed of the high-pressure rotor. As the above speed is achieved, the flaps reduce the exit to 530 mm keeping the position when the engine control lever is shifted and set in position MAXIMUM.

With the engine control lever set in MINIMUM AFTERBURNING position, the flaps are opened to make an exit of 610 mm due to which the afterburner will be switched on.

As the engine control lever is shifted from position MINIMUM AFTERBURNING towards FULL AFTERBURNING, the flaps are smoothly opened, and as soon as the engine control lever is set in position FULL AFTERBURNING, the flaps open completely to make an exit of 673_{-10} mm.

When the engine control lever is shifted in the opposite direction, i.e. pulled backward, the operation of the flaps is reversed. Now the flaps are moved to change the exit from 530 mm to 673_{-10} mm when the speed is 60^{+1}_{-2} per cent and not 66^{+2}_{-1} per

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cent. The indicated difference in speed at which the flaps are caused to close, when pushing the lever forward, and open, when pulling the lever backward, has been introduced to avoid recurrent opening and closing of the flaps during flights at an engine speed close to 66^{+2}_{-1} per cent speed of the high-pressure rotor.

The engine is fitted with an emergency system intended to control the flaps in case the nozzle flap automatic follow-up control system fails when controlling engine thrust at augmented rating.

To change over to the nozzle flap emergency control system, switch EMERGENCY NOZZLE CONTROL arranged on the right-hand console is turned on.

When switch EMERGENCY NOZZLE CONTROL is turned on, the nozzle flap automatic follow-up control system is disengaged; with the engine running, the flaps are set in the following positions:

(a) as the engine control lever is within the sector between stop CUTOFF and the position corresponding to 66^{+2}_{-1} per cent speed of the high-pressure rotor, the flaps are moved to make an exit of 675_{-10} mm;

(b) as the engine control lever is moved from the position corresponding to 66^{+2}_{-1} per cent speed of the high-pressure rotor, the flaps close to make an exit of 530 mm. This exit is retained until the engine control lever is set in the position close to stop FULL AFTERBURNING which corresponds to 100° of the ПУРТ-10 dial. With the engine control lever in the above position, the full augmented rating is started and the nozzle flaps are caused to open completely to make an exit of 675_{-10} mm. In the case of emergency flaps control (Fig. 37) there will be neither MINIMUM AFTERBURNING nor engine thrust control at augmented rating.

Normal operation of the power plant is ensured by sound functioning of the following systems:

(a) the engine rating control system and the jet nozzle flap control system;

(b) the air intake cone control and anti-surge shutters control system.

Adequate checking, scheduled maintenance and care of the above-mentioned systems guarantee reliable operation of the power plant.

2. CHECKING ENGINE RATING CONTROL SYSTEM

The engine is controlled by the engine control lever through a control unit composed of the fuel regulator pump НР-2102 and ratings control panel ПУРТ-10 which are interconnected via a rod.

As the engine control lever is shifted from one position to another, the control system initiates:

(a) ratings from IDLING to MAXIMUM (achieved by virtue of changing the engine speed);

(b) MINIMUM AFTERBURNING rating;

(c) INTERMEDIATE AFTERBURNING ratings;

(d) FULL AFTERBURNING rating.

The above-mentioned ratings are achieved by virtue of changing the exit diameter and, consequently, changing the amount of fuel delivered to the afterburner by pump НР-2202.

While checking the engine control system, make sure that:

(a) the engine control lever can easily be shifted over the sector;

(b) there is no play in the control system;

(c) the engine control lever can exactly and reliably be fixed against the stops of the sector.

While checking the engine control, proceed as follows

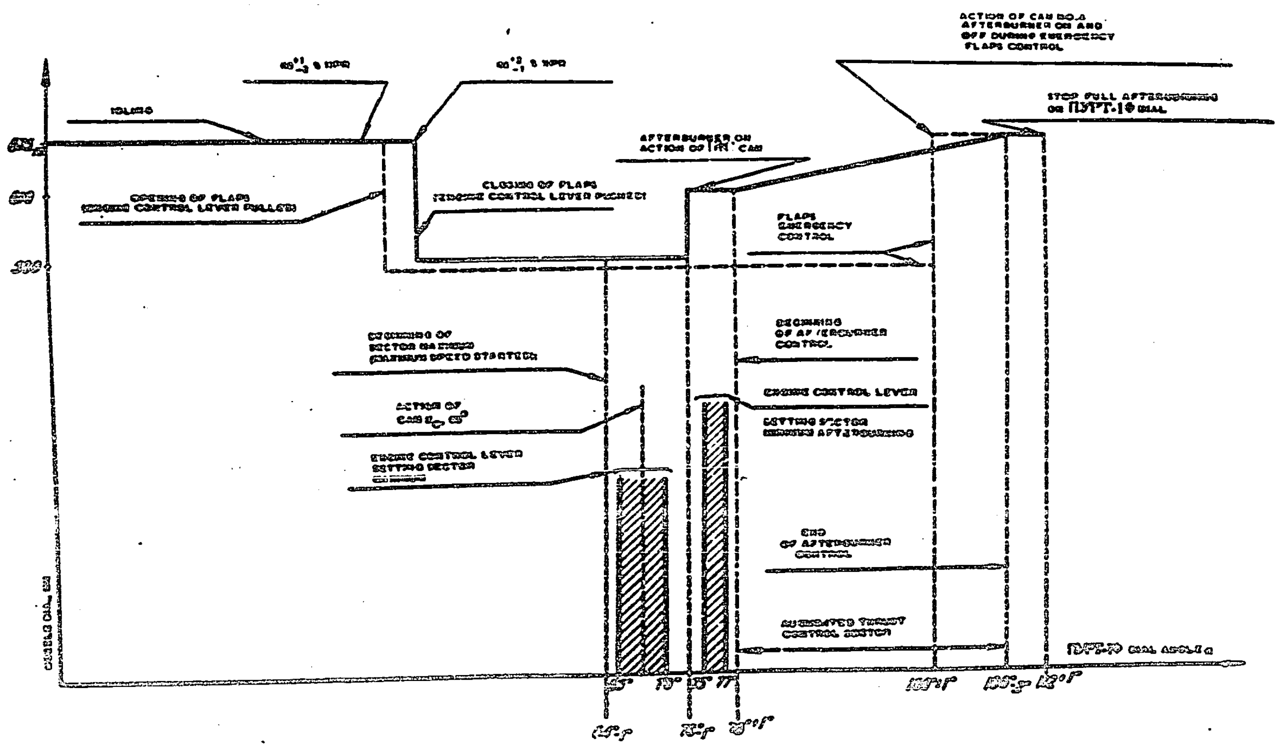

FIG.37. ENGINE RATING CHART

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1. Release the engine control lever completely by turning the clamp knob counter-clockwise.

2. Shift the control lever between stops CUTOFF and FULL AFTERBURNING to check whether the lever travels easily in the two directions and that no jamming occurs. As the lever is shifted, see if the clearances between the movable elements of the system (such as rods and bell-cranks) and the fuselage parts are within 3 to 5 mm (minimum clearance).

3. Fix the HP-2102 pump lever by hand and then easily shift the engine control lever to check that there is no play in the control system.

Check whether the engine control lever is properly fixed against all stops of the sector as is specified by the engine rating adjustment data.

To check setting of the stops on the sector for correspondence to the engine ratings, proceed from the reference mark lines notched on the HP-2102 pump body when the engine control lever is set against stop IDLING, but when the control lever is set against stops MAXIMUM and MINIMUM AFTERBURNING, proceed from the degree marks graduated on the ПУРТ-10 ratings control panel dial.

In checking, observe the following sequence:

1. On shifting the engine control lever towards CUTOFF, make sure whether the HP-2102 pump lever has settled against its stop, the engine control lever being some 1 to 2 mm off sector stop CUTOFF. Pull the engine control lever to set it against stop CUTOFF and see that the sector button fixes the engine control lever in position CUTOFF. Make sure that the sector button checks the motion of the engine control lever if the latter is pushed forward and that the HP-2102 pump lever does not move off its stop. Check if the button tooth locks and unlocks the engine control lever pin easily when the sector button is depressed and released, respectively.

2. Depress the sector bracket button and shift the engine control lever into position IDLING.

Release the button and make sure that the travel of the engine control lever is checked by the button stop when the lever is pulled backward and that the lever moves easily when it is pushed forward.

As the engine control lever is set in position IDLING, check that the HP-2102 pump lever is set between the first and third mark lines. Check if the HP-2102 pump lever moves properly into position IDLING when the engine control lever is sharply changed from the maximum rating position, and see that the HP-2102 regulator pump lever stops closer to the first mark line and is shifted 1 to 1.5 mm toward the third line on the HP-2102 pump dial.

3. Shift the engine control lever into position MAXIMUM.

Check that as the engine control lever is pushed forward, its motion is arrested by the button arranged on the lever, the button resting against stop MAXIMUM. When the engine control lever is abruptly set at stop MAXIMUM from the idling rating, check whether the lever on ПУРТ-10 is set at 65 to 70° of the dial.

4. Depress the button on the engine control lever, shift the lever into position MINIMUM AFTERBURNING and then release the button. Make sure that the engine control lever is arrested by the button when the lever is pulled backward the button resting against stop MINIMUM AFTERBURNING. As the engine control lever is abruptly set against stop MINIMUM AFTERBURNING, check if the lever on ПУРТ-10 is set at 75° to 77° of the dial. Pushing the engine control lever from stop MINIMUM AFTERBURNING forward, make sure that the lever travels freely. To release the engine control lever from stop MINIMUM AFTERBURNING, depress the lever button and pull the lever backward.

Note: The angles as measured by ПУРТ-10 may vary with the models of engines; therefore when checking and adjusting the engine control system, follow the Engine Operating Instructions.

5. Shift the lever from position MINIMUM AFTERBURNING towards stop FULL AFTERBURNING until the ПУРТ-10 lever settles against its stop, and make sure that a clearance of 1 to 2 mm is present between the engine control lever and the stop installed on the sector. Pull the engine control lever to set it against stop FULL AFTERBURNING; as a result the lever button tooth will lower and fix the engine control lever against stop FULL AFTERBURNING.

After the engine control lever has been fixed, try to push it forward and pull it backward, and check that the ПУРТ-10 lever does not displace from its stop. To release the engine control lever from stop FULL AFTERBURNING, depress the lever button and pull the lever backward. Make sure that as the button is depressed and released, its tooth easily engages and disengages the shoulder of stop FULL AFTERBURNING.

When the engine control lever is operated within the range of thrust control at augmented rating, i.e. between stops MINIMUM AFTERBURNING and FULL AFTERBURNING, the lever button should be released.

3. CHECKING NOZZLE FLAPS OPERATION WITH ENGINE CUT OFF

When the engine is cut off, artificial methods used to imitate the operation of unit БУ-4Б are not employed; therefore the checking of the nozzle flaps operation is not complete and involves only testing of the flaps follow-up control system during engine thrust control at augmented rating.

For setting the flaps to make an exit of 530 mm which corresponds to MAXIMUM rating, the circuit breaker AFTERBURNING, MAXIMUM, is employed to take check measurements of the exit or to adjust the exit when necessary.

In order to check the change-over of the flaps from one exit to another at 65^{+2}_{-1} or 60^{+1}_{-2} per cent speed of the high - pressure rotor, the engine is to be started.

While checking the operation of the nozzle flaps, proceed as follows:

1. Make sure that all circuit breakers and switches arranged in the cockpit are turned off.

2. Set the processing switch arranged inside the processing box in position PROCESSING.

3. Eliminate electrical interlocking of limit switches HYDRAULIC DEBOOSTER and R.P.M. AFTERBURNER INTERLOCKING installed inside box КАО-13Л by turning screw Я into position ELIMINATED.

4. Couple the ground electric power supply to the aircraft.

5. Couple the main hydraulic system pipe connections to the ground hydraulic pump and build up the operating pressure in the system to obtain 180 to 215_{-12} kg/cm².

6. Switch on circuit breaker AFTERBURNING MAXIMUM, and then turn off switch BATTERY, AIRCRAFT - GROUND.

7. While the engine control lever is shifted over the sector from stop CUTOFF to stop MAXIMUM the nozzle flaps make a maximum exit of 675_{-10} mm which corresponds to the full augmented rating.

8. Set the engine control lever in position CUTOFF, switch off circuit breaker AFTERBURNING MAXIMUM and make sure that the nozzle flaps are changed over from the fully opened exit to an exit of 530 mm

9. Shift the engine control lever from stop CUTOFF to stop MAXIMUM. Within the above range of the engine control lever travel the nozzle flaps maintain an exit of 530 mm.

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10. With the engine control lever set in position MAXIMUM, turn on circuit breaker AFTERBURNING, MAXIMUM and make sure that the flaps make a full exit of 675_{-10} mm.

11. Set the engine control lever against stop MINIMUM AFTERBURNING; this causes the flaps to close to 610 mm, and lamp AFTERBURNING to go on at the light panel.

12. As the engine control lever is shifted from stop MINIMUM AFTERBURNING, the nozzle flaps are caused to open smoothly, and as the lever is [illegible]t against stop FULL AFTERBURNING, the flaps open completely to make an exit of [illegible]$_{-10}$ mm.

13. Shift the engine control lever from stop FULL AFTER[illegible] towards stop MINIMUM AFTERBURNING. While the lever is being shifted, the [illegible] flaps are closed smoothly. As the engine control lever is stopped within the [illegible] between the above positions, the flaps stop moving for closure as well. When the engine control lever is set against stop MINIMUM AFTERBURNING, the flaps make an exit of 610 mm.

14. Shift the lever to stop MAXIMUM; this causes the nozzle flaps to open completely so that the exit becomes equal to $67[illegible]_{-10}$ mm. So that the light panel lamp AFTERBURNING comes off.

Turning of the engine control lever to CUTOFF does not bring about a change in the position of the flaps which remain completely open.

Leave the engine control lever in position CUTOFF.

15. After checking the operation of the flaps as is described in the given Section, turn off switch BATTERY AIRCRAFT - GROUND, switch off circuit breaker AFTERBURNING, MAXIMUM, change over the processing switch into position OPERATION, turn screw H arranged on box KAG-13A into the initial position, disconnect the ground electric power supply and the ground hydraulic pump.

CAUTION. 1. Never forget that to leave the nozzle flaps open after checking their operation and each time after stopping the engine, circuit breaker AFTERBURNING, MAXIMUM be switched off only when switch BATTERY, AIRCRAFT - GROUND has already been turned off.

2. Listed above in the given Section are the rated nozzle flap exit diameters. Whenever checking the flaps operation, refer to the Aircraft Engine Log for the diameter values.

4. CHECKING NOZZLE FLAP EMERGENCY CONTROL SYSTEM WITH ENGINE IN OPERATION

No checking of the nozzle flap emergency control system can be made when the engine is cut off. In this case the flaps will stay in a completely open position when switch NOZZLE EMERGENCY CONTROL is turned on and the engine control lever is shifted over the sector. Therefore, the nozzle flap emergency control system must be checked with the engine switched on for testing its augmented rating.

When checking the flap emergency control system, observe the following priority:

1. After testing the engine augmented rating, and prior to cutting off the afterburner, run the engine at full augmented rating and turn on switch NOZZLE EMERGENCY CONTROL. The engine will keep running at the full augmentation rating.

2. Release the engine control lever from stop full AFTERBURNING and pull it backward. As soon as the lever is displaced from the full augmentation range and comes into a position which corresponds to 100° of the ПУРТ-10 dial, the augmentation is caused to cease, the nozzle flaps close so that the exit becomes 530 mm, and the light panel lamp AFTERBURNING comes off.

3. Gently shift the engine control lever to stop IDLING. As the lever is shifted at the engine speed equal to 60^{+1}_{-2} per cent speed of the high-pressure rotor, the nozzle flaps previously set to make an exit of 530 mm are caused to open completely so that the exit becomes equal to 675_{-10} mm.

4. Shift the engine control lever to position MAXIMUM and start the augmentation by moving the lever forward. As the lever comes against stop MINIMUM AFTERBURNING, the augmentation would not be initiated. As the engine control lever is displaced further on, the full augmented rating is started before the lever reaches stop FULL AFTERBURNING which occurs at the moment when the lever is set in a position corresponding to the position of the ПУРТ-10 lever set at 100° of the dial. In this case the nozzle flaps are caused to open completely and the light panel lamp AFTERBURNING lights up. After this, set the engine control lever against stop FULL AFTERBURNING.

5. Turn off switch NOZZLE EMERGENCY CONTROL.

Stop the augmentation by setting the engine control lever against stop MAXIMUM, cut off the engine and stop testing the engine.

Note: The nozzle flap exit diameters mentioned in this Section are given for general experience only, since when the engine runs the actual variation of the flap exit diameter can be observed at a safe distance only and estimated by noting the indications of the main hydraulic system pressure gauge pointer.

5. AIR INTAKE CONE CONTROL

System УВД-2М is designed for automatic control of the air intake cone position governed by the engine operating rating and for ensuring maximum effective thrust of the engine and its stable operation in all modes of flight.

The air intake cone automatic control system is switched on during L.G. retraction; the system operation depends upon the compressor pressure ratio and is governed by the linear law

$$L_{cone} = f(\pi_c),$$

where $\pi_c = \frac{P_2}{P_1}$ is the compressor pressure ratio defined as the ratio between the absolute static pressure P_2 at the compressor outlet and the absolute static pressure P_1 at the compressor inlet; L_{cone} is the cone displacement value.

The maximum value of $\pi_c = 11.15$ represents the cone retracted position, and the minimum value of $\pi_c = 4.15$ represents the fully extended position of the cone equal to 200 mm.

When the cone is controlled automatically, its displacement proceeds in proportion to variation of π_c within the range from 4.15 to 11; in this case the cone is not retracted completely. During L.G. extension at $\pi_c = 11$ to 11.15 the cone is caused to retract in a leap completely. During L.G. retraction at $\pi_c = 11$ to 11.15 the cone is caused to extend in a leap to a length of 4.5 mm and then to come out linearly in proportion to decrease of π_c.

In order to achieve stable operation of the engine at various angles of attack, the correction for the aircraft angle of attack has been introduced into the cone automatic control system.

A change in the aircraft angle of attack is effected by the respective deflection of the stabilizer. Therefore, the control stick-to-stabilizer gearing includes pick-up ДСУ-2 of special design intended to feed an auxiliary signal to extend or retract the cone irrespective of the present value of π_c.

Thus, a shift in the cone displacement program required for the given angle of attack is effected, due to which normal operation of the engine is ensured.

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A typical chart representing the cone displacement program shift introduced in the aircraft equipped with an engine of modification 2 is shown in Fig. 38.

6. DIAGRAM AND PRINCIPLE OF OPERATION OF CONE CONROL SYSTEM УВА-2М

Complete system УВК-2М comprises the following main units (Fig. 39):

1. Transducer ИДО-$Д_1$ used to measure the pressure at the compressor inlet.
2. Transducer ИДО-$Д_2$ used to measure the pressure at the compressor outlet.
3. Output signal unit ИДО-БВС.
4. Amplification and commutation unit БУК-2А.
5. Feedback pick-up ДК-3 with drive П-1.
6. Cone position indicator УПВС-3.

Apart from this, the system comprises control unit АУ-35-1, hydroelectric ГА-184У, filter, hydrolock, check valve, actuating cylinder and pick-up ДСУ-2.

The sensitive elements used in the system are represented by the induction transducers ИДО-$Д_1$ and ИДО-$Д_2$ which pick up the pressures at the compressor inlet and outlet, respectively, and convert them into voltage.

The voltages fed by the transducers are compared and amplified by unit ИДО-БВС and then, shaped as signals proportional to ratio $\frac{P_2}{P_1}$, are supplied to unit БУК-2А. The signals amplified in unit БУК-2А are fed to unit АУ-35-1 which converts them into the hydraulic signals supplied to control the unit distributing slide valve.

As the distributing slide valve is displaced, it connects one of the hydraulic cylinder cavities to the pressure line and couples the other to the return line so that the cone is caused to extend or retract. As the hydraulic cylinder rod is displaced, the feedback and indication potentiometer wipers connected to the rod are being shifted as well. As a result, the feedback potentiometer feeds unit БУК-2А with a follow-up signal which reduces the misalignment between the present position of the cone and the position to which the cone is to be displaced by virtue of the control signal applied. As the signals are balanced, the control signal is removed and the cone is caused to stop.

The cone position indication is ensured by indicator УПЗС-3 fed with signals supplied by the indication potentiometer. The indicator is installed on the upper board of the instrument panel. It has a dial graduated from 0 to 100 per cent, the division value being 5 per cent.

The zero position of the indicator pointer corresponds to the retracted position of the cone, and the 100 per cent position corresponds to the extended position of the cone. Displacement of the cone through 3 to 6 mm from the retracted position is indicated by the glow of lamp CONE EXTENDED installed on the instrument panel on light panel Т-4У2.

In case the cone automatic control system fails, the cone can be controlled manually by means of a setter installed in the УПЗС-3 indicator body and operated by a knob. When the cone is controlled manually, the system of cone additional extension correction in response to stabilizer deflection is out of operation.

If no feed voltage is supplied to hydraulic valve ГА-184У or in case of a pressure drop in the hydraulic system, the control system stops the cone in place by means of the check valve and hydrolock and keeps it in the position which it occupied at the instant of voltage interruption or pressure drop.

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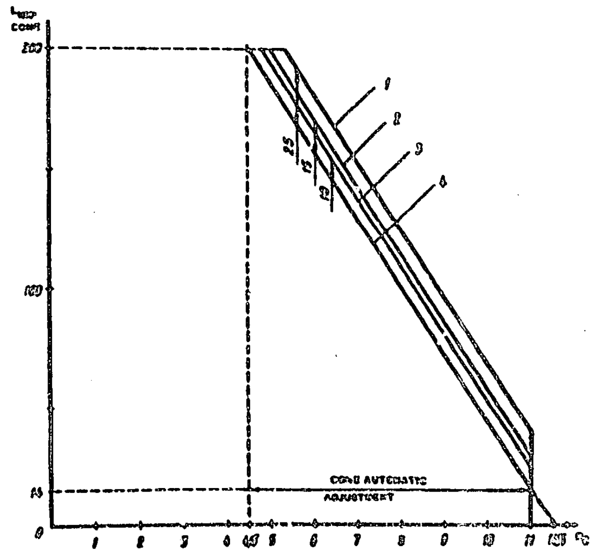

FIG.38. CONE TRAVEL CHART

1 – shift in program of cone adjustment due to electric signals fed from microswitches Nos 1 and 2 of pick-up ДСУ-2; 2 – shift in program of cone adjustment due to electric signal fed from microswitch No.2 of pick-up ДСУ-2; 3 – shift in program of cone adjustment due to electric signal fed from microswitch No.1; 4 – cone position adjustment program governed by value σ_{c}.

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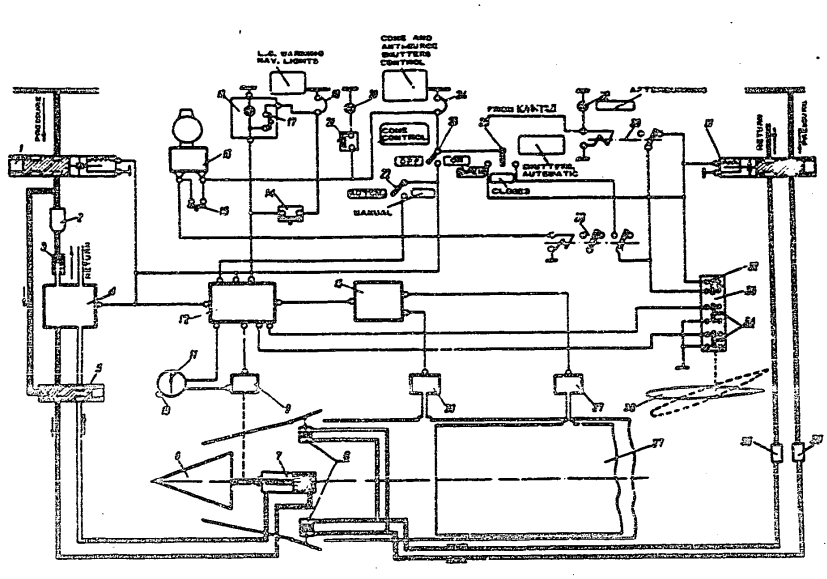

FIG.39. CONE AND ANTI-SURGE SHUTTER AUTOMATIC CONTROL BLOCK DIAGRAM

1 – cone valve ГА-184У; 2 – filter; 3 – check valve; 4 – control unit АУ-35-1; 5 – hydrolock; 6 – cone; 7 – cone cylinder; 8 – anti-surge shutter cylinders; 9 – feedback and indication pick-up ДК-3 with drive П-1; 10 – cone manual control knob; 11 – cone position indicator УПЗС-3; 12 – amplification and commutation unit БУК-2А; 13 – output signal unit П.20-5ВС; 14 – L.G. right-hand strut retracted position indication limit switch; 15 – relay action initiation button КР-1.35; 16 – pick-up КР-1.35; 17 – button LAMP CHECKING; 18 – L.G. indication panel ППС-2К; 19 – circuit breaker L.G. WARNING, NAV. LIGHTS; 20 – signal light CONE EXTENDED in light panel Т-4; 21 – cone position indication limit switch; 22 – cone selector switch; 23 – cone switch; 24 – circuit breaker CONE CONTROL, FLAPS; 25 – switch FLAPS; 26 – compressor inlet pressure P_1 transducer [illegible]; 27 – compressor outlet pressure P_2 transducer [illegible]; 28 – Mach-number flap system interlocking relay; 29 – signal light AFTERBURNING; 30 – augmented rating flap system interlocking relay; 31 – flap control valve ГА-184У; 32 – flap control microswitch; 33 – pick-up ДСУ-2; 34 – cone control microswitch; 35 – two-way throttle; 36 – throttle; 37 – engine; 38 – stabilizer.

7. GROUND CHECKS OF CONE AND AIR INTAKE ANTI-SURGE SHUTTER CONTROL SYSTEM УВД-2М

The ground checks of system УВД-2М are classified as follows:

1. Pre-flight checks of the system for proper operation.

2. Checking of the system operation performed every 10 flying hours, or after replacement of the engine. The check is made when testing the engine.

3. Checking of the system operation made with the help of a test panel when carrying out 50-hour scheduled maintenance or after replacement of the engine.

Note: When the flight personnel complain of the engine operation (stall, insufficient thrust, failure in gaining the calculated altitude, jitter), check the system program regardless of the schedule.

8. PRE-FLIGHT CHECK OF CONE AND AIR INTAKE ANTI-SURGE SHUTTER CONTROL SYSTEM УВД-2М

(The check is made when the engine is tested)

1. To prepare cone and anti-surge shutter control system УВД-2М for operation, proceed as follows:

(a) make sure that circuit breakers CONE AND SHUTTER CONTROL and L.G. WARNING, NAVIG. LIGHTS arranged on the rear right-hand electric board are switched on;

(b) set the left-hand console switch CONE CONTROL in position ON and turn the cone selector switch into position AUTOMATIC;

(c) set the left-hand console switch SHUTTERS in position AUTOMATIC.

2. To check the УВД-2М cone control system operation, proceed as follows:

(a) run the engine at 85 per cent speed of the low-pressure rotor;

(b) depress button LAMP CHECKING installed on panel ППС-2К to imitate interlocking of system УВД-2М with the L.G. retracted, and check that the УПЗС-3 cone position indicator pointer travels to the right in a clockwise direction and that lamp CONE EXTENDED lights up on light panel Т-4У2.

Keeping the ППС-2К button depressed, set the engine control lever against stop IDLING; make sure that the cone is extended completely and that the УПЗС-3 indicator pointer moves to the right to stop at division 10;

(c) as the engine is run at the idling rating check the cone manual control system by shifting the cone selector switch from position AUTOMATIC to position MANUAL. Turning the manual control knob smoothly right and left to extend and retract the cone, note the deflection of the УПЗС-3 indicator pointer to check the extension of the cone. In checking, make sure that the difference in deviation of the wide and narrow pointers, while the cone is moved forward and backward, does not exceed 2 per cent, and that the total difference in deviation of the pointers does not exceed ±5 per cent of the scale reading and ±3 per cent of the scale extreme readings. Set the cone selector switch in position AUTOMATIC and turn switch CONE CONTROL to position OFF.

3. Run the engine at the idling rating and check the operation of the anti-surge shutter control system. To do this, depress button IMITATING MP-1.33 OPERATION installed on the right-hand console, and make sure that the shutters have opened. Then check if the shutters close as the button is released.

Note: Checking of the shutter operation in response to the augmentation cut-off and stabilizer deflection must be accomplished with the engine stopped in the course of the 50-hour scheduled maintenance.

9. CHECKING SYSTEM УВА-2М WHEN TESTING ENGINE AFTER 10 FLYING HOURS OR AFTER REPLACEMENT OF ENGINE

Prior to starting the check, measure and register the ambient temperature in °C.

After testing the engine, check operation of the air intake cone automatic control system taking into account the ambient temperature and stabiliser deflection angles while the engine is running. To do this, proceed as follows:

1. Switch on the right-hand console circuit breakers CONE AND SHUTTER CONTROL and L.G. WARNING, NAVIG. LIGHTS.
2. Set switch CONE CONTROL in position ON 2 to 3 min. before starting the check.
3. Set the cone selector switch in position AUTOMATIC.
4. Set the shutters change-over switch in position AUTOMATIC.
5. Run the engine at 85 per cent speed of the low-pressure rotor.
6. Shift the control stick completely forward to set the stabiliser nose in the extreme upper position.
7. Depress the lamp control button installed on panel ППС-2М and keep it depressed for the whole period of checking of the cone automatic system.
8. After the control stick is set in the foremost position and the ППС-2М panel lamp control button is depressed, determine the extension of the cone by indicator УПЗС-3. Register the measured value of cone extension L_{cone} in terms of per cent.
9. Check the additional displacement of the cone when changing the stabiliser deflection angles. To do this, start pulling the control stick from the extreme forward position; the instant the cone begins retraction, hold the stick in place and read the indicator to make sure that the cone has retracted by 5 per cent.
10. Continue to pull the control stick backward till the instant of another retraction of the cone, and check that the cone has retracted additionally through 7.5 per cent. Stop shifting the stick.
11. As the control stick is pulled further on backward, see that the cone starts extending.

The instant the cone starts extending, hold the stick and see that the cone has extended by 5 per cent, and shifting the stick further on, make sure that the cone has extended additionally through 7.5 per cent. As the stick is shifted into the extreme forward position, see that the cone displaces until it moves into the initial position specified in Item 8. Set the stick in the neutral position and turn switch CONE CONTROL into position OFF. Stop the engine.

<u>Note</u>: Additional extension of the cone caused by changes of the stabiliser deflection angles proceeds at a high rate, i.e. within 1 to 1.5 sec., whereas additional retraction proceeds slowly, i.e. within 10 to 15 sec.

12. Using the obtained measurement data of cone extension and ambient temperature and consulting the chart enclosed (Fig. 40), determine the cone extension value referred to temperature by the equation:

$$L_{referred}, \text{ per cent} = L_{measured\ by\ УПЗС-3}, \text{ per cent} - \Delta L_{t\ cone}, \text{ per cent},$$

where $\Delta L_{t\ cone}$, per cent is the ambient temperature correction for the cone extension which has a positive or negative sense as determined by the chart.

13. Compare the referred value of cone extension thus obtained ($L_{referred}$, per cent) with the respective value given in the Appendix to the Aircraft Log at the Manufacturing plant. See that the difference in values does not exceed ±3 per cent.

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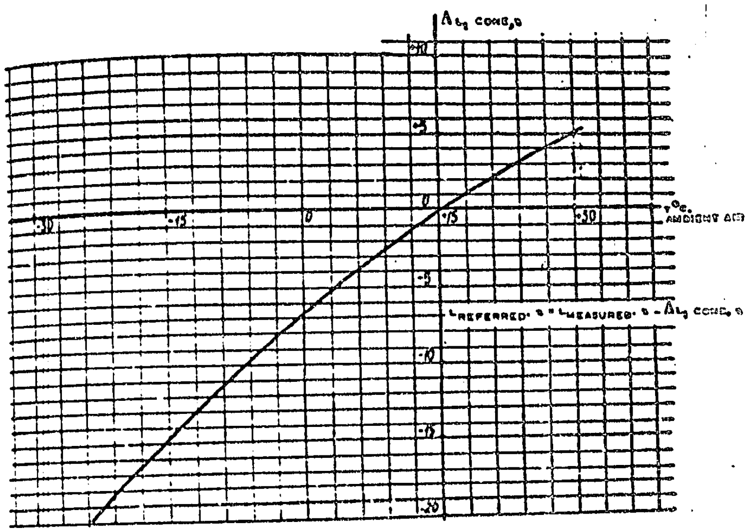

FIG.40. CHART FOR DETERMINATION OF CONE EXTENSION CORRECTIONS FOR AMBIENT TEMPERATURE

[redacted]

Notes: 1. The cone extension indicated in the Appendix to the Aircraft Log has been referred to the temperature of +15°C and measured with the engine running on the aircraft.

2. When replacing the engine with another one whose n_e characteristics are different, cone extension value $L_{referred}$, per cent becomes different accordingly. When adjusting the engine after replacement, determine $L_{referred}$, per cent as specified above in the given Section, register the estimated value in the Appendix to the Aircraft Log so that the new value $L_{referred}$, per cent may be used as the basic value for subsequent checking of the system.

10. CHECKING SYSTEM YBA-2M MADE EVERY 30±5 FLYING HOURS OR AFTER REPLACEMENT OF ENGINE

In the course of scheduled maintenance, check the pre-set program of adjustment specified in the Appendix to the Aircraft Log. To prepare for checking, proceed as follows:

1. Couple to the ground D.C. supply.
2. Couple to the ground hydraulic pump and produce the pressure in the main hydraulic system.
3. To measure the cone extension, install a special arrangement at the air intake duct inlet.
4. Connect transducer ИДО-Д$_2$ to a special panel used for checking system УВД-2М.

Checking Cone Manual Control System

To check the cone control system of the aircraft, start with checking the manual drive of the system and observe the following procedure:

1. Turn on the right-hand console switch BATTERY, AIRCRAFT – GROUND, circuit breakers CONE AND SHUTTER CONTROL and L.G. WARNING, NAVIG. LIGHTS; besides, turn on the left-hand console switch CONE CONTROL and set the cone selector switch in position MANUAL.

2. Check and, if necessary, set the УПЗС-3 cone position indicator wide pointer at zero by turning the knob.

3. Produce an operating pressure of 180 to 215_{-12} kg/cm^2 in the system. If the cone has previously been extended, see that it retracts completely and that the indicator narrow pointer rides to 0 (the tolerance is ±3 per cent).

4. Turning the УПЗС-3 indicator knob to extend or retract the cone, note the positions of the two indicator pointers.

As the knob is turned slowly and evenly, and when it is stopped, the permissible misalignment between the wide and narrow pointers should not exceed ±3 per cent of the scale, with an exception of the extreme divisions of 0 and 10 where the misalignment should not exceed ±3 per cent.

5. The value of misalignment between the pointers during cone retraction (or extension) should not differ from the value of misalignment during its extension (or retraction) by more than 2 per cent, when the wide pointer is stopped at the same reference points of the scale (0, 2, 4, 6, 8 and 10). Make sure that the misalignment of the pointers does not exceed the maximum tolerances listed in Item 4.

The misalignment value in excess of 2 per cent as measured during cone extension and retraction is indicative of faulty operation of unit АУ-35-1, the amplifier of unit БУК-2А or of indicator УПЗС-3. In this case, check the automatic operation of the system by means of th[e te]st panel. In case the automatic system parameters lie within the tolerances of the parameters being checked, replace indicator УПЗС-3; if the parameters are out of tolerances, replace unit АУ-35-1 or some other unit of complete system УВД-2М (See Possible Troubles of System УВД-2М, Their Causes and Remedies).

6. If the checking specified in Items 4 and 5 proves that the system is good, continue checking as described below.

As the wide pointer is set at figure 0, check that the cone is retracted completely and as it is at figure 10, make sure that the cone is extended completely and that the narrow pointer is also set at the same scale divisions, the tolerated misalignment being ±3 per cent.

When the cone is extended through 3 to 6 mm from the fully retracted position, check that lamp CONE EXTENDED lights up on panel Т-4Я2.

Abrupt turning of the knob should not induce self-oscillations of the cone, the cone occupying a stable position. One jump of not more than 10 mm per the complete travel of the cone is permissible which corresponds to 5 per cent of the indicator scale.

7. Turn the knob to set the indicator wide pointer at division 10 and shift switch AUTOMATIC - MANUAL into position AUTOMATIC. Make sure that the cone is retracted completely and that the indicator narrow pointer travels to 0 (the tolerance being ±3 per cent). Set switch CONE CONTROL in position OFF. Turn the knob to set the indicator wide pointer at 0. After this, the manual control check is over.

Checking Cone Control System Automatic Operation

Prior to checking the automatic operation of the system, draw a record, Form No. 1 (See Table 8).

The purpose of checking is to determine whether the cone adjustment program is followed correctly, i.e., to check the dependence of cone displacement L_{cone} upon the pressure ratio $\pi_0 = \frac{P_2}{P_1}$.

The cone adjustment program should be checked at values π_0 specified in Form No. 1 (Table 8).

In drawing Form No. 1, the values of pressure $P_{2\ excess}$ introduced into transducer ДДО-Д$_2$ for the indicated values π_0 should be taken from Table 9. Mind that the atmospheric pressure of the day is expressed in mm Hg. Proceeding from this pressure, select the proper Column in Table 9 which contains the pressure closest to the pressure of the day.

Example. The pressure of the day is $P_{ambient}$ = 742.8 mm Hg. Select the pressure $P_{2\ excess}$ in Table 9 from the Column which contains the pressure of 745 mm Hg. Then use the cone test panel pressure gauge calibration chart and select the pressure $P_{2\ excess}$ expressed in divisions of the pressure gauge scale.

The values P_2 expressed in kg/cm^2 and in pressure gauge divisions are entered into the respective Columns of the Form (Table 8). Entered into the same Form are the cone positions for the indicated values of π_0 derived from the Appendix to the Aircraft Log.

Besides, Form No. 2 (second part of Table 8) is prepared for checking the values of cone extension caused by shifting the stick to control the stabilizer.

When checking the automatic system, proceed as follows:

1. Install the arrangement used for measuring the cone travel and adjust it so as to set the nut edge against 0 division of the measuring rule when the cone is in the retracted position; for setting the arrangement, turn the stop (Fig. 50).

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Table 8

Form No. 1

Record Used in Checking Cone Control System Automatic Operation

Pressure of the day, mm Hg	Pre-set values x_o	P_2, kg/cm^2 (taken from Table 9)	P_2 expressed in scale divisions (taken from calibration chart)	Cone position, mm (taken from Appendix to Aircraft Log)	Measured position of cone, mm		Permissible error in cone travel, mm		Actual error in cone travel L_{cone}, mm	
					extension	retraction	extension	retraction[x]	extension	retraction
	5 6 7 8 9 10									

Form No. 2

	Initial position of cone L_o, mm, at $x_o = 7$	Position of cone after first extension effected by control stick, L_1, mm	Position of cone after second extension effected by stick, L_2, mm	
Cone extension $\Delta L_1 = L_1 - L_o$				Stick shifted forward Stick shifted backward
Cone extension $\Delta L_2 = L_2 - L_1$				Stick shifted forward Stick shifted backward
Travel caused by shifting control stick forward		$\Delta L_1 = 15^{+3}_{-1}$ mm	$\Delta L_2 = 10^{+3}_{-1}$ mm	
Travel caused by shifting control stick backward		$\Delta L_1 = 10^{+3}_{-1}$ mm	$\Delta L_2 = 15^{+3}_{-1}$ mm	

[x] Taken from Appendix to Aircraft Log

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Table 9

Values of Pressure P_2 for π_o

π_o value to be checked	Pressure P_2, kg/cm^2, set by gauge at pressure of the day, mm Hg																				
	675	680	665	690	695	700	705	710	715	720	725	730	735	740	745	750	755	760	765	770	775
5	3.67	3.70	3.73	3.75	3.78	3.81	3.84	3.87	3.89	3.92	3.95	3.975	4	4.02	4.05	4.09	4.11	4.14	4.16	4.18	4.22
6	4.59	4.63	4.66	4.69	4.72	4.76	4.8	4.84	4.86	4.895	4.94	4.97	5	5.03	5.07	5.10	5.13	5.18	5.20	5.23	5.27
7	5.51	5.55	5.59	5.63	5.67	5.71	5.75	5.80	5.84	5.87	5.92	5.96	6	6.03	6.08	6.12	6.15	6.21	6.24	6.27	6.83
8	6.43	6.47	6.52	6.57	6.61	6.66	6.71	6.77	6.81	6.85	6.90	6.95	7	7.04	7.08	7.14	7.18	7.24	7.28	7.30	7.38
9	7.35	7.39	7.46	7.51	7.56	7.63	7.68	7.73	7.78	7.83	7.89	7.95	8	8.04	8.11	8.16	8.21	8.27	8.32	8.37	8.42
10	8.27	8.33	8.39	8.45	8.50	8.58	8.63	8.70	8.75	8.81	8.88	8.94	9	9.05	9.12	9.19	9.24	9.30	9.36	9.42	9.48

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2. Prepare the test panel for operation, disconnect the pipe and couple the hose to transducer ДДО-Д$_2$ of the aircraft. Should the hose be attached to transducer ДДО-Д$_1$ by mistake, the whole automatic system will be damaged.

Pull the control stick backward and set it in the position where the stabilizer nose moves down through an angle of about -7^0.

3. Switch on circuit breakers CONE AND SHUTTER CONTROL and L.G. WARNING, NAVIG. LIGHTS.

4. Set switch CONE CONTROL in position ON and shift the cone selector switch into position AUTOMATIC.

5. Produce the operating hydraulic pressure, depress button LAMP CHECKING on panel ПКС-2К and keep it depressed while checking. Check that the cone moves into the extreme extended position.

6. Set pressure $P_{2excess}$ expressed in the panel pressure gauge division values as indicated in Form No. 1 (Table 8).

Measure the cone position for each value of π_c both when the cone is extended, and then when it is retracted.

The measured cone positions corresponding to the indicated values of π_c should be entered into Form No. 1 (Table 8).

7. Calculate the actual error in cone extension which is defined as the difference between the measured position and the position pre-set in the Appendix to the Log.

Make sure that the actual error in cone travel does not exceed the permissible error (Table 8) for every value of π_c.

8. Check operation of the cone additional extension system controlled by the aircraft control stick by supplying pick-up ДДО-Д$_2$ with pressure $P_{2excess}$ corresponding approximately to $\pi_c = 7$).

Pull the stick backward and set it in the position at which the stabilizer nose will move down through an angle of about -7^0.

Measure the cone position and enter the result into Form No. 2 (Table 8). This is the initial cone position L_0.

Push the stick forward to obtain the first cone extension L_1.

Measure the cone position and enter the result into Form No. 2 (Table 8).

9. Push the stick forward to obtain the second cone extension L_2.

Measure the cone position and enter the result into Form No. 2 (Table 8).

10. Proceed similarly to measure the cone position after extending it twice by pulling the control stick from a position which corresponds to $\varphi = -7^0$ of stabilizer deflection.

11. Find cone extension values ΔL_1 and ΔL_2.

See that values ΔL_1 and ΔL_2 do not differ from respective values ΔL_1 and ΔL_2 indicated in Form No. 2 (Table 8).

Mind that while extending the cone by the stabilizer control stick, the system must not start self-oscillations.

As the cone is extended, one jump within 5 mm is permissible which corresponds to 2.5 per cent of the indicator scale.

When the cone is caused to retract by shifting the control stick, no jump is permissible and the cone must return to its initial position slowly within 10 to 15 sec.

After checking, release button LAMP CHECKING on panel ПКС-2К and see that the cone is retracted completely. Set switch CONE CONTROL in position OFF, release the pressure in the hydraulic system and in system P_2 of the aircraft, and connect the pipe to transducer ДДО-Д$_2$. De-energize the system.

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CAUTION. When checking the system in the course of scheduled maintenance as well as in all other cases of checking, set switch CONE CONTROL in position ON 2 to 3 min. before starting the check and turn it off immediately after the check is over.

11. CHECKING AIR INTAKE ANTI-SURGE SHUTTER CONTROL SYSTEM WITH ENGINE CUT OFF

To check the operation of the anti-surge shutters, observe the following priority:

1. Make sure that all circuit breakers and switches installed in the cockpit are turned off.

2. Set the switch arranged in the processing box in position PROCESSING.

3. Prevent interlocking of limit switches HYDRAULIC DEBOOSTER and R.P.M. AFTERBURNING INTERLOCKING housed in box KAG-13Д by turning screw H into position INTERLOCKING ELIMINATED.

4. Couple the ground electric power supply to the aircraft.

5. Couple the main hydraulic system pipe connections to the ground hydraulic pump and produce an operating pressure of 180 to 215_{-12} kg/cm^2.

6. Switch on circuit breaker CONE AND SHUTTER CONTROL and turn switch SHUTTERS into position AUTOMATIC.

7. Switch on circuit breaker AFTERBURNING and then turn on switch BATTERY, AIRCRAFT - GROUND.

8. Depress right-hand console button IMITATING MP-1.35 OPERATION and keep it depressed throughout the check.

9. As the above button is depressed, the system designed to interlock the shutters with regard to cutting-off the augmented rating and deflecting the stabilizer is switched on. Inasmuch as the engine control lever is set in position CUTOFF in this case, i.e. the augmented rating is cut off, the anti-surge shutter control valve ГА-184У gets switched on and the shutters open.

10. To check the operation of the anti-surge shutter interlocking system, proceed as follows:

(a) check interlocking of the shutters in response to switching off of augmented rating:

shift the engine control lever from position CUTOFF to position MAXIMUM. See that within this range the shutters are open;

set the engine control lever against stop MINIMUM AFTERBURNING, and make sure that the augmented rating is on, the light panel lamp AFTERBURNING lights up and the anti-surge shutters close. As the engine control lever shifts from stop MINIMUM AFTERBURNING to stop FULL AFTERBURNING, the anti-surge shutters must be closed;

shift the engine control lever from stop MINIMUM AFTERBURNING to stop MAXIMUM and see that the augmented rating is cut off, lamp AFTERBURNING comes off and the anti-surge shutters are caused to open;

(b) check interlocking of the shutters in response to deflection of the stabilizer:

set the engine control lever against stop MINIMUM AFTERBURNING and see that the augmented rating is cut in and the shutters close up;

pull the control stick backward till the stabilizer nose travels down through an angle of -19° and check that the shutters open and remain in this position through the range of angles from -19° to -28°;

shift the control stick towards the neutral position and make sure that after the stabilizer nose moves up through an angle less than -19° the anti-surge shutters close up.

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As the control stick is pushed forward further on and the stabiliser nose travels upward through an angle of +3°, see if the shutters open and maintain this position until the stabiliser completes its full way through an angle of +13°; set the control stick in the neutral position and see if the shutters close. Set the engine control lever in position CUTOFF and make sure that the shutters open.

After checking the operation of the shutters as described in the given Section, turn off switch BATTERY, AIRCRAFT – GROUND, breaker AFTERBURNING, MAXIMUM, turn the processing switch to position PROCESSING, turn screw Н on box НАФ-13Д to the initial position, and disconnect the ground electric power supply and hydraulic pump. Turn off all circuit breakers and switches engaged for checking the system.

12. INSTRUCTIONS ON MOUNTING AND ADJUSTMENT OF PICK-UP ACY-2 ON AIRCRAFT

When checking or replacing the stabiliser deflection pick-up ДСУ-2, observe the following procedure to adjust its operation:

1. Make sure that controller APУ-3B is set in position LOW SPEED, set the aircraft along the line of flight and install a protractor on the stabiliser.

2. Couple the main hydraulic system to the ground pump and build up the operating pressure in the system.

3. Shift the control stick to set the stabiliser in position $\varphi = +1^{\circ}$ as indicated by the protractor (the stabiliser nose upwards). As the stabiliser is placed in this position, uncouple plug connector ШР-7 of the pick-up bunched conductor and, using a tester, make sure that the position of contacts of the pick-up microswitches corresponds to the diagram shown in Fig. 41.

4. Set the stabiliser in position $\varphi = \pm 0.5^{\circ}$ as indicated by the protractor and use the tester to check whether microswitch No. 1 has been switched off.

For switching off microswitch No. 1 when the stabiliser is set in the above position, slightly turn the ДСУ-2 pick-up rod clockwise or counter-clockwise till microswitch No. 1 is caused to cut off.

To adjust the length of the rod, first loosen the rod cap locking screw. After adjusting the rod, drive home the rod cap locking screw (Fig. 42).

5. Once again set the stabiliser in position $\varphi = +1^{\circ}$ as indicated by the protractor and check the positions of contacts of the microswitches as has been described in Item 3.

6. Shift the stabiliser through the angles specified in Fig. 41 and use the tester to determine the positions of contacts of the microswitches according to the diagram.

7. To ensure the action of the microswitches within the permissible range specified in the diagram, Fig. 41, it is allowed that while checking as described in Item 6 the pick-up rod travel can be adjusted by changing the bell-crank arm by ± 3 mm of the normal length of arm R = 52 mm.

To adjust the bell-crank arm length, displace the rod cap attachment hinge bolt along the groove inside the bell-crank eyes.

After adjustment, tighten the hinge bolt and lock the nut with a cotter pin.

8. Make a final check of the operation of pick-up microswitches which must switch on and off at the pre-set stabiliser deflection angles. See that the pick-up microswitches are switched off at the same limits of the angles at which they are switched on. A permissible lag in switching off is 2.5° of the stabiliser turn from the indicated rated angle, when the stabiliser is moving towards the zero position.

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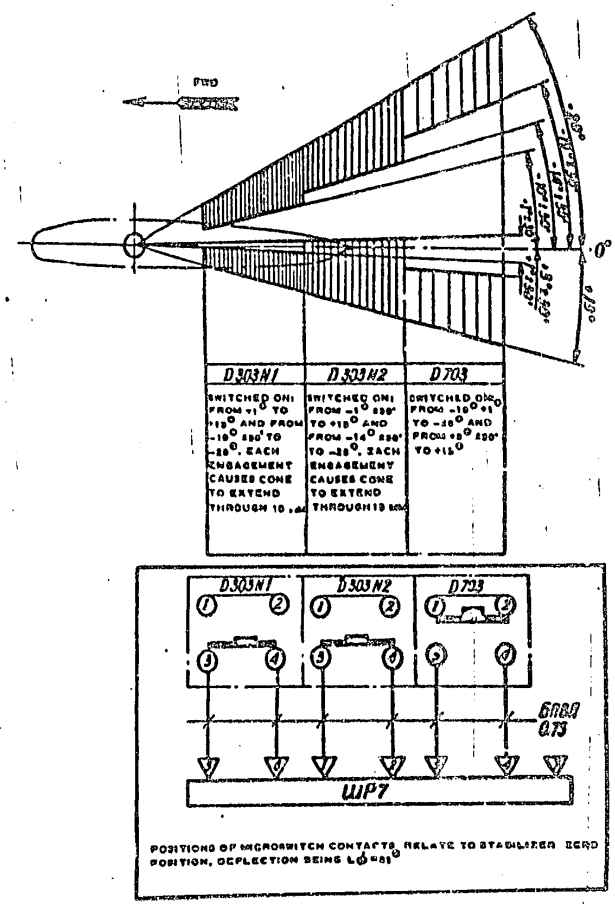

FIG.61. MICROSWITCH CIRCUIT OF PICK-UP ДСУ-2

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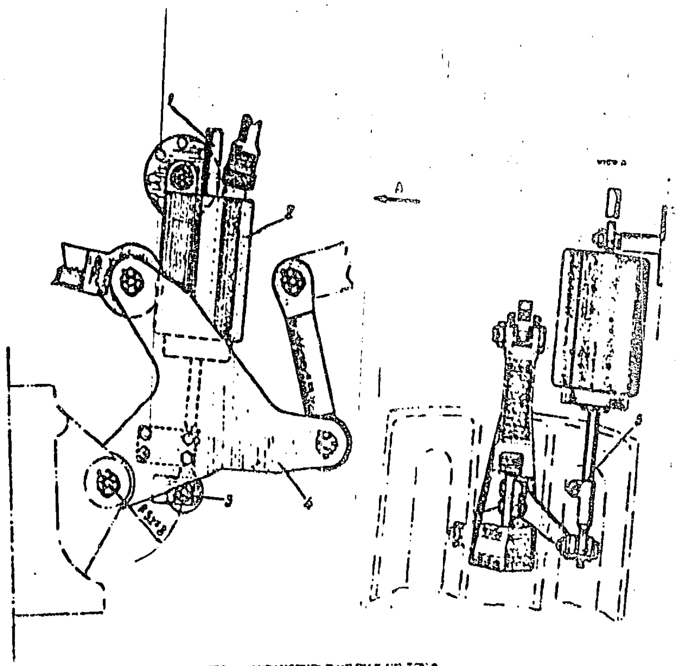

FIG. 62. ARRANGEMENT OF PICK-UP JCY-2
1 – pick-up rod; 2 – pick-up JCY-2; 3 – hinge bolt; 4 – bell-crank; 5 – rod cap locking bolt.

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9. Couple plug connector ШР-7 of pick-up ДСУ-2, disconnect the ground hydraulic pump and remove the protractor.

The additional displacement of the cone controlled by the pick-up signals should be checked when testing the system with the help of a test panel.

13. REPLACEMENT OF УВД-2М AIR INTAKE CONE AUTOMATIC CONTROL SYSTEM UNITS

If in the process of use or during a ground check, the performance of system УВД-2М is found to be out of tolerances of the parameters being checked or if the system fails to follow the signals being applied, detect the cause of trouble and remove the fault. If a separate unit of system УВД-2М is found faulty replace it with a new one and then adjust the system on the aircraft.

Listed below are the units of the system which can be replaced individually:

1. The ИДО-1 complete set comprising output signal unit ИДО-БВС-1 and transducers ИДО-$Д_1$ and ИДО-$Д_2$.
2. Amplification and commutation unit БУК-2А.
3. Feedback pick-up ДК-3 with drive П-1.
4. Position indicator УПВС-3.
5. Cone control unit АУ-35-1.

CAUTION. Never replace individually the ИДО-1 set units, such as transducer ИДО-$Д_1$ and ИДО-$Д_2$ and unit ИДО-БВС-1.

When adjusting system УВД-2М on the aircraft after replacement of its separate units, except cone position indicator УПВС-3 see to it that the ambient temperature is within 0° and $+40^{\circ}$C. Otherwise, never adjust the system. In this case do not replace separate units, but replace the complete set as a whole, if necessary.

Given below are the possible troubles of system УВД-2М as well as their causes and remedies. In using the trouble-shooting chart mind that the system should be switched on, which means that all switches and circuit breakers involved should be cut in and that an operating pressure of 180 to 215_{-12} kg/cm^2 should be produced in the main hydraulic system.

Possible Troubles of System УВД-2М, Their Causes and Remedies

Trouble	Possible cause	Remedy
1. System fails to operate either automatically (selector switch being set in position AUTOMATIC) or manually (selector switch being set in position MANUAL)	1. Circuit +27 V of aircraft mains is broken between bus A and terminal 2 of valve ГА-184У	Eliminate O/C
	2. Circuit 115 V, 400 c/s is broken in aircraft mains up to terminal 17 of unit БУК-2А	Same
	3. Circuits of aircraft mains are broken:	Same
	(a) between terminal 9 of unit БУК-2А and terminal 7 of pick-up ДК-3	Same
	(b) between terminal 10 of unit БУК-2А and terminal 6 of pick-up ДК-3	
	(c) between terminal 18 of unit БУК-2А and terminal 8 of pick-up ДК-3	

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Trouble	Possible cause	Remedy
	(d) between terminal 13 of unit БУК-2А and terminal 3 of unit АУ-35-1	
	(e) between terminal 15 of unit БУК-2А and terminal 4 of unit АУ-35-1	
	(f) between terminal 16 of unit БУК-2А and terminal 6 of unit АУ-35-1	
	(g) between terminal 14 of unit БУК-2А and terminal 5 of unit АУ-35-1	
	4. Breaks of minus circuits of aircraft mains connected to terminals 18, 25 or 26 of unit БУК-2А or to terminal 2 of unit АУ-35-1	Eliminate O/C
	5. Unit БУК-2А faulty	Replace unit БУК-2А
	6. Unit АУ-35-1 faulty	Replace unit АУ-35-1
	7. Pick-up ДК-3 faulty	Replace pick-up ДК-3
2. System fails to operate automatically (selector switch being set in position AUTOMATIC), whereas manual operation is normal (selector switch being set in position MANUAL)	1. Jumper between terminals 1 and 2 of ИДО-БВС-1 unit (19-terminal connector) broken	Eliminate O/C
	2. Circuits of aircraft mains are broken:	Same
	(a) between terminal 18 of unit ИДО-БВС-1 and terminal 3 of unit БУК-2А	
	(b) between terminal 15 of unit ИДО-БВС-1 and terminal 5 of unit БУК-2А	
	(c) between terminal 6 of unit ИДО-БВС-1 and terminal 6 of unit БУК-2А	
	3. Complete set ИДО-1 faulty	Replace complete set ИДО-1
	4. Unit БУК-2А faulty	Replace unit БУК-2А
3. While checking automatic operation of system, adjustment program $L_{ocmo} = f(s_0)$ is out of tolerances listed in Appendix to Aircraft Log:		
(a) system operates normally when controlled manually	1. Leakage in pipe connections of transducers ИДО-$Д_1$ and ИДО-$Д_2$	Remove leakage
	2. Complete set ИДО-1 faulty	Replace set ИДО-1

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Trouble	Possible cause	Remedy
(b) during manual operation, misalignment between pointers of indicator УПЗС-3 is out of tolerance	1. Maladjustment of feedback pick-up ДК-3	Readjust pick-up ДК-3
	2. Shift of zero of unit АУ-35-1 outside tolerance	Replace unit АУ-35-1
4. During automatic or manual operation, oscillations of system exceed tolerance, or signals are followed too slowly	Unit АУ-35-1 faulty	Replace unit АУ-35-1
5. During automatic operation, cone jerks as stabilizer deflection correction is introduced	Poor contact of ДК-3 feedback pick-up potentiometer wiper	Replace feedback pick-up ДК-3
6. System fails to operate manually, whereas automatic operation is normal	1. Circuits of aircraft mains are broken: (a) between terminal 6 of indicator УПЗС-3 and terminal 8 of unit БУК-2А (b) between terminal 7 of indicator УПЗС-3 and terminal 7 of unit БУК-2А (c) between terminal 8 of indicator УПЗС-3 and terminal 4 of unit БУК-2А	Eliminate O/C
	2. Unit БУК-2А faulty	Replace unit БУК-2А
	3. Indicator УПЗС-3 faulty	Replace indicator УПЗС-3
7. Though system operation is normal, indicator pointer would not travel	1. Breaks of aircraft mains logometer circuits: (a) between terminal 1 of indicator УПЗС-3 and terminal 1 of pick-up ДК-3 (b) between terminal 2 of indicator УПЗС-3 and terminal 2 of pick-up ДК-3 (c) between terminal 3 of indicator УПЗС-3 and terminal 3 of pick-up ДК-3 (d) between terminal 4 of indicator УПЗС-3 and terminal 4 of pick-up ДК-3	Eliminate O/C
	2. УПЗС-3 indicator logometer faulty	Replace indicator УПЗС-3
	3. ДК-3 pick-up indication potentiometer faulty	Replace pick-up ДК-3

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Trouble	Possible Cause	Remedy
8. Additional cone displacement would not be produced, when stabilizer is deflected	1. Broken aircraft mains circuits between pick-up ДСУ-2 and terminal 21 or 23 of unit БУК-2А	Eliminate C/C
	2. Unit БУК-2А faulty	Replace unit БУК-2А
9. Cone returns into initial position without time-lag when microswitches Nos 1 and 2 of the pick-up ДСУ-2 are switched off.	Unit БУК-2А faulty	Replace unit БУК-2А

In finding the cause of trouble on the basis of any possible symptom listed above, first check the simple elements of the system (e.g., make an external examination, ring out the circuits) and then decide upon replacement of this or that unit of system УВД-2М. Replacement of separate units and subsequent adjustment of the system are performed as instructed below.

Replacement of Unit БУК-2А

Unit БУК-2А is installed between frames Nos 7А and 9 under the cockpit floor (Fig. 43). To make an access to the unit, remove the APK-10 frame, aircraft storage batteries and other units that may block the way to unit БУК-2А.

To replace unit БУК-2А proceed as follows:

1. Uncouple the electric connector from unit БУК-2А loosen the nuts of the upper bolts, drive out two lower screws used to secure the unit and take the unit out (Fig. 44).

2. Couple the plug connector to a new unit БУК-2А but do not install the unit before the adjustment of the system is over.

3. After the adjustment of the system install the new unit into the aircraft and secure it with two bolts and two screws. Lock the plug connector. To attach the unit, make use of the attachment bolts, having replaced the washers inserted under the upper bolts with new ones.

4. Assemble the units which have been previously removed to make an access to unit БУК-2А.

Adjustment of System after Replacement of Unit БУК-2А

After replacing unit БУК-2А (the other units of the system being not replaced), readjust and check the system УВД-2М.

To adjust the pre-set program of the system, proceed as follows:

1. Determine the atmospheric pressure of the day in mm Hg.

2. Draw Table 10 proceeding as follows:

(a) from Table 9 select a Column containing the pressure closest to that of the day. From the Column write out the values of P_2 kg/cm^2 for the indicated values of π_0 and enter them into Column 3 of Table 10;

(b) use the calibration chart of the test panel reference pressure gauge (See the test panel description), convert the values of P_2 into the values of the pressure gauge scale and enter them into Column 4 of Table 10;

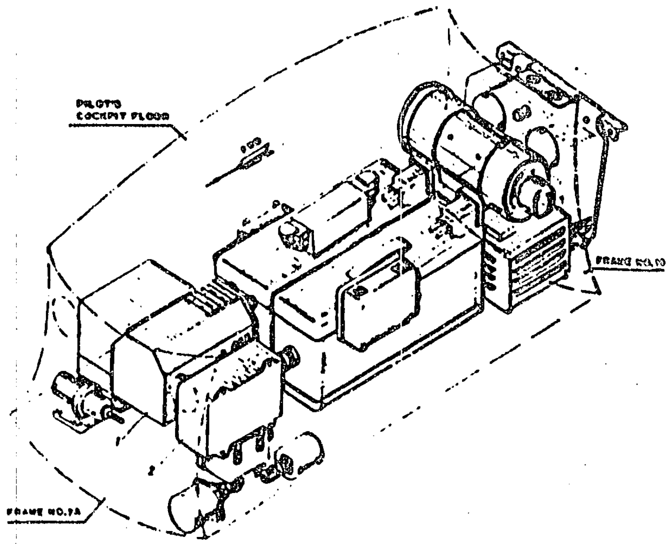

FIG.43. LAYOUT OF ELECTRIC EQUIPMENT UNITS UNDER COCKPIT FLOOR
1 – unit ШЗО-БВС; 2 – unit БУК-2А.

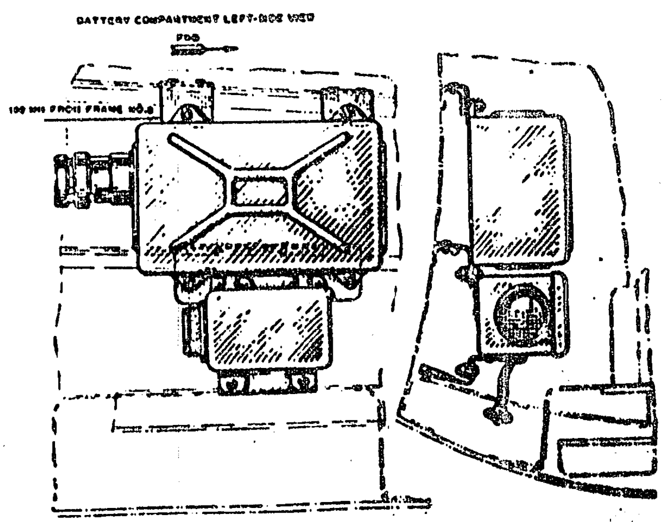

FIG.44. ARRANGEMENT OF UNIT ШЗО-БВС

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(c) take cone extension values L_{cone} corresponding to the respective values of π_o from the Appendix to the Aircraft Log which contains a Column of cone extension values determined at the Manufacturing plant and enter the values into Column 5 of Table 10.

3. After the bunched conductor plug connector has been coupled to new unit ЭУК-2А, open the hatch in the unit's bottom and set the wipers of potentiometers R_1, R_2, R_3 and R_4 of the unit approximately in the central position.

Table 10

Data for Adjustment of Unit ЭУК-2А

Pressure of day, mm Hg	Pre-set values of π_o	P_2, kg/cm^2	P_2, in pressure gauge scale divisions, according to calibration chart	L_{cone}, in mm, taken from Appendix to Aircraft Log	L_{cone} actual, in mm; actual cone position after adjustment of system	Permissible errors, mm
	5					±3
	6					±3
	7					±1
	8					±1
	9					±1
	10					±3

4. Install the arrangement for measuring the cone travel at the inlot of the air intake duct and adjust the arrangement so that the edge of the nut should be set exactly at 0 division of the measuring rule when the cone is completely retracted. To adjust the arrangement, turn the stop.

5. Prepare the test panel for operation and couple its hose to transducer НДО-А$_2$.

CAUTION: Should the hose be connected to transducer НДО-А$_1$ by mistake, the whole system will be damaged.

6. Couple the aircraft mains to the ground electric power supply and couple the main hydraulic system pipe connections to the hydraulic cart to produce an operating hydraulic pressure of 180 to 215_{-12} kg/cm^2.

7. Install the protractor on the stabiliser and engage the trimming effect mechanism to shift the stabiliser nose down through an angle of $-7°$ as indicated by the protractor.

8. Turn on the right-hand console switch BATTERY, AIRCRAFT - GROUND, switch on circuit breakers CONE AND SHUTTER CONTROL and L.G. WARNING, NAVIG. LIGHTS and set the left-hand console switch CONE CONTROL in position MANUAL.

9. Turn the knob of indicator УПЗС-3 to extend and retract the cone and note the positions of the two indicator pointers.

When the knob is turned slowly and when it is stopped, the permissible misalignment between the wide and narrow pointers should be within ±5 per cent of the scale, except the extreme divisions of 0 and 10 where the misalignment must not exceed ±3 per cent.

The value of misalignment between the pointers caused during retraction (or extension) of the cone should not differ from the value of misalignment between the pointers caused during extension (or retraction) by more than 2 per cent when the wide pointer is set at the same reference points of the scale (0, 2, 4, 6, 8 and 10). Make sure that the mutual misalignment between the pointers does not exceed the maximum tolerances, i.e. ±3 per cent over the scale and ±5 per cent at the extreme divisions of the scale.

As the wide pointer is set to 0, see that the cone is retracted completely, and as it is set to 10, see that the cone is extended completely.

Abrupt turning of the knob should not induce self-oscillations of the cone, the cone occupying a stable position. One jump of not more than 10 mm is permissible which corresponds to 5 per cent of the indicator scale.

10. Turning the knob, set the indicator wide pointer to 10 and check that the cone has extended completely.

Turn the cone selector switch from position MANUAL to position AUTOMATIC and make sure that the cone has retracted completely and the indicator point has moved to division 0±3 per cent.

11. Depress the ППС-2К panel lamp checking button and keep it depressed throughout the adjustment. The button depressed, make sure that the cone has completely extended into the front position.

12. Supply transducer МДО-Д$_2$ with pressure $P_{2\ excess}$ expressed in the test panel pressure gauge scale values (Table 10) which corresponds to $\pi_0 = 7$. Turn the R_2 potentiometer wiper smoothly and displace the cone over the measuring rule to position $L_{cone\ 7}$ (the value of $L_{cone\ 7}$ being taken from column 5, Table 10).

Increase pressure $P_{2\ excess}$ to obtain a value of $\pi_0 = 9$. Turn the R_1 potentiometer wiper and displace the cone over the measuring rule to position $L_{cone\ 9}$ (the value of $L_{cone\ 9}$ being taken from Column 5, Table 10).

Once again set pressure P_2 which corresponds to the value of $\pi_0 = 7$ and check cone position $L_{cone\ 7}$. In case the cone position requires adjustment, turn the R_2 potentiometer wiper.

Check cone position $L_{cone\ 9}$ again at $\pi_0 = 9$, and in case the cone position requires adjustment, turn the R_1 potentiometer wiper. Make sure that the adjustment is good and reliably tighten the locknuts of the R_1 and R_2 potentiometers adjustment screws.

13. Inasmuch as the system may be maladjusted when tightening the locknuts of potentiometers R_1 and R_2, make another check of adjustment of the cone at $\pi_0 = 7$ and $\pi_0 = 9$. If the adjustment tested at the above values is good, check cone extension for each value π_0 by supplying transducer МДО-Д$_2$ with a pressure specified in Columns 3 and 4, Table 10. Record the actual results obtained into Column 6, Table 10. See that the difference between the actual cone extension values (Column 6) and the values derived from the Appendix to the Log (Column 5) do not exceed the permissible errors listed in Column 7, Table 10.

Enter actual cone extension values thus obtained into the Appendix to the Aircraft Log and use them as basic data for subsequent checking of system УВД-2М or for scheduled maintenance.

14. After adjustment of the pre-set program of the system, adjust cone extension by the stabilizer deflection signals fed by pick-up ДСУ-2.

While adjusting, proceed as follows:

(a) change pressure P_2 applied to transducer МДО-Д$_2$ and set the retracted cone in position $L_{cone} = 100$ mm using the measuring rule;

(b) push the control stick forward evenly and slowly until the first extension of the cone occurs, and stop the stick. See that this causes microswitch No. 8 of pick-up ДСУ-2 to switch on and that the cone extends to about 17 mm. Check the cone extension by the measuring rule and see that it is equal to $L_{cone} = 117^{+1}$ mm. If the above position of the cone is not achieved, evenly turn the R_3 potentiometer wiper to shift the cone into the position where $L_{cone} = 117^{+1}$ mm.

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Continue to push the stick further forward until the second extension of the cone is effected and stop shifting the stick. See that microswitch No. 1 of pick-up КУ-2 switches on and the cone travels further forward through 19_{-1} mm. Check the cone position, and, if necessary, smoothly turn the R_3 potentiometer wiper to shift the cone into the position where $L_{cone} = 127 \pm 1$ mm.

Make sure that during cone extensions no self-oscillations of the system are induced.

While shifting the control stick back into the initial position (the stabilizer nose shifts downward through $-7°$) see that the cone returns smoothly into its initial position where $L_{cone} = 100$ mm within 10 to 15 sec.

Reliably tighten the locknuts of potentiometers R_3 and R_4 and check the cone extension according to the procedure described in Items 6 to 11, Section "Checking Automatic Operation of Cone Control System".

15. Install and secure unit БУК-2А as described in Section "Replacement of Unit БУК-2А". Set the trimming effect mechanism in the neutral position indicated by the glow of the signal lamp. Release button LAMP CHECKING, on panel ППС-2К and see that the cone is caused to retract completely, then disconnect the hose of the arrangement and couple the pipeline to transducer ИДО-$Д_2$. Turn off all switches and circuit breakers engaged while adjusting the system. Make a respective record in the Log to register the replacement of the unit.

Replacement of Complete Set ИДО-1

When replacing complete set ИДО-1, replace unit ИДО-БВС and transducers ИДО-$Д_1$ and ИДО-$Д_2$. Unit ИДО-БВС is installed between frames Nos 7A and 8 under the cockpit floor (See Fig. 43). Transducers ИДО-$Д_1$ and ИДО-$Д_2$ are housed in the L.G. right- and left-hand wells.

Replacement of Unit ИДО-БВС

1. To make an access to the unit, remove the АРК frame, the aircraft storage batteries and other units that may block the way to unit ИДО-БВС.

2. Uncouple two electric connectors from unit ИДО-БВС, screw off two nuts, drive out two pins and take the unit out together with its attachment bracket. Screw off four screws and disconnect the unit from the bracket (Fig. 45).

3. Attach a new unit ИДО-БВС to the attachment bracket and secure it with four screws. Install the unit and the bracket into the aircraft, attach it with two nuts and two studs and lock the nuts with wire. Couple the 19- and 10-terminal connectors to the unit. Do not assemble the units which have been removed to make an access to unit ИДО-БВС since unit БУК-2А is to be demounted for adjusting the system.

Replacing Transducers ИДО-$Д_1$ and ИДО-$Д_2$ and Checking System for Tightness

When replacing the transducers, drain the deposit from the moisture trap and test the pipeline system for tightness. To do this, proceed as follows (Figs 46 and 47):

1. Uncouple the plug connectors and pipelines from the transducers housed in the L.G. right- and left-hand wells, unbolt the binding stirrups and remove transducers ИДО-$Д_1$ and ИДО-$Д_2$ from the aircraft.

2. Through the lower left-hand engine access hatch, remove the moisture trap installed in the P_2 excess piping and drain down the deposit. Before mounting

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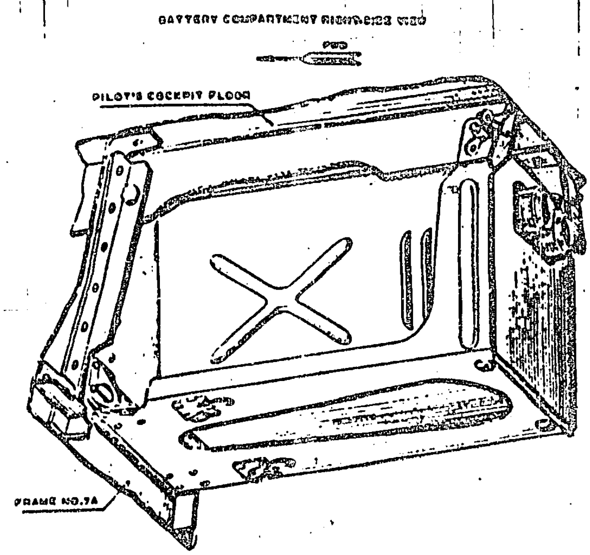

FIG.65. ARRANGEMENT OF UNIT БУК-2A

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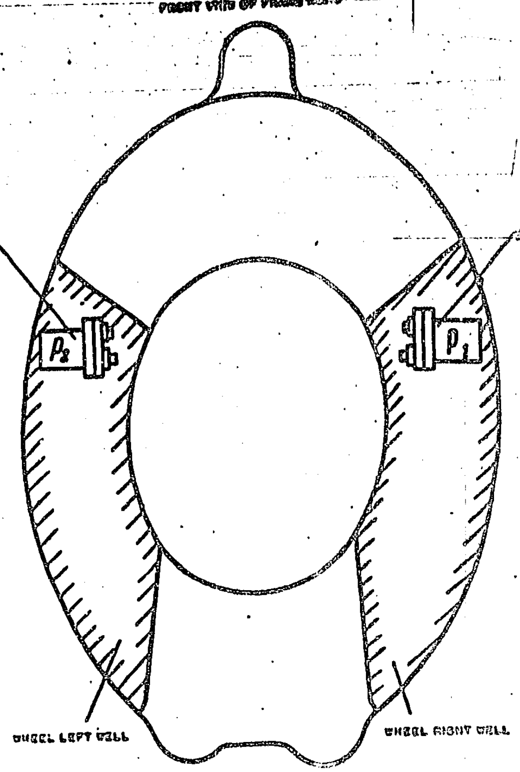

FIG.65. ARRANGEMENT OF CONE CONTROL SYSTEM TRANSDUCER ИДО-Д
1 – transducer ИДО-Д$_1$; 2 – transducer ИДО-Д$_2$

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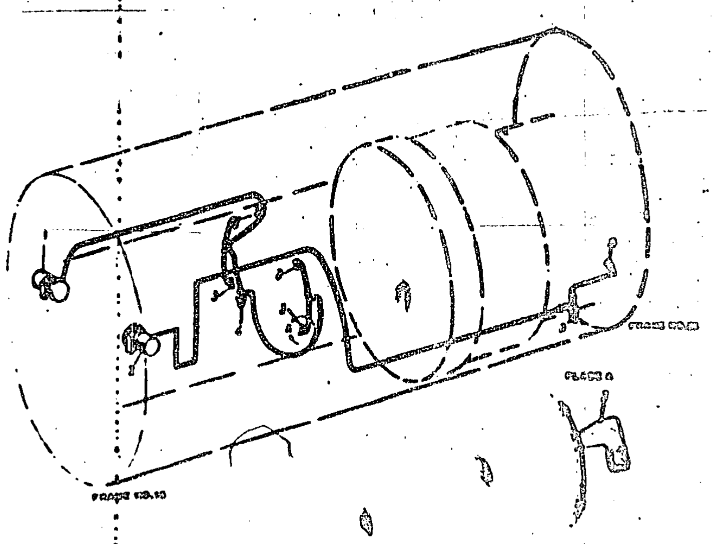

FIG. 67. SUPPLY CIRCUIT OF CONT. CONTROL TRANSDUCERS [illegible]

1 – transducer ILID-J_1; 2 – transducer ILID-J_2; 3 – tap of pressure P_1; 4 – [illegible] tap of system P_1; 5 – [illegible] tap of system P_2; 6 – tap of pressure P_2.

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the moisture trap, couple the pipe of the demounted transducer МДО-$Д_2$ to the hose of the arrangement and flush the pipeline with compressed air delivered at a pressure of 2 to 3 kg/cm^2. Install the moisture trap back into its place, tighten and lock it with wire.

3. Through the L.G. right-hand wall, remove the moisture trap installed in the P_1 piping and drain the deposit. Before mounting the moisture trap, couple the pipe of the demounted transducer МДО-$Д_1$ to the hose of the arrangement and flush the pipeline with compressed air delivered at a pressure of 2 to 3 kg/cm^2. Install the moisture trap back into its place, secure and lock it with wire.

4. Check the tightness of the pipeline system delivering the pressure P_2 to transducer МДО-$Д_2$. To do this, uncouple the moisture trap pipe connection from the pipe coupled to the pipe connection of the engine. Stop the moisture trap pipe connection with a plug. Couple the hose of the arrangement to the pipe connected to transducer МДО-$Д_2$ and pressurize the system with compressed air delivered at a pressure of 10 kg/cm^2. Make sure that the system is absolutely tight and the pressure does not drop within an interval of 10 min.

5. Disconnect the hose of the arrangement, remove the plug from the moisture trap pipe connection, couple the pipe end to the moisture trap, secure and lock it reliably.

CAUTION. 1. To flush the system and check the tightness, use dry compressed air.
2. To check the tightness of the pipeline joints in the pipe connection of transducer МДО-$Д_2$ moisture trap and in the pipe connection of the engine pressure P_2 delivery line, use soapy water while the engine is running.

6. Check the tightness of the pressure P_1 delivery pipeline system connected to transducer МДО-$Д_1$. To do this, stop the pressure taps inside the duct with special plugs inserted therein through the air duct examination hatch. Couple the hose of the arrangement to the end of the МДО-$Д_1$ pipe and pressurize the system with compressed air supplied at a pressure of 5 kg/cm^2. Make sure that the system is absolutely air-tight so that there should be no pressure drop over an interval of 10 min. Remove the plugs from the pressure taps in the air duct and flush the system with compressed air supplied at a pressure of 2 to 3 kg/cm^2. Disconnect the arrangement hose.

7. Insert new transducers МДО-$Д_1$ and МДО-$Д_2$ into the binding stirrups and secure them with bolts. Couple the transducers to the electric connectors and pipes of the P_1 and P_2 pressure systems (tighten the pipe joints securely and lock them). After the adjustment, connect the pipe to transducer МДО-$Д_2$.

CAUTION. In order to differentiate between the transducers according to their purpose МДО-$Д_1$ transducer body is marked with the letter P_1, whereas the МДО-$Д_2$ transducer body carries the letter P_2. In installing transducers МДО-$Д_1$ and МДО-$Д_2$ and when connecting them to the pipelines, use care to set the transducers in their proper places and to connect the pipes to the appropriate transducers.

Should the transducers be installed into wrong places by mistake, or the pipelines be coupled incorrectly, the entire system will be damaged.

To check the tightness of the pipeline joints of transducer МДО-$Д_2$, use soapy water while the engine is running.

Adjustment of System УВД-2М after Replacement of МДО-1 Complete Set

After replacing the МДО-1 complete set, proceed as follows to adjust system УВД-2М:

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1. Complete Table 11. To do this, use the Certificate of the newly installed set ЭМО-1, wherein find the Table of test results (the test being performed in accordance with Item "e"), write out the actual extension errors expressed in terms of percentage of relative resistance and enter the data into Table 11. The above-mentioned errors are derived only for the pressures P_1 = 1 atm. abs., 0.7 atm. abs., 0.5 atm. abs., and 0.3 atm. abs. at the pressure ratios π_0 = 7, 8 and 9.

Table 11

Actual Errors of ЭМО-1 Complete Set

P_1, atm.abs. / π_0	1.0	0.7	0.5	0.3
	actual extension errors expressed as a percentage of relative resistance ($\delta R_{relative}$)			
7				
8				
9				

2. Of the actual extension errors listed in Table 11, select the maximum plus error for each pressure ratio π_0 = 7, 8 and 9, when the given pressure ratio has at least one error of positive sense, or choose the minimum minus error, when the given pressure ratio has all errors of negative sense.

Example. The actual errors of the ЭМО-1 set are the following:

P_1, atm.abs. / π_0	1.0	0.7	0.5	0.3
	actual extension errors expressed as a percentage of relative resistance ($\delta R_{relative}$)			
7	+0.2	+0.5	−1.3	+0.1
8	+1.1	+0.6	−0.3	−0.2
9	−0.2	−0.1	−0.4	−0.6

Following from Item 2, the chosen errors of the given ЭМО-1 set are:

at π_0 = 7, the maximum plus error is $\delta R_{relative}$ = +0.5 per cent;

at π_0 = 8, the maximum plus error is $\delta R_{relative}$ = +1.1 per cent;

at π_0 = 9, the minimum minus error is $\delta R_{relative}$ = −0.1 per cent.

3. To adjust the system for the required program of operation, find the corrections to be introduced into the initial program at pressure ratios π_0 = 7, 8 and 9.

In order to determine the above corrections (expressed as a percentage of relative resistance) proceeding from the errors at π_0 = 7, 8 and 9 chosen as explained in the previous Item, make algebraical subtraction of the respective errors at P_1 = 1 atm.abs. listed in Table 11.

π_0	Actual errors chosen as specified in Item 2, $\delta R_{relative}$	Actual errors at P_1 = 1 atm.abs., $\delta r_{relative}$	Corrections ΔR per cent = ($\delta R_{relative}$) − ($\delta r_{relative}$)
7	+0.5 per cent	+0.2 per cent	(+0.5)−(+0.2) = +0.3 per cent
8	+1.1 per cent	+1.1 per cent	(+1.1)−(+1.1) = 0
9	−0.1 per cent	−0.2 per cent	(−0.1)−(−0.2) = +0.1 per cent

4. To convert the obtained corrections expressed as a percentage of relative resistance into mm of the cone travel, use the following formula:

$$\Delta L_{cone} = \frac{200 \cdot \Delta R \text{ per cent}}{88 \text{ per cent}},$$

where ΔL_{cone} is the correction for cone extension in mm;

ΔR per cent is the correction expressed as a percentage of relative resistance and determined as explained in the previous item;

200 is the complete travel of the cone in mm;

and 88 per cent is the operating range of relative resistance which corresponds to a 200-mm travel of the cone.

Approximate the obtained corrections to the cone travel to an accuracy of 1 mm.

<u>Example:</u>

π_0	Correction, ΔR per cent	Correction, ΔL_{cone} mm	Approximated correction L_{cone} mm
7	+0.3 per cent	$\frac{200 \times 0.3}{88} = 0.7$	$\Delta L_{cone\,7} = 1$
8	0	$\frac{200 \times 0}{88} = 0$	$\Delta L_{cone\,8} = 0$
9	+0.1 per cent	$\frac{200 \times 0.1}{88} = 0.2$	$\Delta L_{cone\,9} = 0$

5. Compute the required extension of the cone in mm at all pressure ratios π_0 being checked (see Table 12).

Add the initial (rated) cone position value in mm at $\pi_0 = 7$, 8 and 9 to the corrections expressed in mm of the cone travel ΔL_{cone} calculated at $\pi_0 = 7$, 8 and 9 as described in the previous Item.

Add the initial cone position value in mm at $\pi_0 = 5$ and 6 to the correction $\Delta L_{cone\,7}$ calculated at $\pi_0 = 7$. Add the initial cone position value in mm at $\pi_0 = 10$ to the correction $\Delta L_{cone\,9}$ calculated at $\pi_0 = 9$. Enter the results into Table 12.

Table 12

Required Cone Extension Corrected Depending on Values π_0

π_0	Initial cone position, in mm, specified by rated program	Correction determined as specified in Item 4	Actual cone position, in mm, used for adjustment
5	176.0	$\Delta L_{cone\,7}$	$176.0 + \Delta L_{cone\,7}$
6	147.0	$\Delta L_{cone\,7}$	$147.0 + \Delta L_{cone\,7}$
7	118.5	$\Delta L_{cone\,7}$	$118.5 + \Delta L_{cone\,7}$
8	90.0	$\Delta L_{cone\,8}$	$90.0 + \Delta L_{cone\,8}$
9	61.5	$\Delta L_{cone\,9}$	$61.5 + \Delta L_{cone\,9}$
10	33.0	$\Delta L_{cone\,9}$	$33.0 + \Delta L_{cone\,9}$

6. To adjust the system at the pressure P_1 equal to the atmospheric pressure of the day, proceed as follows:

(a) determine the atmospheric pressure of the day expressed in mm Hg;

(b) draw Table 13;

(c) use Table 9 to choose the Column which contains a pressure closest to the pressure of the day. Write out the values P_2 kg/cm^2 at specified π_0 from the above-mentioned Column and enter them into Column 3, Table 13;

(d) use the test panel pressure gauge calibration chart to convert the values P_2 listed in Column 3, Table 13 into the pressure gauge scale values and enter the values into Column 4, Table 13;

(e) fill Column 5, Table 13 with the cone position values at the specified values π_0 derived from Column 4, Table 12. Adjust the system to an accuracy specified in Column 7, Table 13;

(f) remove unit БУК-2А from its place in the aircraft, keeping the plug connectors coupled. Open the hatch in the БУК-2А unit bottom;

Table 13

Data for Adjustment of УПВ-2И System

Pressure of the day, mm Hg	Pre-set values π_0	P_2, kg/cm^2	P_2 expressed in calibration chart pressure gauge scale values	L_{cone}, in mm, derived from Column 4, Table 12	L_{cone}, a.., in mm actual cone position after adjustment	Permissible errors, mm
	5					+15 to -7.5
	6					+15 to -7.5
	7					±1
	8					±1
	9					±1
	10					+15 to -7.5

Note: Permissible displacement of the cone from the position specified by any of the three values π_0 = 7, 8 or 9 is +14 to -1 mm.

(g) prepare the system for adjustment as described in Items 8 to 11 of Section "Adjustment of System after Replacement of Unit БУК-2А;

(h) supply transducer ИДО-Д$_2$ with the pressure $P_{2\ excess}$ expressed in the test panel pressure gauge scale values (Column 4, Table 13) at π_0 = 7.

Smoothly turn the R_2 potentiometer wiper of unit БУК-2А and shift the cone to position 118.5 + $\Delta L_{cone\ 7}$ using the measuring rule of the arrangement (the value is taken from Column 5, Table 13, for π_0 = 7). Supply transducer ИДО-Д$_2$ with the pressure $P_{2\ excess}$ which corresponds to π_0 = 9. Turn the R_1 potentiometer wiper to set the cone in position 61.5 + $\Delta L_{cone\ 9}$ (derived from Column 5, Table 13, for π_0 = 9). Successively supply transducer ИДО-Д$_2$ with the pressure $P_{2\ excess}$ at π_0 = 7 and π_0 = 9 and turn adjusting potentiometers R_2 and R_1 to set the cone in the predetermined positions, with the permissible errors taken into account.

After the adjustment is over, securely tighten the locknuts of adjusting potentiometers R_1 and R_2. Make sure that the tightening has not caused maladjustment by making another check of the pre-determined cone positions at π_0 = 7 and 9. Enter the obtained values into Column 6, Table 13;

(i) check the cone extension values at each value π_0 specified in Table 13 by supplying the pressures listed in Column 4, Table 13 to transducers ИДО-Д$_2$. Enter the results obtained into Column 6, Table 13. The values of actual cone extension determined by the measuring rule of the arrangement should not differ from the respective values listed in Column 5, Table 13 by more than the permissible error given in Column 7, Table 13.

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In case the check proves that the cone extension is normal at π_0 = 7 and 9
and is out of tolerance at other values of π_0, it is allowed to make an adjust-
ment at π_0 = 7 and 8, or π_0 = 8 or 9;

(j) enter the cone extension values estimated at specified values π_0
(Column 6, Table 13) into the Appendix to the Aircraft Log and use them as basic
for other checks of system УВД-2М made during scheduled maintenance;

(k) check the values of the additional cone extensions by shifting the air-
craft control stick as described in Section "Checking Cone Control System Automatic
Operation". If the cone extension differs from the desired values, make additional
adjustment of the system as described in Item 14 of Section "Adjustment of System
after Replacement of Unit БУК-2А";

(l) close the cover of unit БУК-2А, install the unit into its place, lock it,
mount the units which have been previously removed to make an access to the replaced
units, uncouple the hose of the panel, connect the pipe to transducer МДО-Д2. Remove
the arrangement from the air intake and turn off all switches and circuit breakers
engaged for adjustment of the system.

7. After replacing the МДО-1 set, estimate the temperature referred cone ex-
tension ($L_{cone, referred}$, per cent) when the engine is running and enter the value
into the Appendix to the Log. Use these values ($L_{cone, referred}$, per cent) as basic
parameters of the given engine and complete set МДО-1 each time when checking the
system as specified by the Instructions.

8. Further checking of system УВД-2М should be made on the basis of parameters
of the newly adjusted system, i.e. the basic cone extension data used for further
checks are not the data which have been specified at the Manufacturing plant, but
the data obtained during adjustment of the system after replacing unit БУК-2А
or МДО-1 complete set.

Replacement of Cone Position Indicator УПВС-3

1. Uncouple the electric connector from the cone position indicator mounted on
the instrument panel left-hand console, and remove the indicator.

2. Set a new indicator УПВС-3 instead, secure it and couple to the electric
connector (Fig. 48).

3. After replacing the indicator, check the manual cone control operation of
the system as described in Section "Checking УВД-2М System Operation". Inasmuch as
the indicators are interchangeable, no additional adjustment of the system is re-
quired after replacement of the indicator.

Replacement of Feedback Pick-Up ДОС-3 with Drive П-1

Reach the feedback pick-up through the equipment bay hatch and remove unit
2ПАС-21 together with its panel.

Reach the cone hydraulic cylinder through the open hatches in the L.G. nose
strut well. The feedback pick-up is secured to the bracket installed on the side
of frame No. 3 (Fig. 49).

While replacing the pick-up, observe the following priority:

1. Remove the hatch covers and the equipment that may block the way to the
pick-up and cone hydraulic cylinder, and replace the pick-up.

2. To set the cone in the fully retracted position, proceed as follows:

(a) connect the main hydraulic system to the ground hydraulic pump and obtain
an operating pressure of 180 to 215_{-15} kg/cm^2;

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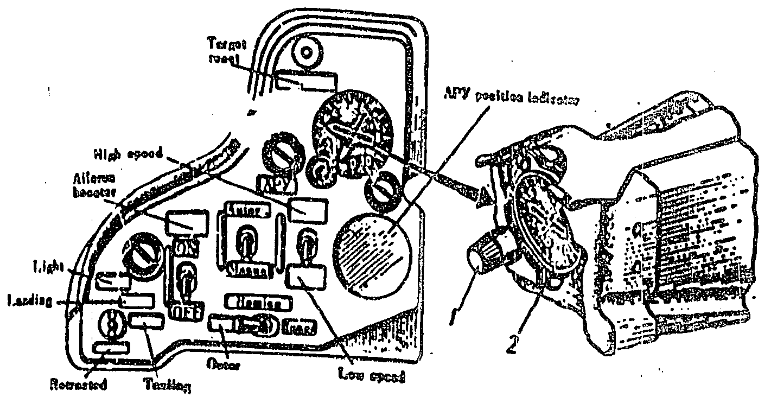

FIG. 68. CONE POSITION INDICATOR [illegible]
1 – cone manual control knob; 2 – cone position indicator [illegible].

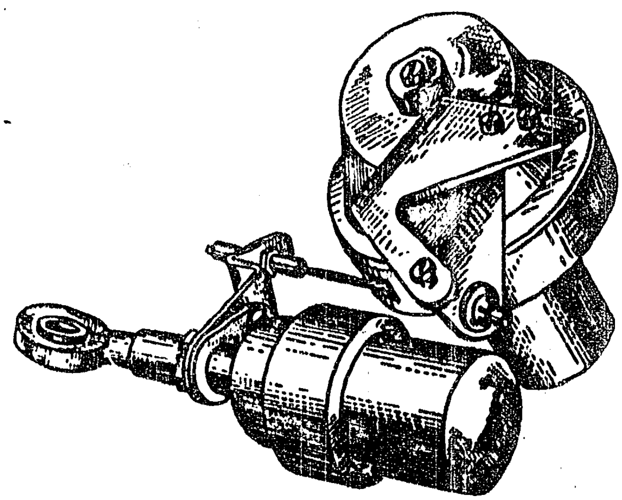

FIG. 69. FEEDBACK AND INDICATION PICK-UP [illegible] WITH DRIVE [illegible]

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(b) couple the ground electric power supply to the aircraft, turn on switch BATTERY, AIRCRAFT - GROUND, switch on circuit breakers CONE AND SHUTTER CONTROL, and L.G. WARNING, NAVIG. LIGHTS, set switch CONE CONTROL in position OFF and turn the cone selector switch into position AUTOMATIC. As a result, a signal to retract the cone is applied to unit AY-35-1 so that the cone is caused to retract completely.

3. To check whether the cone fully retracted position is correct, install the arrangement for measuring the cone extension into the air intake duct. Align the reference mark line on the cone surface with the stop on the arrangement strut support to make sure that the cone adjusted length is 33 ±1 mm relatively to the air intake edge.

The above-mentioned cone adjusted length is set at the Manufacturing plant. In case the length requires adjustment (after replacement of the hydraulic cylinder), change the length of the cone hydraulic cylinder rod. After adjustment, safety-wire the rod butt and put it under load. When the cone is demounted in the course of use of the aircraft, never turn the rod butt to change the rod length since this will disturb the adjustment of system УВД-2Н.

Note: In order to align the reference stop exactly at 33 mm relatively to the air intake edge, it is advisable that a control measuring plank, 33 mm long, should be used by fitting it between the air intake edge and the reference stop (Fig. 50).

4. When the cone control system is switched on and the adjusted length of the retracted cone is set as described in Item 3, check if the УПКС-3 cone position indicator narrow pointer travels to division 0 ±3 per cent.

5. To extend the cone, depress the ПКС-2К panel button LAMP CHECKING and see that the cone is extended completely.

6. To retract the cone, release the ПКС-2К panel button LAMP CHECKING and check again if the cone adjusted position measured by the arrangement is exact (i.e. check if the retracted cone mark lines on the pick-up drive coincide when the indicator narrow pointer is at 0 ±3 per cent).

7. Make sure that the retracted cone mark lines on the pick-up drive coincide when the cone is retracted and the indicator narrow pointer is at 0 ±3 per cent.

8. Extend and retract the cone by depressing and releasing the ПКС-2К panel button LAMP CHECKING and check that the pick-up drive reference mark lines coincide when the cone is extended and retracted and that the indicator pointer is set in the respective position. Check that the permissible misalignment of the extended cone mark line on the pick-up drive housing and the . rk line on the drive roller lie within 0^{+1}_{-3} mm. When the cone is set in the retracted position, make sure that the pick-up drive mark lines are aligned, that the cone adjusted length determined with the help of the arrangement is 33 ±1 mm and that the УПКС-3 indicator narrow pointer is at 0 ±3 per cent.

9. Install all units previously demounted, close the hatches, and turn off all circuit breakers and switches engaged while replacing the pick-up.

Replacement of Unit AY-35-1

Unit AY-35-1 is arranged on the left side of the nose strut well between frames Nos 5 and 6.

To replace unit AY-35-1 proceed as follows:

1. Uncouple the hydraulic pipes from the AY-35-1 unit pipe connections and stop them with special plugs. Separate the electric connector from the unit and wrap it up with cellophane.

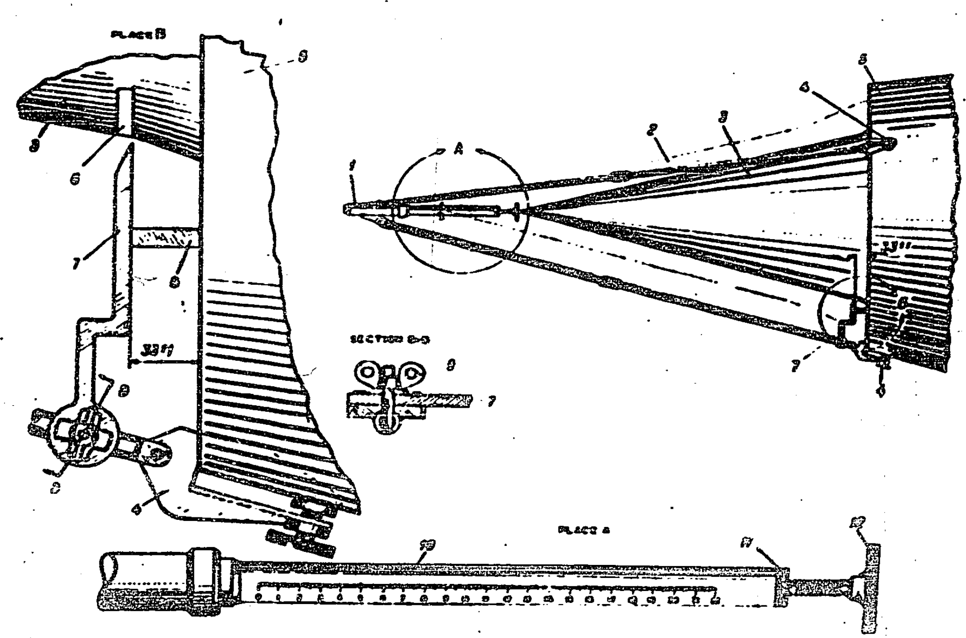

FIG. 22. [illegible]

1 – [illegible]; 2 – extended cone; 3 – retracted cone; 4 – clamp; 5 – [illegible]; 6 – cone adjusted position reference line; 7 – cone adjusted position measuring head; 8 – measuring head setting reference line; 9 – [illegible]; 10 – measuring rule; 11 – [illegible]; 12 – stop.

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2. Screw off four attachment nuts and remove the AY-35-1 unit from the aircraft.

3. Prepare a new unit AY-35-1 for mounting as is described in the Instructions and Certificate supplied with the unit. Install and secure the new unit. Insert new fixing washers 15A49-8 under the attachment nuts. Connect the hydraulic system pipelines to the unit. Use wire KOH-0.8 to lock the union nuts of all pipeline joints and check the joints for tightness. Couple the connector to the unit and lock it.

When replacing unit AY-35-1, remove its pipe 73-5511-10-002 to attach it to the new unit AY-35-1.

Adjustment of System after Replacement of Feedback Pick-Up MN-3 with Drive B-1 or Unit AY-35-1

1. After replacing either the feedback pick-up or unit AY-35-1, check the operation of system YRD-2M according to the instructions contained in Section "Checking System YRD-2M Every 50±5 Flying Hours or after Replacement of Engine".

2. In case the checking shows that the cone extension program $L_{cone} = f(n_g)$ at the pressure P_1 = 1 atm. abs. does not lie within the permissible ratings listed in Form No. 1 (enclosed in the Appendix to the Aircraft Log), readjust the system according to the instructions given in Items 1 - 10 of Section "Adjustment of System after Replacing Unit HPK-2A".

14. BRIEF DESCRIPTION OF TEST PANEL. OPERATION AND STORAGE

The panel comprises the following main assemblies: the body, cover and board which carries a 2-lit. bottle filled with compressed air charged at a pressure of 50 kg/cm^2 (Figs 51 and 52).

Compressed air delivered from bottle 5 to reducer 9 is first reduced to a pressure of $13_{-0.3}$ kg/cm^2 and then supplied to the system P_2. The desired amount of pressure delivered into the pressure system is controlled by throttle valve 3 and vent valve 1.

The range of pressure delivered by the test panel to the system P_2 lies within $P_{2\ excess}$ = 0 to $13_{-0.3}$ kg/cm^2.

The pressure is measured by the reference pressure gauge, type MO3 x 16, prec. cl. 0.35.

The pressure gauge scale being graduated into 300 divisions, use should be made of the calibration chart to convert the pressure gauge scale values into the respective pressure values (in kg/cm^2). The maximum pressure as estimated by the gauge is 16 kg/cm^2.

The reference pressure gauge must be calibrated on a weight press of a piston-type reference pressure gauge, type MON, according to the data contained in Table 14.

Table 14

Table of Reference Pressure Gauge Calibration

P_2, kg/cm^2	Scale divisions	P_2, kg/cm^2	Scale divisions	P_2, kg/cm^2	Scale divisions
4		7		10	
4.5		7.5		10.5	
5		8		11	
5.5		8.5		11.5	
6		9		12	
6.5		9.5		12.5	

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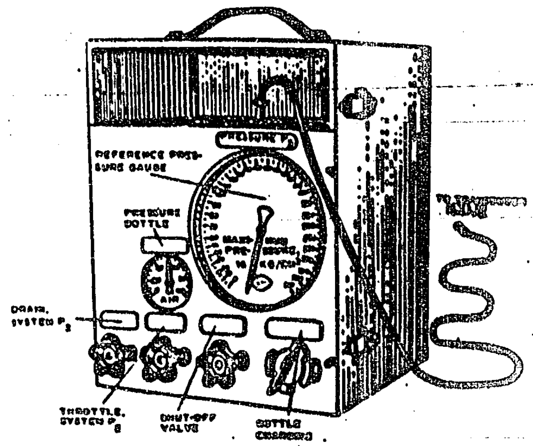

FIG.51. PANEL FOR TESTING SYSTEM [illegible]

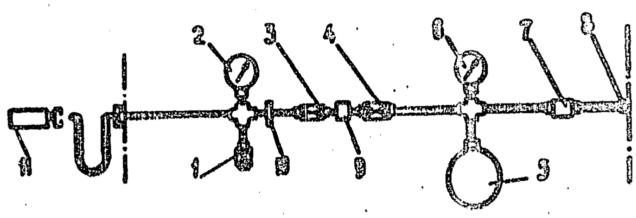

FIG.52. PANEL FOR TESTING CONE CONTROL SYSTEM VRR-SH. SCHEMATIC DIAGRAM

1 – vent valve of system P_3; 3 – pressure gauge of system P_3 up to 16 kg/cm²; 2 – throttle valve of system P_3; 4 – cut-off valve; 5 – air bottle; 6 – air bottle pressure gauge; 7 – filter; 8 – pipe connection with check valve; 9 – reducer (output pressure 12...[illegible] kg/cm²); 10 – throttle washer; 11 – transducer [illegible].

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The above table is employed for constructing the calibration chart of the test panel reference pressure gauge. A version of the calibration chart is shown in Fig. 53. To construct the graph, use graph paper.

Before engaging the test panel, remove the cover and cut off all valves arranged on the panel. Set the panel vertically and couple the hose to transducer ИД-$Н_2$ of the aircraft, having disconnected the pipeline from the transducer.

In order to obtain the required pressure P_2, open shut-off valve 4, slowly open throttle valve 3 and follow the indications of the test panel pressure gauge. As the desired pressure is achieved, close valve 3.

The amount of the required pressure expressed in the pressure gauge scale values is determined with the help of the pressure gauge calibration chart.

To release the pressure, open vent valve 1 slowly since a sharp pressure drop may damage pressure gauge 2.

Storage of Test Panel

Prior to charging the air bottle, close shut-off valve 4 (Fig. 52). To charge the bottle, use dry air at dew point of $-50^{\circ}C$ supplied at a pressure up to 50 ± 2 kg/cm^2, and check the applied pressure against pressure gauge 6.

To achieve reliable operation of the test panel, avoid any shocks or jolting.

To store the panel, use a dry room and keep the panel hose stopped with a plug.

To prepare the panel for long storage (over 4 months) do the following:

1. Wrap the hose nose in cellophane and tie it up with a string.
2. Coat the valves and reducer with a thin layer of petrolatum.

15. CARE OF AIR INTAKE ADJUSTABLE CONE MECHANISM

General

The air intake adjustable cone is displaced by the energy produced by hydraulic cylinder 13 (Fig. 54). The cylinder rod adjustable cap is attached with bolt 14 to the beam interconnecting the telescopic rails of the cone. Guide rails 7 are caused to travel between four couples of rollers 4 anchored rigidly. Installed inside the guide rails is another pair of rails whose joints are used to mount the set.

Apart from its normal travel designed to control the air intake diameter, the cone can be extended additionally over the inside telescopic rails used for examination of the set on the ground.

The front part of cone 1 consists of a radio transparent radome whose circular rim is secured with bolts 2 to cast ring 16.

To make an access to the bolts mentioned above as well as to bolts 9 used to fix the front detachable part of the cone to its rear part, remove outside ring 3 designed to form the boundary layer suction slot. Outside ring 3 is secured with six locks with self-locking bolts.

Care of Cone Mechanism

The care of the adjustable cone mechanism lies in regular examination and cleaning of surfaces of the guide rails, rollers and inside telescopic rails, as well as in checking the easy run of rollers. The above operations must be performed during scheduled maintenance of the set entailing the removal of the set from the aircraft.

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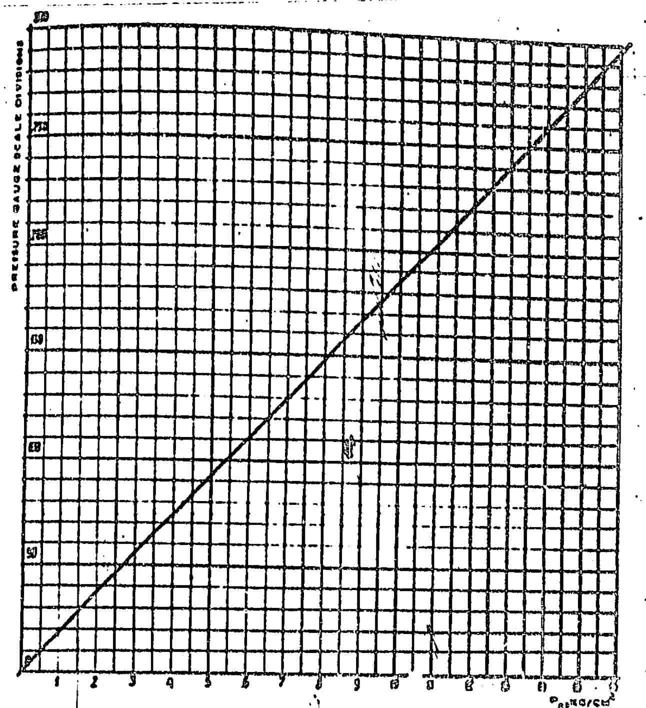

FIG.55. CALIBRATION CHART. VERSION

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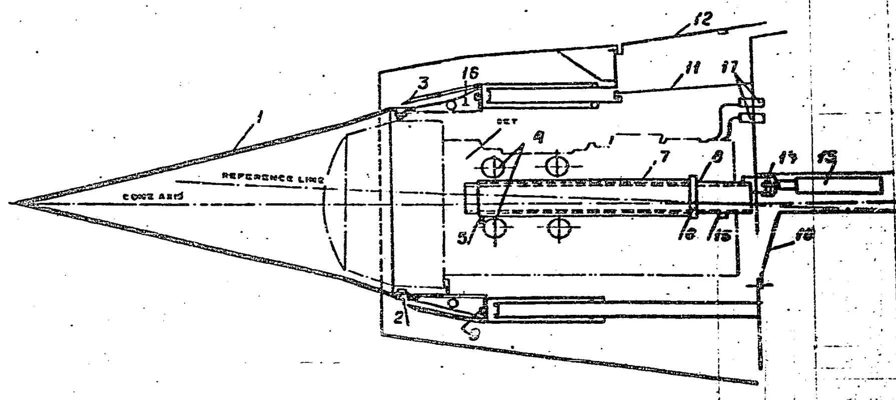

FIG.54. CONE MECHANISM DIAGRAM

1 — cone; 2 — cone attachment bolt; 3 — removable ring; 4 — guide rollers; 5 — thrust bolt; 6 — removable stops 7 — outside rail; 8 — inside rail; 9 — cone frame attachment bolt; 10 — nose strut bay hatch; 11 — hatch; 12 — nose [illegible] hatch; 13 — cone hydraulic cylinder; 14 — cylinder rod attachment bolt; 15 — inside rail stop; 16 — cone ring; 17 — [illegible].

[redacted]

Procedure for Moving-Out and Demounting of Set from Aircraft

The set may be moved out for examination or completely demounted from the aircraft. In both cases an access to the cone mechanism is made.

To move the set out, proceed as follows:

1. Open hatch 12 located above the air intake near frame No. 3 and hatch 11 situated on the inside skin of the cone.

2. Disjoint the manufacturing connectors of the set circuitry that come outside the container and disconnect the set pressurisation unit hose. The above operations are performed by the personnel responsible for maintenance of the set.

3. Open hatch 10 through the L.G. nose strut well.

4. Unlock, turn out and remove bolt 14 securing the hydraulic cylinder rod. On installing the units back in their proper places, turn in bolt 14 and lock its head with wire KOK-0.8.

CAUTION. In the course of use of the aircraft, never change the length of the hydraulic cylinder rod by turning the rod butt since this may lead to maladjustment of system УВД-2М. See to it that the rod butt is always locked and put under lead.

5. Remove outside ring 3 by screwing off the bolts of six locks by means of a special screw-driver 76-7804-1370.

When securing ring 3, use care to align the reference mark lines notched on the ring and screw in the bolts of the locks without tightening. To tighten the bolts completely, follow the sequence specified in Fig. 55, i.e. after driving home the bolt of the first lock, tighten the bolt of the lock situated oppositely (i.e. of the second lock), then screw tightly the third one and the fourth one, and so on.

After tightening each bolt, make sure that it has been locked so that the butt end of the pin arranged in the bolt groove is flush with the bolt head or protrudes above it by 0.5 mm. Sinking of the pin is indicative of the unlocked condition of the bolt. In case the pin is sunk, turn the bolt off through 1/6 revolution to lock it in place.

6. Roll the cone forward till stops 6 arranged on outside rail 7 come against the limiting stops. As a result, the cone will move out through a length of about 220 mm (Fig. 54).

7. Drive out four bolts 9 arranged along the axis of symmetry and along the cone axis.

8. Roll the cone forward till stop 15 arranged on inside rail 8 comes against limiting bolt 5 of outside rail 7.

In order to remove the set from the aircraft, proceed as follows:

screw off lock bolt 5;

remove the set from the aircraft and place it on a special ground cart.

Inspection of Cone Mechanism
(made during scheduled maintenance)

After removing the set from the aircraft make use of the access to examine inside telescopic rails 8. To check the easy run of the rollers, to wipe the dirt and to examine the outer profile surfaces of outside rails 7, demount the rails together with the rear movable part of the cone. While removing the rear part of the cone, proceed as follows:

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1. Remove stops 6 from guide rails 7 by driving out four attachment bolts in the inside portions of the rails.

It should be noted that since the bolts have been installed on sine white, a sufficient effort is required to screw them off; therefore use should be made of a large-calibre screw-driver.

When mounting stops 6 after disassembling, fix their attachment bolts by applying zinc-white paste based on the natural boiled oil.

2. Remove the rear part of the cane together with the guide rails.

To examine the cone mechanism, observe the following priority:

1. Wipe the guide rail profile surfaces dry to remove dust and dirt and examine them for absence of cracks, nicks, burrs or traces of wear-out caused by the rollers. Apply a thin layer of lubricant ЦИАТИМ-201 to the rail profile surfaces.

2. Moisten a cloth in gasoline and wring it out to wipe the interior surfaces of guide rails 7 and outer surfaces of inside rails 8 so as to remove dirt and lubricant formerly applied; after this coat the surfaces with a thin layer of lubricant ЦИАТИМ-201.

3. Turn all four rollers by hand in succession and make sure that they rotate easily, without jamming and that they have no radial play.

The lubricant is packed into the roller bushings at the manufacturing plant during the aircraft assembly; no lubricant repacking is required before 200 flying hours are over.

4. If it has been detected during checking that the run of the rollers is heavy and that jamming occurs, remove the rollers, examine the axles and bushings and apply fresh lubricant.

Demounting and Installation of Cone Guide Rollers

1. Drive out the locking screw of the roller bolt head washer.

2. Use a socket wrench to screw off the bolt and remove the roller.

3. Examine the bolt, wash the former lubricant from the roller with gasoline, wipe the roller bushing, apply a sufficient amount of lubricant ЦИАТИМ-201 to smear the roller bushing and install the roller back into its place.

4. Drive the axle-bolt home, lock the bolt head with a special washer and stop the washer with a screw. To fix the screw, coat it with zinc white.

Follow the reverse priority when mounting the outside rails, fixing the stops to the rails and installing the cone into the aircraft.

Locking of Bolts Used for Attachment of Cone Radio Transparent Radome

In order to demount or install the removable portion of the radio transparent portion of the cone, observe the order of installation and tightening of the cone attachment bolts indicated on the reference plate secured to the cone (See Fig. 55).

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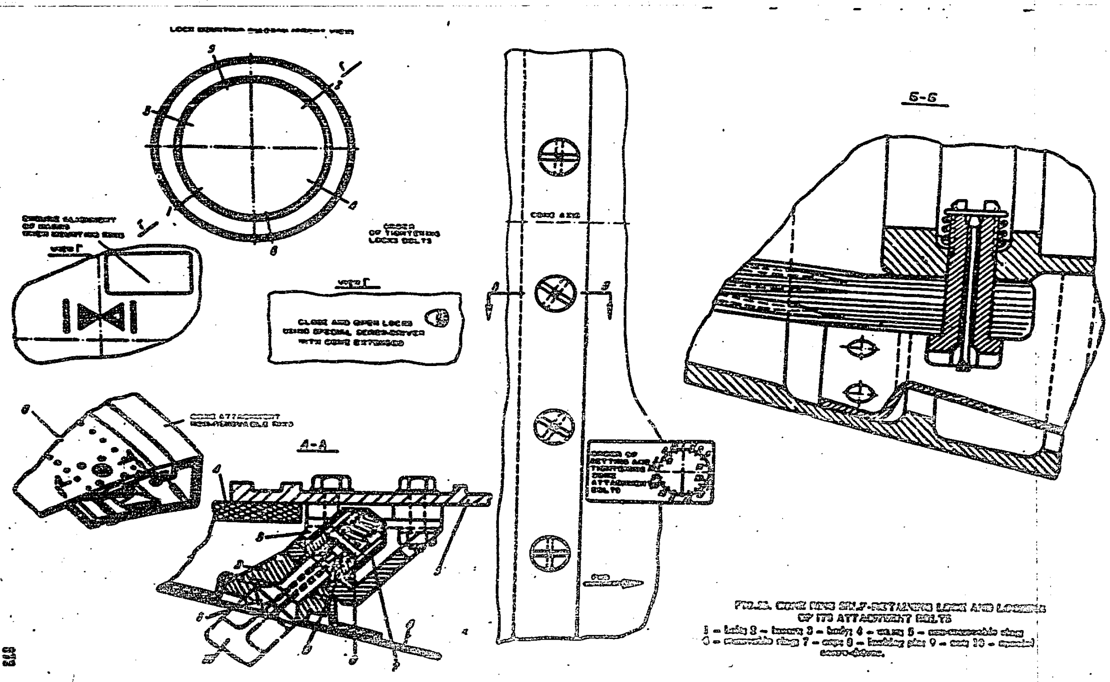

FIG. [illegible] CONE RING SELF-RETAINING LOCK AND LOCKING OF ITS ATTACHMENT BOLTS

1 – [illegible] 2 – [illegible] 3 – [illegible] 4 – [illegible] 5 – [illegible] ring 6 – [illegible] ring 7 – [illegible] 8 – [illegible] 9 – [illegible] 10 – [illegible]

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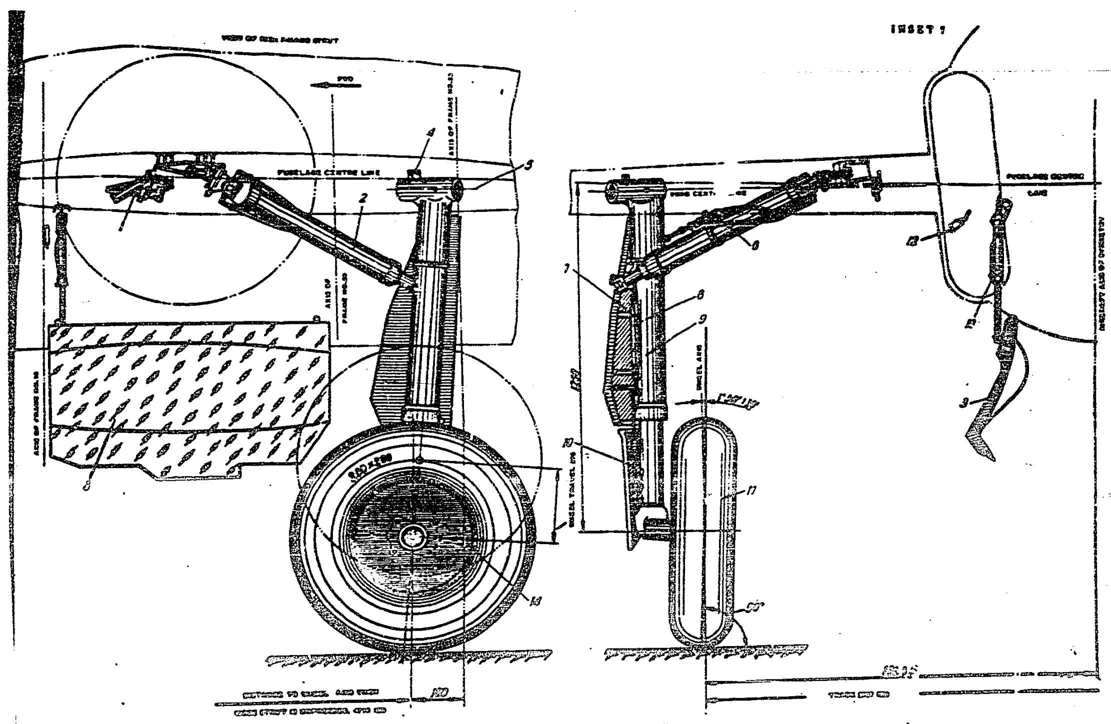

FIG.[illegible] L.G. MAIN STRUT ASSEMBLY

1 – L.G. main strut up-lock; 2 – L.G. main strut extending cylinder; [illegible] 6 – hydrolock; 7 – strut [illegible] 8 – wheel [illegible] during retraction; 9 – L.G. main [illegible] 10 – [illegible] 11 – wheel [illegible] 12 – [illegible] 13 – [illegible] 14 – [illegible]

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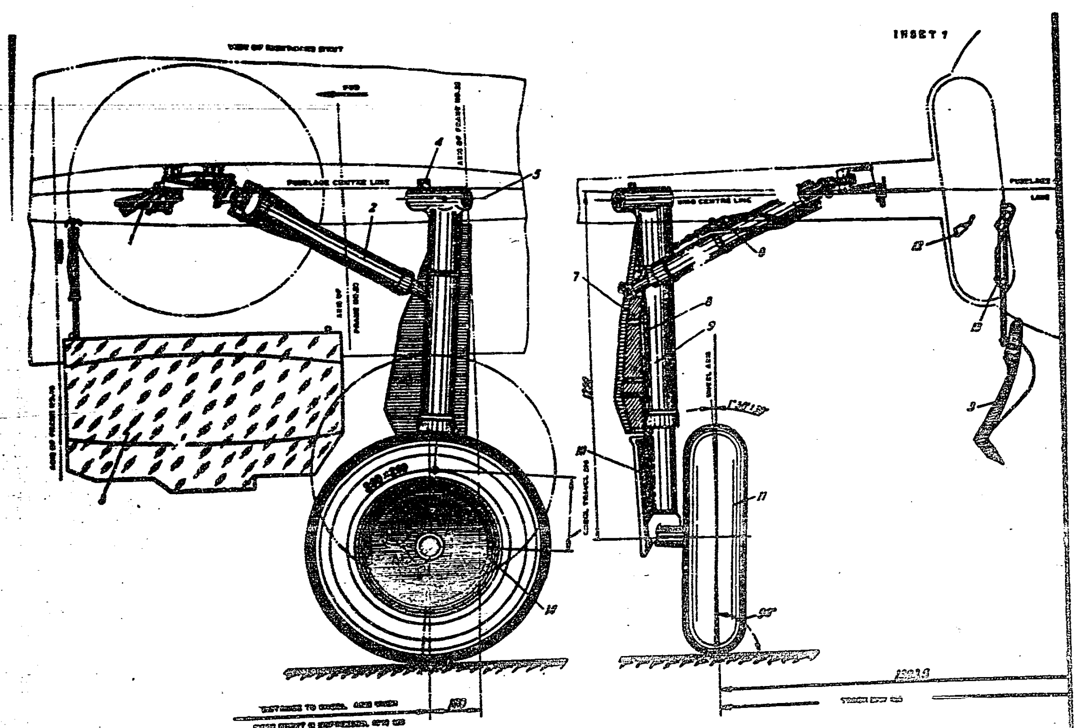

[illegible] L.G. [illegible]

1 — L.G. [illegible] 2 — L.G. [illegible] cylinder 3 — [illegible] 4 — [illegible] 5 — [illegible] 6 — [illegible] 7 — [illegible] 8 — wheel [illegible] 9 — L.G. [illegible] 10 — [illegible] 11 — wheel [illegible] 12 — [illegible] 13 — [illegible] cylinder 14 — [illegible]

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Chapter VII

TAKE-OFF AND LANDING EQUIPMENT

1. GENERAL

The take-off and landing equipment provides taking off from, and landing on, both concrete runways and grass airfields.

The take-off and landing equipment includes the landing gear, wing flaps and a drag chute.

Landing Gear

The aircraft is equipped with a tricycle landing gear retracted during flight. The L.G. main struts (Fig. 56) are fitted with wheels KT-92, size 800x200 B, and air disc brakes and installed in the wings.

In flight, the main struts are retracted into the wings, whereas the wheels turning about the struts are retracted into the fuselage.

The L.G. nose strut of a half-lever action (Fig. 57) secured to frame No. 6 in the fuselage nose portion is fitted with wheel KT-38, size 500x180A, and with two-chamber air brakes. In flight, the nose strut and wheel are retracted forward into the fuselage.

When the main struts are extended, they are retained in place by brace cylinders fitted with mechanical ring locks and hydrolocks. Similarly, the nose strut is equipped with a mechanical lock and a hydrolock.

All struts are retained retracted by mechanical locks (Figs 58 and 59).

The retraction and extension of the landing gear are effected by the hydraulic system, and the emergency extension is produced by the emergency air system. If a necessity arises, the nose strut can be extended independently by means of a special handle which is connected through a cable to the nose strut down lock. The nose wheel is forced out of the fuselage well due to its own weight and action of the airstream.

All three struts employ the hydronitrogen shock absorbers used for braking the forward and backward travel of the strut. The absorbers are arranged inside the struts.

The upper cavities of the main struts are used to store the compressed air of the main air system.

The L.G. nose strut (Fig. 60) is equipped with the following elements:

(a) the mechanism designed to return the nose wheel to the neutral position (in the direction of flight). The wheel return mechanism is housed inside the strut. As the shock absorber is compressed during taxiing, the return mechanism is switched off so that the wheel can be castored. But as the shock absorber is released when taking off, the mechanism is switched on to stop the wheel in the neutral position (in the direction of flight);

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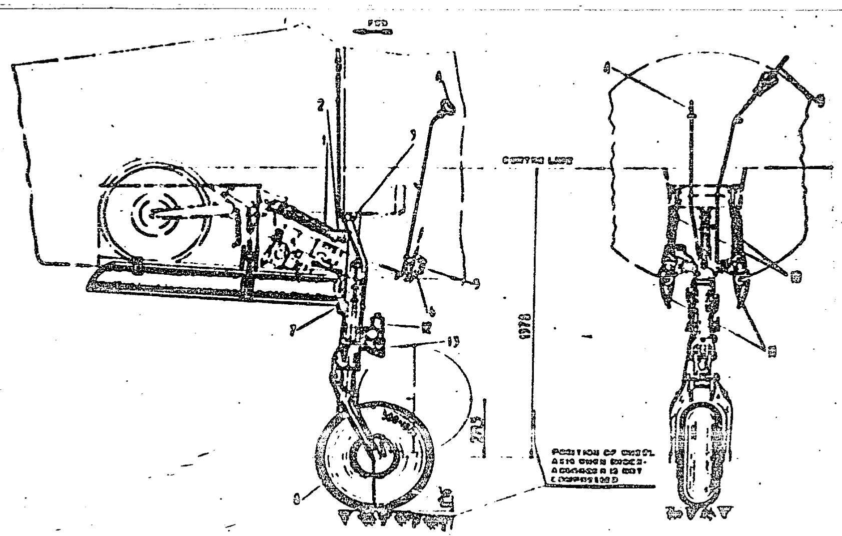

FIG. 87. L.G. NOSE STRUT ASSEMBLY

1 – strut retraction cylinder; 2 – strut down position indicating limit switch; 3 – extended strut stop; 4 – nose strut independent extension handle; 5 – strut upper position indicating limit switch; 6 – strut uplock; 7 – nose strut down position signal light; 8 – wheel KT-38; 9 – nose strut down position mechanical indicator; 10 – nose strut door retracting mechanism; 11 – nose strut well doors; 12 – shimmy damper; 13 – cam-lever drive of shimmy damper.

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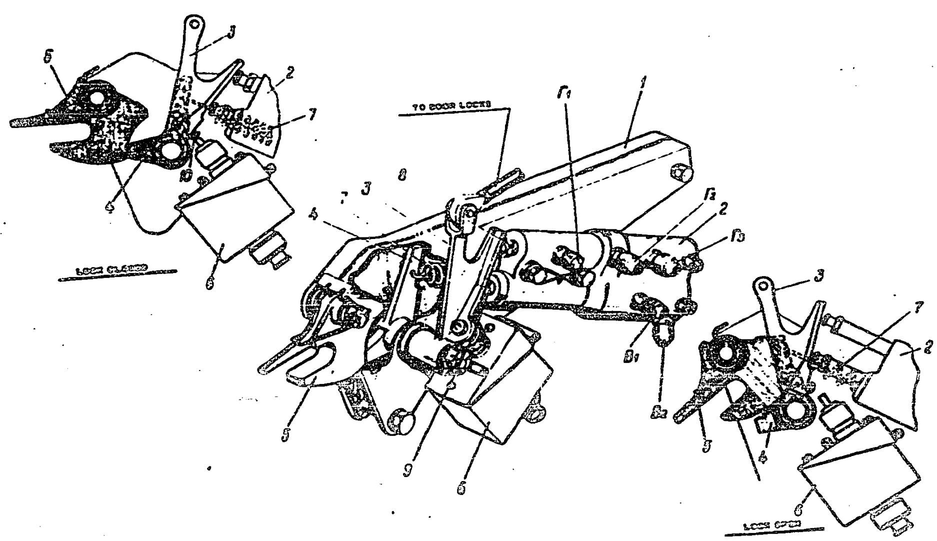

FIG.[illegible] L.G. MAIN STRUT UP-LOCK
1 – lock body; 2 – lock release cylinder; 3 – lever; 4 – cam; 5 – hook; 6 – strut upper position indication limit switch; 7 – spring; 8 – hydraulic cylinder rod; 9 – emergency air cylinder rod; 10 – adjusting screw; Γ_1 – L.G. retraction pipe connection; Γ_2 – main strut cylinder retraction pipe connection; Γ_3 – L.G. extension pipe connection; B_1 – L.G. emergency extension pipe connection; B_2 – L.G. main strut cylinder pipe connection (emergency extension)

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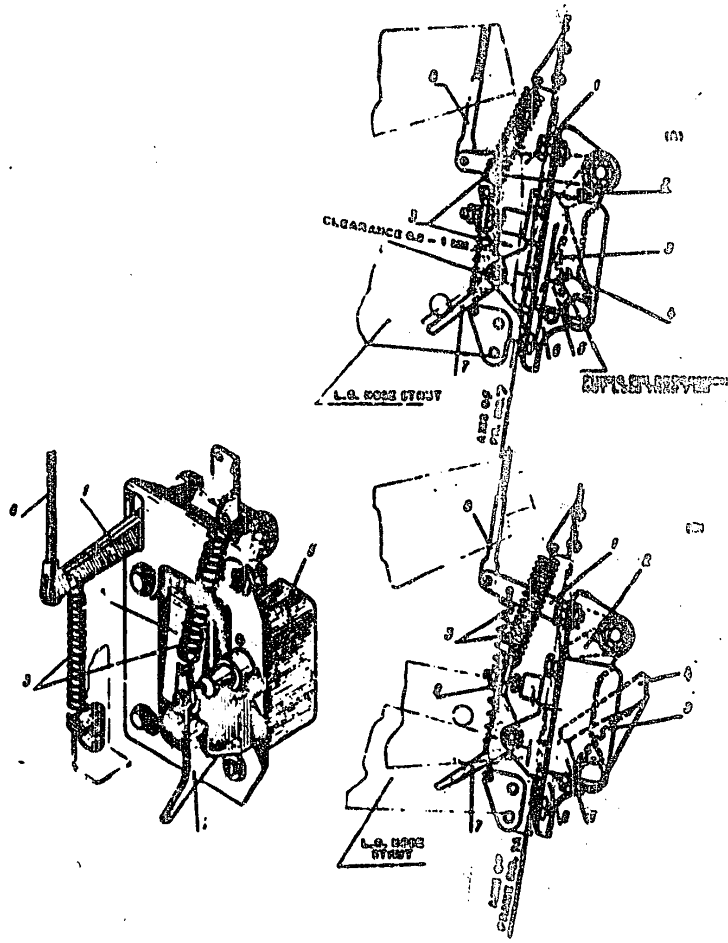

FIG.59. L.G. NOSE STRUT UP-LOCK
1 – lever; 2 – cam; 3 – springs; 4 – support lever; 5 – strut upper position indication limit switch; 6 – bracket; 7 – warning system lever; 8 – cable from strut independent extension handle; 9 – adjusting screw.

(a) nose strut extension by hydraulic system or emergency extension by air system (lock is closed, nose strut fixing pin is sunk, warning circuit is broken by limit switch, red light is off);
(b) nose strut independent extension by own extension handle (lock is open, nose strut fixing pin is not sunk, warning circuit is broken by limit switch, red light is off).

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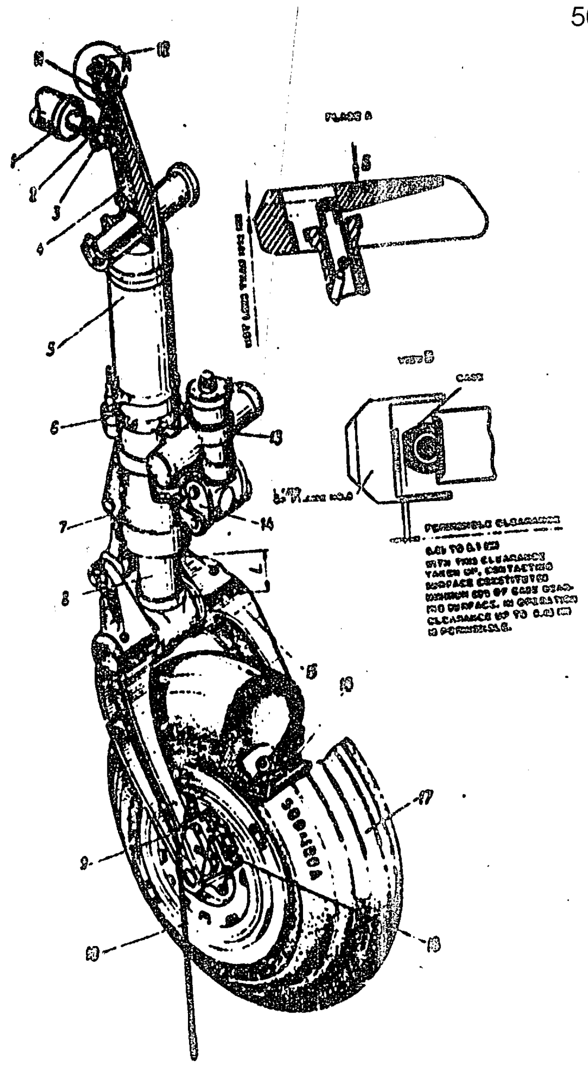

FIG.69. L.G. NOSE STRUT

1 – strut retraction cylinder; 2 – link; 3 – link-to-retraction cylinder attachment bolt; 4 – spring; 5 – strut upper sleeve; 6 – signal light; 7 – strut lower attachment unit; 8 – strut rod; 9 – brake pipe connection; 10 – grounding cable; 11 – bolt connecting link with fixing pin; 12 – strut fixing pin; 13 – shimmy damper; 14 – non-linear drive; 15 – strut fork; 16 – chamber charging (gas connection); 17 – wheel KT-38; 18 – inertia pick-up YA-24/TS-8

Shock absorber compression at parking
at normal take-off weight, L = 71±5 mm
at maximum take-off weight, L = 87.5±5 mm.

(b) the damper non-linear drive intended to set wide angles of the damper carrier travel when the wheel is displaced through narrow angles within ±15° off the neutral line (i.e. the probable angles of shimmy) and thus to prevent shimmy, and to set narrow angles of the damper carrier travel when the wheel is displaced through wide angles up to ±50° which facilitates taxiing of the aircraft since the amount of work expended to actuate the damper in this case is almost zero;

(c) the damper used to avoid sustained oscillations (shimmies) of the L.G. nose strut which are caused during the aircraft run (Fig. 72).

The shimmy damper is fitted with a compensating chamber designed to add working fluid AMT-10 to the damper operating chambers while in operation.

The fluid contained in the compensating chamber is permanently compressed by the spring-loaded piston whose rod extends through the upper portion of the chamber.

The amount of fluid AMT-10 contained in the compensating chamber is determined by the length of the extending part of the rod. To check up the level of fluid AMT-10 in the damper, the rod bears two reference lines. If the white reference line on the rod coincides with the surface of the top cover of the compensating chamber, the amount of fluid AMT-10 contained in the damper is said to be normal at +20 ±10°C. Notched above the white reference line is the red reference line which indicates the small amount of fluid.

The shimmy damper is considered to operate normally, if the red reference line on the rod does not disappear.

If the fluid temperature varies within ±55°C, the white reference line may be situated 2 to 3 mm above the top cover edge when the damper is properly charged with fluid. In the case of negative temperature or leakage from the shimmy damper the white reference line settles itself above or below the compensating chamber top cover edge.

The shimmy damper is simultaneously used as a thermal compensator when the volume of fluid varies due to its heating or cooling.

The L.G. main strut (Fig. 61) is fitted with the following elements:

(a) the wheel axle shaft turning mechanism composed of rods, bell-cranks, yokes and kinematic lock which is used for stopping the axle shaft with the wheel when the L.G. is set up or down;

(b) the actuating hydraulic cylinder with a mechanical down-lock and a hydraulic lock also used for retaining the struts in the extended position.

L.G. Basic Specifications

Nos	Name	Main struts	Nose strut
1	Type of shock absorption	Hydronitrogen	Hydronitrogen
2	Working fluid charged into shock absorbers	AMT-10, GOST 6794-53	AMT-10, GOST 6794-53
3	Full travel of shock absorber	275 ±2 mm	85^{+2}_{-3} mm
4	Type and size of wheels	KT-92 800x200B	KT-30 500x180A

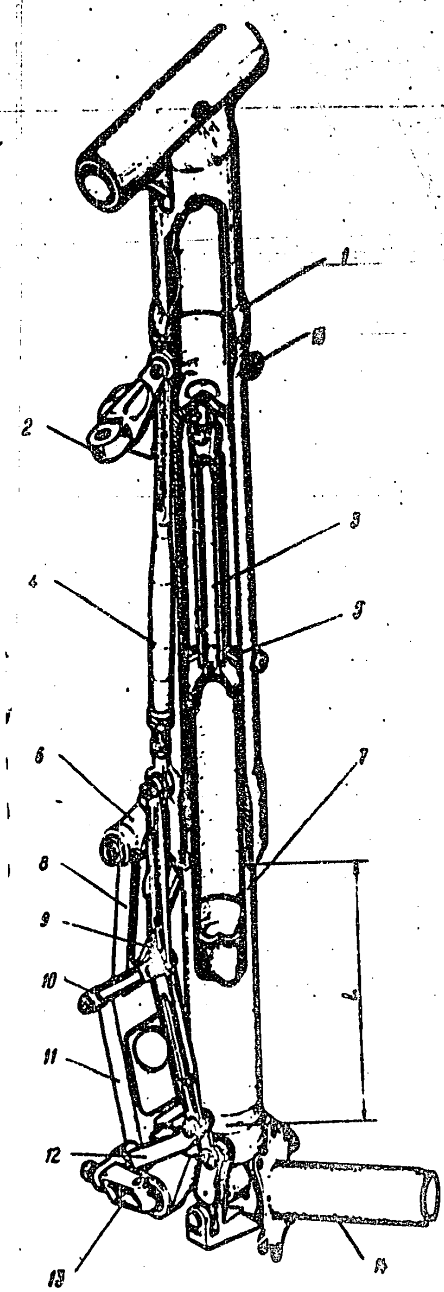

FIG.61. L.G. MAIN STRUT

1 – strut sleeve; 2 – actuating hydraulic cylinder bolt; 3 – strut plunger; 4 – adjusting rod; 5 – upper boss; 6 – bell-crank; 7 – strut rod; 8 – upper cross-member; 9 – rod; 10 – bell-crank; 11 – lower cross-member; 12 – bell-crank; 13 – bracket; 14 – axle shaft; 15 – charging valve.

Shock absorber compression at parking at normal take-off weight, $L = 93^{+10}_{-5}$ mm; at maximum take-off weight, $L = 83^{+10}_{-5}$ mm.

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No	Name	Main struts	Nose strut
5	Initial pressure of nitrogen in shock absorber at normal and maximum take-off weights	24 ±1 kg/cm²	37 ±3 kg/cm²
6	Pressure in the pneumatic tyres at normal and maximum take-off weights	$7.5^{+0.5}$ kg/cm²	$7^{+0.5}$ kg/cm²
7	Pneu (tyre) deflection:		
	(a) at normal take-off weight	50 mm	30 mm
	(b) at maximum take-off weight	60 mm	30 mm

Notes: 1. The method of measuring the compression of shock absorbers at parking is shown in Figs 60 and 61.

2. Under the conditions of grass airfields:
   (a) the initial pressure in the nose strut shock absorber at normal and maximum take-off weight should be 40 ±1 kg/cm²;
   (b) the nose strut shock absorber compression at parking is L = 42 ±3 mm at normal take-off weight and L = 37 ±3 mm at maximum take-off weight.

Wing Flaps

In order to reduce the take-off run of the aircraft and to diminish its speed at landing, the butt trailing portion of the wing is provided with flaps.

The flaps can be set in either of the two positions: extended or retracted. The flaps are controlled electrohydraulically (Fig. 62). When the flaps are retracted, they are retained in this position by the hydraulic cylinder ball locks and by the pressure applied by the working fluid, and when they are extended, it is the working fluid pressure alone that keeps them in place.

The wing flaps are of a float design.

When the wing flaps are extended and the speed increases, the dynamic pressure forces the working fluid out of the extension cavity of the hydraulic cylinders which in turn brings about a decrease in the wing flap deflection angle.

The wing flaps must start retraction when the flight speed amounts to 340 km/hr. As the speed is achieved, the dynamic pressure acting upon the wing flap surfaces is not sufficiently high to exceed the forces produced by the hydraulic cylinders, therefore the retraction cavity pipe connection of the cylinder is supplied with a constant pressure delivered from the hydraulic system bypassing valve ГА-184У. Thus, the wing flaps are caused to start retraction when the speed amounts to, or exceeds, 340 km/hr.

Consequently, valve ГА-184У supplies the fluid only to extend the wing flaps, and returns the fluid when the wing flaps are shifted to retract. The retraction line pipe connection of the valve is stopped with a plug. The wing flaps are extended by virtue of difference in extension and retraction areas of the cylinder piston, i.e. by virtue of a greater area of the piston in the extension cavity of the cylinder.

Arranged on the horizontal portion of the left-hand console inside the aircraft cockpit is a two-button mechanism designed to control the wing flaps.

The mechanism is provided with two buttons RETRACTED and EXTENDED used to control the position of the wing flaps by depressing the respective button. The wing flap control mechanism is not fitted with light indication system. The position of the wing flaps is indicated by the warning light mounted on the [illegible] panel inside the cockpit.

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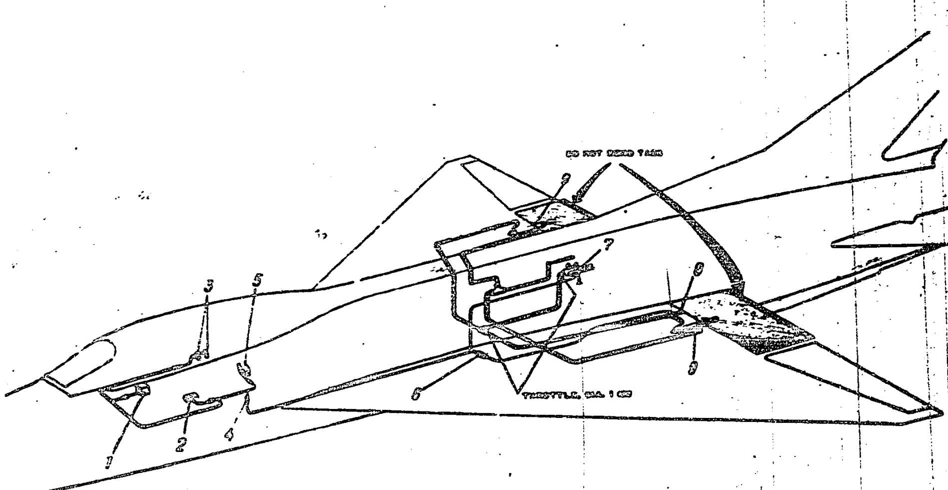

FIG.62. WING FLAPS CONTROL SYSTEM

1 – [illegible] landing director indicator; 2 – wing flap mechanism [illegible]; 3 – circuit breaker L.G., WING FLAPS; 4 – control [illegible]; 5 – relay box; 6 – wing electric connector; 7 – valve [illegible]; 8 – microswitch [illegible]; 9 – actuating cylinder.

[redacted]

Drag Chute

To reduce the landing roll, the aircraft is provided with a drag chute, type ПТ-21.

The drag chute consists of a canopy, shroud lines, cover, pull, link, cotter pin operating cable with a flag and an auxiliary cable chute.

Folding of the drag chute into the cover and packing of the removable container are performed according to the Drag Chute Operating Instructions by a parachute rigger who uses a special bench for the purpose. After packing, the container with the chute and pull cable are inserted into the aircraft drag chute bay and closed with the doors. The doors are secured with a lock and safetied with wire КТК-1.

The drag chute cable is packed into the clamps (lugs) of the ventral fin and into the fuselage tail groove; its one end is attached to the shroud line dead-eye by means of a fork and the other is secured to the link which in its turn is fastened with a shackle to the chute attachment lock installed in the aircraft tail portion (Fig. 73).

The link is designed to couple the cable to the chute attachment lock with the help of a special shackle. The link is made of an elastic high-strength capron cord.

In the process of use of the drag chute, type ПТ-21, the following factors should be taken into account:

1. The normal speed to release the drag chute is 250-260 km/hr.
2. The maximum speed to release the drag chute is not more than 310 km/hr.
3. In case the chute has been released at a speed above 310 km/hr, it must be replaced together with the pull cable and link.
4. The guaranteed number of releases of drag chute ПТ-21 presented in Table 15 depends upon the speed at which the chute is released during landing.

Table 15

Number of Releases of Drag Chute ПТ-21

Speed, km/hr	Number of releases	Notes
310	Once	Maximum allowable speed
290	Twice	
280	20 times	Maximum operating speed
250 to 260	40 times	Average operating speed

It is the duty of the parachute rigging personnel that immediately after taxiing the aircraft to the parking place, they should gather the drag chute from the runway, put it into the pack, transport to a respective place and prepare it for a repeated flight according to the Operating Instructions of Drag Chute ПТ-21.

2. L.G. RETRACTION-EXTENSION PROCEDURE AND CHECKING OF L.G. OPERATION

L.G. Retraction and Extension

To make a check test of the L.G. retraction and extension (Fig. 69), observe the following procedure:

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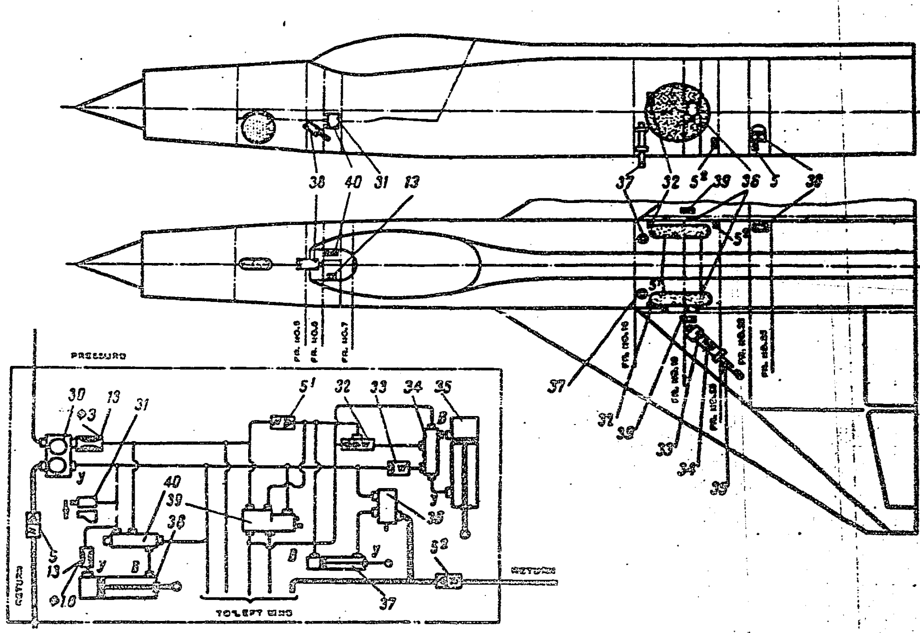

FIG.43. L.G. CONTROL SYSTEM

5 – check valve; 13 – throttle; 30 – ГА-142/1 valve; 31 – automatic brake cylinder; 32 – emergency valve; 33 – one-way throttle; 34 – L.G. main strut actuating cylinder hydrolock; 35 – L.G. main strut actuating cylinder; 36 – sequence valve; 37 – L.G. main strut wheel door cylinder; 38 – nose strut actuating cylinder; 39 – L.G. main strut up-lock cylinder; 40 – L.G. nose strut actuating cylinder hydrolock.

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1. Jack up the aircraft until the wheels are clear off the ground.

2. Couple to the ground electric power supply.

3. Couple to the ground hydraulic pump.

4. Produce the operating pressure in the main hydraulic system.

5. Shift the L.G. change-over handle first into position EXTENDED and then into position RETRACTED. 10 to 15 sec. after the L.G. red signal light comes on, shift the L.G. change-over handle into the neutral position and fix it with a catch.

6. Set the L.G. change-over handle in position EXTENDED. 10 to 15 sec. after the L.G. green signal lights go on, shift the change-over handle into the neutral position and fix it with the catch.

The extension of the L.G. nose strut is also checked by the extension of the mechanical L.G. nose strut position indicator.

Note: During landing see that the L.G. change-over handle is in position EXTENDED. The L.G. change-over handle should be kept in this position as long as the aircraft is taxied to the parking place; after the taxiing is over the handle should be set in the neutral position and fixed with the catch.

7. Jack down the aircraft to position it on the wheels.

CAUTION. The ground hydraulic pump should not be switched off earlier than one minute after the L.G. valve handle is turned into position EXTENDED and the L.G. green signal light goes on. After this shift the L.G. valve into the neutral position and jack the aircraft down. In this case the strut is fixed by the mechanical down-lock.

Checking Independent Extension of L.G. Nose Strut

1. Jack up the aircraft by means of the wing and nose jacks till the wheels are clear off the ground.

2. Couple to the ground electric power supply and hydraulic pump, retract the L.G., and shift the L.G. valve into position NEUTRAL.

3. Turn the independent extension handle arranged in the lower part of the instrument panel and release the nose strut up-lock; as a result, the nose strut will extend by gravity. To engage the lock, elevate the strut manually and then close the retracted position lock.

In case the lock is released, close it manually; for this pull up the L.G. nose strut independent extension handle as far as it will go and reaching support lever 4 (Fig. 59) through the access door located between frames Nos 6 and 7, set it in the position which corresponds to the closed position of the lock. To check the strut position, observe the electrical and mechanical indication arrangements. Check if the fixing pin is inserted into the up-lock through not less than 10±2 mm and that there is a clearance of 0.05 to 0.45 mm (Fig. 60).

After the independent extension of the nose strut set the handle into its initial position and safety it with wire KOH-0.5.

4. Make 3 or 4 check cycles of retraction and extension of the landing gear by engaging the hydraulic system.

5. Jack the aircraft down on the ground.

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Checking Landing Gear for Good Condition

1. Examine the welds on the struts and L.G. assemblies using a lens; pay particular attention to the end points of the welds and to boundaries between the welds and the metal base.

Prior to examination, remove dust and dirt from the welds and wash the welds with gasoline. In case a crack has been detected, remove the damaged strut or assembly and send it for repair.

2. Check the total play at the wheel axle acted upon by a force of 30 kg applied along and across the axle; the play must not exceed:

(a) 8 mm for the main struts, and

(b) 5 mm for the nose strut.

3. Measure the main strut wheel door play in the direction of the door rotation at one end with the main and nose struts extended; the play must not exceed 12 mm when a force of 2 to 3 kg is applied. (No play in the doors anchored to the strut is permissible).

The play in the nose strut wheel doors, measured in the direction of rotation at the ends of the doors, should not exceed 7 mm when a force of 2 to 3 kg is applied to the end of the door.

4. Align the outside surface of the doors when the L.G. is retracted (the valve handle is set in position NEUTRAL) with the contour of the wing and fuselage. Measure the clearances between the doors and the edges of ports in the wing and fuselage for correspondence to the values listed in Fig. 64.

Note: In the course of use of the aircraft, wear-out of the hinge joints and residual deformation of the struts may lead to a reduction in clearance along the tail edge of the wing doors to a value of 3 mm. A clearance of 3 mm is indicative of high residual deformation caused by rough landing at high speeds.

If the clearance is less than 3 mm, replace the struts. Never file off the tail edge of the doors or the edge of the skin along the wing cut-out to obtain the desired clearance.

5. While the aircraft is on the ground, measure the tyre pressure; after the aircraft has been jacked up, measure the pressure in the shock absorbers.

6. Note the position of the red mark lines on the tyre and on the wheel rim to make sure that the tyre does not slip off the rim of the wheel. In the case of misalignment of the mark lines, check the condition of the tube and charging fitting.

3. CHECKING AND ADJUSTMENT OF L.G. POSITION INDICATION SYSTEM

In order to check the operation of the L.G. retracted and extended position indication system, observe the glow of lights arranged on panel ШС-2К inside the cockpit while the struts are being retracted and extended.

In case the indication system fails to operate normally, make an adjustment according to the instructions given below.

Extended Position of L.G. Main Struts

Check that the respective green signal lights go on as the struts move into their extreme extended position.

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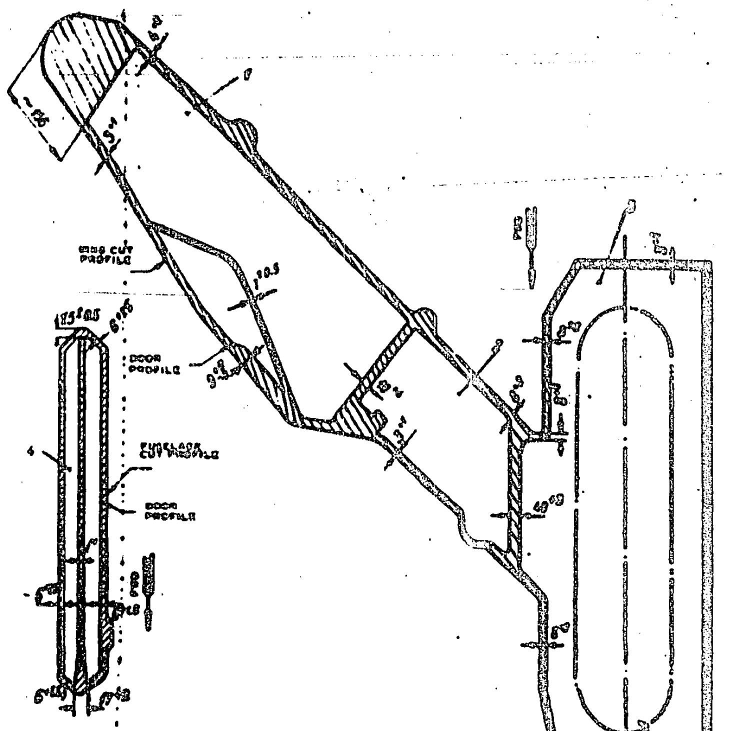

FIG.66. CLEARANCES IN L.G. DOORS
1 – strut door; 2 – cross-member door on strut; 3 – L.G. well door; 4 – nose strut door.

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To adjust the L.G. main strut extended position signalling, proceed as follows:

1. Jack up the aircraft with the wing and nose jacks until the wheels are clear off the ground.

2. Couple to the ground electric power supply and hydraulic pump.

3. Fix the L.G. main strut hydraulic cylinders with the mechanical locks by shifting the L.G. valve handle into position RETRACTED and apply the hydraulic pressure to shift the main struts through an angle of 45 to 50°.

After this, shift the L.G. valve handle into position EXTENDED and keep the handle in the above-mentioned position for one to two minutes before shifting it into position NEUTRAL.

4. Apply a for[ce] to the wheel to displace it in the direction of retraction and try to retract the strut manually, pushing it by jerks. A hard check will testify the closure of the lock.

5. Make sure that the hydraulic cylinder mechanical lock is closed, and then adjust the limit switch proceeding as follows:

(a) screw off the lock nut and drive in the adjustment screw of the strut yoke all the way to the screw (Fig. 65,a);

(b) apply a force of 50 kg to the wheel acting in the direction of the extended position of the strut, and drive out the adjustment screw carefully to avoid pushing the limit switch rod by the hand. Stop driving out the screw when the green light goes on at panel ШПС-2К inside the cockpit.

After this, drive out the screw through half or one and a half turn.

Apply a force of 50 kg to the wheel axle acting towards the retracted and extended positions of the landing gear, to take up the play of the strut, and make sure that the green signal light on panel ШПС-2К inside the cockpit does not come off;

(c) sink in the limit switch rod till it stops and measure additional travel (play) of the rod to check if it is not less than 2 mm (Fig. 65,a);

(d) safety the adjustment screw of the yoke with a lock nut and washer (Fig. 65,a).

6. After adjusting the microswitch, make 3 to 4 check cycles to extend and retract the L.G. struts and check the indication system for stable operation.

7. In case the operation of the indication system is not stable, unlock the adjustment screw, drive it out through half a turn, safety the screw again and perform the operations described in Item 6.

Retracted Position of L.G. Main Struts

To adjust the retracted position indication system, extend the landing gear after the aircraft has been jacked up and the ground electric power supply and hydraulic pump have been connected, and proceed as follows:

1. Close the mechanical up-lock by closing hook 5 by hand (Fig. 59) after the rods of the lock hydraulic and emergency cylinders have been sunk (with the L.G. valve handle set in the neutral position).

2. Unlock the adjustment bolt (Fig. 65,b) and drive it out till the red light on panel ШПС-2К goes on.

3. Screw off the adjustment bolt a little more to sink the limit switch rod by 1 to 1.5 mm, and check if the red light on panel ШПС-2К continues to glow.

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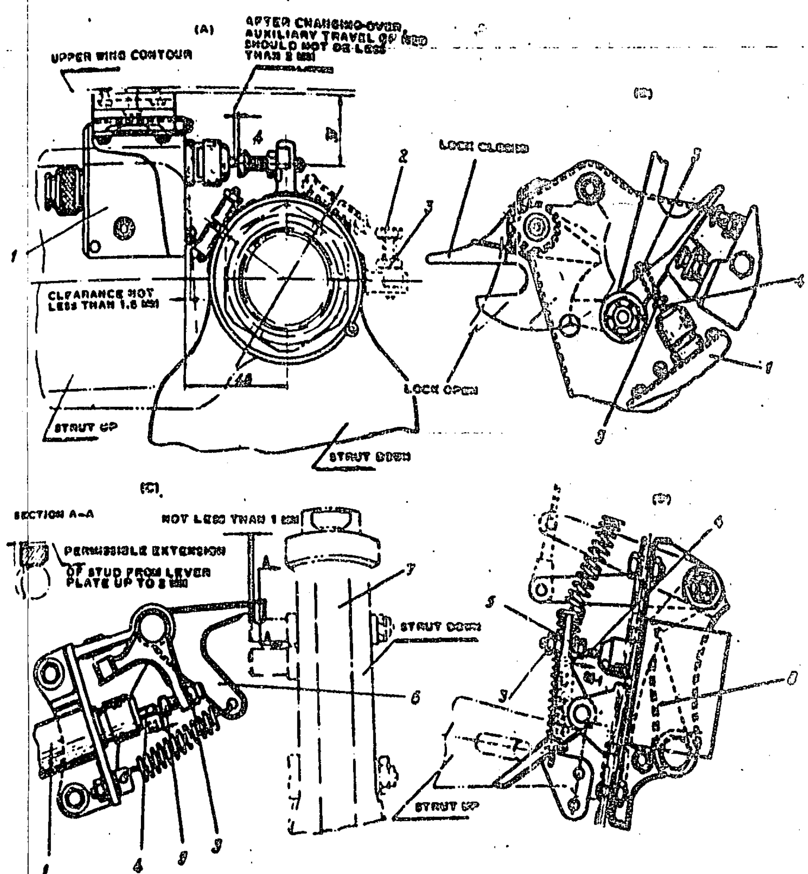

FIG.65. ADJUSTMENT OF L.G. POSITION WARNING SYSTEM

(a) setting of L.G. main strut down position limit switch;
(b) lock and setting of L.G. main strut upper position limit switch;
(c) lock and setting of L.G. nose strut down position limit switch;
(d) lock and setting of L.G. nose strut upper position limit switch;

1 – limit switch; 2 – adjusting screw; 3 – locknut; 4 – switch rod; 5 – adjusting bolt; 6 – lever; 7 – nose strut; 8 – limit switch.

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4. Sink the switch rod until it stops and measure the additional travel of the rod to see that it is not less than 2 mm.

Axial displacement of the limit switch rod from the centre of the adjustment bolt bearing surface should not exceed 2 mm.

5. Fix the adjustment bolt with the lock nut (Fig. 65,b).

6. Retract the landing gear three or four times and check the indication system for stable operation (i.e. the glowing of the red light on panel ППС-2К inside the cockpit) when the struts are in the retracted position and the L.G. valve is set in position NEUTRAL.

7. In the case of unstable operation of the system, unlock the adjustment bolt, drive it out through half a turn, lock it again and perform the operations described in Item 6.

Extended Position of L.G. Nose Strut

To adjust the nose strut extended position indication system, jack up the aircraft, extend the strut and proceed as follows:

1. Make sure that the strut is extended and fixed by the mechanical down-lock.

2. Unlock the adjustment bolt (Fig. 65,c).

3. Drive in or out the adjustment bolt so as to obtain a clearance of 0.5 mm between the adjustment bolt and rod 4 of the limit switch (Fig. 65,c), and see that:

(a) the green light on panel ППС-2К burns;

(b) there is a thread margin of not less than three screw threads in the adjustment bolt;

(c) the adjustment dimensions of the lever correspond to those listed in Fig. 65,c.

4. Apply hydraulic pressure to shift the strut through 45° to 50° so that the adjustment bolt should press upon the limit switch rod and the green light on panel ППС-2К should come off.

5. Depress the limit switch rod and check that the additional travel of the rod should not be less than 2 mm.

6. Lock the adjustment bolt.

7. Extend the strut completely and make 3 to 4 cycles of the nose strut retraction and extension to check whether the green light arranged on panel ППС-2К does not come off when the nose strut is set in the extended position.

Retracted Position of L.G. Nose Strut

To adjust the L.G. nose strut retracted position indication system, jack up the aircraft, retract the nose strut, couple the ground electric power supply and hydraulic pump to the aircraft, and proceed as follows:

1. Remove the hatch cover and make sure that the L.G. nose strut up-lock is closed.

2. Unlock the adjustment bolt (Fig. 65,d), drive it in or out so as to obtain a clearance of 0.5 mm between the adjustment bolt head and the limit switch rod, and ascertain the glowing of the red light on panel ППС-2К.

3. Extend the nose strut and see that the adjustment bolt presses upon the limit switch rod and that the red light on panel ППС-2К comes off.

4. Press the limit switch rod and make sure that the additional travel of the rod is not less than 2 mm.

5. Safety the adjustment bolt by means of the lock nut.

6. Retract the landing gear three or four times to check the indication system for stable operation (the glowing of the red light on panel [illegible] inside the cockpit).

7. Jack the aircraft down on the ground and disconnect the ground electric power supply and hydraulic pump.

4. RECHARGING L.G. SHOCK ABSORBERS

General

1. Jack up the aircraft with the wing and nose jacks until the wheels are clear off the ground.

2. Couple the strut charging valve fitting to the charging device.

3. Reduce the nitrogen pressure in the shock absorbers to zero.

4. Do not actuate the struts for 2 to 2.5 hours to let oil AMT-10 reside.

Nose Strut

1. Drive out the charging valve, remove the plug from the nose strut shock absorber drain hole (Fig. 66) and use a grease gun to charge about 100 cm^3 of oil AMT-10 into the shock absorber through the hole in the strut (the total volume of oil AMT-10 contained in the shock absorber being about 650 cm^3).

2. Jack down the aircraft nose smoothly till the nose strut shock absorber is completely compressed.

Operate the jack to set the strut vertically when the shock absorber is pressed completely. The excess oil should pour out from the shock absorber through the charging valve opening.

Keep the shock absorber compressed for 20 min. to force out the excess oil completely. In case no oil pours out, add more oil and pour out the excess amount proceeding as described above.

3. Drive in the charging valve and drain hole plug, jack up the aircraft nose until the wheels are clear off the ground and use the charging device for filling the shock absorber with compressed commercial nitrogen to obtain a pressure of 37 ±1 kg/cm^2.

Main Struts

1. Drive out the main strut shock absorber charging valve (Fig. 67) and use a grease gun to charge about 100 cm^3 of oil AMT-10 into each shock absorber through the holes in the struts (the total volume of oil AMT-10 contained in the shock absorber is about 2400 cm^3).

2. Slowly lower the aircraft by the wing jacks until the main strut shock absorbers are pressed down completely.

Operate the jacks to set the struts vertically with the shock absorbers pressed down completely. See that excess oil AMT-10 pours out from the shock absorbers through the openings of the charging valves. Keep the shock absorbers pressed down for 20 min. to drain excess oil AMT-10 completely. In case no oil pours out, refill the shock absorbers and drain the excess oil.

3. Drive in the charging valves, raise the aircraft with the wing jacks till the wheels are clear off the ground and use the charging device for filling the shock absorbers with compressed commercial nitrogen to obtain a pressure of 24 ±1 kg/cm^2.

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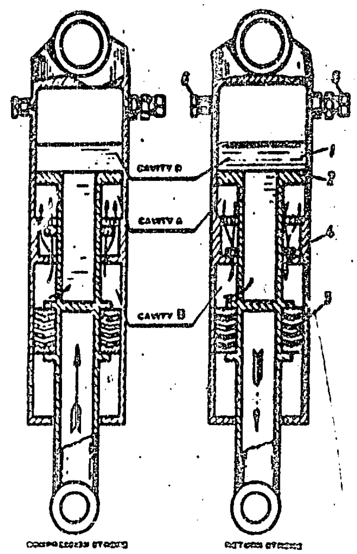

FIG.66. FUNCTIONAL DIAGRAM OF L.G. WING STRUT SHOCK ABSORBER

1 – cylinder; 2 – piston; 3 – packing; 4 – valve ring; 5 – connection for filling shock absorber with oil AMG-10 and for charging with nitrogen; 6 – AMG-10 oil drain connection.

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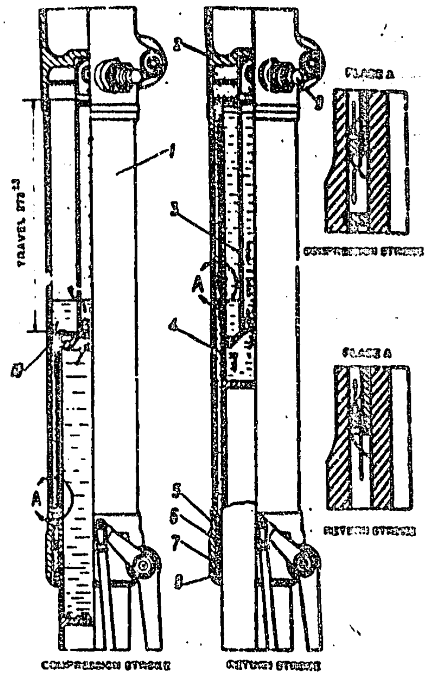

FIG.67. FUNCTIONAL DIAGRAM OF L.G. MAIN STRUT SHOCK ABSORBER

1 – strut sleeve; 2 – strut cylinder; 3 – plunger; 4 – rod; 5 – support ring; 6 – collars; 7 – lower bearings; 8 – nut; 9 – connection for filling with AMG-10 oil and charging with nitrogen; 10 – upper collar bearing.

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4. Jack down the aircraft to place it on the wheels.

Notes: 1. If the charging is performed in winter in a heated room, mind that the pressure in the shock absorbers diminishes as the ambient temperature drops down.
In this case the charging pressure should be increased by 4 kg/cm^2 per 10°C of difference between the room and outside ambient temperatures.

2. In case commercial nitrogen is not available, the shock absorbers filled with nitrogen may be recharged with air, though recharging with air should not be resorted to too often (maximum two or three times within the 50-hour scheduled maintenance period).

3. To replace oil АМГ-10 in the strut shock absorbers, remove the struts from the aircraft.

9. USE OF L.G. WHEELS

Checking Wheel Tyres and Brakes

1. If one side of the tyre has worn out, turn the tyre over to the other side with an object of prolonging its service life.

It is allowed to use the tyres of the L.G. wheels till the protector worn-out to the cord.

2. While inspecting the КТ-92 wheels, mind the following:

(a) any amount of small cracks and circular scores, 0.5 mm deep, is quite permissible in the pig-iron layer of the brake disc bimetallic sector working surfaces;

(b) open cracks spread as wide as the sector side and as deep as the sector thickness down to the steel frame are impermissible. Even in case the cracks of this nature have been detected on a single sector, replace the disc with a new one;

(c) any amount of cracks in the metal ceramic layer of the metal ceramic discs, pressure disc and in the brake body butt edge coated with metal ceramic are permissible;

(d) cracks spread through the metal ceramic layer and frame are impermissible;

(e) buckling of bimetallic and metal ceramic discs which does not cause braking effect upon the wheel when the brakes are released, is permissible;

(f) breaking-off of the sector metal ceramic layer edges along their whole profile to a 12-mm length of the broken-off width is permissible in the intermediate and pressure discs and in the bearing flange;

(g) it is permissible that the metal ceramic discs may be worn out till they are 6 mm thick and that the bimetallic discs may be worn out till the rivets appear (Fig. 68);

(h) in case the total wear-out of the bimetallic and metal ceramic discs amounts to a value at which the pressure disc rods are extended from the bushes of the unit through a length exceeding 13 mm, replace the discs most of all effected by the wear-out with new ones;

(i) discard the wheels whose pressure discs travel through a length equal to, or exceeding, 13 mm when the pressure is applied to the cylinders.

3. Each time the tyres are replaced, new grease should be applied to lubricate the wheels. To lubricate the roller bearings, use grease, type НК-5С.

Demounting L.G. Main Wheels

Prior to demounting the wheels, jack up the aircraft.

To demount the L.G. main wheels (Fig. 68), observe the following priority:

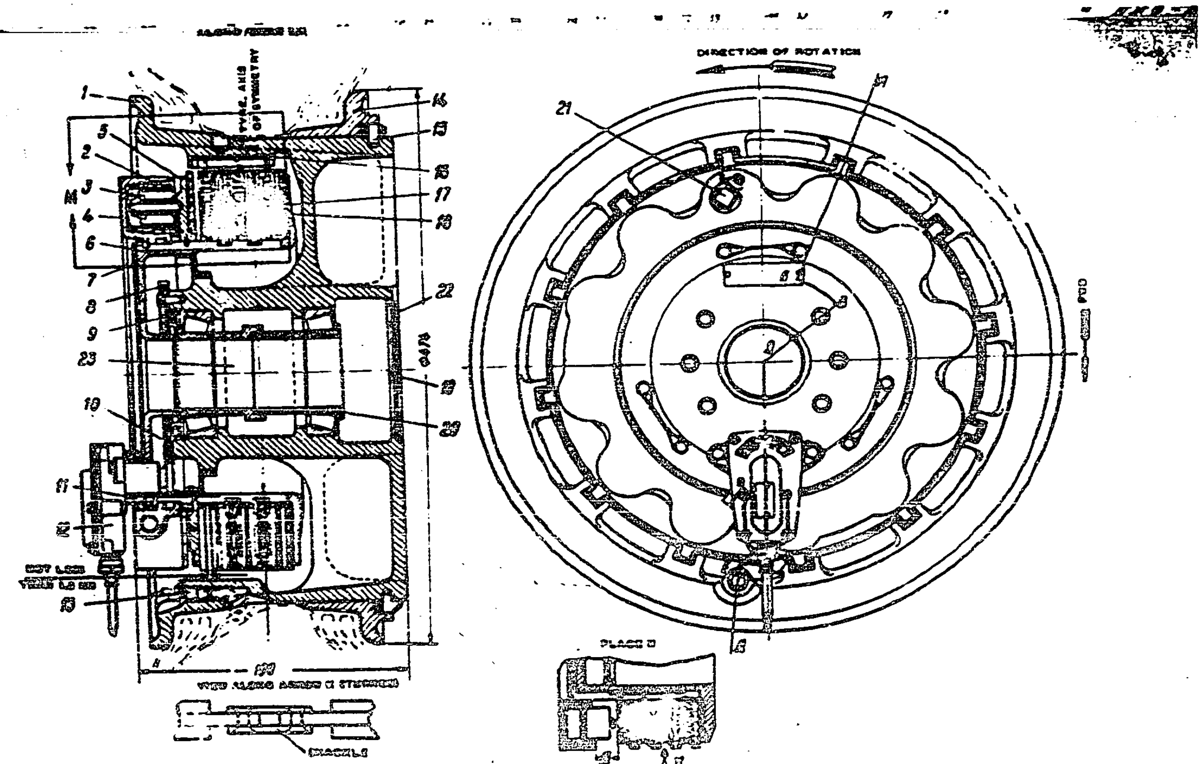

FIG.64. WHEEL KT-92

1 – wheel drum; 2 – parking ring; 3 – brake pistons; 4 – brake cylinder unit; 5 – pressure disc; 6 – guard; 7 – brake body; 8 – pick-up gear; 9 – gland; 10 – drum gear; 11 – flange; 12 – inertia pick-up YA-23 TM; 13 – tyre cock; 14 – removable rim bolt; 15 – stud; 16 – guide; 17 – bimetallic disc; 18 – metal ceramic disc; 19 – cover; 20 – radial-thrust roller bearing; 21 – pipe connection; 22 – thrust expansion ring; 23 – distance bushing.

Note: The left-hand wheel is equipped with pick-up YA-22/ZM-14, and the right-hand wheel is fitted with pick-up YA-22/ZM-15.

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1. Disconnect the air brake system hose from the pipe connection of the wheel.

2. Disconnect the electric wires and remove the YA-24/2M pick-up from the wheel.

3. Remove thrust expansion ring 22 from the groove in the wheel drum and remove wheel cover 19.

4. Unlock the nut, screw it off the wheel axle and remove the safety flange.

5. Remove the following parts assembled on the wheel axle: the outside roller bearing, distance sleeve, wheel drum, inside roller bearing and gland.

6. Screw off the nuts and remove the bolts securing the brake to the wheel axle.

7. Remove the wheel brake from the axle.

<u>Note</u>: When replacing the tyres, do not demount the brake. Tyres 600x200 bearing mark A-50-17, brake, bearings and distance sleeve must be installed in a complete set only and according to their numbers.

8. To assemble the wheels, use the reverse procedure and apply grease HK-50 to lubricate the roller bearings.

<u>Notes</u>: 1. Drive the wheel nut as far as it will go and secure it with a splint.
2. Install the drum, brake, roller bearings and distance sleeve in a complete set only and according to their Certificates.

<u>Demounting L.G. Nose Strut Wheel</u>

1. Disconnect the air lines from the wheel brake pipe connections (Fig. 69).

2. Disconnect the electric wires, without removing the YA-24/2M pick-up.

3. Unlock and screw off the wheel axle nut.

4. Drive the wheel axle from the strut fork and from the wheel proper by means of a puller.

5. Take the wheel from the strut fork.

6. To install the wheel into the strut, reverse the priority, apply grease HK-50 to the roller bearings, drive the wheel nut as far as it will go and lock it with a splint.

When replacing a the wheel, remove the brakes. Screw off the nut and drive out the bolts used to attach the brakes.

Remove the flanges and set them into new brakes. Install the brakes into the wheel.

6. CHECKING OPERATION OF L.G. MAIN STRUT WHEEL TURNING MECHANISM

<u>General</u>

The L.G. main strut is equipped with the wheel axle shaft turning mechanism provided with kinematic locks used for fixing the strut in the retracted and extended positions.

When the landing gear is retracted or extended, the angle formed by the longitudinal axes of the retraction hydraulic cylinder and strut undergoes a change which causes the cylinder and the brace bolt connected to it to turn about the brace bolt axis. Rotation of the brace bolt caused during retraction and extension of the landing gear is utilized to drive the L.G. main strut wheel axle shaft turning mechanism (Fig. 70).

The brace bolt arm is connected to the adjustable upper rod of the turning mechanism whose lower end is secured to the upper bell-crank of the parallelogram

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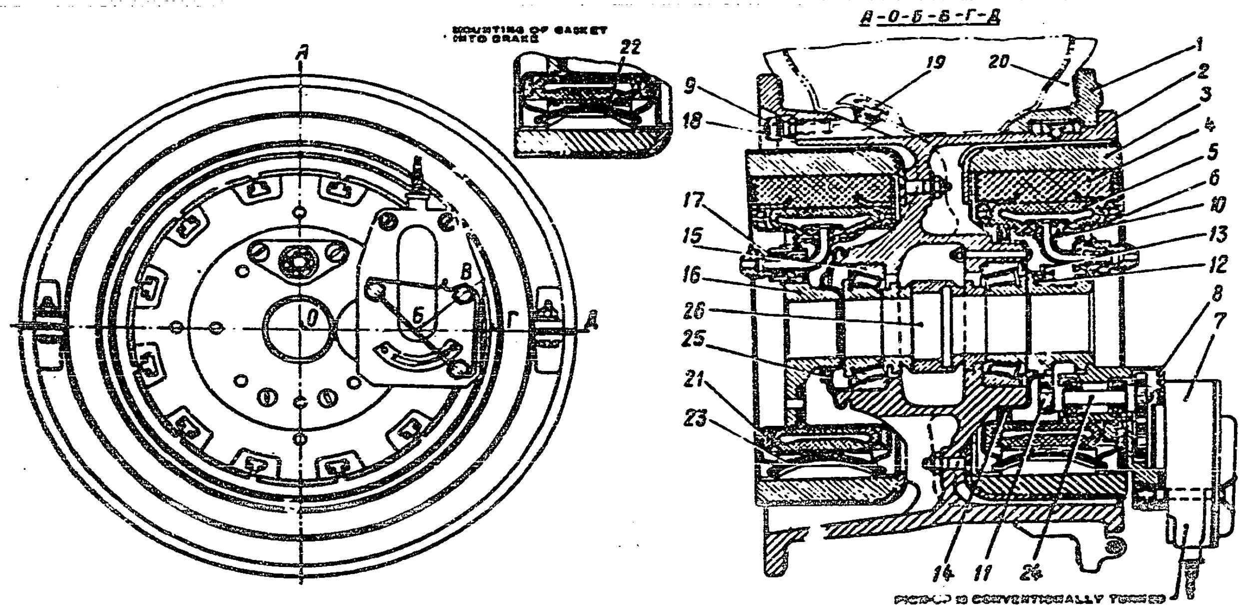

FIG.69, WHEEL KT-03

1 — removable rim bolt; 2 — wheel drum; 3 — brake jacket; 4 — brake shoe; 5 — tube; 6 — cup; 7 — inertia pick-up YA-24/2M; 8 — bracket; 9 — cap; 10 — valve; 11 — driven gear; 12 — gland; 13 — driving gear; 14 — gland; 15 — roller bearing; 16 — wheel body; 17 — pipe connection; 18 — nut; 19 — valve; 20 — tyre; 21 — adjustable ring; 22 — packing ring; 23 — return spring; 24 — shaft; 25 — gland; 26 — distance bushings.

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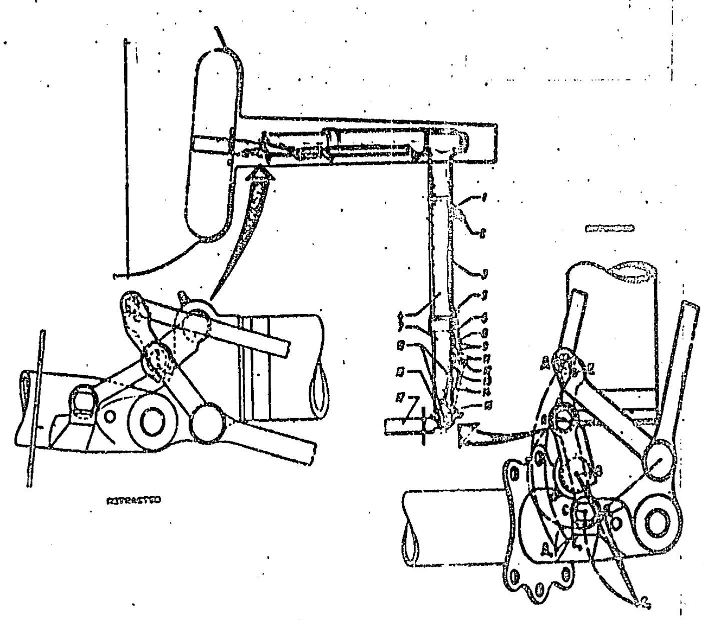

FIG. 70. L.G. MAIN STRUT WHEEL TURNING MECHANISM
1 – mechanism lever; 2 – brace bolt; 3 – adjustable rod; 4 – strut sleeve; 5 – bell-crank; 6 – rod; 7 – [illegible] rod;
8 – upper cross-member; 9 – four-link chain; 10 – rod; 11 – torque arm; 12 – bell-crank; 13 – lower cross-member;
14 – four-link chain; 15 – kinematic lock; 16 – bell-crank; 17 – wheel axle shaft.

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linkage of the mechanism. The parallelogram linkage lower bell-crank is connected to the kinematic lock links by means of a rod.

All the rods of the wheel turning mechanism except the upper rods are not adjustable. To adjust the kinematic lock, adjust the length of the upper rod.

In service, regularly check whether the upper adjustable rod is locked and the mark lines notched on it are coincident (See Fig.71, Plase A). When carrying out scheduled maintenance, inspect all hinge joints of the mechanism, treat them with lubricant НИАТИМ-201 and check the clearance between the support on the strut rod and the axle shaft thrust bolt head (See Fig. 71, view В - В).

Kinematic Lock Adjustment

When adjusting the kinematic lock, observe the following priority:

1. Jack up the aircraft with the nose and wing jacks till the wheels are clear off the ground.

2. Retract and extend the landing gear two or three times.

3. As the strut is extended completely, check the operation of the kinematic lock with the help of a round probe rod, dia. $3_{-0.05}$ mm. When the lock is fully closed, make sure that the probe rod easily enters the reference hole in the kinematic lock links and passes down through a depth not less than 22 mm (See Fig. 71, view Б-Б). In case the reference holes in the kinematic lock links do not coincide (the probe rod enters the holes through a length less than 22 mm), readjust the lock as follows. Unlock and screw off the lock nuts of upper adjustable rod 2, take out the locking blocks (2 pieces), and adjust the kinematic lock by screwing adjustment sleeve 5 in or out till the reference holes are completely aligned as is shown in view Б-Б. One complete turn of the adjustment sleeve causes the length of the rod to change by 1 mm. Since the sleeve is provided with the right-hand thread, the rod length diminishes when the sleeve is screwed in, and increases when the sleeve is screwed out.

4. The kinematic lock fully closed, make sure that the clearance between the strut rod and axle shaft thrust bolt head is within 0.03 to 0.25 mm.

If the clearance exceeds 0.25 mm, replace the thrust bolt with a new one and file off the bolt head to obtain a clearance of 0.03 to 0.1 mm and to achieve a 75 per cent coverage of the bolt head surface. After this, wipe off the filings thoroughly and coat the filed surface with a thin layer of НИАТИМ-201 (See Fig. 71, view В-В).

Notes: 1. To achieve convenience in measuring the play and to file off the bolt head, the brake hose may be disconnected from the wheel and
the electric wire from the УА-23/2Н pick-ups.
2. To check the engagement of the kinematic lock, the aircraft must be previously jacked up till the wheels are clear off the ground
and the landing gear must be extended and retracted three times.
When the shock absorbers are compressed at parking, the play
in the wheel axle shaft lock indicated by errors Ж-Ж (Fig. 71,
Place Г) is permissible and needs not be checked since it does not affect the operation of the lock. In this case it is not required to check the lock engagement by a probe rod, dia. 3 mm.

5. Jack the aircraft down on the ground.

Checking Securing of L.G. Main Strut Actuating Hydraulic Cylinders with Mechanical Locks

After adjustment of the L.G. main strut wheel turning mechanism, check its operation during retraction and extension of the landing gear and perform an

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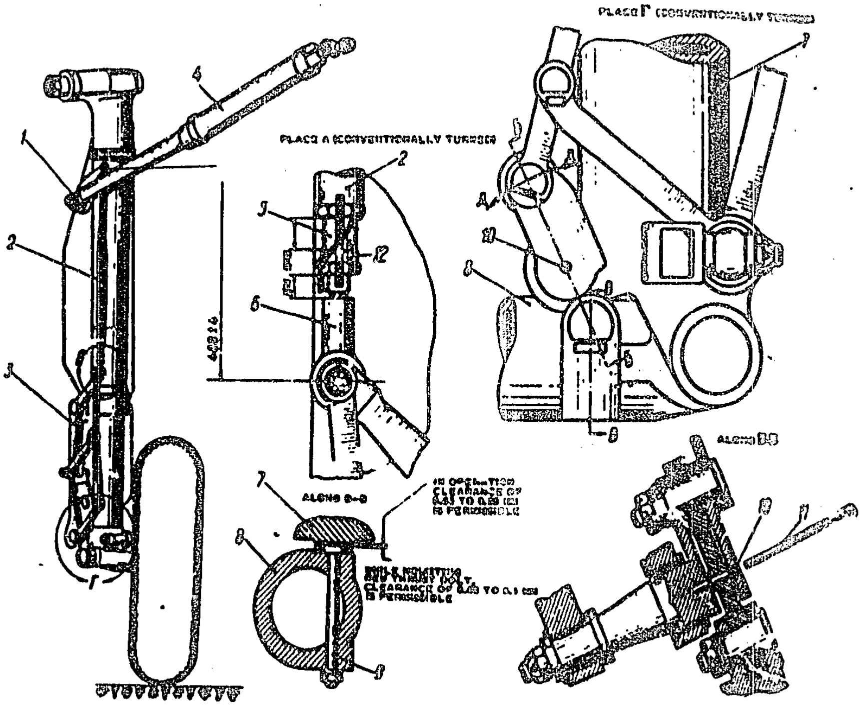

FIG.71. L.G. MAIN STRUT WHEEL TURNING MECHANISM ASSEMBLY
1 – brace rod lower bolt; 2 – adjustable rod; 3 – wheel turning mechanism and kinematic lock; 4 – actuating hydraulic cylinder; 5 – adjustable bushing; 6 – rod cap; 7 – strut rod; 8 – wheel axle shaft; 9 – thrust bolt; 10 – reference ...; 11 – probe rod; 12 – stop block.

[redacted]

emergency extension by means of compressed air (Chapter IV, "Air System") so as to check the securing of the L.G. main strut retraction and extension cylinders with the respective mechanical locks. To do this, relieve the air pressure produced in the cylinders after the emergency extension of landing gear, and apply a force of about 50 kg to shift each wheel towards the retracted position.

If the strut travels towards the retracted position, the mechanical lock is faulty. In this case the hydraulic cylinder should be replaced with a new one.

7. USE OF L.G. NOSE STRUT SHIMMY DAMPER

General

The strut nose portion damper should not be used if the red reference line disappears (Fig. 72).

Note: The white reference line is marked at a distance of 20.5 mm, and the red one at a distance of 10 mm, from the plug top.

Care of the damper involves checking it for external leaks of working fluid AMГ-10, regular refilling of its compensating chamber with fluid, replacing of the worked-out fluid and cleaning of openings in the compensator housing.

Refilling Damper with Oil AMГ-10

In summer, at a temperature of +20° ±10°C, the damper is filled with the oil directly on the aircraft, whereas in winter it is filled inside a closed room after keeping the system at least 3 hours at a temperature of +20°C.

To refill the damper, observe the following priority:

1. Set the damper in the operating position (as a result, the actuating cylinders are set horizontally).
2. Drive out the charging plug from the compensating chamber rod and screw in adapter 65641/233.
3. Connect the charging device to pump working fluid AMГ-10 into the compensating chamber and make sure that the rod displaces through a length of 24 mm away from the top of the upper cover.
4. Disconnect the device and remove adapter 65641/233.
5. Use a duralumin rod to press upon the check valve ball (Fig. 72) and release the excess fluid till the white reference line is aligned with the top of the upper cover.
6. Screw the plug in and safety it with wire KO-0.8.

Changing Oil AMГ-10 Contained in Damper

When changing fluid AMГ-10 in a closed room at a temperature of +20° ±10°C proceed as follows:

1. Drive the charging plug out of the rod, press the check valve ball with the duralumin rod and release the fluid completely till the compensating chamber rod sinks all the way downwards. Drive compensator 3 out of damper body 2 (Fig. 72).
2. Screw out plugs 1 and completely drain the fluid from the damper.
3. Use clean fluid AMГ-10 to wash thoroughly the working chamber interior cavities and the damper central chamber, as well as the compensating chamber of the demounted compensator by shifting the pistons into the extreme positions with the help of the drive. Drain the complete amount of fluid used for washing out.

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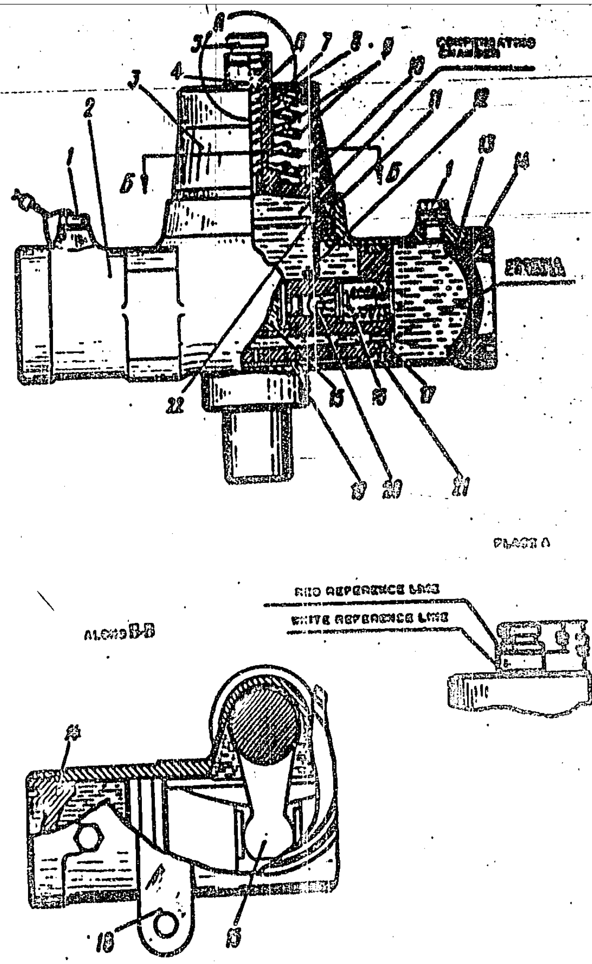

FIG.72. DAMPER

1 — filler neck plugs; 2 — damper body; 3 — compensator body; 4 — ball check valve; 5 — filler plug; 6 — rod and piston; 7 — top cover; 8 — ball valve spring; 9 — compensator piston springs; 10 — piston packing ring; 11 — compensator body packing ring; 12 — limiting bushing; 13 — damper body packing ring; 14 — cover; 15 — [illegible]; 16 — check valve; 17 — throttle; 18 — attachment eye; 19 — [illegible]; 20 — piston slide groove; 21 — rubber collar; 22 — packing ring.

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4. Install the damper horizontally to turn the non-linear drive downward. Pour clean working fluid AMГ-10 into the working chambers through the charging holes till the fluid is as high as the upper edge of the plug mounts, and into the damper control chamber till the fluid reaches the upper edge of the body (the temperature of the fluid filled in being +20° ±10°C).

5. Check the condition of packing ring 11 installed in the compensator body and when necessary, replace the ring with a new one. Screw the compensator into the damper body in gentle strokes so as to avoid damage of the packing ring.

6. Screw the adapter into the rod and couple the AMГ-10 fluid charging device.

7. Pump fluid AMГ-10 until it starts pouring out of the working chamber charging holes in clean jets free of bubbles.

8. Screw the plug into the working chamber charging holes and make three or four complete turns of the bell-crank arm shifting it from one extreme position into the other and then screw the plugs out of the working chamber charging holes.

9. Pump oil AMГ-10 till it pours out of the working chamber charging holes in clean jets free of bubbles; after this stop pumping.

10. Screw the plugs into the charging holes of the working chambers, lock the plugs and put them under lead.

11. Refill the compensator according to the instructions given in Section "Refilling Damper with Oil AMГ-10".

Note: In refilling, carefully check if air bubbles are not present in the fluid being discharged through the compensating chamber check valve. Otherwise repeat refilling several times, each time pressing the compensator rod downward as far as it will go. When the bubbles are no longer produced, make refilling in full accord with the instructions given in Section "Refilling Damper with Oil AMГ-10".

8. USE OF WING FLAPS

Retraction and Extension of Wing Flaps

To extend and retract the wing flaps, build up the operating pressure in the main hydraulic system, and couple to the ground electric power supply or switch on the aircraft storage battery, run the engine, and proceed as follows:

1. Turn on switch BATTERY, AIRCRAFT - GROUND.

2. Turn on circuit breakers L.G., FLAPS and L.G. WARNING, NAVIG. LIGHTS arranged on the right-hand console.

3. Couple to the ground hydraulic pump (to the main hydraulic system pipe connection).

4. Depress button EXTENDED arranged on the wing flaps control panel; as a result wing flap valve ГА-184У will operate and the wing flaps will start extending. With the wing flaps in the extended position, make sure that signal light FLAPS EXTENDED goes on at panel ПКС-2Н inside the cockpit.

In case the landing gear is in the retracted position, see that signal light EXTEND L.G. goes on at panel ПКС-2Н.

5. Depress button RETRACTED; as a result, wing flap valve ГА-184У will operate and the wing flaps will be caused to retract.

Note: If any of the buttons arranged on the wing flaps control panel is depressed, it is held in this position; as soon as another button is engaged, the depressed one returns to its original position.

[redacted]

[redacted]

Checking Wing Flaps for Good Condition

In inspecting the wing flaps, check the following:

1. Condition of the wing flap tabs. Make sure that the tabs are free from bends, cracks, disruption of coating or other troubles.

2. Condition of the outside skin of the wing flaps. Make sure that the skin is free from dents, nicks or bends and that the rivet seams are integral.

3. Condition of the wing flap control attachment joints.

4. Condition of carriages and bearings and absence of damage of the wing flap rails.

<u>Note</u>: Prior to checking as described in Items 3 and 4, remove the wing flaps, wash the joints with gasoline, grade Б-70, and lubricate them with ЦИАТИМ-201.

5. Extend and retract the landing gear to check the maximum deflection (extension) of the wing flaps according to the levelling data, and make sure that the retraction and extension hydraulic cylinders and hydraulic valve ГА-164У operate reliably so that the wing flaps are extended and retracted normally.

6. Asynchronous extension and retraction of the wing flaps. While checking mind that it is possible that one flap may extend or retract completely while the other only starts to extend or retract. If the control rod of the delay wing flap is disconnected, the effort applied to the centre of its trailing edge for extension or retraction must not exceed 5 kg.

<u>Notes</u>: 1. In service, the operation of the wing flaps should be checked up each time the asynchronism observed exceeds one complete travel of the flap or when the pilot complains of irregularities in lateral control of the aircraft.
2. It is the duty of the aircraft mechanic that before the flight he should check up the fully extended position of the wing flaps.

7. Operation of the wing flap position indication system during extension and retraction of the wing flaps. To do this, depress the respective button on the wing flap control panel and check whether the respective lights go on at panel ППС-2К.

8. Listed below are the permissible values of plays:

(a) the longitudinal play of the wing flap measured between the rail and the roller axle is 0.2 to 2.2 mm;

(b) radial play of the wing flap rollers in the wing rail is within 1 mm;

(c) play measured at the end of the extended wing flap is within 11^{+2}_{-3} mm, and that of the retracted wing flap, -2 ± 1 mm.

9. The wing flap should be easily displaced by hand over the wing rails on applying a force of 5 kg (with the hydraulic cylinder rod disconnected).

9. USE OF DRAG CHUTE

Release and Disconnection of Drag Chute

The release and disconnection of the drag chute are controlled from the cockpit at the air system pressure not less than 30 kg/cm^2. To release and disconnect the drag chute, proceed as follows:

1. Switch on the storage battery or the ground electric power supply and turn on the cockpit starboard circuit breaker DRAG CHUTE.

2. Depress button CHUTE RELEASE mounted on the instrument panel; as a result the electropneumatic valve will operate and feed the air into the chute doors opening cylinder so that the chute falls out of the container.

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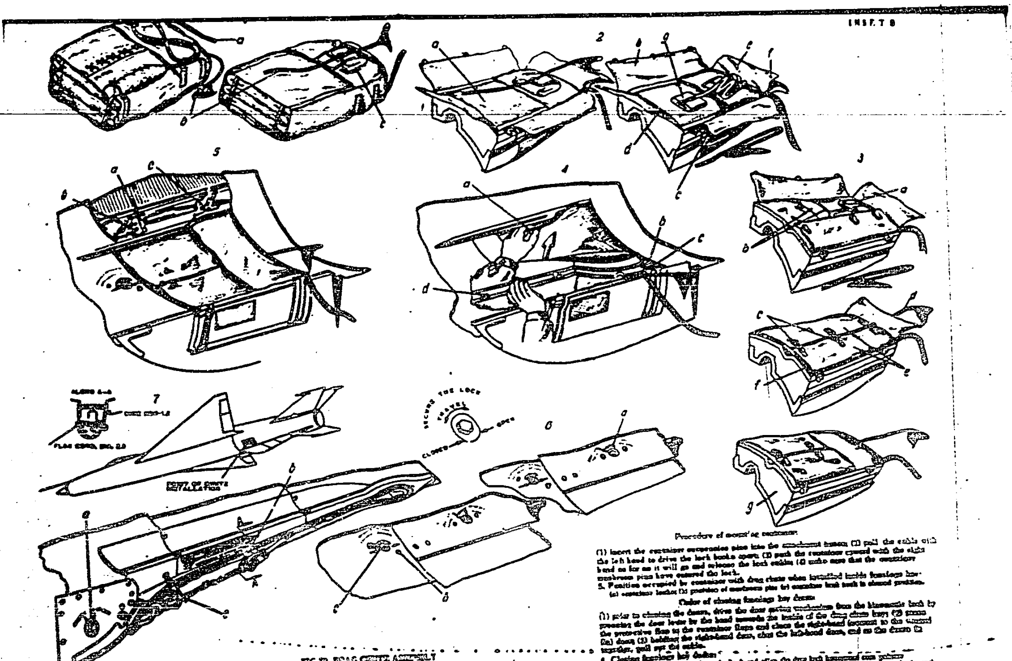

FIG.[illegible] DRAG CHUTE ASSEMBLY

1. Drag chute [illegible]: [illegible]
2. Packing of drag chute into removable container [illegible]
3. Order of [illegible] drag chute with flaps [illegible]
4. Installation of container with drag chute into fuselage bays [illegible]

Procedure of mounting container

(1) Insert the container suspension pins into the [illegible] (2) pull the cable with the left hand to drive the lock hooks open (3) push the container upward with the right hand as far as it will go and release the lock cable (4) make sure that the container mushroom pins have entered the lock.
5. Position occupied by container with drag chute when installed inside fuselage bay: (a) container lock (b) position of mushroom pins (c) container lock hook in closed position.

Order of closing fuselage bay doors

(1) prior to closing the doors, drive the door [illegible]
6. Closing fuselage bay doors: [illegible]
7. Packing [illegible]

3. To disconnect the chute, depress button CHUTE DROPPING mounted on the horizontal portion of the left-hand console; the second electropneumatic valve will operate and feed the air into the chute cable lock cylinder. The lock will open and release the cable.

Installation of Drag Chute in Aircraft
(Fig. 73)

If the drag chute has been used at landing, disconnect the cable from the lock (in case the chute has not been dropped during run), remove dust, dirt, snow or moisture from the bay, examine the doors, bay and locks to make sure that no damage has been caused, and pack a new chute into the bay.

Assemble the chute used in landing and place it into the pack according to the Instructions on Folding and Use of Drag Chute ПТ-21.

To retain the drag chute in the container when installing it into the aircraft, the container is fitted with five flaps made of special fabric (four of them being primary and one being protective) and used for locking the chute. The side flaps (attached in the upper and lower portions of the container) are fitted with eyes fastened by a cable with a red flag after the chute has been packed into the container (Fig. 73).

To install the drag chute in the aircraft, observe the following priority:

1. Arrange the cable in eights and pack it into the container so that the cable end passes out from the container rear right-hand corner (in the direction of flight), and place the chute, packed in the cover over the cable (in packing the chute into the cover follow the Drag Chute Operating Instructions; in doing so insert the chute with its exposed end in the direction of flight taking care to spread the cover evenly within the entire container space). Place the drag chute over the container rear flap in the upper left corner (Fig. 73).

2. Secure the chute and cable by means of the flaps.

First fasten the front flap and then the rear one, fasten the right and left (lower and upper) flaps and fix them by means of the cable with the red flag. Finally, fasten the fifth (protective) flap.

3. Install the container with the chute into the fuselage compartment (Fig. 73) proceeding as follows:

(a) make sure if the doors are open and fixed by the spring mechanism levers, while the door opening air cylinder rod is retracted (Fig. 73, 5, 6).

Notes: 1. The doors are caused to open by turning the lock kernbodrem mounted on the outside door (so that the mark line on the lock is set in position OPEN), or by depressing button CHUTE RELEASE arranged inside the cockpit.
2. When opening the doors, check their travel by hands taking care to avoid injuring since each door is spring-loaded and is flung open abruptly;

(b) insert the container with the chute into the fuselage compartment (bay) moving its lower right-hand side forward so as to fit the dowels into the holes made in the boxes arranged on the fuselage (Fig. 73, 4);

(c) insert the container upper left-hand side into the compartment (bay), pull the locks cable to open the locks, make sure if the container left side dowels fit into the locks arranged on the fuselage, and let the cable go;

(d) make sure that the container is secured with the locks and with the fifth (protective) flap.

[redacted]

CAUTION. When inserting the container with the chute into the drag chute fuselage bay:

1. Be careful not to pull out the chute cotter pin operating cable or to tear off the binding threads.

2. Use care not to push the fifth (protective) flap into the gap between the container rear edge and the doors packing.

4. First close the chute bay right-hand (lower) door by bending the door arm, then close the left-hand (upper) door checking the motion of the doors by hands, and drive the chute pull cable out (Fig. 73, 5, 6).

5. To fix the doors with the locks, shut the doors tightly; use wrench to turn the axle of the lock mounted on the left-hand door (the hexahedron socket), press the doors tightly, fix the front lock by depressing the catch pin of the lock, and finally turn the lock axle home with the wrench (the hexahedron socket is in front of the doors on the fuselage skin) (Fig. 73, 6).

6. Make sure that the mark lines on the lock axles coincide with the mark lines on the fuselage skin, and safety the hexahedron locking pins on the fuselage with wire M2K-1 (Fig. 73, 6).

7. If the drag chute pull cable suspension lock (Fig. 74) is closed, release it by depressing button CHUTE DROPPING installed inside the cockpit, or manually by using a socket wrench.

8. Secure the chute pull cable link shackle ring to the lock hook and close the lock (Fig. 74).

9. Pack the chute cable and link into the clamps on the fin and into the groove in the tail cone. See that the clamps provide reliable attachment of the cable along its whole length. It is not allowed that the cable comes out of the clamps (Fig. 73, 7).

To remove the drag chute and its container from the aircraft, observe the reverse priority of operations.

Note: Each time after the container with the drag chute has been installed, make a single check test of door opening; for this purpose depress button CHUTE RELEASE holding the left door with the right shoulder. If the doors tend to open (exercising pressure on the shoulder), the system is in good condition. After checking, lock the doors and safety the catch lock with wire M2K-1.

Checking Operation of Drag Chute System

While carrying out scheduled maintenance, check the system operation proceeding as follows:

1. Spread the canvas under the fuselage chute bay to avoid fouling of the chute after it falls on the ground.

2. Make sure that the chute bay doors are closed and that the lock is secured with wire.

3. Make sure that the air system pressure is not less than 50 kg/cm^2 (the normal operating pressure).

4. Depress button CHUTE RELEASE and check that the locking wire is cut away, the doors open and the drag chute falls out by gravity from the chute bay container. See that the doors remain open.

5. Apply a force of 5 to 15 kg to the chute pull cable and depress button CHUTE DROPPING. Check if the lock opens.

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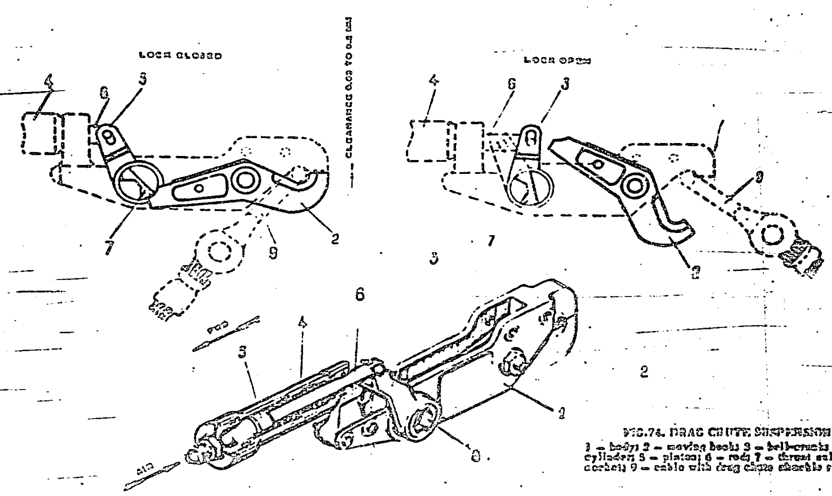

FIG.74. DRAG CHUTE SUSPENSION LOCK
1 – body; 2 – moving hook; 3 – bell-crank; 4 – air cylinder; 5 – piston; 6 – rod; 7 – thrust axle; 8 – [illegible]; 9 – cable with drag chute shackle ring.

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Repeat the operations described in Items 4 and 5 when the air system pressure is 30 kg/cm^2 (the minimum pressure required to operate the system).

6. Check the operation of the check valve installed at the drag chute bottle by releasing the air from the main air system and releasing and disconnecting the chute after maintaining the system in this state for 30 min.

After checking, restore the original condition of the system.

7. Check fitting of the drag chute container doors to the fuselage skin required to provide tightness of the drag chute bay in the fuselage tail portion.

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1. GENERAL

The pilot's cockpit is a pressurised ventilated cabin provided with an automatic electrical remote control of the air supply system.

At altitudes from 0 to 2000 m. natural ventilation of the cabin is employed; at an altitude of 2000 m. a pressure difference is produced in the cabin, and as the altitude increases to 9000 to 12,000 m. the pressure difference amounts to [illegible] 210 mm Hg (i.e. 0.3 kg/cm^2). This pressure difference is maintained constant till the aircraft ceiling is reached.

The cabin pressure is controlled by the pressure regulator, type АРД-57В.

To protect the cabin against excess pressure, use is made of safety valve [illegible] calibrated to an excess pressure of 0.32 to 0.35 kg/cm^2.

In order to estimate the difference in the cabin and atmospheric pressures and to determine the cabin altitude, an indicator, type УВПД-20 is used.

The cabin is fed with the air delivered from the engine compressor (Fig. 73).

From the engine compressor the air is supplied via the electric air distributing valve, unit 525 (Ref. 14) to cabin air supply valve 8 through the cold or hot line. While passing through the cold line, the air is fed through air cooler 13 and cools down, and is then supplied through turbocooler 12 to check valve 11. When passing through the hot line, the air is similarly supplied to the check valve bypassing the cooling system.

Prior to entering the cabin, the two lines are coupled together so that the mixed air is delivered through the check valve to the cabin air supply valve. From the latter valve, the air is supplied via manifolds 4 and 5 respectively to the movable section of the canopy and to the pilot's feet.

Installed on the pipe connecting the cabin air supply valve with the canopy glass and pilot's feet blow-off manifold is valve 10 ("manifold air supply limiter") intended to limit the pressure of the air supplied to the canopy movable portion and pilot's feet blow-off manifolds.

In case the pressure of air supplied to the blow-off manifolds exceeds 0.12 kg/cm^2, the limiting valve bypasses part of the air from the air line into the cabin.

A portion of air supplied through the same pipe is delivered to blow-off the ТРТВК-45М regulator coil. After blowing-off the coil, the air is ejected into the cabin to maintain a medium temperature inside the cabin.

The electrical remote control of the cabin air supply system is effected by means of four-position switch 6.

These are the four positions of the switch: HOT, COLD, AUTOMATIC and NEUTRAL. When the switch is set in the NEUTRAL position, the electric air distributing valve control is switched off.

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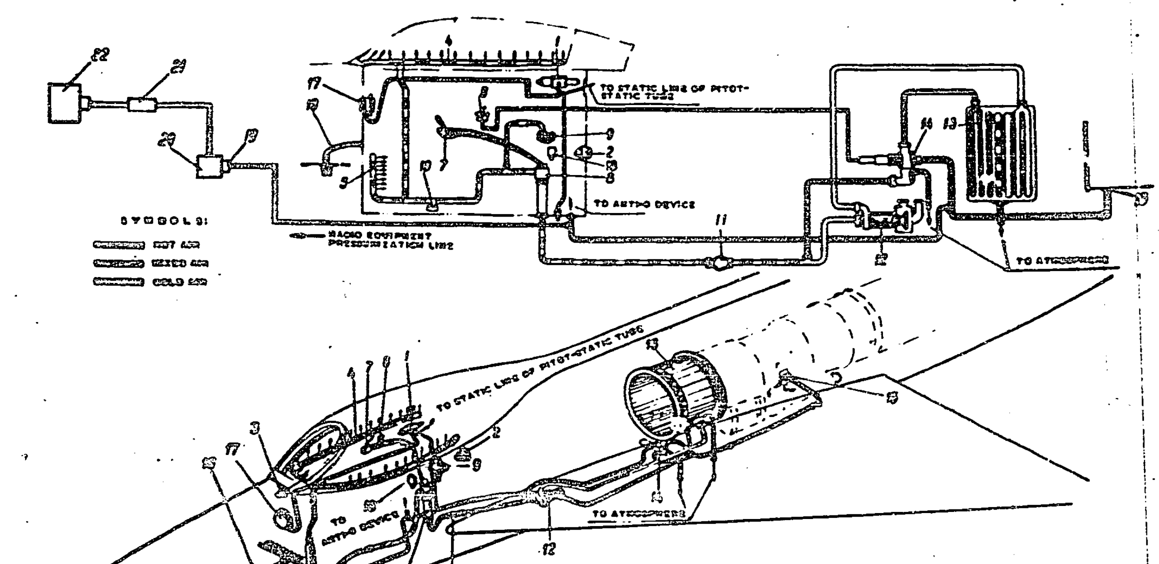

FIG.78. COCKPIT AIR SUPPLY SYSTEM

1 – pressure regulator AP-5-57B; 2 – safety valve [illegible]; 3 – cabin altitude and pressure differential indicator [illegible]-20; 4 – canopy cooling air manifold; 5 – manifold delivering air to pilot's feet; 6 – four-position switch; 7 – cockpit air supply valve control handle; 8 – cockpit air supply valve; 9 – temperature regulator [illegible]; 10 – manifold air supply limiter; 11 – pressurization check valve [illegible]; 12 – turbocooler [illegible]; 13 – air cooler; 14 – electric air distributor, unit [illegible]; 15 – point of air supply from engine; 16 – cockpit ground ventilation pipe connection; 17 – pressure regulator valve [illegible]; 18 – relay unit [illegible]; 19 – throttle, dia. 0.3 mm; 20 – pressure regulator [illegible], 1.1 [illegible] kg/cm²; 21 – [illegible] for coupling to arrangement for checking P-122 unit pressurization system tightness; 22 – unit P-122.

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[redacted]

When the switch is thrown over to position HOT, the electric air distributing valve supplies only hot air delivered to the cabin from the engine compressor.

When the switch is set in position COLD, the electric air distributing valve supplies only cold air fed to the cabin through the air cooler and turbocooler.

If the switch is set in position AUTOMATIC, the air distributing valve is controlled automatically by regulator ТРТВК-45М which maintains a pre-set temperature inside the cabin.

The desired temperature is set by shifting the automatic regulator head to the respective value of the scale. The regulator can be adjusted to provide a temperature within the range of +10° to +20°C graduated on the scale.

<u>Note</u>: It is the duty of the aircraft mechanic to set on the ground the required temperature. It is recommended to set the regulator head at +12°C.

In case the temperature of the cabin air departs from the pre-set value, the regulator engages the respective coil of the air distributing valve reversible electric mechanism which turns the distributing valve gates to supply the cabin with the air passing either through the hot or cold line.

After the required temperature is set in the cabin, the automatic regulator breaks the electric circuit and the air distributor is fixed in a position which ensures supply of the cold and hot air in the required proportion.

<u>Note</u>: In order to provide effective operation of the cold air line, the distributing valve is provided with a vent to release the hot air fed through the hot line gate into the atmosphere.

Location of Instruments and Units Used in Cabin Heating, Ventilation and Pressurization Systems

The air cooler installed between frames Nos 20 and 22 is intended for cooling the air prior to delivering it to the turbocooler. On passing through the air cooler, the air loses about 60 per cent of its heat.

The electric air distributing valve (unit 525) mounted on frame No. 22 is an actuating mechanism of the aircraft cabin air temperature automatic remote control system. The valve distributes the air to be fed into the cabin either through the cold or hot air line, or through both lines simultaneously. The distributing valve is controlled automatically by regulator ТРТВК-45М.

The turbocooler (unit 2323) installed near frame No. 15 in the lower left-hand part is used to cool the air fed from the air-cooler into the aircraft pressurized cabin.

The cabin air supply valve is arranged inside the cockpit near frame No. 11 behind the pilot's seat.

The valve shutter can be set in two fixed positions, namely OPEN and CLOSED.

The valve is remotely controlled through a cable linkage by means of the control handle arranged on the right-hand console in the cockpit (Fig. 75).

In case smoke, kerosene vapours or oil from the engine penetrate into the cabin, disconnect the cabin pressurisation system from the engine by shifting the cabin air supply valve control handle into position CLOSED. Mind that the engine is started with the open valve.

<u>Note</u>: If the ambient temperature in summer is 2° to 6°C below that one set on the temperature regulator scale, it is advisable that prior to starting the engine the electric air distributing valve should be set in position COLD to prevent supply of hot air to the cabin at the initial stage of operation.

Air pressure regulator АРД-57В is installed on the port side of the cockpit between frames Nos 10 and 11 (Fig. 77).

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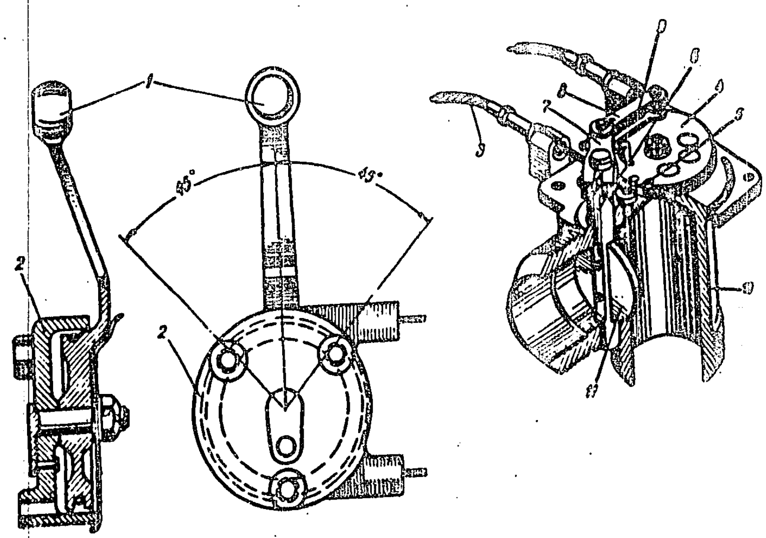

FIG.76. COCKPIT AIR SUPPLY VALVE AND ITS CONTROL SECTOR
1 – valve control handle; 2 – cockpit air supply valve control sector body; 3 – Bowden cable; 4 – roller; 5 – cylinder; 6 – axle; 7 – guide; 8 – rod; 9 – spring; 10 – valve body; 11 – shutter.

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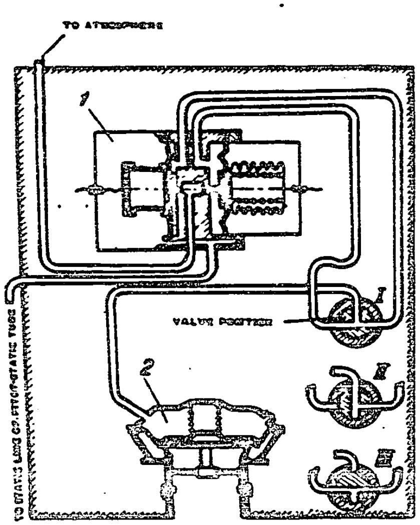

FIG. 77. FUNCTIONAL DIAGRAM OF PRESSURE REGULATOR [illegible] AND VALVE [illegible]
1 – [illegible] [illegible] [illegible]; 2 – valve [illegible].

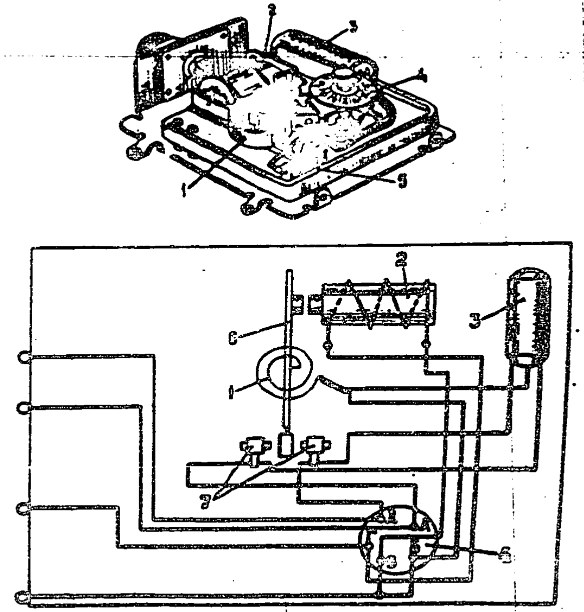

FIG. 78. [illegible]
1 – [illegible] spiral with [illegible]; 2 – [illegible] electromagnet; 3 – [illegible] capacitor; 4 – dial; 5 – contact panel; 6 – movable contacts; 7 – fixed contacts.

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The air pressure regulator is designed to maintain the pre-determined air pressure automatically by adjusting the expenditure of air escaping the cabin.

The pressure regulator consists of two units, namely, the regulator (pick-up) and valve 520Б (actuating mechanism).

The regulator is provided with a valve whose handle sets the regulator in either of the three positions: OFF, ON and CHECK. When the handle is turned into position ON, the regulator is switched on to operate during flight, i.e. the normal operation of the regulator during flight is provided. The handle must be locked in the above position.

When the handle is set in position OFF, the regulator cuts off the release of the air from the cabin through valve 520Б so that the pressurisation of the cabin can be checked on the ground. In service, position CHECK is not used.

Safety valve ПК is arranged behind the pilot's seat inside the cockpit.

The safety valve is intended to protect the cabin against damage that may be caused due to increase of pressure above the permissible value. When the excess pressure amounts to 240_{-5} mm Hg, the valve opens and releases the excess air from the cabin.

Cabin altitude and pressure differential indicator УВПД-20 is installed in the lower part of the left-hand console.

Indicator УВПД-20 is used to determine the cabin altitude and difference in pressures inside and outside the cabin. The altitude range is from 0 to 20 km., the pressure difference range lying within -0.04 and +0.6 kg/cm^2.

Air temperature regulator ТРТВК-45М and blocking relay РП-2 (Fig. 70) are installed in the cockpit behind the pilot's seat on frame No. 11.

The air temperature regulator is designed to maintain automatically the cabin air temperature within the pre-set range (through the actuating mechanism consisting of the electric air destributing valve, unit 525).

The cabin temperature can be set at any value within the range from +10° to +20°C by means of a scale. The normal position of the scale is +12°C.

To prevent burning-out of contacts in regulator ТРТВК-45М its electric circuit employs blocking relay РП-2 (Series 2).

The four-position switch is arranged on the cockpit left-hand console. The switch is used to control the distributing valve.

The check valve (unit 783И) is mounted near frame No. 12. It is used to pass the air only in the direction from the engine toward the cabin. When the engine stops or if the cabin air supply pipeline is damaged, the valve is cut off to prevent leakage of the air from the cabin. Notched on the valve body is an arrow indicating the direction of air supply.

The manifold air supply limit valve is used to reduce the pressure of air fed into the manifolds delivering air to the canopy movable section and pilot's foot. It is arranged under the cockpit floor, port side, near frame No. 7A.

The cabin ground ventilation pipe branch is intended for forced ventilation of the cabin if the pilot stays inside the cockpit for a long time while the aircraft is on the ground and the engine is cut off.

2. CHECKING CABIN PRESSURIZATION

In order to check pressurisation of the cabin, use special ground device 76-9861-150 and proceed as follows:

1. Unlock the АРД-57В pressure regulator valve handle and set it in position OFF (i.e. in the position used for checking the cabin pressurisation on the ground).

[redacted]

3. Remove pressure ratio regulator РСД-3М and the ОРК-2 connector upper block and stop the ОРК-2 upper and lower blocks with plugs in accordance with the respective instructions.

Set the air suction handle installed on the КУ-2 remote control panel in position MIXED.

4. Couple the ground device hoses to the pipe connections arranged on the plug of the cabin ground ventilation pipe branch inside the nose strut well.

Connect the airfield air bottle to the ground device.

5. Close the canopy and seal it from outside.

Note: Checking the cabin pressurisation by means of the ground device does not require presence of a man inside the cockpit.

6. Open the airfield bottle cock and slowly turning the cock of the ground device, fill the cabin with air. Note the indications of the ground device pressure gauge and check that the rate of pressure increase during filling does not exceed 0.1 kg/cm^2 per minute.

7. As the pressure reaches 0.3 kg/cm^2, cut off the air supply and quickly shut off the cock of the device and then of the air bottle.

Measure the time during which the pressure in the cabin drops from 0.3 to 0.1 kg/cm^2.

8. The cabin is considered airtight in case the time of cabin air pressure drop from 0.3 to 0.1 kg/cm^2 is not less than 90 sec.

In case the time is less than that indicated above, detect the leaky points and eliminate leakage.

9. Disconnect the hoses of the ground device from the pipe connections, set the АРД-57В handle into position ON, lock it, and stop the pipe connections with plugs.

10. Remove the plugs from ОРК-2 blocks, install pressure ratio regulator РСД-3М and make a check of the complete set envisaged by the preliminary preparation.

CAUTION. In case the cabin pressure rises above 0.3 kg/cm^2 (when the measurement РСД-3М error does not exceed +0.02 kg/cm^2), make an additional check of the following parameters of oxygen regulator КП-34:

(a) percentage of oxygen supplied by the regulator at various altitudes;

(b) altitude of engagement and disengagement of oxygen permanent supply;

(c) oxygen supply with the oxygen mask off the face;

(d) excess pressure maintained by the safety valve of the instrument at various altitudes.

The check is made with the help of device КУ-5 or КУ-7 in compliance with the operating instructions for these devices.

Aircraft oxygen instrument КП-34 is designed for 40 applications of an excess pressure not more than 0.3 kg/cm^2. After 40 pressure applications, oxygen regulator КП-34 must be replaced.

3. CHECKING OPERATION OF AIR TEMPERATURE AUTOMATIC CONTROL SYSTEM

Electric Air Distributing Valve
(Unit 525)

To check the operation of the electric air distributing valve, use the ground electric power supply and observe the following priority:

1. Turn on switch BATTERY, AIRCRAFT – GROUND and switch on circuit breakers COCKPIT SUPPLY, FAN arranged on the right-hand console.

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2. Set the four-position switch of the cabin air supply system in position COLD, observe the travel of the electric air distributing valve levers through the lower left-hand hatch arranged between frames Nos 20 and 22, and make sure that the distributing mechanism operates normally; the distributing valve setting in the extreme position, make sure (aurally) that the electric mechanism is switched off.

3. Set the switch in position HOT and, observing the levers travel, ascertain proper operation of the distributing mechanism before it is switched off. The time taken to change-over the distributor should not exceed 30 sec.

<u>Note</u>: If setting of the switch in position COLD does not cause the electric mechanism to switch on (since the distributor may have already been set in this position), turn the switch first to position HOT and then throw it over to position COLD.

Turn off switch BATTERY, AIRCRAFT – GROUND and circuit breaker COCKPIT SUPPLY, FAN which have been switched on for checking.

<u>Note</u>: When replacing unit 525, apply a thin layer of grease ПФМС-4С to the valve pipe connection thread prior to connecting the pipe lines to the unit, taking care to prevent penetration of grease into the pipes.

<u>Cabin Automatic Air Temperature Regulator ТРТВК-45М</u>

(To be checked in case the system fails)

To check the operation of the automatic air temperature regulator, use the ground supply and proceed as follows:

1. Turn on switch BATTERY, AIRCRAFT – GROUND and circuit breakers COCKPIT SUPPLY and FAN arranged on the right-hand console.

2. Make sure whether the cabin air supply valve is open.

3. When the ambient temperature is below +12°C, switch the system for cold air supply and then set the switch in position AUTOMATIC.

In the case of normal operation of the air temperature regulator, the system must change over to hot air supply.

4. If the ambient air temperature is above +12°C, switch the system for hot air supply and then turn the switch to position AUTOMATIC.

In the case of normal operation of the air temperature regulator the system must change over to cold air supply.

5. Turn off switch BATTERY, AIRCRAFT – GROUND and circuit breaker COCKPIT SUPPLY, FAN which have been switched on for checking.

<u>Note</u>: Mind that at an ambient temperature of +12° ±4°C, the regulator contact may be set in the neutral position, so that no change-over of the distributing mechanism operation would occur under the given temperature conditions. In this case the regulator should be blown off with hot or cold air delivered from the ground supply.

<u>Turbocooler (Unit 2323)</u>

Checking of the turbocooler operation which is performed with the engine running consists in the following.

When the system is changed over to cold air supply by the pipelines used to blow off the canopy, see that the air is delivered at a temperature which is 9 to 15°C lower than the ambient air temperature (at medium humidity). If the air temperature is not below the ambient temperature, though the cold air supply line is engaged, check whether the turbocooler shaft revolves freely. In case the cold air line temperature does not notably decrease, though the turbocooler is in good condition, the flow of the air from the hot to the cold line through the gates of unit 525 has increased to an inadmissible value.

[redacted]

Refill the system with oil CHS-122-14 each 90 flying hours. Fill 99 gr of oil into the system through one of the filling holes.

4. PRESSURIZATION OF UNIT P-132

To ensure normal operation, the unit is pressurised by the air delivered from the engine compressor (through the pipeline feeding the anti-g arrangement of the pressure suit).

To avoid condensate accumulation, the unit pressurisation system pipeline is fitted with a sump located between frames Nos 8 and 9.

Checking System Tightness

To check whether the system arranged between pressure regulator 20 (Fig. 73) and unit P-132 (Ref. 22, the unit engaged) is airtight proceed as follows:

1. Open the upper hatch in front of frame No. 9.
2. Remove the plug from T-piece 21.
3. Connect the T-piece to ground device 76-9361-150 (the device is used for checking the tightness of the cabin and the fuel system).
4. Couple the airfield air bottle to the ground device.
5. Open the air bottle cock and slowly turning off the ground device cock, produce an excess pressure of 0.3 kg/cm^2 in the system.
6. Stop feeding the air into the system by cutting off first the ground device cock and then the air bottle cock.

The system is considered airtight if its pressure drop does not exceed 0.15 kg/cm^2 within the time interval not less than 1 hour.

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Chapter IX
COCKPIT CANOPY

1. GENERAL

The cockpit canopy (Fig. 79) is designed to protect the pilot against dynamic pressure in flight or during ejection, as well as to provide a normal field of vision and pressurization of the cabin while in flight.

The particular features of the canopy design and operation are the following:

1. To let the pilot in and out of the cockpit, the cockpit canopy is opened, i.e. hinged about the front attachment of the canopy to the fuselage (Fig. 80). In case of necessity the canopy can be jettisoned during flight by the emergency control system or separated from the fuselage together with the pilot's seat.

2. The canopy glazing is manufactured from the following materials:

(a) a greater portion of glazing (except the windshield) is manufactured from heat-proof plexiglass, grade CT-1, 10 mm thick (Fig. 79, Ref. 12);

(b) flat windshield is manufactured from the silicate triplex, 14.5 mm thick (Ref. 11).

Arranged under the canopy is the transparent armour glass, 62.9 mm thick (Ref. 1) which is fitted with protective glass shields installed at the sides to protect the pilot against dynamic pressure in the case of an emergency canopy jettison.

3. The canopy is controlled by two systems: the operating control system and emergency control system.

The operating control system is designed for lifting and lowering the canopy, pressurization of the cabin and securing the canopy on the fuselage.

The emergency control system is intended for an independent jettison of the canopy (independently of the ejection seat), for separating the canopy from the fuselage in the case of ejection with canopy used for pilot's protection, and for separation of the canopy from the seat after ejection.

Coupled to the canopy-to-fuselage locks as well as to the canopy-to-seat grip locks used during ejection, are rigid control rods. The location and principle of operation of the locks are described below.

Arranged on the fuselage, inside the canopy-carrying panel are six fixing locks 2 (Fig. 80) controlled through a rod linkage by handle 15 installed in the cockpit, port side (the operating control system).

Installed in the canopy frame respectively to fixing locks 2 on the fuselage are six emergency side locks 3 (Fig. 81) released in the case of an emergency jettison of the canopy.

Movable loops 20 used commonly by the operating and emergency control systems, fit into the grooves in the fixing locks when the canopy is closed, and, when the handle is shifted forward, the loops are stopped by dowels 21 so that the canopy elevated portion is anchored to the fuselage.

When handle 15 (Fig. 80) is shifted backwards, the dowels move out of the loops and disengage the canopy.

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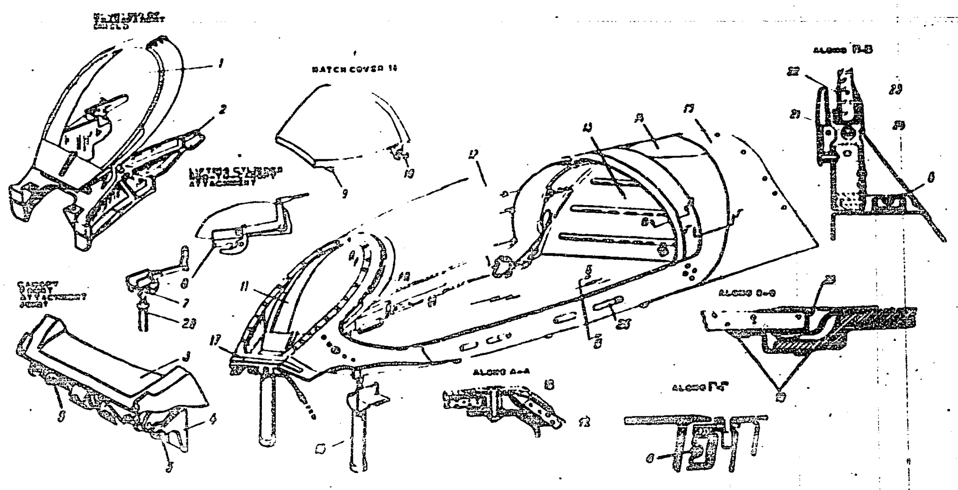

FIG. 79. COCKPIT CANOPY, GENERAL VIEW

1 – transparent canopy shield; 2 – sight bracket; 3 – canopy assembly; 4 – fuselage bracket; 5 – canopy movable portion [illegible]; 6 – cable sealing hose; 7 – pin; 8 – support; 9 – shear bolt; 10 – axle shaft; 11 – front windshield; 12 – [illegible]; 13 – pressure bulkhead; 14 – access cover; 15 – front portion of superstructure; 16 – canopy lifting cylinder; 17 – [illegible]; 18 – bolt; 19 – sealing; 20 – canopy lifting cylinder rod; 21 – manifold to supply air to canopy [illegible]; 22 – [illegible]; 23 – sealing; 24 – rod; 25 – handle for opening the canopy in case air pressure is zero; 26 – rubber.

Note: Front portion of superstructure 15 and pressure bulkhead 13 are attached to the fuselage.

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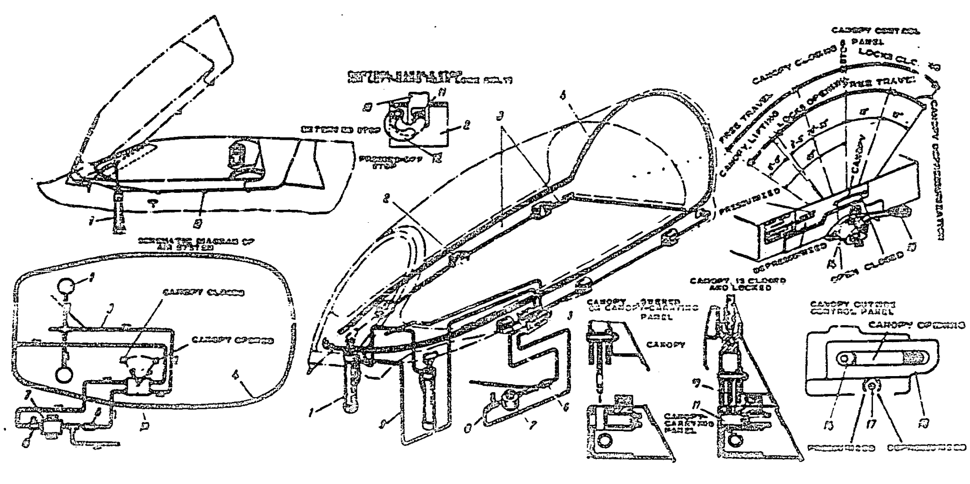

FIG.60. CANOPY CONTROL SYSTEM

1 – canopy lifting cylinder; 2 – canopy operating lock; 3 – lock control rods; 4 – sealing hose; 5 – canopy control handle plate; 6 – check valve; 7 – reducer PB-1,5; 8 – safety and check valve; 9 – air pipeline; 10 – canopy lock hoop; 11 – fixing pin; 12 – canopy left-hand rear lock fixing dowel stop; 13 – canopy lifting and sealing valve; 14 – canopy sealing button; 15 – canopy opening and closing control handle; 16 – canopy outside lifting control handle; 17 – splined axle of canopy outside pressurization control valve; 18 – canopy control outside handle release button.

Canopy emergency jettison locks 3 (Fig. 81) are interconnected through a linkage of rods and bell-cranks inside the canopy frame. The linkage is actuated by the powder gases produced by ejection gun 6 which is fired when canopy emergency jettison handle 2 installed starboard inside the cockpit is shifted backward (the emergency control system).

When the emergency control system operates, locks 3 are caused to open and release loops 20 which get out of locks 3 and stop at dowels 21 inside the grooves of the canopy-carrying panel. Consequently, the canopy is no longer anchored to the fuselage.

Hinging of the canopy during opening (i.e., lifting) is effected about front bracket 4 (Fig. 79) secured to the fuselage and connected to the canopy by two locks (the left and right ones) which are mounted on the canopy hinge joint. Since the locks operate as hinges, they are permanently closed in the course of operation and can therefore be released only by the canopy emergency jettison system which releases them simultaneously with releasing side locks 3, so that bolt 22 (Fig. 81) is disengaged and the canopy is no longer anchored to the fuselage.

4. Opening (lifting) and closing (lowering) of the canopy are effected by turning the canopy about the front hinge joint through an angle of 45°.

The canopy is opened by two lifting cylinders 1 (the right and left ones) (Fig. 80) whose rods are connected to the canopy through special pins by means of curved hooks and support units on the canopy. In their turn, the cylinders are hinged to the fuselage.

The upper ends of curved hooks 25 (Fig. 81) fit into the grooves of two-arm bell-cranks 24 of the canopy emergency jettison system (when the system is closed completely) so that pins 23 of the rods are connected with the canopy.

When the canopy emergency jettison system operates, two-arm bell-cranks 24 are turned and release the curved hooks which in turn disengage the canopy lifting cylinder rod spindles.

In order to open the canopy, the lifting cylinders are fed with air compressed at 50 kg/cm^2 from the common air system of the aircraft. The canopy is closed by gravity which causes the air contained in the cylinders to exhaust into the atmosphere.

5. Closing and opening of the canopy are controlled by the valve installed on the port side in the cockpit and used to supply the lifting cylinders with air during opening and to exhaust the air into the atmosphere during closing.

The valve is actuated by handle 15 (Fig. 80) hinged to the axle which carries a toothed sector. The teeth of the sector engage the gear wheel mounted on the valve axle. Installed on the valve control handle axle is the lever coupled to all air fixing locks arranged on the fuselage; these locks fix the canopy side lock loops by means of dowels.

When the valve handle is set in position CANOPY CLOSED (i.e., in the front position), it is acted upon by a spring and enters the panel cut-out to prevent the backward motion of the handle. When the handle is placed in this position, fixing dowels 11 (Fig. 80) engage loops 10 of the canopy side locks and close the canopy. In this case the lifting cylinder air supply valve and the air release valve are cut off.

In order to shift the valve handle for opening the canopy, the handle must first be shifted aside to disengage it from the valve panel cut-out, and then pulled backward to open the canopy. As the handle covers an angle of about 60°, the fixing dowels move out of the canopy side lock loops; and as the handle is further displaced through 8° to 12°, the lifting cylinders are fed with the air delivered from the air system through the valve.

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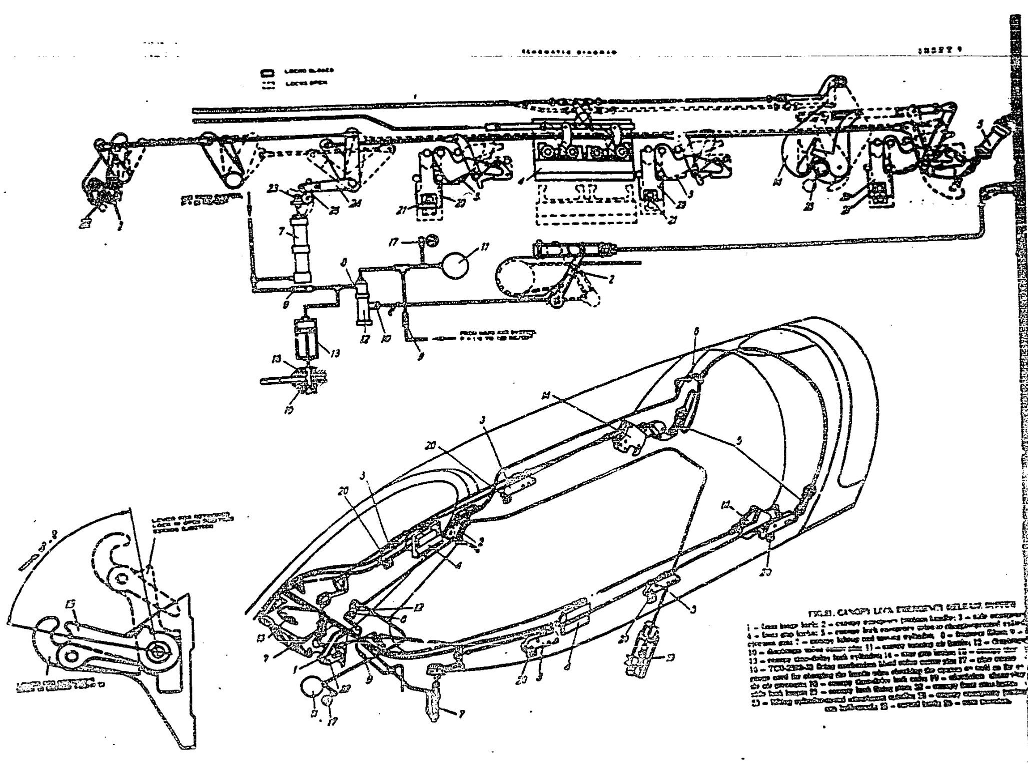

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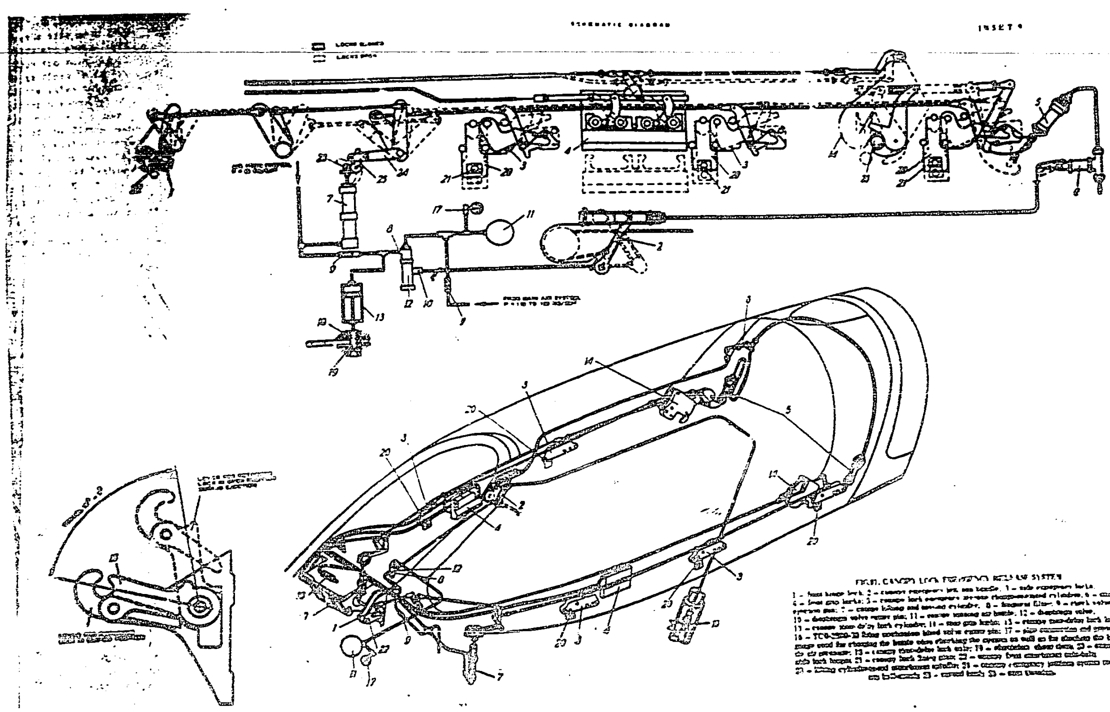

FIG. [illegible]. CANOPY LOCK [illegible] SYSTEM

[illegible]

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The air starts passing into the lifting cylinders after the valve handle displaces through 3° to 6° from the position where the dowels are completely moved out of the side lock loops, which prevents possible accumulation of air inside the cylinders and abrupt opening of the canopy after the dowels move out of the loops.

When the valve handle is shifted to close the canopy (i.e., forward) the valve handle is fixed in the vertical position (after covering an angle of 45°). This causes the valve to release the air contained in the cylinders into the atmosphere.

After the canopy is closed completely and the lock loops enter the groove of the canopy-carrying panel, while the left rear loop of the lock presses down spring stop 12 of the fixing dowel (Fig. 80), it is possible that the valve handle may still go on moving towards position CANOPY CLOSED. In this case the fixing dowels enter the canopy side lock loops and the valve handle is finally moved into the panel cut-out and locked thereat.

Since the handle is locked in the intermediate position by means of spring stop 12 which rests against the left rear dowel butt edge as long as the left rear lock loop travels to the limit, no take-off of the aircraft with the open locks is possible.

To open or close the canopy from outside the cockpit, use is made of a handle attached to the valve axle which extends through the outer skin.

When the canopy is closed, the handle sinks in the depression in the fuselage (Fig. 80, Ref. 5).

The operation of the valve when the canopy is opened or closed by means of the outside handle, is similar to that performed when the cockpit handle is used.

To achieve smooth opening and closing of the canopy, the valve is provided with throttle openings (made at the valve inlet and in the release line) which are designed to open the canopy within 3 to 6 sec. and to close it within 17 sec. (including a time lag not more than 8 sec. as from the starting moment of closing), after the canopy control handle has been displaced. Thus, the canopy travels down smoothly till it sets softly onto the canopy-carrying panel.

When it is required to open the canopy from outside at zero pressure in the aircraft air system, another handle sunk into a depression on the left rear side of the canopy is employed. In this case the canopy locks must be opened by outside handle CANOPY OPENING.

6. The airtight connection between the canopy and the fuselage is achieved by means of a shaped rubber hose which is filled with air delivered from the aircraft common air system at a pressure of $2^{+0.55}_{-0.3}$ kg/cm^2. The rubber hose is laid on the canopy-carrying panel and in the groove along the rear side of the pressure bulkhead rim. The air fed to fill the hose is delivered through the same valve used for opening and closing the canopy. For this purpose the valve is fitted with another cavity which employs an independent connection of the hose to the air system pipe-line.

Button 14 (Fig. 80) used to fill the hose with air and to exhaust the air from the hose into the atmosphere, is mounted on the common axle together with the canopy operating handle and is connected to the valve axle through the gear wheel.

The canopy sealing (i.e., filling the hose with air) is effected by pushing the button forward only in case the canopy is closed.

The canopy is unsealed (i.e., the air is released from the hose) before opening the canopy for which purpose the button is shifted backward.

To save the time and the amount of motions, the canopy is opened and unsealed by a single backward stroke of the valve handle, the button travelling together with the handle.

To seal the canopy from outside, the valve axle passes through a gland to the fuselage skin where it carries spline 17 for screw-driver control.

The air fed to fill the hose passes from common air system through reducer PD-1.5 (Ref. 7), safety and check valves 8 and then is injected into the hose.

7. On emergency in flight, the canopy can be jettisoned with the help of the canopy emergency jettison system arranged on the canopy and fuselage (described above) which provides emergency release of the locks and forced jettison of the canopy under the action of compressed air supplied at 110 to 130 kg/cm^2.

To engage the canopy emergency jettison system, an independent canopy jettison handle with a collapsible grip is installed starboard inside the cockpit. The procedure of canopy emergency jettison is the following.

When handle 2 (Fig. 81) is thrown off through an angle of about 65°, the cable connecting the handle with cotter pin 10 of diaphragm valve 12 pulls the cotter pin out and causes striking pin 2 (Fig. 82) to release and brake diaphragm 3.

The air contained in emergency air bottle 11 (Fig. 81) separated from the main air system by check valve 9 is delivered to canopy lifting cylinders 7 to make the canopy ready for tossing and to time-delay lock release cylinder 13 whose rod 2 (Fig. 83) cuts off rivet 4, knocks out axle 3 and opens the lock.

When the canopy emergency jettison collapsible handle is shifted through an angle of about 75°, its tooth disengages the locking pin of the handle bracket to allow backward travel of the handle.

When the handle is pulled backward and travels 20 to 30 mm, the end of the handle lever entering the recess of the release drive on the canopy will shift the drive plunger which is connected to the ejection gun release lever by means of a cable, making ejection gun 6 fire (Fig. 81).

The pressure produced by powder gases of the ejection gun is applied to two charge-operated cylinders 5 whose rods are displaced to open six emergency side locks 3 and two front hinge joint locks 1 through a linkage of bell-cranks and rods.

Two-arm bell-cranks 24 release curved hooks 25 which connect the canopy to the elevating cylinders, and the air pressure applied to the cylinders from the emergency air bottle tosses the canopy.

While the handle is pulled further backward, the valve releasing the powder gases produced by ejection mechanism TCB-2500-38 is engaged as its cotter pin is pulled out (See Section 5).

<u>Note</u>: If one of the charge-operated cylinders fails, the system is reliably actuated by the other cylinder. For this purpose the right- and left-hand emergency jettison locks are interconnected by means of an axle carrying the levers of the canopy front locks.

When in the closed position, the canopy emergency jettison system is locked and put under lead seals at the following movable parts (Fig. 84):

front canopy grip lock 1, secured with a shear screw made of material AД-1;
rear grip lock button 2, locked with a shear screw made of material AД-1;
rear canopy grip lock hooks 3, locked with rivets 3581A-2.6-10;
charge-operated cylinder bell-crank rear arms 4, of the canopy emergency jettison system, locked with wire KC-0.5;
diaphragm valve cotter pin 5, locked with wire M1H-0.5;
canopy emergency jettison handle lever upper end 6, locked with wire KC-0.5;
collapsible grip of canopy emergency jettison handle 7, locked with wire M1H-0.5;
ejection gun nuts and pipeline T-piece 8, locked with wire KC-0.8;
ejection gun trigger 9, locked with wire M1H-0.5;
charge-operated cylinder nuts 10, locked with wire KC-0.8;
canopy hatch ejectable cover 11, locked with shear screws made of material AД-1.

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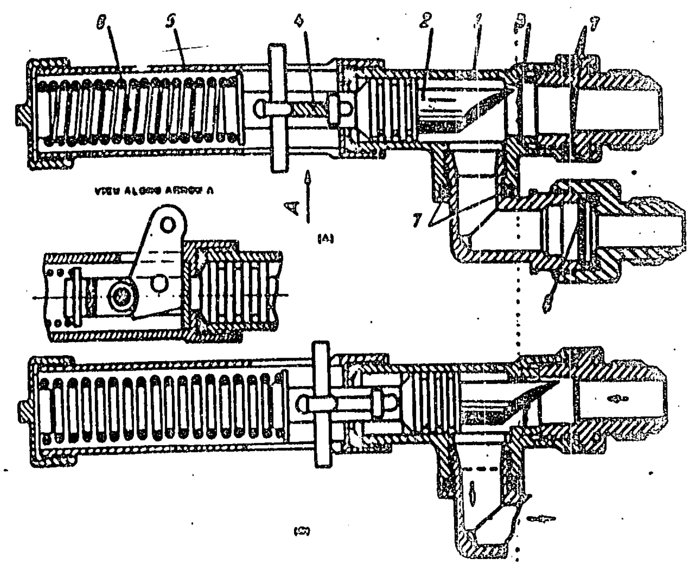

FIG. 92. DIAPHRAGM VALVE

1 – valve body; 2 – striking pin; 3 – diaphragm; 4 – cotter pin; 5 – valve cylinder; 6 – spring; 7 – sealing gaskets; 8 – fragment filter.

(a) Valve with cocked striking pin
(b) instant of valve action.

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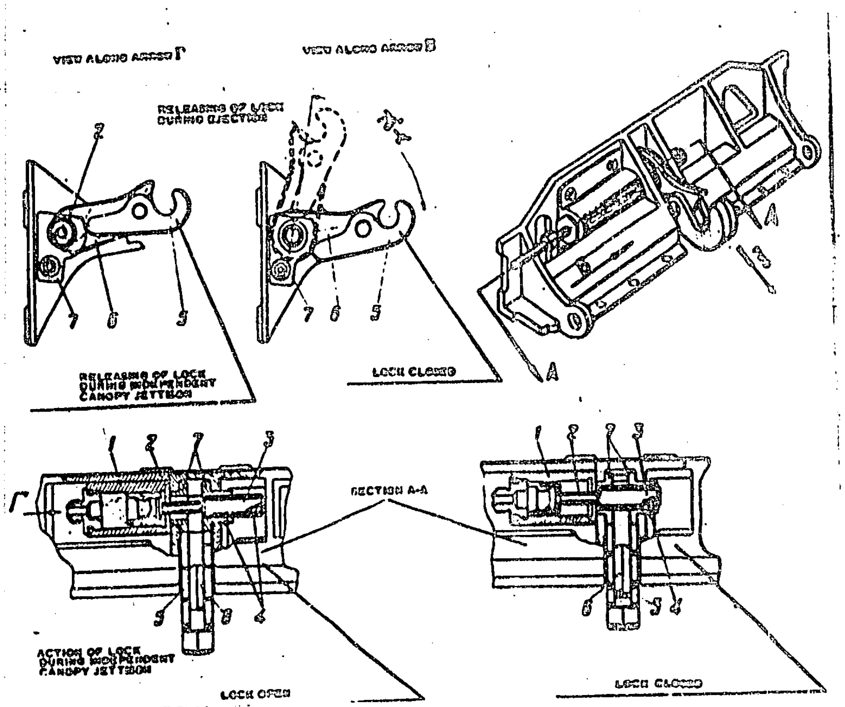

FIG.83. CANOPY TIME-DELAY LOCK

1 – air cylinder; 2 – piston with rod; 3 – lock axle; 4 – aluminium shear rivets; 5 – lock lever; 6 – bracket; 7 – bushing with flat.

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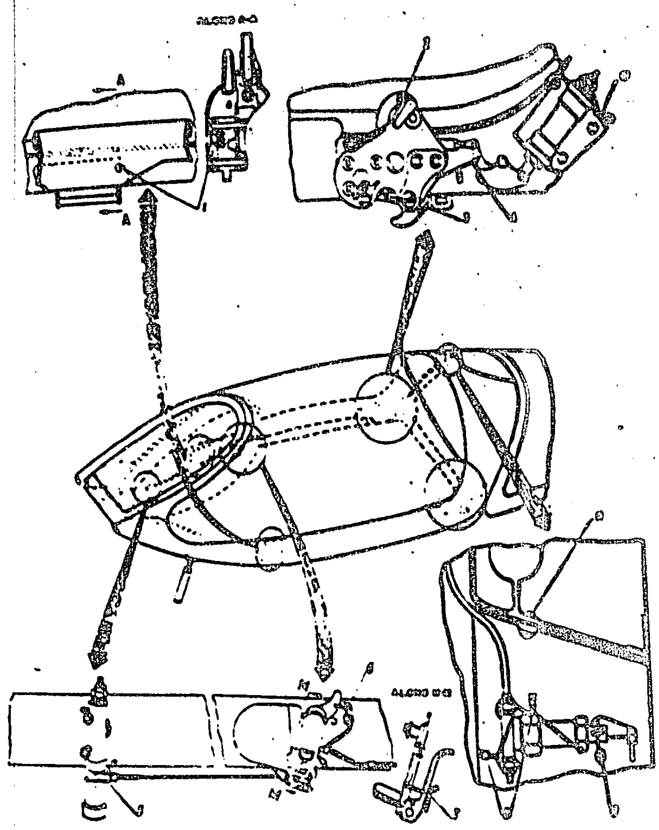

FIG 84. SAFETY WIRING OF CANOPY MECHANISMS

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The closed position of the canopy emergency jettison system (except the above-mentioned locking devices) can be determined by the position of curved hooks 23 (Fig. 81) with respect to the cuts in two-arm bell-cranks 24. This position is checked up by:

(a) red marks on the hooks; the hooks should fit into the cuts in the two-arm bell-cranks so that the painted surfaces of the hooks be completely concealed inside the cuts of the bell-cranks (Fig. 85);

(b) alignment of the holes in the left-hand hook and in the two-arm bell-crank; this is checked by pushing the ground locking pin through the holes in the bell-crank and hook.

Apart from checking the alignment of the holes, the above locking pin is used for fixing the cut-off position of the system so as to prevent its shifting. The pin must be installed each time the canopy was opened together with another ground locking pin to be inserted into the left-hand canopy lifting cylinder rod.

8. Installed on the canopy are the front and rear grip locks intended for securing the canopy to the seat when ejecting with canopy used for protection (Ch. X).

Front grip locks 4 (Fig. 81) are arranged on the right and left sides of the canopy; during ejection they engage the collapsible stops on the ejection seat sides.

Rear grip locks 14, similarly arranged on the right and left sides of the canopy near the rear side locks, engage the seat trunnions during ejection.

To prevent elevation of the canopy front portion during ejection and to achieve reliable connection between the canopy and seat, the fuselage is provided with a time-delay lock (Fig. 83) which opens only after the canopy is elevated through an angle of about 70°. Installed on the front hinge joint are two rollers designed to facilitate motion of the canopy over the armour glass when the seat is moving up out of the cockpit at the initial stage of catapulting with the canopy used for protection.

When catapulting with the canopy used for protection, the seat trunnions fit into the rear grip locks (Fig. 86) and remain fixed thereat as long as the seat shifts upwards through 20 mm. Simultaneously, the rods release all emergency locks 3 and 1 (Fig. 81), and all the devices connecting the canopy to the fuselage, with an exception of the time-delay lock, get disengaged.

As the seat moves further upwards together with the canopy the time-delay lock turns, too, till it reaches an angle of 70° at which the canopy gets disengaged and starts sliding on the rollers of bracket 3 (Fig. 79) over the armour glass.

The instant the seat pan gets out of the cockpit, the hinged spring stops of the seat open, allowing the canopy to engage them with front grip locks 4 as the canopy rolls off the armour glass (Figs 81 and 87).

The canopy is uncoupled from the seat when charge-operated mechanisms 2159 operate and turn the two-arm levers of the seat. The levers press upon retainers 6 (Fig. 86) arranged on the rear grip locks and through a linkage of rods, open front grip locks 4 (Fig. 81), whose brackets fall out of the locks disengaging the canopy from the seat hinged stops.

In order to achieve simultaneous disconnection from the seat and duplication required in the case of failure of one of charge-operated mechanisms 2159, the front grip locks are interconnected with a two-cord cable.

The forces produced by charge-operated mechanisms 2159 cause the canopy turn about the seat trunnions through the two-arm levers, the forces of dynamic pressure making the canopy hinge back and open the pilot.

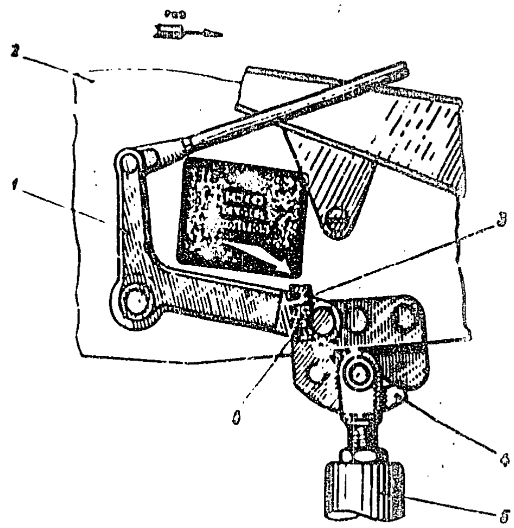

FIG.85. CHECKING OF CANOPY EMERGENCY JETTISON SYSTEM CLOSED POSITION (PORT SIDE VIEW FROM COCKPIT)

1 - two-arm bell-crank; 2 - canopy movable portion; 3 - rod with line to hatches (closed by two-arm bell-crank lever); 4 - curved hook; 5 - canopy lifting cylinder rod; 6 - hole for ground pin.

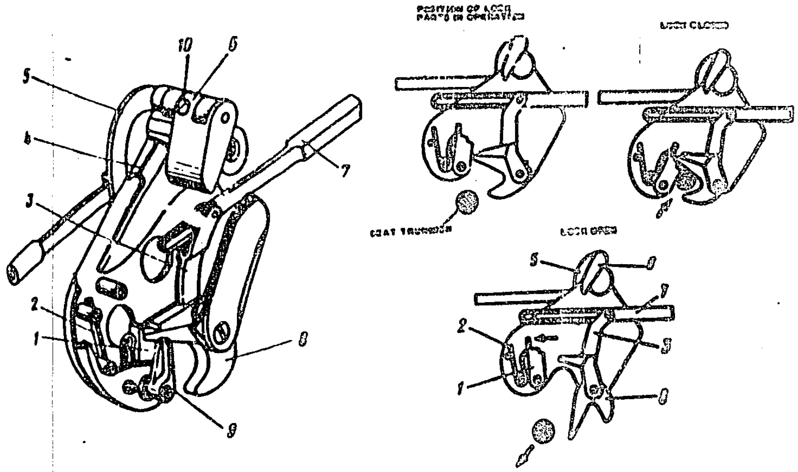

FIG.86. REAR GRIP LOCK

1 - stop; 2 - spring, 3 - lever, 4 - lock body, 5 - bell-crank; 6 - retainer; 7 - rod; 8 - hook; 9 - arm; 10 - lock catcher

above arrow from A/B-I material.

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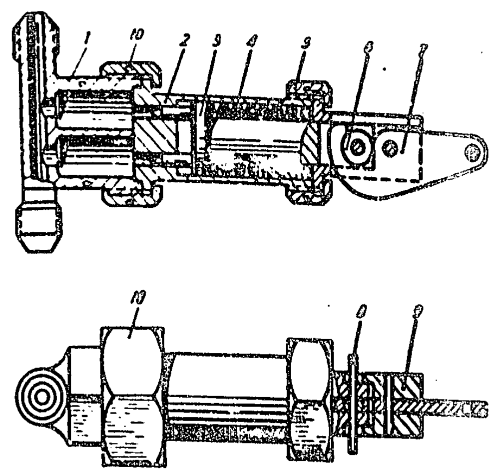

FIG.92. CANOPY EMERGENCY JETTISON GUN
1 – cartridge chamber; 2 – gun bolt body; 3 – striker; 4 – main spring; 5 – nut; 6 – roller; 7 – trigger lever; 8 – roller axle; 9 – sleeve; 10 – cartridge chamber-to-bolt body connection nut.

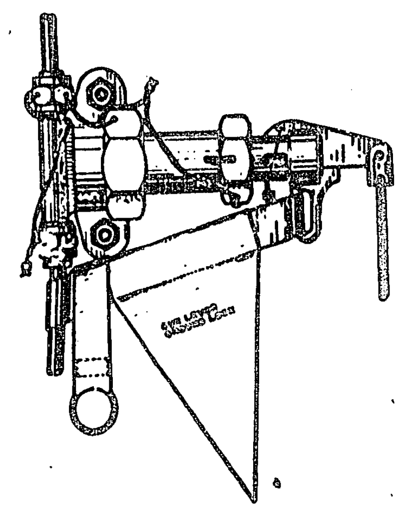

FIG.93. FITTING GROUND LOCKING PIN INTO CANOPY EMERGENCY JETTISON GUN

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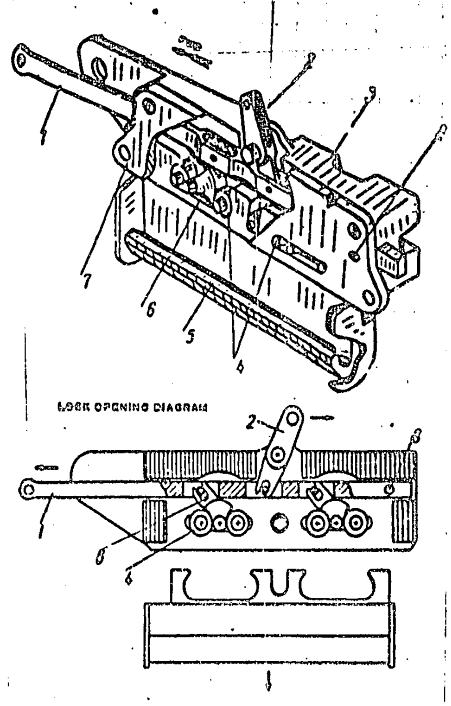

FIG.87. FRONT GRIP LOCK
1 – bar; 2 – drive bell-crank; 3 – lock body; 4 – roller; 5 – insert; 6 – cam; 7 – cover; 8 – shear screw, dia. 3 mm, made from material A/[illegible].

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When the canopy turns through an angle of about 110°, arms 9 (Fig. 86) of the rear grip locks contact the cams of the seat trunnions, the cams move the arms back opening the rear grip locks so that the canopy gets completely disengaged from the seat.

9. In order to remove ice from the windshield in flights under the icing conditions, the canopy is fitted with an alcohol de-icer manifold. Maintenance of the de-icer system and canopy glasses is described in Sections 9 and 10 of the given Chapter.

10. To heat the cockpit and the canopy glasses in the case of icing or sweating, the canopy is fitted with a blow-off manifold. The manifold outlet is joined with the cabin pressurization pipeline after the canopy is closed.

2. GENERAL INSTRUCTIONS ON CANOPY USE

1. The canopy control systems are designed to ensure reliable operation of the pilot's rescue means; therefore operation of the canopy should be entrusted to the personnel who have profound knowledge of the canopy design and its operating instructions, and have passed the respective tests.

2. Care should be taken to make everyday checks of adequate position of units and parts of the emergency systems and of the presence of safety wires and lead seals on them. It should be noted that the safety wires and seals are used only to indicate the correct position of the canopy emergency jettison system and by no means serve as the fastening elements to prevent shifting of the rods and bell-cranks.

3. To avoid inadvertent shifts of rods in the canopy emergency jettison system that may occur during aircraft maintenance on the ground, it is necessary to install two ground locking pins: one into the holes of the two-arm bell-crank and canopy lifting cylinder rod hook (on the left side), and another into the left-hand cylinder rod and the canopy independent jettison handle. The locking pins shall be installed immediately after opening the canopy and removed before flight prior to closing the canopy. A ground locking pin should be installed into the right-hand canopy lifting cylinder rod only when inspecting the dowels used for securing the canopy side lock loops at zero air pressure in the lifting system, and also when performing maintenance behind the instrument panel near the diaphragm valve.

4. In order to avoid inadvertent pulling out of the cotter pin from the diaphragm valve when performing maintenance behind the instrument panel, the cable must be disconnected from the diaphragm valve cotter pin and coupled to the halyard of the ground locking pin which in this case will be installed into the right-hand canopy lifting cylinder rod as well. After maintenance, connect the cable to the diaphragm valve cotter pin.

5. In order to prevent inadvertent firing of the emergency jettison gun when the canopy is removed or installed or when scheduled maintenance of the canopy is performed, the canopy ejection gun is also locked with a ground locking pin to be removed after the maintenance is over.

6. To avoid mechanical damage of the canopy glasses and to protect the canopy against sunrays, a flannel cover should be laid over the aircraft canopy during parking.

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9. OPENING AND CLOSING THE CANOPY

Opening (lifting) and closing (lowering) of the canopy are performed from outside by means of the handle arranged in a depression on the fuselage port side and inscribed CANOPY OPENING or from inside the cockpit by means of the handle installed on the fuselage port side and inscribed CANOPY OPENED, CLOSED (Fig. 80).

To open the canopy from outside the cockpit, proceed as follows:

1. Release the handle by depressing button DEPRESS; as a result the handle will get out of its seat.

2. Turn the handle from the horizontal position downward until all the way to the stop in the direction indicated by the arrow; as a result, the canopy gets unsealed, the dowels move out of the side lock loops and the air is fed into the canopy lifting cylinders.

3. After the canopy is opened, insert the ground locking pins into the left-hand cylinder rod hole and into the holes in the two-arm bell-crank and in the left-hand hook.

To close the canopy by means of the outside handle, turn the handle in the opposite direction after the ground locking pins have been removed.

To open the canopy from inside the cockpit, observe the following priority (Fig. 88):

1. Unlock the valve handle by driving it out of the valve panel cut-outs.

2. Pull the handle backwards and set it in the extreme backward position without any intermediate stops; this causes the canopy to unseal and open similarly to unsealing and opening by means of the outside handle.

3. After the canopy is opened, insert the ground locking pins in a manner described above.

To close the canopy from inside the cockpit, observe the following priority of operations (Fig. 89):

1. Remove the ground locking pins previously inserted into the left-hand canopy lifting cylinder rod and into the two-arm emergency jettison bell-crank.

2. Turn the valve handle up into the vertical position so that the air contained in the cylinders is released; the further travel of the handle in this direction is limited till the canopy closes completely. After the canopy is closed and the left rear loop sinks fixing dowel stop 12 (Fig. 80), the handle can be shifted further forward.

3. Shift the handle into the extreme forward position so that the canopy side lock loops are secured by the dowels, after which the handle enters the valve panel cut-out and is locked by the spring.

4. Seal the canopy by shifting the button into the forward position.

CAUTION. 1. No flying is allowed unless the handle is locked in the extreme forward position (i.e., the handle must enter the valve panel cut-out).

2. When opening the canopy, the handle should be shifted from the forward to the backward position without intermediate stops.

3. To seal the canopy from outside, use a screw-driver to turn axle 17 (Fig. 80) after handle 16 has been previously sunk in the seat and locked with the help of button 18.

4. To avoid deformation in the instrument hatch cover, never open the canopy until the hatch cover has been closed with the locks.

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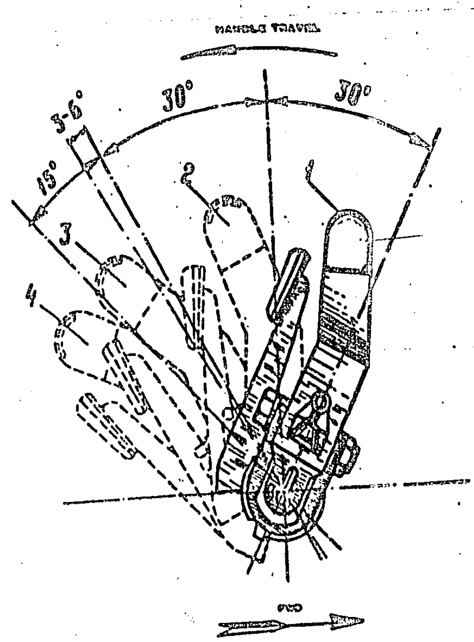

FIG.88. DIAGRAM SHOWING CANOPY CONTROL AND PRESSURIZATION VALVE OPERATION WHEN HANDLE IS PULLED BACKWARD

1 — canopy is closed and sealed. As handle is shifted into position 2, canopy becomes unsealed; 2 — canopy is unsealed. As handle is shifted from position 2 to position 3, fixing pins become disengaged from side lock loops; 3 — canopy is not lifted though fixing pins are disengaged from side lock loops. As handle is shifted from position 3 to position 4, canopy moves up (air being fed to lifting cylinders). Handle travels free through sector of 3 to 6 degrees so that air cannot accumulate inside lifting cylinders before pins move out of lock loops; 4 — canopy movable portion is lifted.

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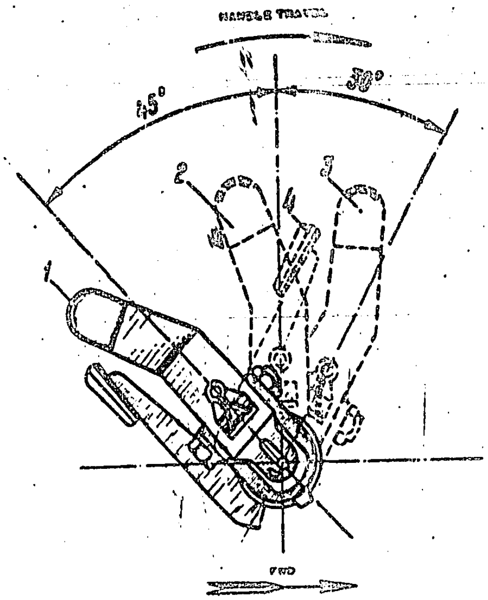

FIG.89. DIAGRAM SHOWING CANOPY CONTROL AND PRESSURIZATION VALVE OPERATION WHEN HANDLE IS PUSHED FORWARD

1 – canopy is open. As handle is shifted into position 2, air is released from lifting cylinders and canopy moves down; 2 – handle is locked till canopy is completely down and fixing pin stop is sunk. As handle is shifted completely to position 3, pins fix side lock loops; 3 – canopy movable portion is down, side lock loops are fixed with pins, canopy is not sealed. When the button moves towards position 4, canopy sealing hose gets inflated with air; 4 – canopy is sealed.

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4. DEMOUNTING AND INSTALLATION OF CANOPY

To demount the canopy, proceed as follows:

1. Open the fuselage front upper hatch cover.

2. Open the canopy, install the ground locking pins into the cylinder rods and into the left-hand joint of the canopy emergency jettison system two-arm bell-crank and make sure that the ground locking pins have been installed in the independent canopy jettison handle, seat mechanisms and plate ИНСТРУКЦИЯ.

3. Insert a ground locking pin into the canopy ejection gun.

4. Hold the canopy by hands and drive spindles 23 (Fig. 81) from the canopy lifting cylinder rods.

5. Get into the cockpit and close the canopy by setting the valve control handle in the vertical position (the canopy locks being opened). Do not seal the canopy.

6. Disconnect the canopy de-icer manifold rubber hose from the pipe arranged on the left side.

To prevent deformation of the manifold, drive out the attachment screws and remove the manifold from the canopy.

7. Unlock and screw off the nuts and drive out two canopy movable section suspension bolts 22 from the hinge joint front locks.

8. Elevate the canopy from inside and, sliding it to some extent backwards to open the time-delay lock, pull the roller axle from the time-delay lock and remove the canopy carefully from the aircraft.

To mount the canopy, proceed in the reverse order having made sure that the canopy emergency jettison system is set in the extreme closed position and that the canopy locks are coated with balloon cloth glued to them from below to prevent fouling.

Prior to installing the canopy, turn the time-delay lock up through 70° and fit the roller axle into the lock mouth; then holding the lock hook with hand align the holes in the front hinge locks of the canopy with the holes used for driving the bolts into the fuselage bracket, and install the bolts previously lubricated with grease ЦИАТИМ-201.

The bolts must easily enter the locks by the hand effort without hammering.

<u>CAUTION</u>. 1. Never place the demounted canopy on the ground unless there is a cloth spread for the purpose.

It is advisable that the canopy should be placed with its loops down. It is allowed to place the canopy on its glass only in case a stand shaped as the glass is used. The stand should be coated with soft rubber and flannel.

2. Spread the cover over the demounted canopy and take measures to protect the locks against dirt and sand.

After the canopy is installed, check the canopy emergency system for complete closing. To do this, proceed as follows:

(a) insert the ground locking pin into the left-hand joint connecting the lifting cylinder rod to the canopy (i.e., check if the holes in the two-arm bell-crank and rod hook are aligned);

(b) make sure that the red marks on the rod hooks are inside the cut-outs of the two-arm bell-crank forks;

(c) check the presence of locking devices and lead seals used in the canopy emergency system (Fig. 88);

(d) make sure that the canopy emergency jettison handle upper end enters the cut-out in the canopy ejection gun trigger drive rod when the canopy is closed. Take

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care that the emergency handle arranged on the fuselage is not in the extreme forward position and locked, and that the gun trigger drive installed on the canopy should be set in the extreme backward position.

5. CHECKING OPERATION OF CANOPY GUN, CANOPY EMERGENCY JETTISON SYSTEM DIAPHRAGM VALVE AND TCM-2500-38 CHARGE-OPERATED MECHANISM BLEED VALVE

This checking is made in the course of scheduled maintenance simultaneously with maintenance of the pilot's seat.

The checking is made with the help of the canopy independent jettison handle in compliance with the procedure described below:

1. Open the canopy, insert the ground locking pins into the lifting cylinder rod and into the canopy emergency jettison system left-hand bell-crank joint, and make sure whether the required ground locking pins have been installed into the seat and canopy mechanisms.

2. Unload the canopy gun and charge it with two blank cartridges.

3. Reduce the pressure in the main air system and in the canopy tossing air bottle to zero by bleeding the air through the pipe connection in the L.G. nose strut well.

To release the pressure, make use of arrangement 76-9840-100. To check the pressure, note the indications of the pressure gauges installed inside the cockpit and on the arrangement.

4. Charge the canopy tossing bottle with compressed air delivered at 40 to 50 kg/cm^2 with the help of the above arrangement.

After charging the canopy tossing air bottle, check the pressure by reading the main air system pressure gauge and see that the reading is zero if check valve 9 (Fig. 81) installed at the emergency bottle is airtight. The pressure indicated by pressure gauge installed on the arrangement should not drop if the canopy tossing air system is airtight.

5. Get into the cockpit, drive the ground locking pin out of the canopy lifting cylinder rod, remove the emergency system locking pin (installed in the left-hand two-arm emergency jettison bell-crank), and close the canopy. Do not seal the canopy.

6. Drive the ground locking pin out of the canopy emergency jettison handle and turn the handle downwards as far as it will go (into the horizontal position). This causes the diaphragm valve to operate and pass the air from the emergency air bottle into the canopy lifting cylinders and into the time-delay lock cylinder, whose rod cuts off an aluminium rivet and knocks out the lock hook axle.

7. Pull the canopy jettison handle strongly backward as far as it will go so that the canopy ejection gun lever locking wire is torn off. As the handle travels 20 to 30 mm, the gun cartridge primers are pricked (measure the handle travel in place where the cable is connected to the handle).

As the handle is further displaced, the valve bleeding the powder gases produced by charge-operated mechanism TMC-2500-38 is engaged, i.e. the cotter pin is pulled out of the valve. Check that after the cotter pin is pulled out of the charge-operated mechanism valve, the handle can still travel not less than 4 mm.

8. Release completely the air pressure from the canopy tossing system.

CAUTION. Prior to releasing the air pressure from the canopy tossing system, do not remove or open the canopy.

9. Demount the canopy from the aircraft as instructed in Section "Demounting and Installation of Canopy" and make sure that the time-delay lock is released, i.e., that the lock mouth opens easily.

10. Proceed as follows to restore the canopy emergency jettison system:

(a) disconnect the pipeline from the diaphragm valve and filter. Screw off their pipe connections and make sure that the diaphragm has been broken; then drive out the sleeve with broken diaphragm 3 from the valve (Fig. 82) and remove the fragments of the diaphragm from the valve and filter;

(b) return the canopy emergency jettison handle into its initial position and check if the cable connected to the handle is laid in the roller grooves and covered with plates to prevent falling of the cable out of the grooves;

(c) use special arrangement 76-7804-560 to cock striker 2 of the diaphragm valve and insert cotter pin 4. Put the cotter pin under lead as is shown in Fig. 84;

CAUTION. Special attention should be paid to check if the cotter pin is set correctly. The cotter pin should be installed between the roller and float gasket and turned with its straight edge towards the float gasket (Fig. 82, view along arrow A). Proper setting of the cotter pin precludes the valve from inadvertent action;

(d) fit a new sleeve with glued-up diaphragm 3 into the valve. Turn the sleeve so as to place the diaphragm against the striker;

(e) assemble the fragment filter, connect the pipeline to the diaphragm valve and filter, and safety the union nuts with wire KC-0.8;

(f) remove the fragments of the cut-off rivet from the sleeve and time-delay front lock axle, close the lock, displace the cylinder rod to insert the axle lubricated with grease ЦИАТИМ-201 into the lock, and rivet the axle and the sleeve by driving aluminium rivet 3520A-2-6 into the old hole;

(g) after the seat has been removed from the aircraft, install the cotter pin into the TCM-2500-38 bleed valve and safety it with wire МЛВ-0.5. To perform the operations listed in the given Item, proceed as described in Chapter X, Section "Demounting and Installation of Charge-Operated Mechanism TCM-2500-38";

(h) unload the canopy ejection gun and make sure that the primers have been pricked.

Charging the canopy gun with firing cartridges ПВ-1 and locking of all units of the system should be performed after checking the operation of the emergency lock release system (Section 7).

CAUTION. 1. While working inside the cockpit, take care to avoid pulling the cable connected to the canopy tossing system emergency valve cotter pin, since this may lead to premature operation of the valve. When maintenance is to be performed near the diaphragm valve behind the instrument panel, install a ground locking pin into the right-hand canopy lifting cylinder rod, disconnect the cable from the diaphragm valve cotter pin, and connect it to the ring of the ground locking pin halyard. After maintenance, restore the system.

2. While working, take care to see that before closing the canopy, the canopy emergency jettison handle is set in the forward position and locked. Closing the canopy with the handle in the backward position may lead to damage of the handle and trigger drive arranged on the canopy.

6. CHECKING OPERATION OF EMERGENCY LOCK RELEASE SYSTEMS

1. Set the canopy on supports and suspend a weight of 5 to 10 kg from six side loops and two front hinge locks (Fig. 90).

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2. Screw off the bolt unit from the canopy ejection gun and connect device 76-9806-100 to the ejection gun body for checking actuation of the canopy locks. Charge the air bottle of the device with compressed air at 5 to 10 kg/cm^2.

3. Make sure that the emergency jettison system is in the closed position, open the device air bottle cock and feed the air from the bottle to the canopy ejection gun.

4. After the pressure is applied see that the lock emergency release system is actuated, the lock loops are disconnected from the canopy and the front hinge locks are opened.

CAUTION. 1. Take measures to prevent nicks and damage of the lock loops when they fall down.

2. Each loop bears the number of the lock where it is installed.

After checking, cock the locks as follows:

1. Insert loop 1 (Fig. 91) into its lock (according to its number), turn lever 2 down and lower fixing lever 4 by turning it with a rod (a marking tool or pin) inserted into the eye to set the lock in position LOCK CLOSED.

When the lock is closed, suspend a weight of 3 kg from the eye of lever 4 or use spring appliance 72-7804-820 to apply the force.

On closing all six side locks, fix the front hinge lock; for this purpose shift the larger grip upper end backwards (i.e., shut the mouth formed by the larger and smaller grips) and throw the fixing lever back.

2. Turn the two-arm bell-cranks simultaneously forward and take care to fit the cylinder rod curved hooks into the grooves of two-arm bell-cranks 24 (Fig. 81). As a result, the linkage of bell-cranks and rods will shift forward and lock the cocked mechanisms of the emergency locks.

Notes: 1. While cocking the system, see that the rear grip locks are set in the initial position (Fig. 86); otherwise, no cocking (locking) of the system can be effected.

2. Prior to cocking the system, see that the charge-operated cylinder rods are retracted into the initial position.

3. Never close the canopy emergency jettison system unless fixing levers 4 of the side locks (Fig. 91) have been pulled out by means of a 3-kg weight or with the help of device 72-7804-820; violation of this rule leads to deformation of contacting surfaces of fixing lever 4 and fixing axle of bell-crank 3 as well as to maladjustment of the system.

4. The system is closed in compliance with the instructions given in Item 2 by shifting the two-arm bell-cranks forward. It is allowed that the system can be closed with the help of two-arm bell-cranks 24 (Fig. 81) used to lock the lifting cylinder rod hooks.

Never close the system by means of the rear lock levers.

3. Remove the appliance and make sure that the side lock loops are fixed and do not fall out and that the front hinge lock grips do not turn.

If the canopy suspension bolt grips are out of the lock mouth, the grips can have a certain play.

4. Lock all units of the canopy emergency jettison system and affix the seals as shown in Fig. 84.

5. Fix with glue balloon cloth to the openings in the canopy locks to prevent fouling of the locks.

6. Install the canopy in the aircraft (See Section 4).

7. Check the proper closing of the canopy emergency jettison system by the alignment of the holes in the rod left-hand hook and in the two-arm bell-crank (for this purpose insert a ground locking pin).

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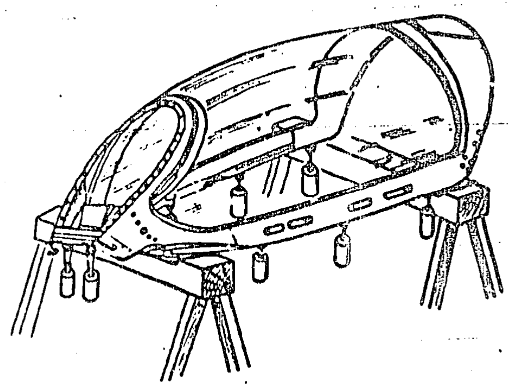

FIG. 90. SUSPENSION OF WEIGHTS TO CHECK OPERATION OF CANOPY EMERGENCY LOCK SYSTEM

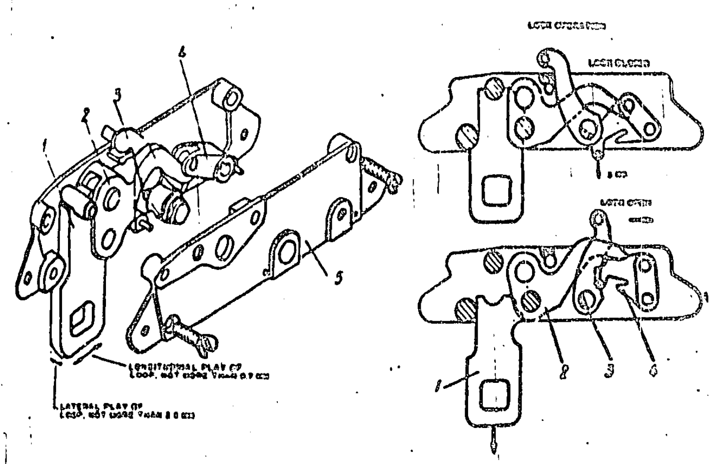

FIG. 91. SIDE EMERGENCY LOCK
1 – loop; 2 – lever; 3 – bell-crank with fixing cable; 4 – fixing lever; 5 – body

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8. Load the canopy emergency jettison system ejection gun with firing cartridges ПК-1, fix the gun with a ground locking pin and lock the larger nut and the canopy ejection gun lever (See Section 7).

9. Make sure that the cable is secured to the diaphragm valve cotter pin and remove the ground locking pin from the canopy emergency jettison system ejection gun.

Operation of the grip lock system is checked only when replacing the canopy or seat, when demounting the special plate or repairing the canopy (replacing locks, glazing and so on).

7. MAINTENANCE OF CANOPY EMERGENCY JETTISON GUN

The canopy jettison gun (Fig. 92) installed in the canopy emergency jettison system consists of the cartridge chamber and gun bolt with the striker, main spring, sleeve, trigger arm and two nuts.

The cartridge chamber is secured to the canopy emergency jettison charge-operated system pipeline by means of two pipe connections. The pipe connection union nuts are interlocked with wire КС-0.8.

Arranged inside the gun bolt body is the striker with the main spring. The body butt end is provided with two holes to let in the striker firing pins at the instant of firing, and there are two centring pins fitted into the respective seats for coupling to the cartridge chamber.

The cartridge chamber and bolt body are secured to each other by means of a larger nut of the bolt. After tightening, the nut is secured to another nut of the bolt and to the pipeline branch by means of wire КС-0.8.

Attached inside the striker stem end cut is a roller intended for engaging the trigger arm which retains the striker in the cocked position.

The striker stem end is connected to the sleeve by means of the protruding ends of the roller axle. The cut in the sleeve used to pass the roller axle is intended for centring the motion of the striker during firing and prevents its turning since the sleeve can be installed inside the bolt body in a definite position only.

To couple the trigger arm to the roller, the sleeve has a lengthwise cut aligned with the cut of the striker stem end, and a hole for setting a pin used as a rotation axle of the trigger arm.

On cocking, the trigger arm is secured to the sleeve with copper wire МН-0.5.

The trigger arm is coupled through a spindle to the link of the cable arranged inside a pipeline. Prior to inserting the cable, the pipeline is smeared with graphite grease.

As the cable is pulled out, the trigger arm turns, cuts off the locking wire and disengages the hook from the striker roller. As the striker is released, it travels under the action of the main spring and hits the primers of the cartridges.

The charge-operated mechanism striker is released by means of the independent canopy jettison handle located on the right-hand canopy-carrying panel on the fuselage.

When the canopy is closed, the upper lever of the handle fits into the gun trigger drive slot.

To release the striker, the handle should be shifted into the horizontal position and then pulled backwards.

While unloading and loading the gun, measures should be taken to avoid inadvertent firing.

When changing the cartridges without checking the trigger system, the following sequence should be observed to unload and load the gun:

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1. Unlock and screw off nut 10 connecting the ejection gun cartridge chamber and bolt body, and disconnect the gun bolt and cable from the cartridge chamber.

2. Take the cartridges from the cartridge chamber.

3. Clean the cartridge chamber and the bolt face.

4. Charge new cartridges ПВ-1 into the cartridge chamber.

5. Insert the bolt centring dowels into the respective seats in the cartridge chamber and tighten the nut of bolt 10 to couple the cartridge chamber and the gun bolt body.

After tightening, secure the nut with wire КС-0.8 to nut 9 of the bolt and to the pipeline connection, and install a ground safety pin (Fig. 93).

CAUTION. Screw the gun bolt-to-cartridge chamber connecting nut as far as it will go, since otherwise the travel of the firing pins engaged when the striker is released is not sufficient to effect firing. For the same reason, make sure that after the nut is tightened, the clearance between the nut butt end and gun attachment stirrup is not less than 0.5 mm.

Checking Operation of Canopy Ejection Gun

The gun operation is checked once a year simultaneously with checking the operation of the diaphragm valve, canopy emergency jettison system and ХОМ-2500-30 charge-operated mechanism gas bleed valve.

Checking of the gun firing is made when carrying out scheduled maintenance of ejection seat CK.

Whenever checking the operation of the canopy mechanisms or of the gun bolt, see to it that the gun is unloaded.

To check the canopy gun firing, use only dummy cartridges with primers.

CAUTION. Never use firing cartridges to check the canopy gun operation.

After checking firing of the canopy gun, proceed as follows:

1. Screw off the bolt body-to-cartridge chamber connecting nut and separate the bolt from the cartridge chamber.

2. Remove the dummy cartridges from the cartridge chamber and check whether the primers have been broken. The permissible displacement of the firing pin trace from the centre of the dummy cartridge primer must not exceed 0.6 mm.

3. Disconnect the trigger arm from the cable link.

4. Screw off the clamping (smaller) nut of the sleeve and remove it from the canopy gun body.

5. Drive out the sleeve to take the striker and main spring from the body.

6. Clean and examine all parts of the canopy gun.

While doing so:

(a) pay special attention to removing the carbonised deposit from the cartridge chamber;

(b) ascertain free rotation of the striker roller and trigger arm on their axles;

(c) check condition of the striker firing pins, extension of the firing pins from the gun bolt face and absence of jamming in striker motion inside the bolt body.

After examination, apply a thin layer of grease ЦИАТИМ-201 to the interior parts of the gun bolt.

7. Assemble the canopy gun bolt and cock the striker. While assembling, observe the following priority:

(a) insert the canopy gun bolt and main spring into the bolt body;

(b) fit the projecting sleeve beads into the respective splines of the bolt body and connect them together;

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(c) tighten up the sleeve clamping nut on the bolt body. See that the mark lines notched on the nut and bolt body are aligned;

(d) pulling the striker backward, allow the trigger arm to pass freely behind the roller and then to engage it;

(e) lock the trigger arm with copper wire ММ-0.5 by securing it to the sleeve. See that the wire is stretched.

8. Connect the trigger arm to the cable link by means of a spindle, and install a washer and a pin on the spindle.

9. Charge two new powder cartridges into the cartridge chamber and connect the bolt body and cartridge chamber with the nut as is directed in the instructions on loading.

10. Lock the canopy gun nuts with wire КС-0.8.

8. SLUSHING OF CANOPY

In case the aircraft is expected to be out of use for over 3 months, it is expedient that the canopy and canopy operating system should be subjected to anti-corrosive treatment.

Prior to slushing, proceed as follows:

1. Bleed the air from the aircraft system and from the canopy emergency air bottle.
2. Unload the canopy gun.
3. Release the canopy gun striker.
4. Screw off the pipeline from the canopy tossing system diaphragm valve, remove the sleeve and diaphragm, and release the valve striker (by pulling out the cotter pin). Take care to preserve the sleeve when the slushed aircraft is stored.

<u>Slushing Procedure</u>

1. Use graphite grease prepared on the basis of lubricant ЦИАТИМ-201 to coat the open portions of the cable linkage assembled both on the canopy and on the fuselage.
2. Apply a thick layer of grease ЦИАТИМ-201 to the following elements:

(a) all joints of the canopy control and emergency jettison system;

(b) emergency diaphragm valve;

(c) canopy gun interior surfaces;

(d) emergency locks, to prevent penetration of moisture inside the locks arranged in the canopy longitudinal profiles;

(e) canopy outside opening handle installed on the fuselage.

The canopy needs not be removed from the aircraft for slushing.

9. MAINTENANCE OF DE-ICER SYSTEM

The de-icer system (Fig. 94) is intended to remove ice formed on the windshield when flying under icing conditions. Ice formations are removed by washing the canopy windshield with ethyl alcohol.

The system is started by depressing the ПУ-7 valve switching button installed on the sight bracket inside the cockpit.

The button switching valve ПУ-7 is arranged in the upper part of the instrument panel. Valve ПУ-7 is calibrated to respond to a pressure of 3 ± 0.2 kg/cm^2.

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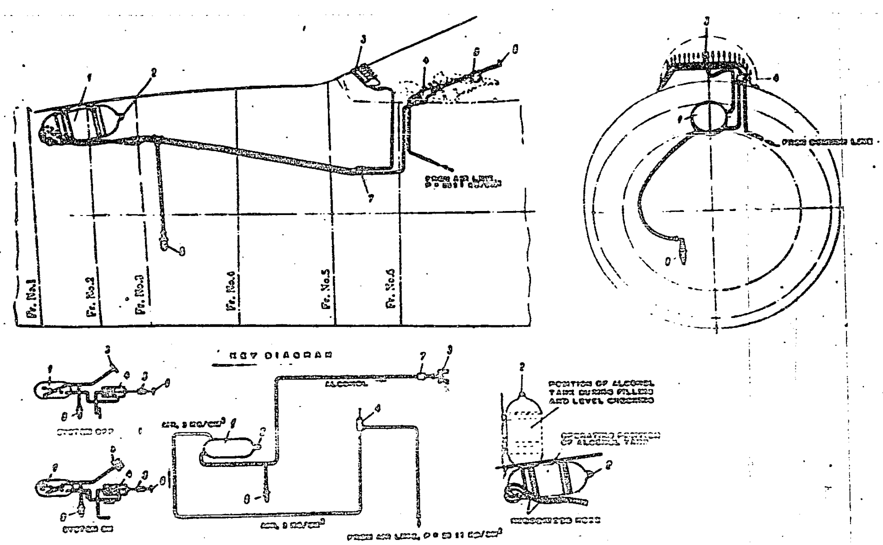

FIG.94. CA[illegible] SYSTEM

1 – alcohol tank; 2 – filler neck; 3 – manifold; 4 – valve [illegible]; 5 – [illegible] springs; 6 – [illegible] button; 7 – check valve; 8 – drain valve.

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The alcohol tank of 4.9 lit. capacity is housed in a special bay in the nose
portion of the fuselage and attached to the hatch cover.
During flight the tank is set horizontally, but as the hatch cover is opened,
the tank gets into the vertical position. The tank is filled when it is set
vertically. The amount of alcohol filled is 4.5 $\pm$0.2 lit., its level being determin-
ed by means of a measuring rod attached to the plug.
As a pressure is applied, the alcohol is forced out of the tank and fed to the
canopy de-icer manifold through the check valve.
The de-icer system is switched off when the switching button is released.
The air released from the alcohol tank passes out through a bleed hole in
valve ПУ-7 after the switching button is released.
In order to achieve maximum effective use of alcohol, the duration of engage-
ment of the de-icer system should be 3 to 5 sec.
In case the ice formations cannot be removed after a single application of
the system, the de-icer must be switched on repeatedly at small intervals till the
ice is removed.
When checking the de-icer system for good operation, the time of engagement
should not exceed 3 to 5 sec. See to it that alcohol pours out of all holes.
Otherwise, use copper wire, dia. 0.4 mm, to clean the outlet holes
(dia. 0.5 mm).
Whenever necessary, wash the de-icer tank with water and check the tightness
of the system and the quantity of liquid consumed through manifold.
Check the de-icer system for leakage by pressurising it with air delivered at
a pressure of 3 kg/cm^2.
For this purpose disconnect the manifold at the pipeline joint at the outlet
of the check valve and stop the free end of the pipeline with a plug. Drive out the
tank plug and screw in a pressure gauge into the filler neck. Depress the ПУ-7
valve switching button for a period of 3 to 5 sec. and fill the system with air.
Make sure that the pressure gauge reads 3 $\pm$0.2 kg/cm^2. Maintain the pressure
for 5 min. Leakage through the pipeline joints is not permissible.
After checking the tightness of the system, ascertain normal operation of the
check valve. To do this, remove the plug from the pipeline and see that the tank
pressure gauge indicates a pressure drop to 1.9 $\pm$0.2 kg/cm^2 and that no leakage
occurs after the pressure has dropped. When the check is over, restore the operat-
ing condition of the system.
To check the amount of liquid consumed through the de-icer manifold, make sure
that the tank filling is complete.
Depress the ПУ-7 valve switching button and estimate the time of liquid flow
through the manifold. The system is considered in good condition if the time
amounts to 1.5 to 2 min.
To check the amount of liquid consumed through the de-icer system manifold,
fill the tank with 4.7 litres of water.
After checking, wash the tank and the system with 1 litre of alcohol by
engaging the system.

10. MAINTENANCE OF CANOPY GLAZING

Parts of the canopy glazing manufactured from plexiglass, require great care
of their surface.
Such defects of the plexiglass surface as scores, scratches and frostwork
impair observation, while cracks, nicks and the like reduce the mechanical strength
of the glass.

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To avoid damage of the glazing, the parts manufactured from plexiglass must not be exposed to durable effects of moisture, sunrays and dust or to effects of organic solvents or their vapours (e.g. acetone, benzole, dichlorethane, alcohol, etc.) which leads to frosting of the glass surface.

Care of the plexiglass parts of the glazing implies the following:

1. When the aircraft is parked, the glazing parts should be closed with covers to protect them against sunrays, dust, rain, snow and mechanical damage.

The covers used to protect the canopy should be cleaned thoroughly to remove sand and dust, particularly undesirable on the side facing the canopy glass.

2. In case the glazing is dirty, proceed as follows to clean it of dirt and dust prior to and after a flight:

(a) wipe the glass with a clean soft cloth saturated with water and wrung out, and then use a dry cloth for final wiping;

(b) in the case of oily fouling, apply a small quantity of paste ВНАИ-2, wipe the glass with a clean soft cloth and wash it as described in Item a.

In case paste ВНАИ-2 is not available, wipe the glass with a soft cloth moistened with soapy water and wrung out (use a 3 to 5 per cent solution of acidless soap).

Notes: 1. For wiping and washing the glass, use soft cotton, flax or flannel cloths that have been previously washed out, or apply hygroscopic cotton which contains no solid inclusions. In washing, rinse the cloth in clean water as often as possible and wring them out.

2. Never use wool or silk for cleaning the glass, since these produce electric discharges in the plexiglass which leads to attraction of dust to the glass surface.

3. Listed below are the permissible defects of the glazing:

(a) crazes that do not form a thick lattice;

(b) separate scratches and scores whose depth is within 0.1 mm, length is within 100 mm and number does not exceed 10 for the entire canopy surface;

(c) separate nicks and dents whose depth is within 1 mm, diameter is within 3 mm and number does not exceed 5 for the entire canopy surface;

(d) minor surface cracks (otherwise called "frostwork") spread in spots, up to 100 mm^2 each; the number of spots must not exceed 5 for the canopy surface, each crack being not more than 5 mm long.

4. In case the glass is crazed, it is allowed to polish its surface with paste ВНАИ-2.

The glass should be polished manually by applying a small quantity of paste and rubbing the scratched surface with hygroscopic cotton in strokes directed first along the scratch, then across it and finally in circles; in doing so care should be used to press the cotton gently and evenly so as to avoid heating of the glass surface caused by friction. Polishing may engage the whole surface.

Emery paper must never be used for removing scratches and scores no matter what their place on the glazing may be.

Frostwork must not be removed by means of emery paper, or by filing, grinding, polishing or heating the places affected.

5. While making scheduled maintenance of the aircraft, the parts of glazing should be protected with jackets or covers to prevent mechanical damage.

Chapter X.

EJECTION SEAT

1. GENERAL

The ejection seat, type CK, mounted on the aircraft (Fig. 95) is characterized by the following specific features:

(a) during ejection, the cockpit canopy is used as a means of pilot's protection against the effect of the airstream, due to which the bailout speed has been increased to about 1100 km/hr;

(b) the parachute harness is utilized for fastening the pilot to the seat;

(c) owing to the forced tension harness restraint mechanism used during ejection, no definite posture is any longer required to be assumed by the pilot;

(d) used instead of the foot holds are the foot rests with grips designed to fasten automatically the pilot's feet during ejection;

(e) to effect an ejection, the pilot performs a single operation easily accomplished in all modes of flight;

(f) arranged on an extendible bar is a drogue parachute designed to stabilize the motion of the seat after it has been ejected from the aircraft;

(g) the use of smooth adjustment of the seat height during flight or on the ground provides convenience in pilot's activities;

(h) since the time required to prepare for ejection has been reduced, the minimum safe altitude of ejection during a level flight has diminished accordingly to 110 m.;

(i) an increase in weight of the ejected mount due to ejection of the canopy and rails installed in the seat has resulted in a decrease of overload affecting the pilot at the initial stage of ejection and after the seat enters the airstream.

The above characteristics ensure safety in ejection at high flight speeds. The ejection procedure is depicted in Fig. 96.

The specific features described above have been achieved due to use of the following systems and mechanisms introduced in the design of ejection seat CK:

1. Combined pilot's parachute harness system, i.e. fastening of the pilot to the seat is effected with the help of the parachute harness, namely:

(a) by means of shoulder belts, i.e. shoulder belt restraint mechanism;

(b) by means of waist belts, i.e. waist belt restraint mechanism.

The combined parachute harness system enables the pilot to lock and unlock the parachute inside the cockpit and to leave the parachute in the seat pan.

The shoulder belt tension is produced by the telescopic cylinder of charge-operated mechanism 215P with a spring and is controlled by the pilot by means of the handle installed on the left hand-rest of the seat (Figs 95 and 97).

To engage the shoulder belt restraint mechanism, the pilot must press the handle button towards the seat pan and pull the handle backward. Due to this, the support is caused to move from under the rod of charge-operated mechanism 215P, and as the charge-operated mechanism spring extends, it pushes the support apart,

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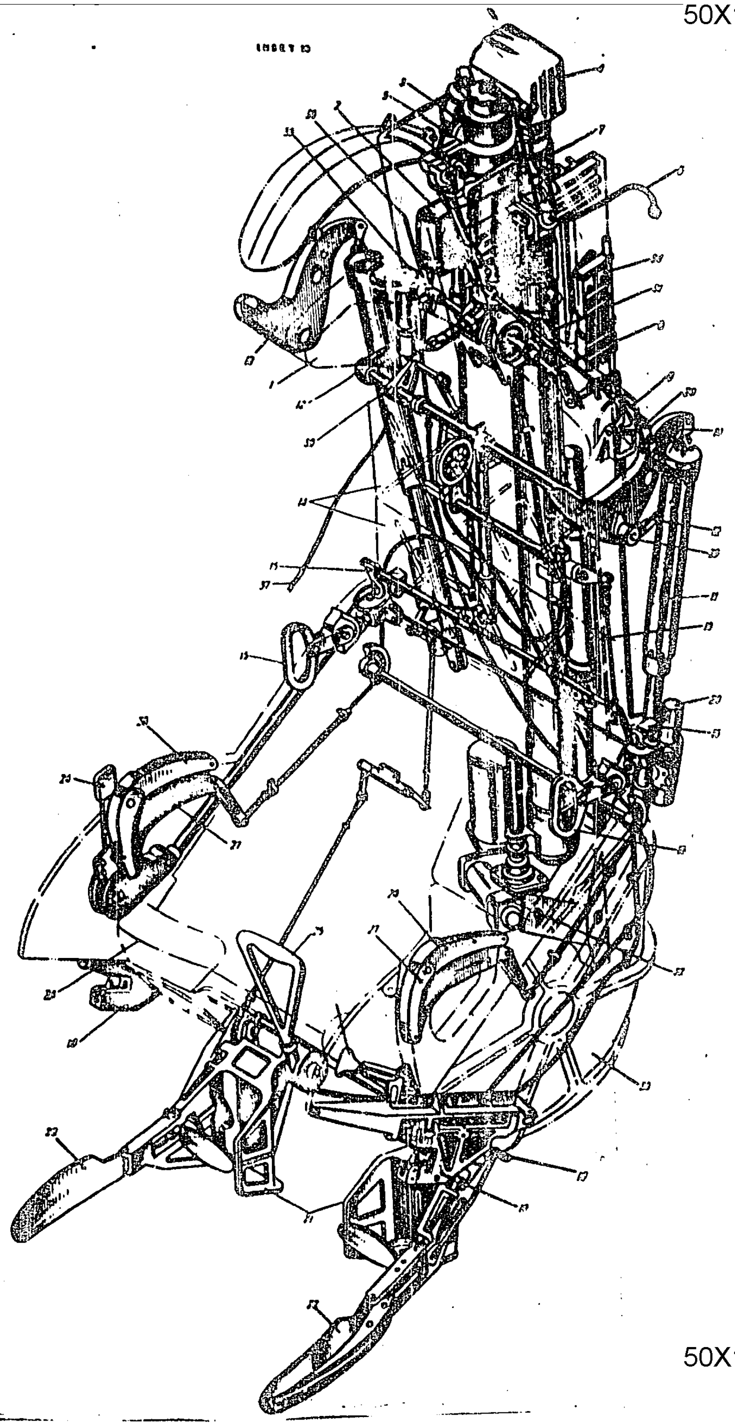

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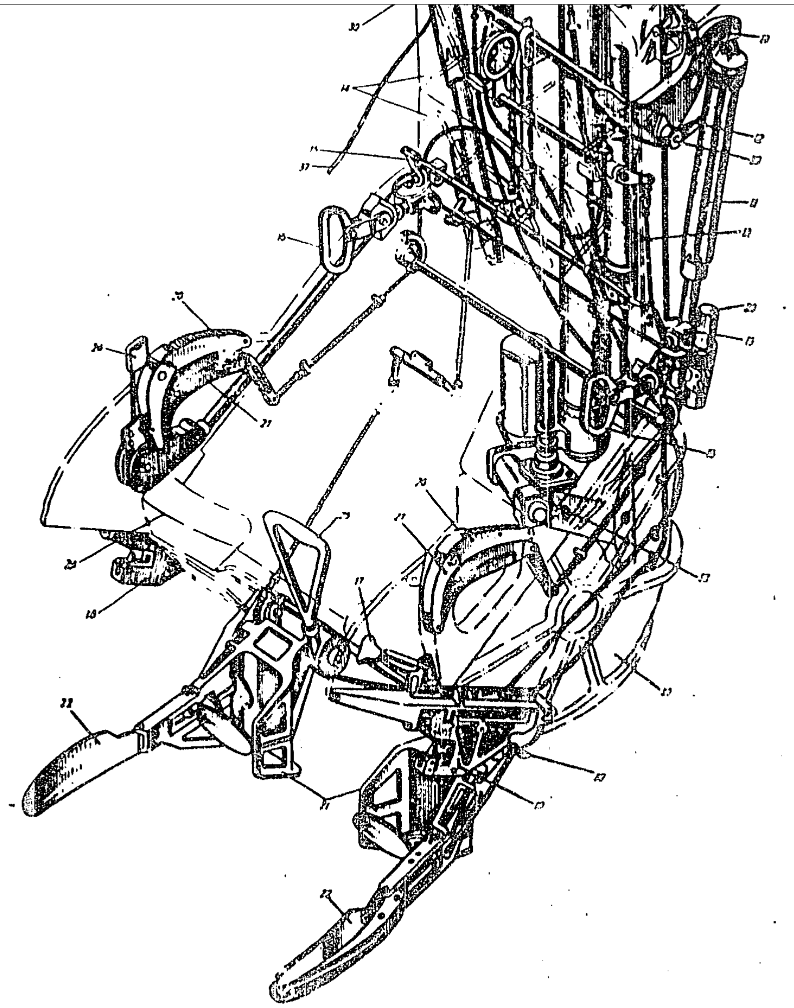

FIG. 61. EJECTION SEAT, GENERAL VIEW

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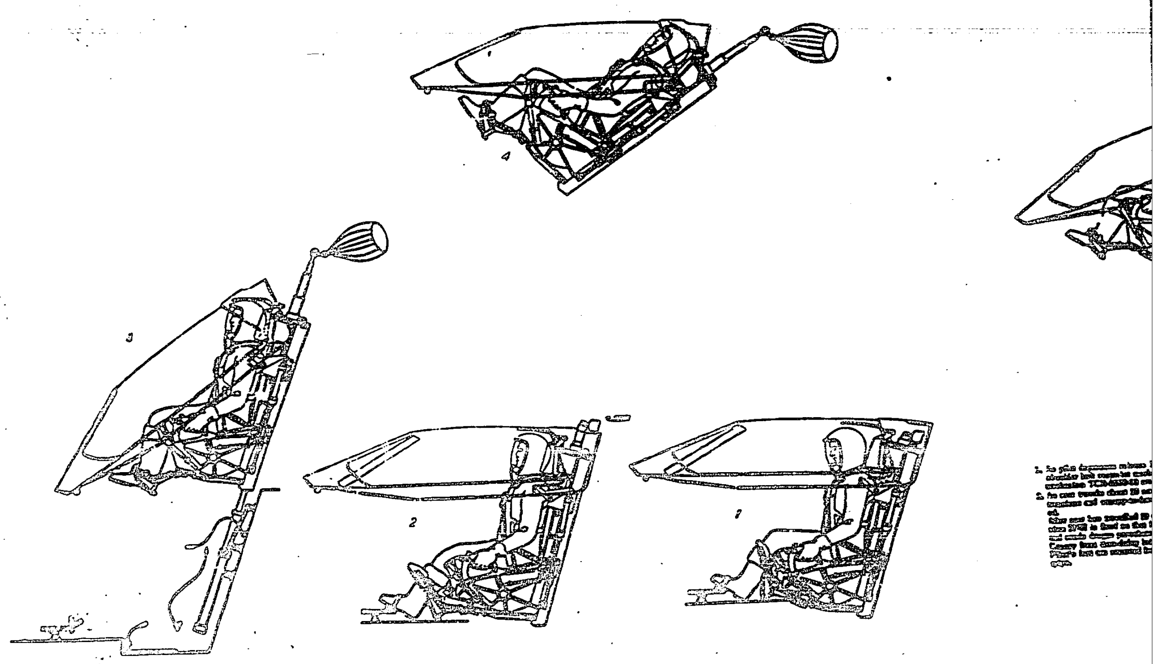

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INSET II

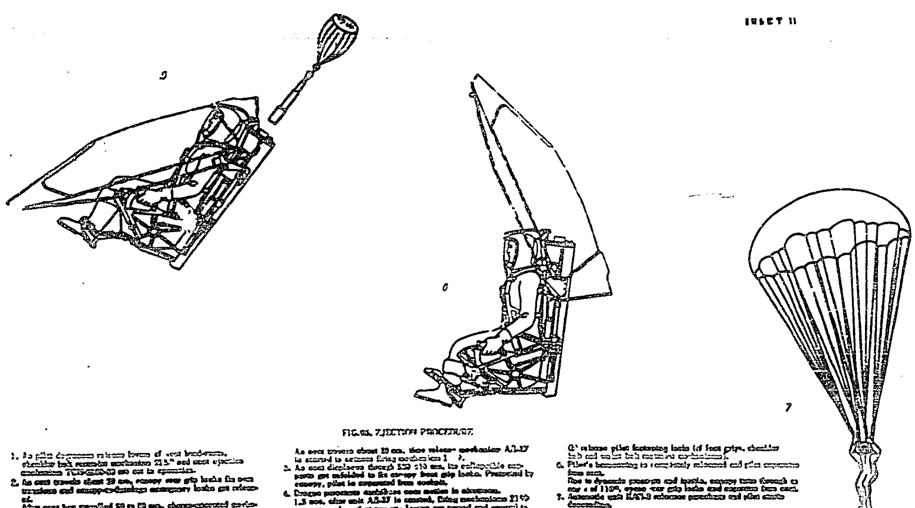

FIG.93. EJECTION PROCEDURE

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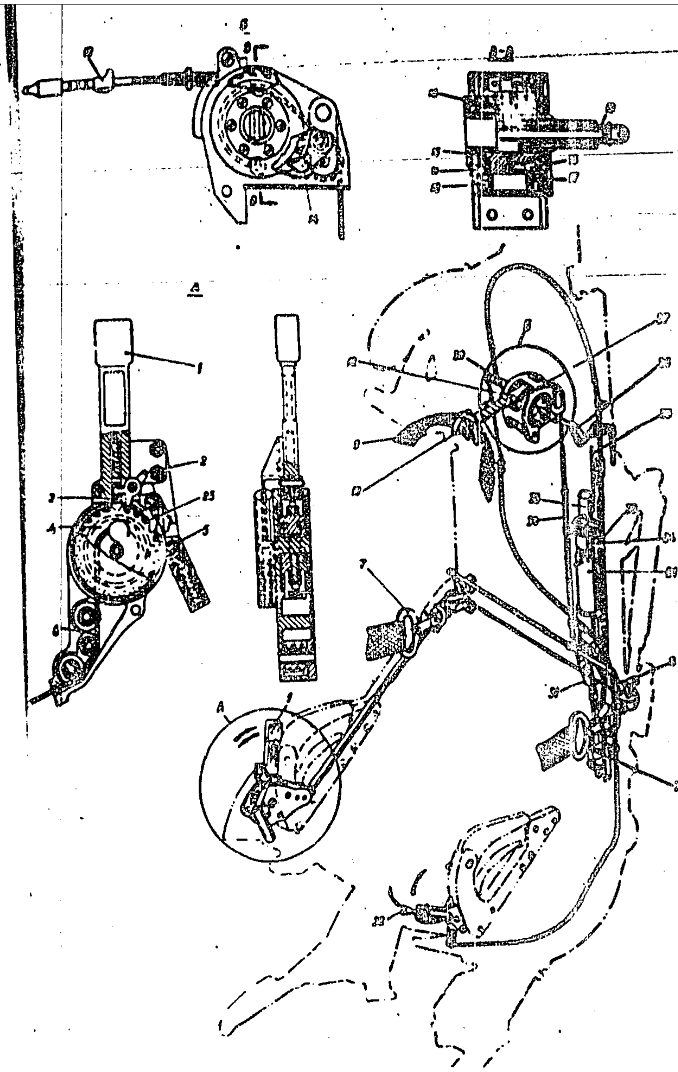

FIG.97. SERVICE HARNESS RESTRAINT SYSTEM

1 – waist belt restraint mechanism handle; 2 – ratchet-wheel pawl; 3 – locking pin; 4 – ratchet wheel; 5 – handle retracting spring; 6 – belt restraint cable; 7 – waist belt restraint pulley with buckle; 8 – waist belt restraint mechanism emergency release lock; 9 – shoulder belt 10 – shoulder harness strap buckle; 11 – ratchet wheel limiting screw; 12 – shoulder harness lock strap; 13 – belt restraint mechanism ratchet; 14 – locking pawl; 15 – lock reel; 16 – lock strap fixing lever; 17 – roller with forced tension and service belt restraint cables; 18 – shoulder belt restraint lock travel limit; 19 – fixing rod; 20 – service belt restraint mechanism bell-crank; 21 – charge-operated mechanism 215P of forced tension belt restraint mechanism; 22 – service shoulder belt restraint mechanism handle; 23 – TCN-2300-30 firing mechanism rod; 24 – 215P firing mechanism rod; 25 – waist belt restraint ratchet pawl; 26 – shoulder belt restraint mechanism lock emergency opening lever; 27 – shoulder belt restraint lock; 28 – shoulder belt restraint lock cable tube; 29 – 215P mechanism gas bolt; 30 – 215P mechanism upper attachment stirrup; 31 – shoulder belt restraint locking mechanism rod shackle.

the shoulder strap is pulled inside the lock, the pilot is fastened to the seat back, and as the handle is released, the pilot is fixed in this position due to operation of the ratchet gear installed inside the shoulder belt restraint lock. The harness should always be fixed during take-off and landing.

To release the shoulder belt restraint mechanism, the pilot pulls the handle backward and then leans forward himself as far as possible against the action of the spring of mechanism 215P so that the spring is made to compress. After the handle is let go, the shoulder belt restraint mechanism is locked in the forward position and the pilot is enabled to move easily during flight. (The pilot can lean forward from the back of the seat to the extreme forward position as far as the shoulder belt allows).

The shoulder belt restraint mechanism is fixed in the extreme forward position by setting charge-operated mechanism 215P against the extendible rest after the mechanism has been compressed.

The ratchet gear locking the shoulder belt restraint mechanism in its extreme backward position, and the extendible rest used to lock the mechanism in its forward position are thus controlled by the same handle connected to the ratchet gear latch and to the extendible rest by means of a cable linkage.

In the event of ejection, the shoulder belt restraint mechanism is driven by charge-operated mechanism 215P which supplies powder gases into the common telescopic cylinder during firing.

Charge-operated mechanism 215P is fired by shifting the seat hand-rest handles which are at the same time used to fire the seat ejection gun.

The waist belts are fastened after the pilot gets into the cockpit and puts on the parachute harness.

To control the waist belt restraint mechanism, the right hand-rest of the seat carries a handle with a ratchet gear. The shoulder belt restraint mechanism operates when the handle is pushed forward and is idle when the handle is pulled backward.

To release the belt restraint mechanism, the same handle is pushed further forward as far as it will go, and retained there while the pilot leans forward.

2. In order to couple to the lines of the aircraft oxygen regulator, the left hand-rest carries common connector ОРК-2; the connector cuts off all lines during ejection and changes over the pilot's oxygen supply to the parachute breathing apparatus.

When the seat moves upwards, the upper and lower blocks of connector ОРК-2 are disconnected automatically by means of a cable coupling connector ОРК-2 to the fuselage.

3. In order to adjust the seat size to fit the pilot's height during flight or on the ground, the seat is equipped with an electric mechanism comprising electric motor МУ-100АП and limit switch mechanism. Motor МУ-100АП is started by depressing the push switch installed on the port side of the cockpit. The seat size is adjusted by displacing the seat pan over the rails (the maximum travel being 80 to 90 mm).

To switch off the electric mechanism when the pan is set in either extreme position, the pan is connected through a rod to the mechanism whose limit switches are arranged on the seat rail.

When the seat pan is in the extreme top position, a clearance should still remain between the pilot's pressure helmet and canopy glass. For this purpose,

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the extreme top position of the seat pan may be adjusted with respect to the pilot's height when in the sitting posture by displacing the upper ring on the rod stem of the limit switch mechanism. Hence, in the case of a tall pilot, the total travel of the seat pan is reduced.

To simplify the procedure of adjusting the seat to fit the pilot's height, particularly when pilots of different height use the same aircraft, the limit switch mechanism is fitted with four stationary pointers indicating the pilot's height in the sitting posture and used to set the rod upper ring (Figs 103 and 104).

In order to feed motor ЭУ-100АП from the aircraft electric power supply, the bracket carries an electric connector whose detachable part is attached to the fuselage yoke through a cable with a snap hook. Due to this, the connector is disengaged during ejection.

4. The seat firing system is engaged during ejection, i.e. charge-operated mechanism ТСМ-2500-38 is fired, by shifting handgrips 15 installed on the right and left hand-rests; the handgrips are connected through rods and cable linkage to the charge-operated mechanism cotter pin.

To switch on the ejection seat firing system, the upper and lower handgrips on either one or two hand-rests should be depressed manually so that the handgrip lock is caused to release.

At the first moment, when the seat firing handgrips are depressed, charge-operated mechanism 215P of the shoulder belt restraint mechanism is engaged, due to which the pilot is pulled back and fastened in the backward position. Further handgrip depression causes charge-operated mechanism ТСМ-2500-38 to switch on.

The firing handgrips are moved into the initial position by means of springs and fixed therein by special lever locks.

5. To stabilize the seat movement in the airflow during ejection, the seat is fitted with a drogue parachute packed up in the container installed behind the headrest. The parachute is ejected into the air stream by charge-operated mechanism 215П which throws off the canopy hatch cover and sends out the telescopic extendible bar and parachute attached to it. The parachute gets into the stream and produces a moment opposite to that imparted by charge-operated mechanism ТСМ-2500-38. Due to this, the seat is turned in such a way as to facilitate separation of the canopy from the seat.

Charge-operated mechanism 215П is fired at the instant when the seat has travelled through 30 to 50 mm upwards and the cable connected to the fuselage has pulled out the 215П charge-operated mechanism cotter pin. The cotter pin is attached to the cable by means of a special pin used for convenient disassembling of the seat. To avoid losing the pin, it is fastened to the seat frame by means of a cable.

Arranged on the extendible bar of the charge-operated mechanism is a bracket fastened to a clip and used to connect the parachute container by means of two pins ending in cables with balls.

The cables with balls are fitt[illegible] into the tubes fixed to the seat. The ends of the tubes are made narrow, so that their diameter is sufficient to pass the cables and stop the balls. When the bar extends by 250 mm, the balls stop at the tubes, pull out the pins from the seats in the profile and in the container, and release the parachute.

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Fixed on the head of the charge-operated mechanism pull-out bar is a swivel used to attach the parachute shroud lines by means of a deadeye. The shroud lines located outside of the container are packed into a case, the case being assembled in the bay on the right side behind the head-rest and secured with a snap hook.

6. To avoid throwing the pilot's feet aside during ejection and to fix them in a certain position, the seat is fitted with foot rests and grips.

Each foot rest carries on its inside a spindle which enters the guide secured to the cockpit floor. When the seat is adjusted to fit the pilot's height, the foot rest spindles move along the guides without getting out.

During ejection, the foot rest spindles run out of the guides and as the seat is moving upwards from the cockpit, the foot rests turn so that the pilot's feet, acted upon by inertia forces, move toward the rests and press upon the levers of the foot grips. As the foot grips turn, they are locked by the ratchet sectors and fix the feet between the grips and foot rest rubber cushions.

In order to prevent hitting the feet against the TCH-2500-38 firing mechanism tube when catapulting at a speed exceeding 950 km/hr, a safety bar is arranged on the seat (Fig. 98).

7. To provide ejection with canopy, the seat is fitted with the following supports intended for coupling to the canopy:

(a) trunnions (Fig. 95) used to carry the canopy rear grips and installed on the seat frame cross beam. When the seat moves upwards about 20 mm, the trunnions get into the canopy rear lock grips and are locked thereat. Simultaneously, the canopy lock emergency release system releases the locks connecting the canopy to the fuselage due to operation of the rods which couple the locks to the bell-cranks. The only lock which is not disengaged is the time-delay front lock which delays release of the canopy nose while its tail portion is moving up.

As the seat travels further upwards, the canopy displaced together with the seat turns about the trunnions and separates from the time-delay locks. The rollers installed in the canopy nose portion roll over the transparent armour glass and the canopy moves into a position where it protects the pilot;

(b) the collapsible supports used to engage the canopy front locks and installed at the seat pan sides so that they are permanently held in a folded-up position and locked with the sectors fitted on a common shaft.

The shaft is fixed with a shear screw turned into the left-hand sector and support.

While the seat moves upwards, i.e. when the supports reach the level of the canopy-carrying panel, the cable secured to the cockpit floor and to the shaft bell-crank, turns the shaft carrying the sectors, cuts off the shear screw and releases the collapsible supports. The springs cause the folded supports to open, fixing them in this position by means of special spring retainers.

As the canopy falls on the supports, it knocks with its front grip (Fig. 97) against the locking dowels, cuts their shear locking screws and causes the spring dowels to lock it on the supports. Thus the canopy gets fastened to the seat in four points.

8. Two charge-operated mechanisms, type 2159 are installed on the seat to provide disengagement of the canopy from the seat after ejection, to disconnect the drogue parachute and its bar and to open the foot grips, shoulder and waist belts. The lower ends of the rods of the charge-operated mechanisms are secured to the seat rail brackets, while the upper ends of the charge-operated mechanism

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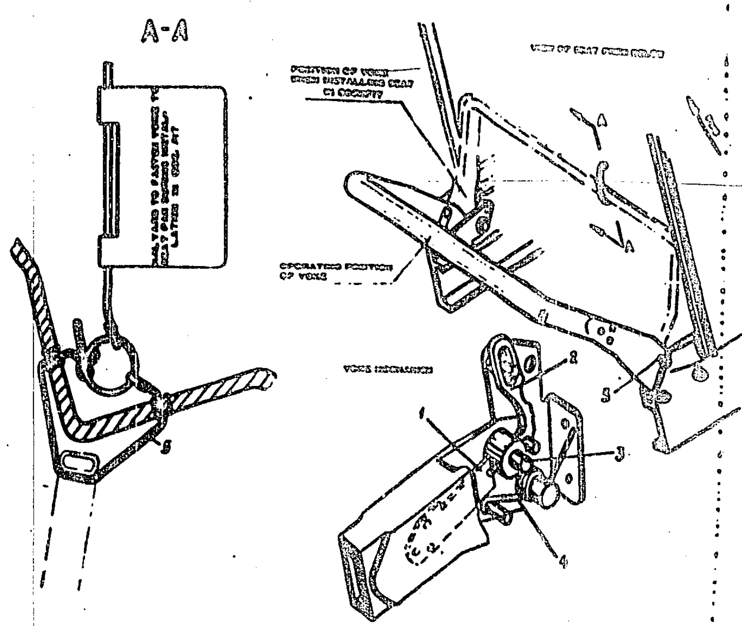

FIG.90. SEAT PROTECTIVE YOKE AND ITS MECHANISM

1 – dowel spring; 2 – bell-crank; 3 – fixing dowel; 4 – yoke actuating spring; 5 – halyard for fastening yoke to seat pan.

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cylinders are fastened to the two-arm levers installed on the seat trunnions. The charge-operated mechanisms employ two-primer firing bolts.

Charge-operated mechanisms 215Ф are switched on by time release mechanism АД-3У. The length of the halyard used to switch on the mechanism must have a slack of about 50 mm, due to which the travel of the seat through this distance causes mechanism АД-3У to switch on and operate 1.5 sec. after its cotter pin has been pulled out.

In case mechanism АД-3У fails during ejection (the canopy does not separate from the seat), or in the event of an emergency abandoning on the ground (when the pilot is to be separated from the seat after the canopy has been jettisoned by emergency system or elevated), the charge-operated mechanisms can be switched on manually by means of the emergency system arrest located on the seat pan. During ejection the arrest must be left in the hand.

The operation of the system described above consists in the following.

<u>Switching by Mechanism АД-3У</u>

1. When the seat travels through 50 mm upwards, the АД-3У mechanism halyard secured to the fuselage pulls out the pin and in 1.5 sec. the mechanism spring pulls the cable and turns intermediate lever 13 of the lock of cross shaft 10 (Fig. 99). After travelling 8 mm, the intermediate lever releases the lock (place A) and the 215Ф mechanism control lever turns the shaft and cuts in mechanisms 215Ф through the rods (Ref. 3).

2. The charge-operated cylinders acted upon by powder gases turn the two-arm levers about the seat trunnions. As a result:

(a) the ends of the two-arm levers press upon retainers 6 (Fig. 86) installed on the rear grip locks and engage the rod linkage to release the front grip locks (Fig. 87) whose brackets fall out of the locks and disconnect the canopy from the seat;

(b) the linkage of rods and bell-cranks attached to the two-arm levers through shackles 16 (Fig. 100) releases the 215П mechanism bar attachment detachable yoke lock, disengages the yoke and causes the bar and parachute to separate from the seat.

<u>Note</u>: In case the seat pan is in the lower position, the front grip locks are released before the drogue parachute bar is disconnected. When the seat pan is in the upper position, the front grip locks are released after the bar is separated from the seat;

(c) at the end of displacement of mechanisms 215Ф (after the canopy turns through 70° to 80°), the two-arm levers press upon the upper cross shaft levers, turn the shaft, engage the linkage of rods and bell-cranks to release the foot grips, shoulder and waist belt restraint locks, due to which the pilot gets free from the seat. The waist belt restraint locks are released last of all so as to achieve proper separation of the seat from the pilot, though simultaneous release of all locks is permissible;

(d) while the canopy travels further on through about 110° to 120°, due to the forces of inertia and airstream, the rear grip lock guides come against the cams of the seat trunnions, move off as the cams push them, and release the rear grip locks. Finally, the canopy is disconnected from the seat.

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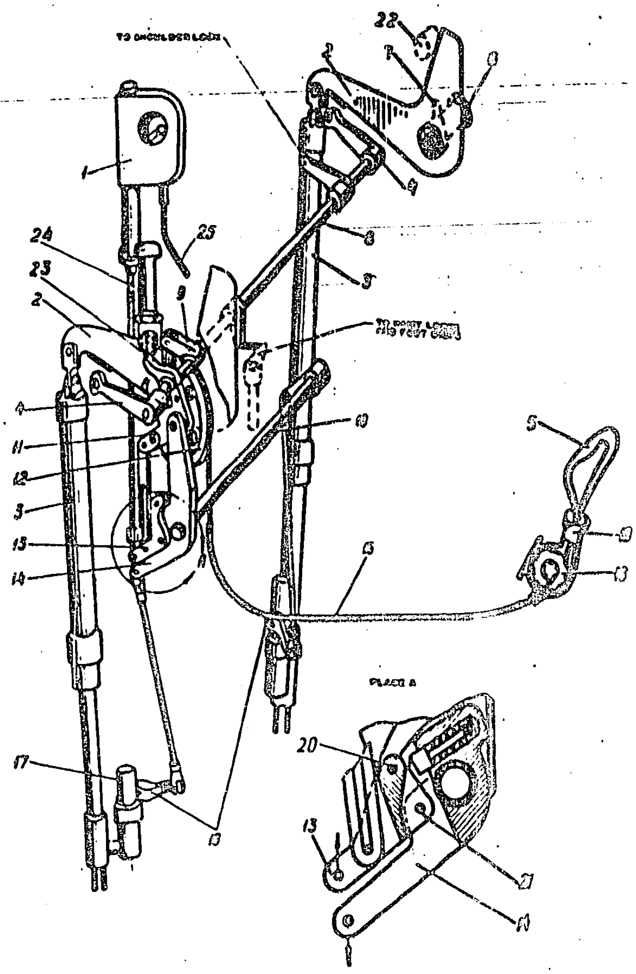

FIG.99. CANOPY SEPARATION AND PILOT FASTENING LOCK RELEASE SYSTEM

1 – time-delay mechanism AD-3U; 2 – two-cam lever; 3 – charge-operated mechanism 2150; 4 – upper cross shaft lever; 5 – arrest; 6 – seat trunnions; 7 – trunnion cam; 8 – upper cross shaft; 9 – cross shaft arrest drive lever, 10 – 2150 mechanism engagement cross shaft; 11 – arrest transmission lever; 12 – pilot fastening lock release mechanism arrest roller; 13 – intermediate lever; 14 – 2150 mechanism control lever; 15 – arrest cable; 16 – 2150 mechanism gun bolts levers; 17 – 2150 mechanism gun bolts, 18 – transmission roller; 19 – roller body; 20 – 2150 mechanism control lever locking stud; 21 – intermediate lever axle; 22 – canopy stop; 23 – spring gear rod cross shaft lever; 24 – spring mechanism; 25 – AD-3U engagement lanyard.

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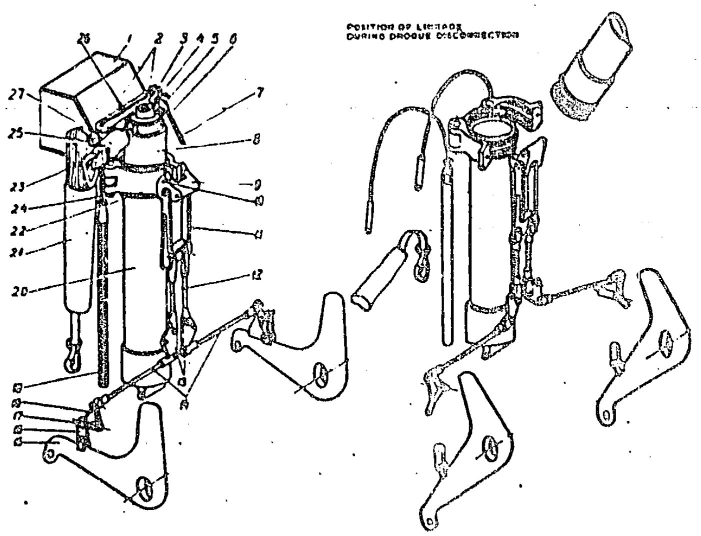
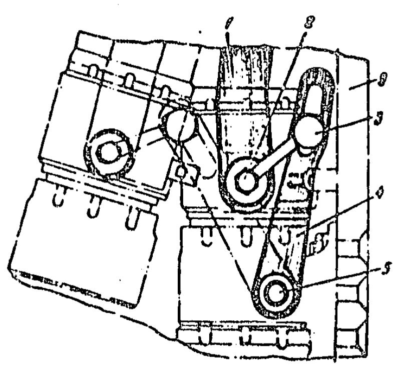


FIG.100. DROGUE PARACHUTE CHARGE-OPERATED MECHANISM CONTROL

1 – container with parachute; 2 – container attachment studs; 3 – container attachment shaps; 4 – 215П mechanism gun bolt; 5 – mechanism cotter pin operating cable sector; 6 – gun bolt ring; 7 – 215П mechanism cotter pin operating cable; 8 – 215П mechanism upper tube; 9 – detachable yoke lock; 10 – fixing shear screw; 11 – shackle; 12 – rods; 13 – bell-cranks; 14 – rods; 15 – two-arm levers; 16 – shackles; 17 – rod; 18 – lever; 19 – tube with cable and container attachment stud; 20 – 215П mechanism lower pipe; 21 – shroud lines case; 22 – detachable yoke connecting upper and lower tubes of mechanism 215П; 23 – parachute shroud lines; 24 – container attachment stud cable; 25 – container tube; 26 – stud safety wire and seal; 27 – swivel.



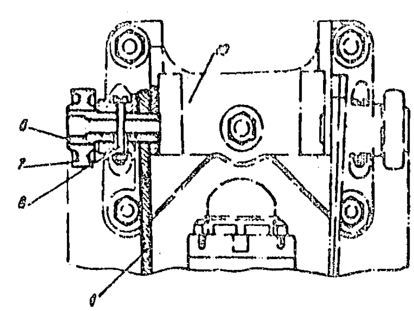


FIG.101. ATTACHMENT OF MECHANISM TCM-2500-30 (LOWER AND UPPER JOINTS ARE SHOWN ON LEFT AND RIGHT SIDES RESPECTIVELY)

1 – rod, 2 – rod attachment bolt; 3 – bell-crank attachment bolt; 4 – bell-crank; 5 – bell-crank attachment hinge bolt; 6 – spindle; 7 – roller; 8 – spindle attachment bolt; 9 – special plate; 10 – seat upper beam.

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Switching by Arrest (Emergency System)

When the arrest is pulled out 65 to 70 mm (so that it is left in the hand), the roller turns to engage the spring mechanism, and charge-operated mechanisms 215Π are switched on. As a result, the mechanisms disconnecting the canopy from the seat and the seat from the pilot are actuated in a manner described above.

9. To reduce the effort required to release the locks by means of the arrest, spring mechanism 24 is installed on the right side of the cross beam (Fig. 99).

The spring mechanism is engaged after charge-operated mechanism 215Π is actuated (by mechanism AД-3У) or by the drive roller after the arrest is pulled out ; as the spring mechanism operates, it secures all locks of the pilot harness system in the open position.

10. When the pilot is disconnected from the seat during ejection, the halyard of parachute device КАП-3Н attached to the seat bracket by means of a snap hook pulls out the КАП-3Н cotter pin which releases the pilot's parachute automatically.

11. In order to prevent overloads acting on the pilot when catapulting with the canopy previously jettisoned (due to which the weight of the assembly reduces), the lower portion of charge-operated mechanism TCK-2500-38 is fitted with a valve to bleed the powder gases.

Since the valve control cable linkage is secured to the independent canopy jettison handle, the valve opens during independent canopy jettison and bleeds the powder gases.

12. The seat is connected to the fuselage by means of the operating split joints listed below:

(a) special hooks secured to the seat headrest, used to catch the TCK-2500-38 charge-operated mechanism upper trunnions and to respond to forces acting on the seat in the vertical direction. Mechanism TCK-2500-38 is secured to the trunnions which are in the central portion of the outer tube and attached to the plate of the fuselage by means of two rods (Fig. 101).

To limit turning of the charge-operated mechanism during ejection to an angle within 15°, the charge-operated mechanism is also connected to the fuselage by means of two bell-cranks whose ends have oval holes for bolting to the charge-operated mechanism, while the other ends are secured to the fuselage plate roller axles;

(b) two pairs of rollers bracketed to the fuselage plate and fitted into the rails. The rollers bear the forces acting upon the seat in parallel to the horizontal axis of the aircraft;

(c) rail guides arranged on the cockpit floor, which receive part of the load acting upon the rollers and prevent vibration in the lower part of the seat;

(d) МУ-100АП electric motor connector, split apart during ejection;

(e) joints used to actuate the mechanisms during ejection; these are:

foot-rest spindles entering the cockpit floor guides to fix the foot-rests in a definite position and to release them during ejection;

shaft bell-crank cable used to control the collapsible supports of the canopy grips and attached to the cockpit floor to open the supports during ejection;

cable attached to connector OPK-2, and a bracket on the fuselage; the cable is used to disconnect OPK-2 and to change over the pilot's oxygen supply to parachute breathing apparatus КП-27М;

cable secured to the 215Π mechanism cotter pin, and attached to the cockpit rear bulkhead; it is used to actuate the drogue parachute charge-operated mechanism;

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АМ-37 mechanism halyard attached to the fuselage and intended to actuate charge-operated mechanism 215Э.

13. Attachment of the parachute harness, and, hence, the pilot's fastening to the seat, are provided by means of the following elements (Fig. 102):

(a) shoulder jumper 3 with the central shackle connected to strap 12 of seat shoulder belt restraint lock 6. The shoulder jumper is fastened to the harness by means of the shoulder belt buckles.

The central shackle is in its turn fastened to the back cushion by means of damping cord 8;

(b) waist belt restraint pulleys 4 (located on the left- and right-hand sides) fastened to the parachute harness foot straps.

The fastening elements, such as shoulder capron jumper 3, central shackle and damping cord 8, have been specially designed for the parachute harness system.

14. After manufacturing the seat at the plant, the systems used to control the mechanisms and to operate them during ejection were locked with shear screws, pins or wire and put under lead seals. The seals may be removed only when carrying out scheduled maintenance.

15. To prevent inadvertent operation of the seat mechanisms on the ground, the aircraft is delivered with two sets of locking pins, each pin being tied up to a capron halyard.

One halyard carries locking pins used on the ground for everyday service of the aircraft (the service halyard), the locking pins being installed inside the cockpit immediately after a flight and removed prior to a flight. The halyard carries the following locking pins attached to it with snap hooks:

(a) locking pin marked with figure "1" (1 piece) to be installed in charge-operated mechanism TCM-2500-38;

(b) locking pin marked with figure "4" (1 piece) to be installed in drogue parachute charge-operated mechanism 215П;

(c) locking pins marked with figure "7" (2 pieces) to be installed in the firing handgrips on the seat hand-rests by passing them through the ports in the protective jackets;

(d) locking pin marked with figure "8" (1 piece) to be installed in the independent canopy jettison handle;

(e) protective jackets marked with figure "9" (2 pieces) to be installed on the seat hand-rests;

(f) locking pin marked with figure "10" (1 piece) to be installed in the 215Э charge-operated mechanism arrest switching drive roller;

(g) locking pin marked with figure "11" (1 piece) to be installed in the inertia fuse of the aircraft identification responder.

The other halyard carries locking pins used on the ground to demount and install the seat (the assembly halyard), the locking pins being installed prior to demounting the seat and removed after assembling the seat in the aircraft.

The locking pins attached to the halyard with the help of snap hooks are listed below:

(a) locking pins marked with figure "2" (2 pieces) to be installed in harness charge-operated mechanism 215P; (the pins are used to lock the lever, and to lock the gun bolt only when loading and unloading the gun);

(b) locking pins marked with figure "3" (2 pieces) to be installed in charge-operated mechanisms 215Э;

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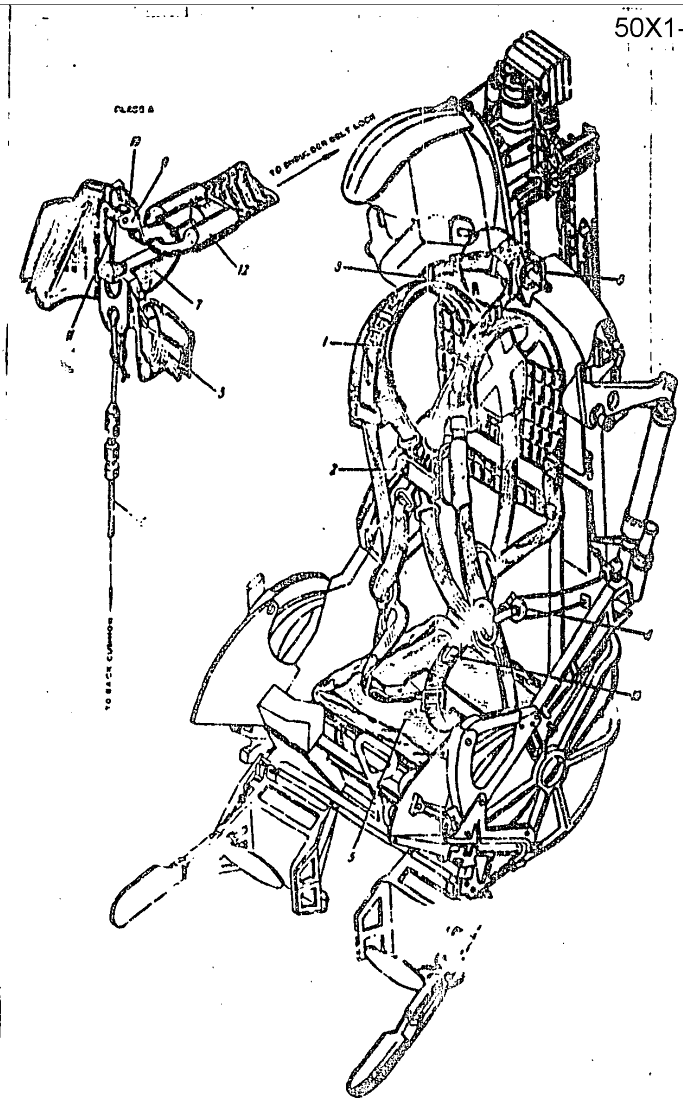

FIG. 102. HARNESS SYSTEM

1 - shoulder belt buckle; 2 - central lock; 3 - shoulder belt; 4 - waist belt restraint pulley; 5 - parachute; 6 - shoulder belt restraint lock; 7 - central shackle for shoulder strap; 8 - damping cord; 9 - strap shackle hook lock; 10 - strap shackle lock release lever; 11 - hook lock spring; 12 - shoulder harness strap; 13 - PCA-3M pressure ratio controller attachment bracket.

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(c) locking pin (stud) marked with figure "4" (1 piece) to be installed in charge-operated mechanism 215Л;

(d) locking pins marked with figure "3" (2 pieces) to be installed in the collapsible supports of the canopy front grips;

(e) locking pins marked with figure "6" (2 pieces) to be installed in the foot grips only in the case of mounting the seat on the aircraft when the grips must be locked in the folded position;

(f) flexible stud (1 piece) to be installed in charge-operated mechanism ТСЫ-2500-38 during loading and unloading;

(g) locking pin marked with figure "10" (1 piece) to be installed in the 215Л mechanism arrest switching drive roller;

(h) capron cord with a halyard used to tie up the bracket to the seat pan when installing the seat into the cockpit.

__Note:__ The points where the locking pins are installed into the seat are numbered in accordance with the figures executed on the locking pins.

2. GENERAL INSTRUCTIONS ON USE OF SEAT

The aircraft technician will always remember that:

1. Only personnel who have mastered the design of the seat and canopy and passed the respective tests may be admitted to handle the seat.

2. The mechanisms of the systems operated during ejection must always be anchored and put under lead seals.

3. The seat may be allowed for use only when fitted with the parachute harness having capron ribbons.

4. Safety in flights as well as in ejection to a great degree is governed by how well the parachute harness fits the pilot. Used to attach the pilot to the seat, the parachute harness should be fastened to the pilot as tightly as possible and the shoulder jumper should closely fit the pilot's neck and shoulders, allowing no slack.

When the flights are performed by the pilot dressed in winter robe, the shoulder jumper may be fastened either on the collar or passed under the collar so that in both cases it is closely fitted to hold the neck and shoulders.

5. In service, care should be taken to prevent occasional loads upon the horizontal shaft bell-cranks since this may lead to cutting off the locking screw installed in the left-hand bell-crank, turning the shaft and releasing the harness restraint locks.

In order to check the initial position of the horizontal shaft, the shaft bearing case and the shaft left-hand bell-crank carry reference lines notched 0.3 mm deep and painted with red enamel.

While inspecting and servicing the system, care should be taken to check that the above-mentioned red lines are coincident. Misalignment of the red lines is indicative of cutting-off of the locking pin of the left-hand bell-crank and of displacement of the horizontal shaft from the initial position. In this case the lines should be matched by turning the horizontal shaft into its initial position which corresponds to the closed position of the harness restraint locks, and locking should be restored by inserting a new locking screw with a washer instead of the cut-off screw.

6. Checking of the system engaged during ejection should be made only in the process of scheduled maintenance.

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7. Disassembly and assembly of the charge-operated mechanisms performed during scheduled maintenance should be carried out in compliance with the Technical Description and Operating Instructions of these mechanisms. The following requirements should be closely observed:

(a) when charge-operated mechanism TCM-2500-38 is disassembled, the lower stirrup of the mechanism must not be screwed off or on since this may change the distance between the upper and lower trunnions with consequent disturbance of the seat position inside the cockpit and maladjustment of its connection with the canopy during ejection;

(b) prior to disassembling charge-operated mechanisms 215Ф it is necessary to measure the distance between the centres of holes by which the mechanisms are fastened to the seat, with the rod extended or retracted completely, to make sure that the assembly of mechanisms has been properly accomplished. A change in the length of the charge-operated mechanisms may cause misalignment of the seat systems;

(c) charge-operated mechanism 215Ш should not be demounted from the seat for disassembly and cleaning.

The safety plates removed from the three-member yoke during disassembly of mechanism 215Ш should be replaced with new ones available in the spares set since no repeated bending of the plates is permissible;

(d) the charge-operated mechanisms should be removed from, and installed on, the seat in compliance with instructions contained in Section "Demounting and Installation of Charge-Operated Mechanisms".

8. In the event of replacing mechanisms TCM-2500-38 and 215Ф, the distance between trunnions of mechanism TCM-2500-38 initially installed should be measured, and the distance between the centres of holes by which mechanisms 215Ф are secured to the seat should be determined with the rod extended or retracted. Use the estimated distances for adjustment of the new mechanisms installed.

9. Charge-operated mechanism TCM-2500-38 delivered by the Manufacturing plant is adjusted for "winter operation", i.e. operation at ambient temperatures from -50 to +20°C; in this case the bleed snout is replaced with a plug.

In case the aircraft is employed at ambient temperatures from +5° to +50°C, the mechanism must be adjusted for "summer operation", and the bleed snout should be installed instead of the plug.

The plug and bleed snout available in the SPT&A set should be installed on the charge-operated mechanism in compliance with the Technical Description and Operating Instructions of mechanism TCM-2500-38. When the mechanism is changed from "winter operation" to "summer operation" and vice versa, a respective record should be made in the Aircraft Log.

10. Since charge-operated mechanism 215P is fitted with a bleed snout, care should be taken to avoid clogging of the snout with dirt or excessive grease when demounting and installing the mechanism.

11. Prior to installing new charge-operated mechanisms into the seat, the mechanisms should be unslushed according to the Operating Instructions of the mechanism.

12. Demounting and installation of the seat should not be performed unless mechanisms TCM-2500-38 and 215Ш have been unloaded.

13. Mechanisms 215P and 215Ф are unloaded after removing the seat from the aircraft and loaded prior to installing the seat back.

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14. The charge-operated mechanisms should be unloaded when the aircraft is to be transported by railway, when the cartridges are replaced and when checking the primers for pricking.

15. The charge-operated mechanisms are loaded with two-primer cartridges of the following types:

(a) cartridges ПК-16 to charge mechanism ТСМ-2500-38;

(b) cartridges ПК-3М-1 to charge mechanisms 215П, 215Р and 215Ф.

16. To unload charge-operated mechanism ТСМ-2500-38, the drogue parachute should be removed as prescribed in Section "Demounting and Installation of Seat".

17. To check breaking of primers, special dummy cartridges which do not produce fouling of the mechanism should be used.

Note: In case dummy cartridges are not available, use washers with primers.

After using the washers with primers, clean and lubricate the bolts, inside cylinders and chambers.

No checking of the charge-operated mechanisms is allowable before making sure that firing cartridges have been unloaded.

The procedure for loading all charge-operated mechanisms of the seat with cartridges is described in Section 3.

18. Since all charge-operated mechanisms are single-action devices, the following measures should be taken in the case of an inadvertent fire of any mechanism:

if mechanism 215P has fired, replace the following parts: mechanism 215P, cable connecting mechanism 215P to the shoulder belt restraint lock, and shoulder restraint straps;

if mechanism 215П or 215Ф has fired, send the seat for repairs;

if mechanism ТСМ-2500-38 has fired, replace the seat with a new one.

3. LOADING AND UNLOADING OF CHARGE-OPERATED MECHANISMS

General

The mechanisms are loaded with two-primer cartridges of the following types:

(a) powder cartridge ПК-16 to charge mechanism ТСМ-2500-38;

(b) powder cartridges ПК-3М-1 to charge mechanisms 215Р, 215Ф and 215П.

Mechanisms ТСМ-2500-38 and 215П are loaded and unloaded after the seat is installed in the aircraft. Prior to loading and unloading mechanism ТСМ-2500-38, remove the container and the drogue parachute of charge-operated mechanism 215П.

Mechanisms 215Р and 215Ф are loaded and unloaded after the seat is removed from the aircraft.

The charge-operated mechanism must never be loaded with cartridges described below:

(a) cartridges whose service life has ended;

(b) cartridges whose primers КВМ-3 have lost varnish.

The varnish should be intact, free of cracks, scratches or wear-out;

(c) cartridges bearing dents in the walls or in the wad;

(d) cartridges that have been stored in unsealed packings at the store houses over a time term exceeding the tolerance.

After the charge-operated mechanism has been loaded, the following records should be made in the Aircraft Log:

(a) date of installing the cartridge into the firing mechanism;

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(b) name, lot number and date of manufacturing the cartridge;

(c) date of opening the sealed packing containing the cartridge.

Records must be made by the person responsible for charging the firing mechanisms.

The procedure of unloading the mechanisms is the reverse of loading and requires that ground locking pins should necessarily be installed in the bolts of the mechanisms.

WARNING! 1. Never hit or jerk the cartridges. Mind that hits of the cartridge base or primers are particularly dangerous.

2. Never handle the loaded mechanism unless a safety locking pin is installed in the bolt.

Loading of Charge-Operated Mechanism TCB-2300-30 (Fig. 106)

1. After the cable has been disconnected from the gun bolt firing cotter pin, screw off the lock nut and union nut, and remove the bolt.

2. Cock the bolt striker by pressing it off with a pin, dia. 5 to 6 mm, passed through the port in the bolt body bottom, and insert the cotter pin.

3. Insert a flexible ground safety stud into the firing mechanism bolt and fasten the stud with wire.

4. Connect powder cartridge ПК-16 to the gun bolt by turning the bolt with the firing pins upwards. See that the lower end of the cartridge indicator is flush with the face of the bolt.

Install the bolt locking pin into the cartridge base coat and turn the cartridge so as to fit its rim into the cuts of the bolt lugs.

5. Install the bolt and cartridge into the mechanism and make sure that the bolt lugs enter the respective splines of the inside cylinder and the cartridge enters into the inside cylinder easily or on light pressure of the hand.

6. Fit the bolt to the inside cylinder tightly by means of a union nut, and tighten up the lock nut. Take care to set the firing cotter pin properly and to lock it with a safety pin, the cotter pin being the element retaining the main spring and firing pin in the cocked position.

7. Drive out the flexible stud and install a ground locking pin instead.

8. Connect the firing cotter pin to the fire control cable.

9. After the mechanism has been loaded, lock it and put under seal.

Unload the mechanism in the reverse order having installed the flexible safety stud into the bolt.

Loading of Charge-Operated Mechanism 2153 (Fig. 107)

1. After the gun bolt cotter pin operating cable has been disconnected, drive out the locking screw.

2. Drive out the inside tube of the firing mechanism until its square portion for wrench engagement comes out.

3. Screw off the gun bolt lock nut.

4. Remove the ring with the drogue parachute container attachment, having turned out its locking screw.

5. Screw off the nut and drive out the gun bolt.

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6. Insert a rod, dia. 4 to 5 mm, into the bolt body face port, cock the striker and install the cotter pin.

7. Lock the cotter pin with a ground safety pin disconnected from the common halyard.

8. Seat cartridge ПК-ЗМ-1 on the dowel installed in the cone face, turn the cartridge and drive the cartridge pin under the bolt lugs.

9. Insert the cartridge and gun bolt into the mechanism tube.

10. Screw on the nut as far as it will go.

11. Draw in the inside tube.

12. Tighten the locking screw.

13. Fit the ring and drogue parachute container attachment.

14. Tighten the gun bolt lock nut.

15. Secure the charge-operated mechanism control cable to the cotter pin passing it over the sheave sector on the ring having a shape to attach the drogue parachute container.

16. Fasten the ground safety pin to the halyard.

Unloading of the charge-operated mechanism is the reverse of loading. Prior to unloading, install the ground safety pin.

Loading of Charge-Operated Mechanism 215P
(Fig. 106)

1. Unfold the flaps on the seat back and lock them in this position.

2. Disconnect the control rods from the lever of the charge-operated mechanism lock, and remove the locking wire and lead seal from the lever.

3. Drive out the screw used to attach the turnable cotter pin bracket which fixes the charge-operated mechanism cotter pin axle in position, and move the bracket aside.

4. Remove the lever from the turnable cotter pin.

5. Screw off the union nut and remove the gun bolt.

6. Screw the cock key into the striker.

7. Cock the striker by turning the cotter pin so as to direct the indicating pin along the axis of the mechanism (cut off) and install the safety locking pin having disconnected it from the common halyard.

8. Fit the cartridge on the bolt dowels and insert it into the mechanism.

9. Fit the lever on the turnable cotter pin and lock the cotter pin axle inside the turnable bracket. Fasten the bracket to the seat rail by means of screws.

10. Screw on and safety the union nut.

11. Secure the control rods to the lever and fix the lever to the bracket by means of wire.

12. Secure the ground locking pin to the halyard.

13. Close the flaps on the seat back.

Unloading of the mechanism is the reverse of loading. Prior to unloading, do not fail to install the ground safety pin.

Loading of Charge-Operated Mechanism 215P
(Fig. 110)

1. Disconnect the rod from the trigger lever.

2. Remove the trigger levers from the gun bolt turnable cotter pin.

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3. Screw off the gun bolt union nut.

4. Remove the gun bolt.

5. Lock the striker by means of the socking key to be found in the [illegible] set, and turn the firing cotter pin so as to direct its indicator pin along the gun bolt axis (cut off).

6. Seat powder cartridge ПК-3М-1 on the bolt pins.

7. Disconnect the safety pin from the common halyard and insert it into the bolt.

8. Install the cartridge and gun bolts into the chamber so as to cause the turnable cotter pin to move into the fixing clevis of the stirrup installed on the chamber. The bolt bearing the letter П should be installed in the right-hand mechanism and that one bearing the letter Л should be installed in the left-hand mechanism.

9. Screw on and lock the union nut.

10. Fit the trigger lever on the bolt turnable cotter pin and lock the lever with a splint.

11. Secure the rod to the trigger lever and safety the rod.

12. Attach the ground safety pin to the common halyard.

Unloading of the charge-operated mechanism is the reverse of loading. Prior to unloading, install a ground safety lock.

4. CLEANING AND LUBRICATION OF CHARGE-OPERATED MECHANISMS

Opportune cleaning and lubrication of charge-operated mechanisms is indispensable for maintaining the operating properties of the mechanisms and for protecting the mechanisms against corrosion.

In the process of use of the mechanisms, their appearance should regularly be checked and fresh lubricant applied.

Inspection, cleaning and lubrication of the charge-operated mechanisms performed in conformity with the maintenance schedule should be done as follows:

1. Remove the mechanisms from the seat and disassemble them. The scope of disassembly is stated in the Technical Description and Operating Instructions of the mechanisms.

2. Clean all parts thoroughly, wash them with hot soap solution and wipe them off with a clean cloth.

The temperature of soap solution and hot water should be 50° to 60°C. Component parts of the soap solution are: 50 gr of acid-free soap per 10 litres of water.

To wash the parts of the firing mechanism, use gasoline Б-70 or dehydrated kerosene.

Rubber and paronite parts need not be washed.

3. After cleaning and drying, coat the parts with a thin layer of grease No.[illegible] Apply a thin film of lubricant ЦИАТИМ-201 to the parts of the bolts, by wiping them off with a cloth saturated with lubricant.

The parts should be lubricated immediately after cleaning and wiping them so as to prevent atmospheric effects upon the clean metal surfaces.

4. Assemble the charge-operated mechanisms.

Make sure whether the ball lock of mechanism ТСВ-2500-39 engages securely. Check by hand mutual displacement of the cylinders of the charge-operated mechanism. See that the cylinders travel easily, without jamming.

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The charge-operated mechanisms delivered to the units from the depots or sent together with the aircraft by railway, should be disassembled, unslushed, dried up with a cloth and subjected to a complete technical inspection prior to installation.

To unslush the mechanisms, proceed as follows:

(a) disassemble the mechanism;

(b) wash the parts in hot spindle oil (at 40° to 90°C) till the slush is removed from the parts;

(c) wipe the parts with a clean cloth;

(d) wash all parts (excluding those manufactured from teflon and paronite) in hot soapy water, rinse them in clean hot water, and then dry them up with a clean cloth.

To lubricate the parts, use the method described above.

To unslush the parts, use dehydrated kerosene whose temperature is 15° to 20°C.

Prior to mounting the charge-operated mechanisms on the aircraft, check the operation of their bolts by means of test firing repeated three times and performed according to the Technical Description and Operating Instructions of the mechanisms.

5. DEMOUNTING AND INSTALLATION OF SEAT

Open the canopy and install the ground locking pins into the canopy cylinder rod and into the canopy emergency jettison system two-arm bell-crank.

Prior to removing the seat, install the ground safety pins of the assembly halyard to lock the seat mechanisms, and take measures of precaution to avoid inadvertent operation of the mechanisms.

IMPORTANT. When installing or removing the locking pin marked with figure "2" and used to lock the 215P mechanism lever, take measures to prevent turning of the lever or breaking of the safety wire.

To remove the seat, observe the following sequence:

1. Apart from the locking pins already installed, insert the ground pins marked with figure "1" and used to lock mechanism TCM-2500-38 and install the pin marked with figure "8" and used to lock the canopy emergency jettison handle.

2. To unload mechanism TCM-2500-38, disconnect the drogue parachute, its container and shroud line swivel from mechanism 215Ш; prior to unloading tie up the parachute container with locking wire passed through the side holes in the plates. Place the container and parachute carefully on the headrest of the seat. Do not take out the locking pins and cover from the bay. To disconnect the drogue parachute, proceed as prescribed in Section 8 of the given Chapter.

3. Unload mechanisms TCM-2500-38 after replacing the ground pin marked with figure "1" with the flexible stud disconnected from the assembly halyard and fastened to the charge-operated mechanism bolt by means of wire KC-0.5.

4. Unload mechanism 215Ш.

5. Disconnect the АД-3У time delay mechanism halyard from the fuselage bracket.

6. Disconnect the cable from the collapsible support control shaft bell-crank.

7. Uncouple the connector of the МУ-100АП motor supply cable.

8. Disconnect the lower block of common connector ОРК-2 from the seat headrest.

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9. Drive out the ... used to fix the upper trunnions of mechanism TCM-2500-38 to the seat beam suspension joints.

10. Secure the canopy lifting ropes to the seat trunnions and start removing the seat from the aircraft by means of a crane.

11. Lift the seat slowly and move the foot rest spindles from the guides arranged on the cockpit floor; lifting the seat still higher, remove the rails from the fuselage rollers.

Lift the seat from the cockpit, place it on the rails in a place specially prepared or put it on a special rack.

When placing the removed seat on the rack, take measures of precaution to avoid bending the protective yoke (Fig. 98).

Note: While removing the seat, shift the engine control lever and canopy control handle into the front position.

The procedure of installing the seat into the cockpit is the reverse of removing. While installing the seat, mind the following:

1. Prior to mounting the seat into the cockpit, charge mechanisms 215P and 2150 and install all safety pins of the assembly halyard into the seat.

2. To achieve convenience in mounting the seat, stop the foot rests by means of the ground locking pins.

3. To install the seat into the cockpit, move up and secure the protective yoke (Fig. 98) by sinking locking dowels 3 into the yoke seats, displacing the yoke into the extreme top position and securing it therein to the seat pan with the help of special capron cord 5 attached to the assembly halyard.

4. While lowering the seat into the cockpit, move it slowly down till the upper trunnions of the charge-operated mechanism stop against the seat hooks. After this, screw in and lock the thrust bolts. During lowering the seat, take care to fit the foot rest spindles into the cockpit floor guides and to retain the foot rest grips open.

Take care that the lower ends of the rails fit into the cockpit floor guides.

When the seat is hauled down into the cockpit, see that the engine control lever and canopy control handle is shifted into the forward position.

5. After installing the seat, connect all cables of the seat mechanisms, fasten the AH-3У halyard to the fuselage, load mechanisms TCM-2500-38 and 215П, and then secure the container with the drogue parachute.

Unfasten capron cord 5 (Fig. 98) and pull it out of the seat pan.

CAUTION. 1. Prior to installing the seat, make sure whether the calibrated orifice of the 215P mechanism nozzle is not clogged with grease or dirt.

2. When connecting the cable to the TCM-2500-38 mechanism cotter pin, insert the attachment bolt moving its head forward in the direction of flight to avoid touching the head against the mechanism trunnion grip bracket bolt.

3. Before fastening the cable to the canopy front grip lock collapsible support control rod bell-crank, make sure whether the cable displaced freely throughout the entire travel limited by the cable shoe, stops against the bracket arranged on frame No. 8 (see the reference plate attached to the false floor of the cockpit).

After checking the length of the cable travel, fit the cable into the pipe, connect it to the shaft bell-crank and lock it with wire AMЦ-2.

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6. DEMOUNTING AND INSTALLATION OF CHARGE-OPERATED MECHANISMS

Demounting of Mechanism TCB-2300-39

(Figs 95 and 101)

The charge-operated mechanism is demounted and installed during scheduled maintenance of the seat and mechanism performed after the seat has been removed from the aircraft.

Prior to demounting the charge-operated mechanism, make sure that it is not loaded. While removing, observe the following priority:

1. Disconnect the cable coupling the canopy emergency jettison handle to the bleed valve in the lower part of the mechanism; for this proceed as follows:

(a) remove the locking wire with the seal from the valve stud;

(b) without disconnecting the flexible covering from the bracket, drive out two screws used to secure the bracket to the mechanism;

(c) drive the stud out of the bleed valve, and move aside the cable with flexible covering and the bracket.

2. Unlock and drive out two screws 2 and 3 situated on the left and right sides of rod 1 and bell-crank 4. Remove the washers from the mechanism lower end trunnions.

3. Screw off the nut of bolt 8 (Fig. 101) used to attach spindle 6 and roller 7, take out the bolt and remove the spindle with the roller (either left or right).

4. Remove the rod from the upper bracket and from the mechanism lower stirrup trunnion.

Leave rods 4 attached to the central bracket.

5. Move the mechanism lower stirrup trunnion from the second rod port and remove the mechanism.

Note: Never demount the mechanism by moving rods 1 apart unless one spindle 6 has been removed, since this may cause damage of the bracket eye or of the rod.

Installation of the charge-operated mechanism is the reverse of demounting.

When demounting the mechanism, mind the following:

(a) in case the cable stud would not fit into its ports when being joined to the mechanism bleed valve, remove the diaphragm of the valve and shift the valve axle by moving it through the bleed hole, dia. 3 mm, or by turning it so as to pass the stud home. After this, use glue БФ-4 to install the diaphragm in place;

(b) after the bracket and cable are installed in the mechanism, safety the attachment screws;

(c) after the screws and bolts are screwed into the mechanism trunnions and bell-cranks, safety them with a plate;

(d) shift the mechanism lower part completely forward and make sure whether the stud does not get out of the valve;

(e) lock the valve stud with wire МК-0.5 and put it under lead.

Note: In case the mechanism is adjusted for summer operation, make sure that the calibrated port in the nozzle is not clogged with grease or dirt.

Demounting and Installation of Mechanisms 215P and 215Э

(Figs 95, 97 and 110)

The mechanisms are demounted and installed back in the aircraft in the case of scheduled maintenance or replacement of unserviceable charge-operated mechanisms with new ones.

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Whenever demounting the mechanisms, take care to preserve the assembling dimensions, for which purpose follow the directions given in the Technical Description and Operating Instructions of the mechanisms. These also indicate the scope of operations intended for disassembling the mechanisms for cleaning them after test firing with primers arranged in washers.

After the charge-operated mechanisms are installed and loaded, safety separate joints and control rods.

The mechanisms are removed and installed only after the seat has been demounted from the aircraft.

IMPORTANT. Prior to removing the mechanisms, make sure that they are not loaded.

When assembling the seat, mount only unloaded mechanisms previously cleaned, lubricated, assembled and checked according to the Technical Description and Operating Instructions of the mechanisms.

1. Demount charge-operated mechanism 215P observing the following priority:

(a) open the flaps on the seat back and fasten them in this position with locking wire;

(b) remove the bolt striker trigger cotter pin supporting bracket after driving out its two fastening screws;

(c) drive out the lever from the striker trigger cotter pin;

(d) turn off the lock nut and remove the gun bolt;

(e) turn off the fastening screw of the mechanism cable tube stirrup to the seat upper cross beam;

(f) install a special arrangement in the mechanism to prevent releasing of the spring;

(g) unlock and drive out the axle used to attach cable guide roller and cover to the mechanism lower bracket;

(h) drive out two bolts used to attach the upper stirrup to the left wall of the seat, turn off two screws of the lower stirrup, and remove the mechanism and the stirrups;

(i) remove the spring retaining arrangement from the mechanism and disassemble, clean and lubricate the parts.

When demounting and lubricating mechanism 215P, make use of arrangement 76-7804-190A.

The procedure of installing the mechanism in the seat is the reverse of demounting. After installing, make sure that the shoulder belt restraint mechanism operates smoothly, without jamming.

2. Remove charge-operated mechanism 2150 from the seat observing the following priority:

(a) unlock the bolt striker trigger cotter pin and remove the lever from the cotter pin;

(b) unlock and drive out the mechanism upper attachment axle;

(c) holding the mechanism by the hand, unlock and drive out the axle used to attach the lower portion of the mechanism to the bracket;

(d) remove the mechanism.

Installation of the mechanism into the seat is the reverse of its removal.

__Note:__ In order to avoid shearing of the mechanism lock screw, proceed as follows:

1. Produce inverse moments when releasing or tightening the bolt union nut (when loading and unloading the mechanism with cartridges) to prevent elimination of clearance in the front and rear attachments of the mechanism.

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Whenever demounting the mechanisms, take care to preserve the assembling dimensions, for which purpose follow the directions given in the Technical Description and Operating Instructions of the mechanisms. These also indicate the scope of operations intended for disassembling the mechanisms for cleaning them after test firing with primers arranged in washers.

After the charge-operated mechanisms are installed and loaded, safety separate joints and control rods.

The mechanisms are removed and installed only after the seat has been demounted from the aircraft.

IMPORTANT. Prior to removing the mechanisms, make sure that they are not loaded.

When assembling the seat, mount only unloaded mechanisms previously cleaned, lubricated, assembled and checked according to the Technical Description and Operating Instructions of the mechanisms.

1. Demount charge-operated mechanism 215P observing the following priority:

(a) open the flaps on the seat back and fasten them in this position with locking wire;

(b) remove the bolt striker trigger cotter pin supporting bracket after driving out its two fastening screws;

(c) drive out the lever from the striker trigger cotter pin;

(d) turn off the lock nut and remove the gun bolt;

(e) turn off the fastening screw of the mechanism cable tube stirrup to the seat upper cross beam;

(f) install a special arrangement in the mechanism to prevent releasing of the spring;

(g) unlock and drive out the axle used to attach cable guide roller and cover to the mechanism lower bracket;

(h) drive out two bolts used to attach the upper stirrup to the left rail of the seat, turn off two screws of the lower stirrup, and remove the mechanism and the stirrups;

(i) remove the spring retaining arrangement from the mechanism and disassemble, clean and lubricate the parts.

When demounting and lubricating mechanism 215P, make use of arrangement 75-7804-190A.

The procedure of installing the mechanism in the seat is the reverse of demounting. After installing, make sure that the shoulder bolt restraint mechanism operates smoothly, without jamming.

2. Remove charge-operated mechanism 2150 from the seat observing the following priority:

(a) unlock the bolt striker trigger cotter pin and remove the lever from the cotter pin;

(b) unlock and drive out the mechanism upper attachment axle;

(c) holding the mechanism by the hand, unlock and drive out the axle used to attach the lower portion of the mechanism to the bracket;

(d) remove the mechanism.

Installation of the mechanism into the seat is the reverse of its removal.

Note: In order to avoid shearing of the mechanism lock screw, proceed as follows:

1. Produce inverse moments when releasing or tightening the bolt union nut (when loading and unloading the mechanism with cartridges) to prevent elimination of clearance in the front and rear attachments of the mechanism.

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2. When installing and fastening the mechanism to the seat, avoid axial efforts upon the mechanism.

Mechanisms 215P, 215Э and 215П are mounted in the aircraft together with the seat. Except drogue parachute charge-operated mechanism 215П which is loaded after installation of the seat into the aircraft, the mechanisms are mounted on the seat and loaded with cartridges before the seat is installed.

Mechanisms 215P and 215Э installed on the seat should be loaded only after checking for proper assembling of the entire mount and after the safety pins have been installed into the control levers and into the mechanisms bolts.

After loading the mechanisms, attach the fire control cables and safety the elements to be locked.

__Note:__ The ground safety pins are removed for the period of flight only. Maintenance of the charge-operated mechanism not locked with ground safety pins is strictly prohibited.

3. Disassemble and clean mechanism 215П without demounting it from the seat. When mechanism 215П is disassembled, replace the three-member yoke lock safety plates already used with the new ones available in the spares set, the repeated bending of the plate ends being impermissible.

7. ADJUSTMENT OF SEAT SIZE
(Fig. 103)

When the canopy is closed, check whether the canopy glass and pilot's pressure helmet ГШ-4М pressed against the headrest, form a space of about 50 mm, irrespective of the pilot's height.

In case the pilot is 94 cm. high in the sitting posture, and when a fresh-packed parachute, type C-3, is used (the parachute thickness should not exceed 250 mm, or 225 mm, if the oxygen apparatus is not used), the space between the pressure helmet or crash helmet and the canopy glass should not be less than 25 mm.

While in use, the parachute shrinks and the space increases to 50 mm.

If the aircraft is used by pilots of different height, the seat size is adjusted by means of readjusting the operation of electric motor МУ-100АП as follows:

1. Move the seat pan down into the extreme lower position.

2. Release the screw locking the upper pressure ring used for switching off the electric motor and installed on the seat adjustment mechanism rod (Fig. 104).

3. Shift the upper pressure ring up or down to place it opposite the pointer which indicates the pilot's height in the sitting posture, and lock the ring with the screw.

4. Move the pan up and down and turn the pressure switch arranged on the left-hand console into positions DOWN and UP to make sure that the limit switches cut off motor МУ-100АП when the seat pan travels into either extreme position.

The aircraft mechanic should know that:

(a) the lower pointer bears the inscription 85 AND LESS which indicates the pilot's height in the sitting posture of 86 cm. and less;

(b) the central pointer bears the figures "87-91" which indicates the pilot's size in the sitting posture from 87 to 91 cm.;

(c) the second central pointer bears the figures "92-93" which indicates the pilot's size in the sitting posture from 92 to 99 cm.;

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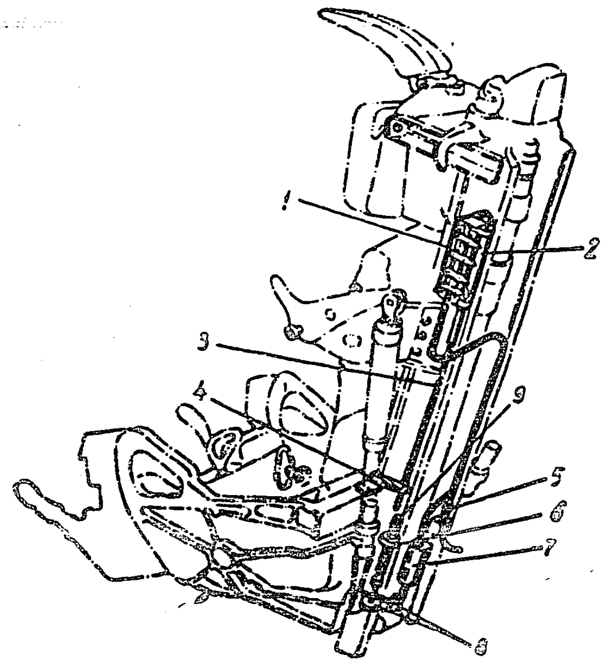

FIG. 103. SEAT PAN ELEVATION SYSTEM

1 – [illegible] mechanism; 2 – upper rod; 3 – lower rod; 4 – [illegible] attachment [illegible]; 5 – electric connector [illegible]; 6 – [illegible]; 7 – electric motor [illegible]; 8 – [illegible]; 9 – [illegible].

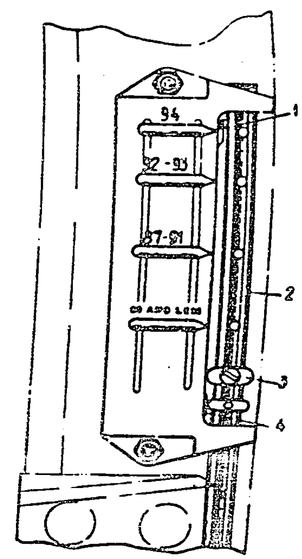

FIG. 104. SEAT SIZE ADJUSTMENT MECHANISM

1 – upper [illegible] button; 2 – adjustment mechanism rod; 3 – rod upper adjustment stop; 4 – lower [illegible] button.

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(d) the uppermost pointer bears the number "94" which indicates the pilot's size in the sitting posture of 94 cm.

Note: The pilot's sitting posture height (less uniform and helmet [illegible]) is registered in the pilot's medical examination card.

For example, when the sitting posture height is 90 cm., set the upper pressure ring opposite the pointer "87-91"; when the sitting posture height is 94 cm., place the ring opposite the pointer "94", and so on.

In the case of sitting posture height of 94 cm., set the upper pressure ring opposite the upper microswitch button which causes the seat pan to travel into the extreme lower position so that the seat cannot be readjusted during flight.

Due to inertia imparted by electric motor МУ-100АП, which is particularly high in the case of downward displacement of the empty pan, the pan continues to move down through 5 to 8 mm after the motor is cut off. Therefore, cut off the motor by depressing the switch when the pan is 8 to 10 mm above the extreme lower position (as can be estimated by the position of the pan adjustment mechanism lower rib), and after the pan stops, move it down by engaging the motor repeatedly for short intervals of 1 sec.

8. INSTALLATION OF DROGUE PARACHUTE

The seat is equipped with drogue parachute set СПК-6381-59 (Fig. 103). The parachute container is put under two seals.

The parachute is demounted for checking or replacement only in the case of scheduled maintenance performed in compliance with the Parachute Operating Instructions.

The parachute is installed into the 215П mechanism bolt shape with the help of two container plates. The shape is mated with the plates by means of two studs. The parachute shroud lines are secured to the mechanism bolt swivel through the eye ring of the lines.

To install the drogue parachute on the seat, observe the following priority:

1. Pack the case with the shroud lines into the headrest right-hand recess after fastening the cover snap hook to the eye inside the recess.

2. Connect the parachute shroud line eye ring to the 215П mechanism bolt swivel.

3. Insert the container plates into the 215П mechanism bolt shape and align the holes in the plates with those in the shape.

4. Mate the shape, the container plates and rings of straps sewn to the shroud line case by means of two studs after the strap rings have been inserted between the container plates.

5. Lock the studs with wire КОК-0.5 and put them under seals.

6. Remove the wire from the side holes of the container plates.

<u>CAUTION</u>. No flight is permissible unless the wire has been pulled out of the side holes of the container plates; otherwise the container would not release the parachute during ejection.

Demounting of the drogue parachute is the reverse of installation. Prior to removing the parachute, tie up the container plates with soft wire inserted through the side holes and affix the seals.

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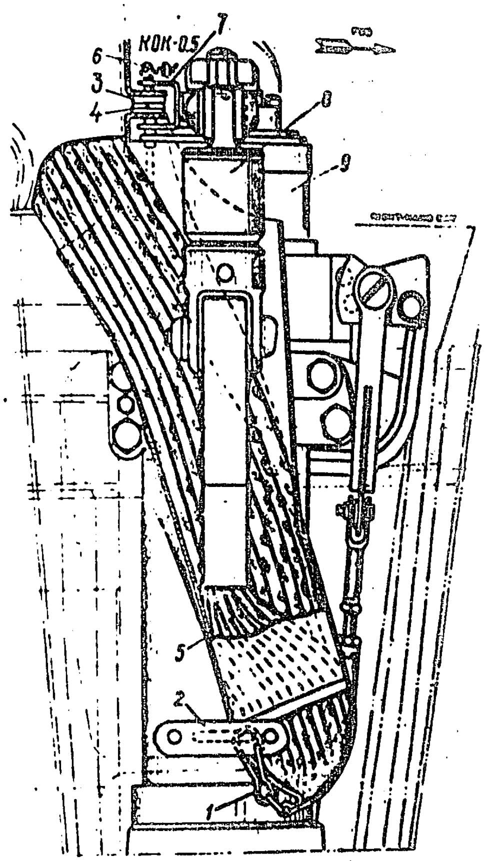

FIG.103. DROGUE PARACHUTE ATTACHMENT
1 – shroud line case snap hook; 2 – bracket; 3 – pins; 4 – case strap ring; 5 – parachute shroud line case; 6 – stud (cable sheath); 7 – gun bolt chape; 8 – parachute swivel; 9 – charge-operated mechanism [illegible]

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9. CHECKING OPERATION OF SEAT UNITS

All units of the seat are checked only during scheduled maintenance of the aircraft. While checking, no adjustment of the seat units is performed since all mechanisms have been adjusted at the Manufacturing Plant. Subjected to checking are functioning of the mechanisms and pricking of primers in all charge-operated mechanisms of the seat.

To check pricking of primers, the charge-operated mechanisms are loaded with special test cartridges which do not foul the mechanisms when the primers are broken.

Functioning of the mechanisms and pricking of the primers are checked simultaneously in a certain sequence.

When carrying out the scheduled maintenance, drive out all shear screws to check their condition, and replace them in case cuts have been detected or the thread has slackened.

The shear screws locking the systems to be checked for functioning should be driven out prior to the check and installed in position after the check is over and the systems are restored. (Install the screws on zinc white).

All principal operations used for checking the functioning of the seat units and the pricking of primers are performed with the seat removed from the aircraft.

To check the seat, it should be installed on a special rack.

The charge-operated mechanisms must be previously unloaded. Described below is the procedure of checking the seat units to be followed in order to avoid superfluous work and accidents.

Checking Functioning of Firing and Harness Restraint Charge-Operated Mechanisms

While checking the operation of the firing mechanism (Fig. 105), check the pricking of primers of mechanisms TCM-2500-38 and 215P.

When checking, observe the following sequence:

1. Demount charge-operated mechanism TCM-2500-38 from the aircraft and attach it to the seat by securing its lower part to the seat by means of wire.
2. Load mechanisms TCM-2500-38 and 215P with test cartridges.
3. Fasten the control cables to the charge-operated mechanism bolts and lock the 215P mechanism lever previously unlocked for unloading.
4. Slowly press the trigger lever on either hand-rest and fire mechanism 215P. Make sure that the cotter pin installed in the main charge-operated mechanism TCM-2500-38 has not started to travel at the moment of action of mechanism 215P.
5. Continue to press the trigger lever slowly and fire mechanism TCM-2500-38. Check that a certain play of the firing lever is still present.
6. Unload mechanisms TCM-2500-38 and 215P and make sure that the test cartridge primers have been broken and have not failed to fire.
7. Install the charge-operated mechanism bolts in place.
8. Repeat checking the action of the charge-operated mechanism to make sure that the cotter pin is pulled out due to engagement of the trigger lever arranged on the other hand-rest, but do not repeat breaking the primers.

<u>Note</u>: If even a single primer has failed to be pricked, repair the fault and repeat the check.

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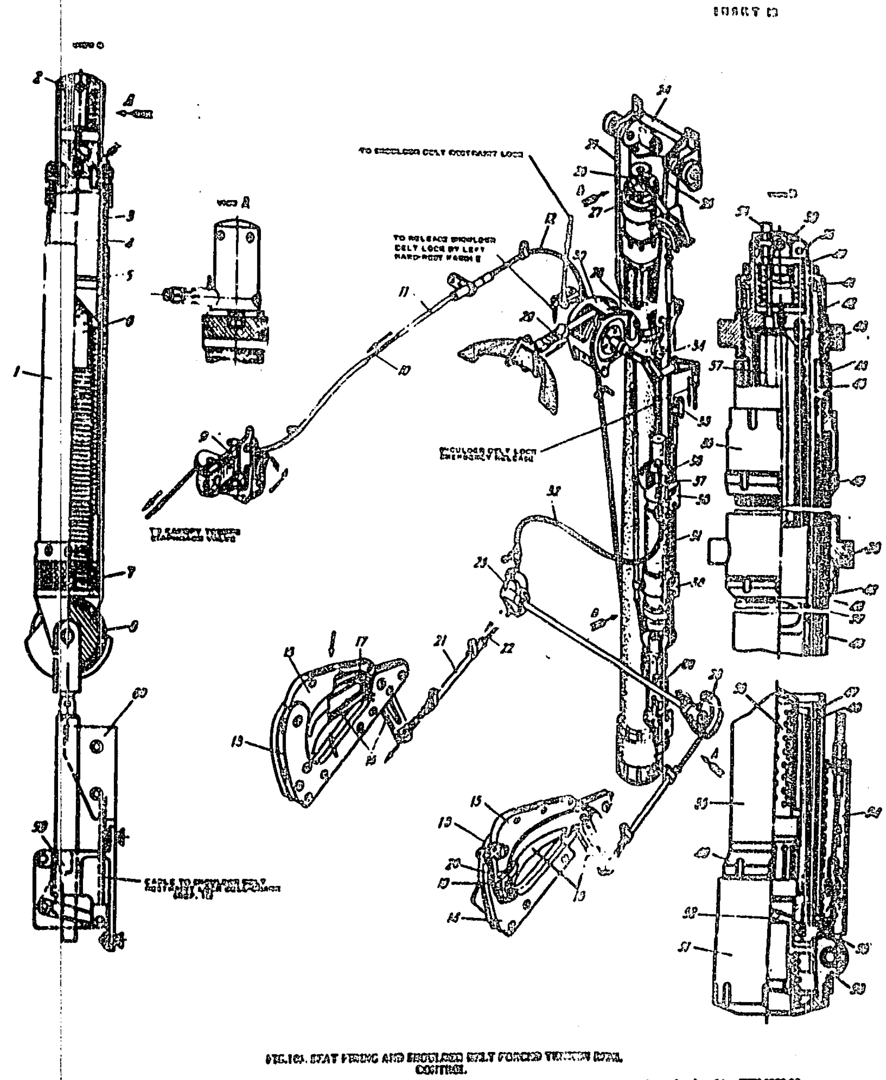

FIG.104. SEAT FIRING AND SHOULDER BELT FORCED TENSION DUAL CONTROL.

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Checking 215Ф Mechanism Cartridge Primers for Pricking

In order to check the pricking of cartridge primers of the mechanisms loaded with special test cartridges, observe the following sequence:

1. If time delay mechanism AД-3У is not triggered, trigger it as follows:

(a) disconnect the AД-3У cable from the seat cross shaft by pulling out the axle;

(b) cock mechanism AД-3У by pulling its cable out as far as it will go by means of a ring with a hook delivered with the mechanism;

(c) insert a flexible stud into mechanism AД-3У;

(d) connect the AД-3У cable to the cross shaft lever by inserting the axle in place.

2. Pull out the flexible stud from mechanism AД-3У and see that the unit is caused to operate (so as to pull in the cable); as a result, the seat cross shaft which controls the 215Ф mechanism bolts through rods, will be turned, and mechanisms 215Ф will operate as well.

3. Remove the gun bolts from mechanisms 215Ф and check the pricking and firing of the test cartridge primers.

4. Trigger the bolts of mechanisms 215Ф and set them in their respective cases.

5. Proceed as described above to trigger time delay mechanism AД-3У and secure the flexible stud with a thread No. 65/6/3 (ГОСТ-23-55).

6. Turn the seat cross shaft used to control the gun bolts, set it in the initial position, and couple the rods to the bolts of the charge-operated mechanisms.

Prior to connecting the rods, check the system for proper locking by acting on the rod with a force directed toward the ON-position of the mechanisms and see that the shaft does not turn.

Note: If even a single primer has not been pricked, remove the fault and repeat the check.

Checking Drogue Parachute 215П

Charge-Operated Mechanism Cartridge Primer for Pricking

In order to check pricking of primers by mechanism 215П charged with a test cartridge (Fig. 107), follow the priority described below:

1. Connect the cable or wire to the cotter pin of the 215П mechanism gun bolt.

2. Extract the cotter pin from the 215П mechanism bolt by pulling the cable.

3. Unload mechanisms 215П and make sure whether the test cartridge primers have been pricked and have fired.

4. Trigger the 215П mechanism bolt and install it in place.

Note: If even a single primer has not been broken, remove the fault and repeat the check.

Checking Emergency Arrest Release of Pilot Fastening Locks

In order to check the release of the pilot fastening locks (Fig. 99), i.e. release of the shoulder and waist belt restraint mechanisms and of the foot locks, the seat should be removed from the aircraft and installed on a special stand, the charge-operated mechanisms should be unloaded and the following priority should be observed:

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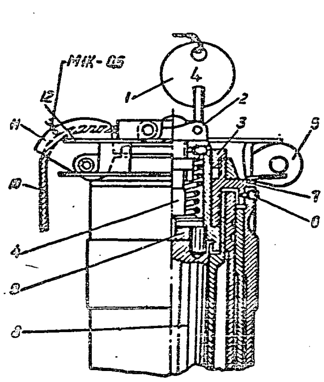

FIG.107. 2[illegible] MECHANISM GUN BELT

1 – ground safety pin; 2 – cotter pin; 3 – gun bolt locknut; 4 – cylinder; 5 – ring with stops and eyes; 6 – locking screw; 7 – union nut; 8 – cartridge [illegible]; 9 – bolt; 10 – cotter pin operating cable; 11 – cable cover; 12 – clamp.

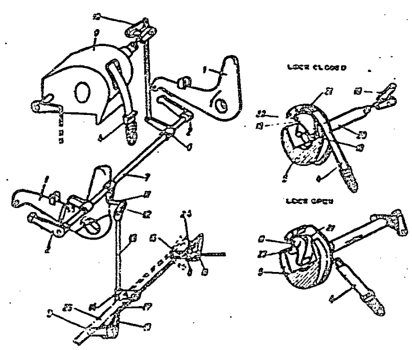

FIG.108. SHOULDER BELT RESTRAINT LOCK

1 – two-arm lever; 2 – upper cross shaft lever; 3 – waist belt restraint emergency release lock; 4 – shoulder harness lock strap; 5 – lock reel; 6 – shoulder belt restraint lock emergency release lever; 7 – upper cross shaft; 8 – waist belt restraint cable termination; 9 – shoulder belt restraint lock; 10 – lock release lever; 11 – transmission rod; 12 – vertical shaft lever; 13 – vertical shaft; 14 – vertical shaft lower lever; 15 – waist lock grips; 16 – waist lock emergency release levers; 17 – waist lock emergency release rod; 18 – pawl; 19 – lock roller; 20 – lock fixing rod; 21 – pawl boss for fixing shoulder harness strap; 22 – pawl axle; 23 – pawl tail for pushing by screw-driver; 24 – lock lever bosses for fixing grips; 25 – foot grip control rod.

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1. Pack the parachute into the seat pan and connect the parachute harness system to the shoulder and waist belt restraint locks.

Drive out the shear screw from the pilot fastening lock release horizontal shaft left-hand bell-crank.

Remove the ground locking pin marked with figure "10" from the pilot fastening lock release system drive roller. Install special arrangement 76-7804-53 (consisting of a limit key with a spring mechanism stop) screwing it in through a port in the spring mechanism upper nut to prevent slippage of the rod and damage of the structure.

2. Get into the seat, put on the harness, fix the harness control lock, fasten yourself to the seat by means of the shoulder and waist belts and close the foot grips.

3. Pull out with a jerk the lock emergency release arrest arranged on the seat pan. The arrest in the hand, check that:

(a) the 2159 mechanism bolts operate;

(b) the upper cross shaft turns;

(c) the spring mechanism operates;

(d) the foot grips and shoulder belt restraint lock are released;

(e) the waist belt restraint locks open.

The priority of releasing the foot grips and shoulder belt restraint lock is of no importance, though the waist belt restraint locks must be the last to open.

Simultaneous release of all locks is permissible.

4. Take the parachute and harness out of the seat pan.

5. Without removing the arrangement (the limit key), disassemble the spring mechanism by turning off the spring mechanism upper nut together with the arrangement. Take measures to prevent abrupt extension of the spring, screw off the arrangement, release the spring, and apply grease ЦИАТИМ-201 to lubricate the spring and rod after washing and inspecting them.

After the locks have acted properly, restore the system as follows:

1. Install the arrest cable into the seat pan roller, for which purpose:

(a) remove the cover from the seat pan transmission roller;

(b) pass the arrest cable ending in a tag through the roller housing branch;

(c) bring the roller cable tag seat against the cable end protruding from the housing;

(d) insert the cable tag into the seat on the roller;

(e) attach the roller cover to the housing.

2. Disconnect the rods from the 2159 mechanism bolt trigger levers.

3. Assemble the spring mechanism with the help of arrangement 76-7804-53 following the reverse priority, and trigger the mechanism by pulling the arrangement upward to compress the spring and inserting the rod inside. Lock the spring mechanism by locking the arrangement with a pin.

4. Cock the shoulder belt restraint lock (Fig. 109), for which proceed as follows:

(a) disconnect the rod (used to couple the upper cross shaft lever to the shoulder belt restraint lock release lever) from the lock release lever by unlocking the axle and driving it out;

(b) insert the fastening strap into the shoulder belt restraint port and push it inside as far as it will go so that the lock reel should revolve;

(c) insert a screw-driver through the lock housing opening, press upon the roller pawl tail and fit the pawl boss into the fastening strap bail due to which the lock is set in position FIXED;

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(d) retain the pawl and roller in this position by means of the screw-driver and insert the fixing rod inside the lock;

(e) make sure that the lock is fixed by pulling the fastening strap.

Note: If the fastening strap bail could not be mated with the pawl boss, pull the lock reel up by shifting the 215P mechanism roller rod somewhat up with the help of the lever and fixing the rod in this position with a wooden block placed under the rod.

5. Trigger the locks of the shoulder belt restraint mechanism and foot grips, for which proceed as follows (Figs 108 and 109):

(a) open the flaps on the seat back to make an access to the rods of the above locks, and fix the opened locks;

(b) turn the locks and bell-cranks of both foot grips so as to gear the locking pins by the ratchet sectors;

(c) turn the upper cross shaft by shifting the side levers upwards so as to touch the cross rod stud with that end of the vertical shaft lower lever slot which is situated on the right side in the direction of flight. As a result, the rod secured to the lever is displaced to the left and is caused to turn the bell-cranks through a linkage of rods and levers so that the bell-cranks are brought close to the foot grip levers;

(d) insert the cable tags into the locks arranged on the seat after securing the cables to the blocks with buckles intended to attach the parachute harness;

(e) close the grips of both waist belt restraint locks and fix them with special clamps;

(f) move the cross rod to the left in the direction of flight so that the bosses of the levers overlap the passage of the locks, and remove the special clamps;

(g) pull the waist belt restraint cables and make sure whether the cables are fixed by the locks;

(h) turn the upper cross shaft in place by lifting the side levers once again. As a result, the rod connected to the vertical shaft lever travels still farther to the left, and the bell-cranks move close to the foot grip levers and fix the levers in place. Check whether the bell-cranks are set in the position where the bearing surfaces of the bell-cranks and levers are matched (Fig. 110).

6. Connect the shoulder belt restraint lock release control lever to the upper cross shaft rod by inserting the axle.

7. Make sure that the spring mechanism lever has locked the triggered rod attached to it and remove the arrangement used for triggering the mechanism.

Mind that the spring mechanism lever may not necessarily touch the spring mechanism housing with its tooth. The main indication of the system being in the initial position is the fact that the locking pin can be inserted into the 215P mechanism locking drive roller. Never press the spring mechanism lever to the housing to remove the clearance.

8. When the pilot fastening system lock control upper cross shaft is turned, the transmission rollers installed on the rear side of the seat back and on the seat pan pull in the arrest cable due to which the rubber portion of the arrest gets into the roller housing so that the spring plates with pins fix the arrest in the initial position.

9. Use wire to lock the pilot fastening lock emergency release arrest and the pilot fastening lock release system drive roller (Fig. 111), and put them under seals.

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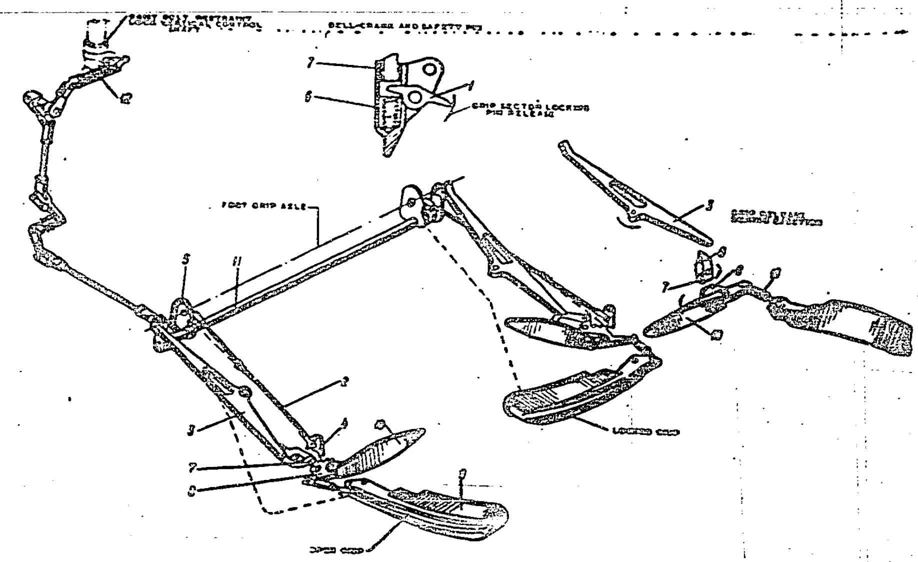

FIG. 1[illegible]. FOOT GRIP CONTROL.
1 – [illegible] lever; 2 – tappet; 3 – bellcrank; 4 – [illegible] pin; 5 – [illegible] lever; 6 – bellcrank and [illegible] pin; 7 – [illegible] pin; 8 – [illegible] sector; 9 – foot grip; 10 – lever; 11 – [illegible]; 12 – [illegible]; 13 – rod.

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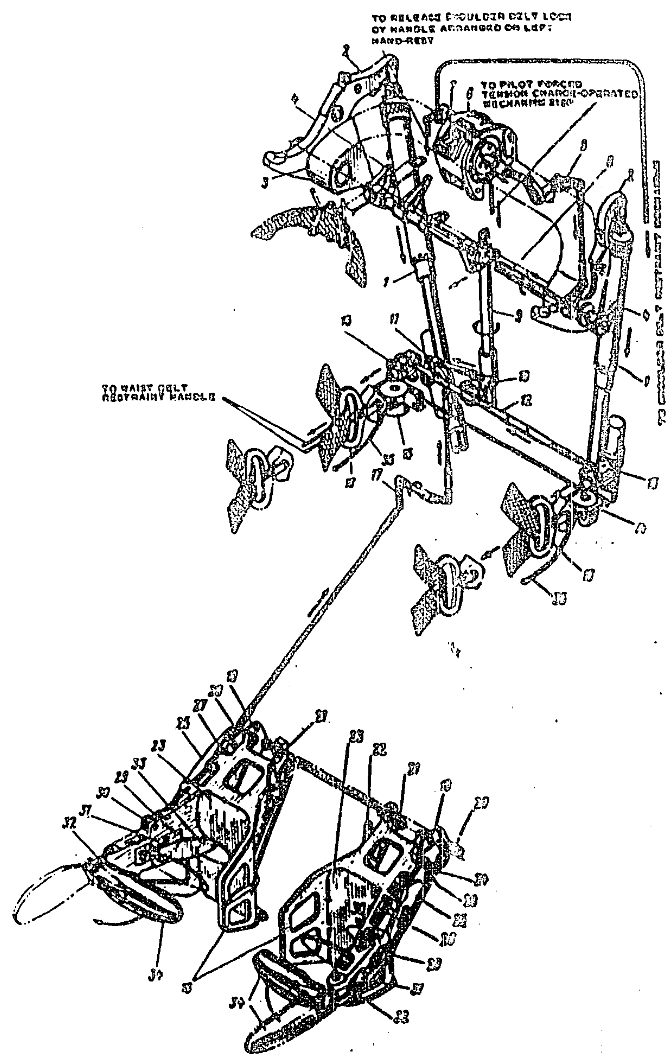

FIG.110. PILOT FASTENING LOCK EMERGENCY RELEASE SYSTEM

1 – charge-operated mechanism 3150; 2 – two-arm levers; 3 – seat frame upper cross beam; 4 – upper cross shaft lever; 5 – shoulder belt restraint lock release bell-crank; 6 – shoulder belt restraint lock; 7 – shoulder harness lock strap; 8 – upper cross shaft; 9 – vertical shaft; 10 – lever with oval part; 11 – foot grip lock release bell-crank; 12 – waist belt restraint release rod; 13 – waist belt restraint emergency release lock; 14 and 15 – waist belt restraint cable roller body; 16 – waist belt buckle; 17 – foot grip release rod bell-crank; 18 – foot rests; 19 – fixing joint; 20 – bell-crank; 21 – springs; 22 – bracket; 23 – cushion; 24 – stop; 25 – bell-crank; 26 – tie-rod and spring; 27 and 28 – spindles; 29 – locking pin; 30 – stop; 31 – foot ratchet sector; 32 – foot grip lever rod; 33 – lever; 34 – foot grips; 35 – waist belt restraint lock cable.

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Insert a shear screw into the left-hand bell-crank of the pilot fastening lock release horizontal shaft.

10. Shut the hinged flaps on the seat back, check the operation of the waist and shoulder belt restraint mechanisms controlled by the handgrips on the seat hand-rests, and make sure whether the opened foot grips are fixed.

11. Remove the used grease from all flexible joints and lubricate them with fresh grease НИАТИМ-201 with graphite admixture.

Checking Operation of Canopy Grip Collapsible Supports

In order to check the operation of the collapsible supports, observe the following procedure:

1. Drive out the shear locking screw from the collapsible support control shaft left sector after making sure that the ground safety pin marked with figure "5" has been installed into the supports.

2. Take measures of precaution and drive out the ground safety pins from each support in succession. To prevent abrupt unfolding of the supports, hold them by the hands and turn the support control shaft so that the supports open through 90° and are fixed in place with spring dowels.

3. Drive out the shear screw from the locking pin used to fix the extensible spring spindle seated in the support groove, hit the locking pin with a rod, dia. 10 mm (to simulate the operation of the insert of the seat grip front lock installed on the canopy), and check that the spring spindle moves out.

If the operation is good, sink the spring spindle and fix it with the lock by driving the shear screw home. Check the operation of each support.

4. Attach a dynamometer to each support in succession and measure the initial force produced when folding the supports and check that the force should not be less than 18 kg. Secure the dynamometer to the support hook, press the dowel by a rod passed through the port in the support bracket top surface and drive the dowel out of the port in the bracket.

5. After measuring the force produced by the spring, fold the supports in the reverse sequence, install the ground locking pins and turn the shear locking screw into the left-hand sector of the collapsible support control shaft.

Checking Presence of Seals and Special Locking Screws on Seat Mechanisms

After checking the operation of the seat units, check the units for presence of safety wiring and special screws installed in the following elements (Fig. 111):

1. Foot grip release rod, locked with wire НМ-0.5, no seal.

2. TCM-2500-38 mechanism fire control cable tip, locked with wire КС-0.5, no seal.

3. Drive roller of 215P mechanism manual (duplicate) fire control and of the harness restraint and foot grip lock release mechanisms, locked with wire НМ-0.5, with seal affixed.

4. Manual (duplicate) control cable flexible shielding shoulder nut, locked with wire КС-0.8, with seal affixed.

5. Driving shaft of harness lock and foot grip release control, locked with shear screw of material АМГ passed through shaft bearing (shear dia. = 2 mm).

6. 215P mechanism cable threaded tip shoulder nut, locked with wire КС-0.5, with seal affixed.

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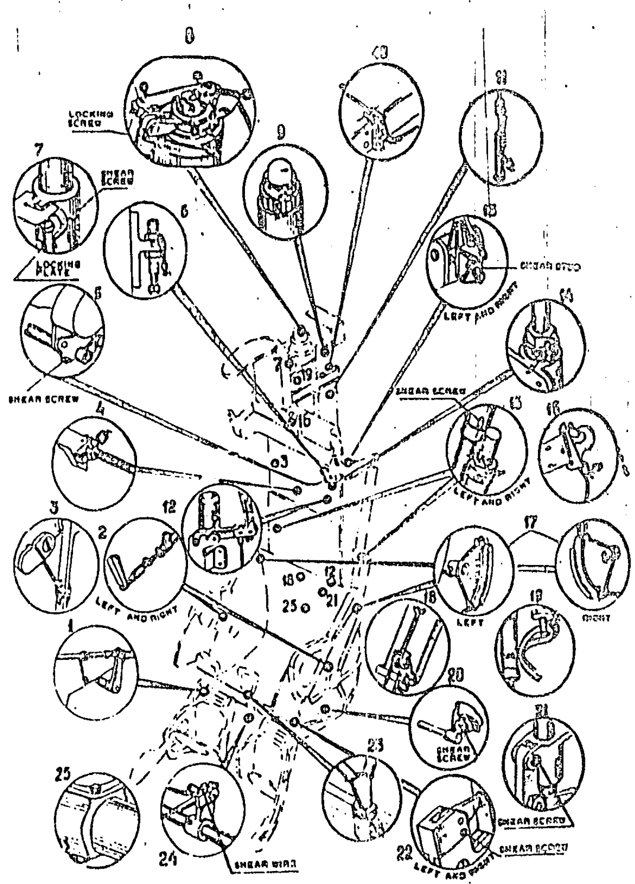

FIG.111. SEAT MECHANISM LOCKING SYSTEM

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7. 215П mechanism three-member yoke attachment lock, locked with screw made of steel, grade 10 (2 pieces) and with locking plate made of steel, grade 10-20.5. 50X1-HUM

8. 215П mechanism head:

(a) drogue parachute attachment studs (2 pieces), locked with wire KC-0.9, with seal affixed;

(b) mechanism firing cotter pin, locked with wire KC-0.5, with seal affixed;

(c) sector for passing the cable, locked with wire KC-0.5, with seal affixed;

(d) sector groove, locked with wire KC-0.5 (attached over the cable), with seal affixed;

(e) mechanism gun bolt nut, locked with wire KC-0.5 (attached to bracket with sector), with seal affixed;

(f) bracket with sector, locked with 215П mechanism organic adjusting screw which fastens it to the sleeve;

(g) sleeve (with outside cylinder snout), fixed with locking screw made of steel, grade 25.

9. Nut of TCM-2500-38 mechanism gun bolt, locked with wire KC-0.8, with seal affixed.

10. Groove on bracket for passing the cable connected to 215П mechanism cotter pin, locked with wire KC-0.5 fastened in two points.

11. Adjustable joint of TCM-2500-38 mechanism fire control linkage located under the jacket, locked with wire KC-0.8, with seal affixed.

12. 215P mechanism cotter pin trigger lever, locked with wire KC-0.5, with seal attached.

13. Shackle of 215П mechanism three-member yoke lock release gear bell-crank, locked with special shear studs, dia. 2 mm, made of material AMц and installed on the left and right sides.

14. 215P mechanism gun bolt nut, locked with wire KC-0.8, with seal affixed.

15. (a) Outside cylinder (with rod) of mechanism 215P locked with 215P mechanism organic locking pin made of steel, grade 25, and installed on the right and left sides;

(b) 215P mechanism bolt nut, locked with wire KC-0.8 fastened on the right and left sides, with seal attached.

16. Damping cord hook arranged on the central clasp of the harness system shoulder belt, locked with wire KC-0.8, no seal.

17. Groove in the right and left sectors of TCM-2500-38 mechanism fire control shaft, locked with wire KC-0.8 secured above cable tags in three points, with seal affixed.

18. Stud (cotter pin) of TCM-2500-38 mechanism bleed valve, locked with wire KIM-0.5, with seal affixed.

19. AД-3У time delay mechanism triggered position flexible stud and halyard, locked with the same cord thread pulled out of a cotton shroud line core (yarn No. 65/6/3 ТУКЛП25-55).

20. Folded collapsible support shaft left-hand limit sector, locked with shear screw, dia. 2 mm, made from material AMT.

21. Shoulder belt stop gear body bracket, locked with shear screw, 3.9 mm, made of material AMц.

22. Collapsible support spring dowel stop, locked with shear screw, dia. 2 mm, made of material AMT and installed on the right and left sides.

23. Emergency release arrest (duplicate control arrest), locked with wire KC-0.5, with seal affixed.

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24. Folded collapsible support locking shaft bell-crank clevis, locked with shear wire, dia. 2 mm, made of material АМЦ and secured above the cable shoe axle.

25. Seat size pan adjustment electric mechanism reducer plug, locked with wire KC-0.8, no seal.

Besides, check the safety wiring in all stationary joints of the seat and install new wire, if necessary.

After checking the seat charge-operated mechanisms for pricking of primers, clean mechanisms 215Э, 215P, 215П and TCM-2500-38 as prescribed by the Manufacturer's instructions. (In doing so, do not remove mechanism 215П from the seat).

Notes: 1. In order to prevent misadjustment of the seat systems, take care that after assembling mechanisms 215Э, their length is equal to the length measured prior to disassembling.
2. To prevent misadjustment of the harness system when demounting mechanism 215P, take measurements of the adjustable cable limit length so as to preserve the system adjustment when installing mechanism 215P back in place.
3. To assemble mechanism 215P, make use of arrangement No. 76-7000-1[illegible] supplied by the delivery agency and intended for cocking the 215P mechanism springs.

Charge mechanisms 215P and 215Э with firing cartridges and install the ground safety pins.

Check whether the charge-operated mechanisms are locked with wire and special screws in accordance with the Operating Instructions of the mechanisms.

After the above-mentioned operations have been completed, the seat is ready for installation into the aircraft.

10. SEAT MAINTENANCE OPERATIONS TO BE PERFORMED ON RECEPTION OF AIRCRAFT FROM MANUFACTURER

1. In case the aircraft has been delivered by transportation facilities, remove the seat from the aircraft and check it for presence of locking wire and seals.

Unslush the seat if it has been slushed.

Pay special attention to the condition of the calibrated ports of the 215P and TCM-2500-38 mechanism snouts which must be free from dirt or grease, since otherwise the seat mechanisms may fail during ejection and the pilot may experience inadmissible acceleration loads.

The snouts with calibrated ports are located in the lower part of the charge-operated mechanisms.

Note: Mechanism TCM-2500-38 adjusted for winter use is fitted with a dead plug instead of the calibrated port.

To check the calibrated ports for clogging with dirt or grease, screw out the TCM-2500-38 mechanism snout and the 215P mechanism nozzle, and wash them with pure gasoline, if they are fouled.

2. Load mechanisms 215P and 215Э with firing cartridges.

3. Install the drogue parachute with the container, if it has not been installed.

4. Install the seat into the aircraft and load mechanisms 215П and TCM-2500-38.

5. Perform the seat maintenance operations required for preliminary preparation.

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11. SEAT SLUSHING

If the aircraft is not to be used for a period of more than 3 months, the seat must be slushed.

Prior to slushing the seat, remove the drogue parachute and send it for storage to a parachute duty agency.

Before removing the parachute, tie up the metal gibs sewed into the container with locking wire, dia. 0.8 mm, and attach a seal.

Notes: 1. To tie the gibs together, insert the wire through the holes at the extreme ends of the gibs.
2. To slush the charge-operated mechanisms, proceed as prescribed in the instructions on cleaning, lubrication, care and storage of the ejection firing mechanisms.

Slushing Ejection Control System

1. Coat the cable linkage with graphite grease based on lubricant ЦИАТИМ-201.

2. Apply a thick layer of lubricant ЦИАТИМ-201 to the following elements:

(a) all control joints, and particularly to the shaft bearings, to prevent penetration of moisture inside the bearings;

(b) seat pan lifting mechanism screws and limit switch adjustment screws;

(c) seat pan guide rails;

(d) foot grip mechanisms;

(e) canopy front grip lock collapsible support mechanisms;

(f) upper beam trunnions for rear grip locks.

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Chapter XI
FIRE-FIGHTING EQUIPMENT

1. GENERAL

The aircraft fire-fighting equipment (Fig. 112) is designed for extinguishing the fire that may occur inside the engine compartment during flight or on the ground.

The aircraft fire-fighting equipment is comprised of the fire-detection and fire-extinguishing systems.

The fire-detection system, type HC-2MC, is intended to send the pilot a light signal to warn him of the beginning and end of fire inside the aircraft engine compartment. The system comprises the following main elements: fire detectors (i.e. pick-ups), electronic amplifier and fire warning light interconnected through an electric circuit.

The fire detector consists of two heat-proof metal tubes, arranged in a semicircle near frame No. 29, below, and fed with electric current.

The tubes are attached through ceramic insulators to frame No. 29 by means of brackets holding them at 15 to 30 mm away from the aircraft frame. The system employs a remote electric signal supply.

The operation of the ion-fire detector is based on the principle described below. Under normal conditions, the air gap between the tubes and the aircraft frame forms an electric insulator due to which the signal relays of the electronic amplifier are dead and light FIRE on panel T-10V does not glow. When flame gets into the gap between the tubes and the aircraft frame, the air is ionized and the gap is converted into an electric conductor. A potential difference is formed which is sufficient to actuate the relays installed in the electronic amplifier. The relays switch on warning light FIRE on panel T-10V.

After the flame disappears, light FIRE on panel T-10V comes off.

Detector HC-2MC being inertialess, its action is practically instantaneous.

Detector HC-2MC does not respond to an increase in temperature.

If fuel, oil or hydraulic fluid gets on the pick-ups of the detection system, no false glowing of the warning light will be caused.

If the pick-ups or wiring of the detection system are affected by moisture (on the ground), false glow of warning light FIRE may possibly occur. After the engine is started, the wet portions of the system will dry up and the system will restore its reliability (warning light FIRE will come off).

<u>CAUTION</u>. In case foreign objects get into the gap between the detector (i.e. pick-up) and the aircraft frame, the system is put out of operation due to short-circuiting.

The aircraft fire-extinguishing system consists of a fire extinguisher and steel discharge ring.

The fire extinguisher (Fig. 113) is a 2-litre spherical cylinder fitted with an electrical discharge bonnet. The fire extinguisher discharge bonnet is actuated by squib III-3.

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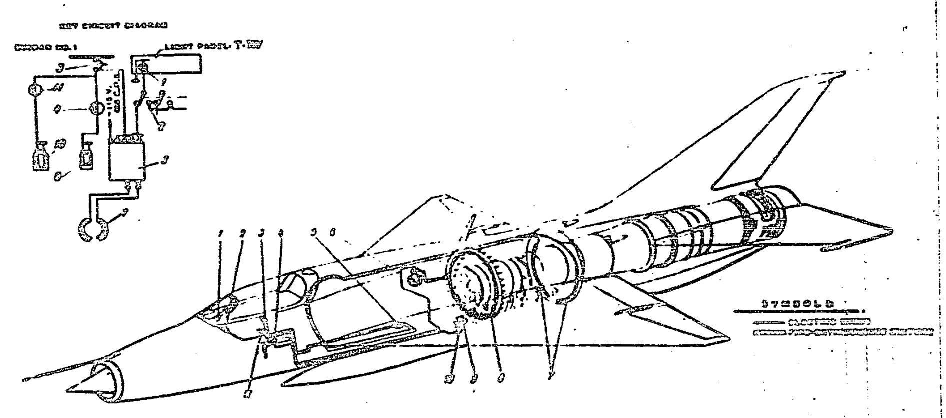

FIG. 112. FIRE-FIGHTING EQUIPMENT

1 – warning light FIRE; 2 – [illegible]; 3 – [illegible] (FIRE-FIGHTING EQUIPMENT, SHUT-OFF COCK); 4 – button FIRE [illegible]; 5 – [illegible] amplifier; 6 – fire-extinguisher bottle; 7 – fire detectors [illegible]; 8 – discharge ring; 9 – fuel system shut-off cock; 10 – fuel shut-off cock electropneumatic valve [illegible]; 11 – shut-off cock closing button.

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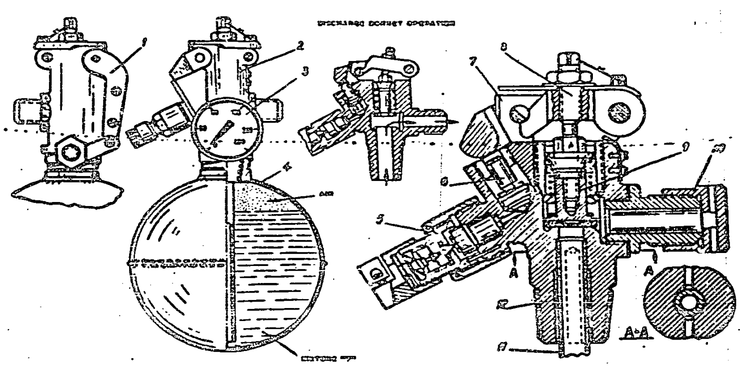

FIG. 113. FIRE-EXTINGUISHER BOTTLE AND DISCHARGE BONNET
1 – safety plate; 2 – discharge bonnet; 3 – pressure gauge; 4 – bottle; 5 – electro-operated device; 6 – piston; 7 – shut-off device; 8 – thrust screw; 9 – valve assembly; 10 – operating pipe connection union nut; 11 – pipe; 12 – discharge bonnet body.

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The fire extinguisher is installed in the upper part of the right-hand wheel cell, between frames Nos 19A and 20.

The discharge ring is installed on frame No. 19.

The system employs mixture "7" as a fire extinguishing agent.

The fire extinguisher is started by depressing button FIRE EXTINGUISHER mounted on the left-hand console inside the cockpit.

When the button is depressed, the squib circuit is closed, and the explosion thus produced causes the discharge bonnet to open. The fire extinguishing mixture compressed by carbon dioxide and air is delivered through the pipeline to the discharge ring and ultimately into the area of fire.

The system is to be engaged as soon as red warning light FIRE starts burning on light panel T-107.

The fire extinguishier bonnet serves as a shut-off valve used for charging, holding and discharging the mixture. The bonnet housing carries four pipe connections for coupling the pipeline, pressure gauge, igniter and safety device adjusted to operate at a pressure of 200 ±20 kg/cm^2.

2. MAINTENANCE OF FIRE-FIGHTING EQUIPMENT

General

In handling the fire-fighting equipment, mind the followings

1. In the course of use of the fire-fighting equipment, see to it that the insulators and pick-ups are always clean, since fouling may lead to false operation of the system.

When carrying out scheduled maintenance, wipe the pick-up insulators with a clean dry cloth. Washing with kerosene with subsequent drying up with a clean cloth is permissible.

IMPORTANT. Never use gasoline for washing the insulators since this may lead to washing off the hydrophobic coating.

2. While handling the fire extinguishers, take care:

(a) to keep off gasoline, oil or water from the discharge bonnet;

(b) to avoid hitting the bottle, discharge bonnet or pressure gauge;

(c) to avoid direct heating of the fire extinguisher from sources of heat.

3. After using the fire-extinguishing system, or in case the fire extinguisher has inadvertently discharged, take care to completely remove the remaining mixture "7" from the system. Care should be used to expell the mixture from the terminal points of the system. To do this, proceed as follows:

(a) demount the fire extinguisher from the aircraft;

(b) drain the remainder of fire extinguishing mixture from the system as completely as possible, and blow the system out with compressed air delivered at a pressure of 50 kg/cm^2 from a ground air bottle until the mixture is removed entirely.

To remove the fire extinguisher, do the following:

(a) disconnect the pipeline from the operating pipe connection, and screw a plug (with holes) on the connection;

(b) disconnect the igniter charge from the discharge bonnet and take the squib out. Screw a plug on the squib pipe connection;

(c) remove the fire extinguisher from the bracket and send it for recharging.

The traces of mixture "7" are removed from the aircraft compartments by intensive airing and blowing off with air through the hatches. Absence of smell in a compartment is an indication of complete vaporization of the mixture.

[redacted]

IMPORTANT. In order to prevent formation of poisonous compounds, never wash the aircraft compartments or the fire-extinguishing system for removing the remaining mixture "7".

4. During pre-flight inspection of the aircraft, check up the pressure by the pressure gauge installed on the fire extinguisher discharge bonnet. Mind that the pressure of the compound contained in the cylinder varies with temperature, i.e. an increase in temperature causes the pressure to rise, and a decrease in temperature causes it to diminish as is shown in Table 16.

Table 16

Pressure in Cylinder Versus Ambient Temperature

Ambient temperature, °C	-55	-45	-35	-25	-15	-5	0	+5	+15	+25	+35	+45
Pressure in fire extinguisher, kg/cm²	30	35	40	45	50	55	60	65	70	80	90	100

5. In case the plug connectors are to be disconnected from the amplifier unit, take care to keep off moisture from the connector terminals; for this, protect the terminals by special plugs.

6. When performing work at the place where the pick-ups are installed, do not fail to check the fire warning circuit after the work is over.

7. Check the condition of the pick-ups each time when installing or dismounting the engine, disjointing the aircraft, or performing work in the region of the pick-ups. No damage, contamination or greasing of the pick-ups and insulators is permissible.

8. When recharging the squibs, make sure that the cone contact is securely pressed to the squib. For this purpose, check whether the circuit is de-energized, screw on the plug connector and insert the squib. After this, screw off the plug connector and check whether a depression had been formed on the squib case. If the depression is present, screw on the connector and lock it for use. In case no depression is formed, replace either the squib or the cone contact.

Checking Fire Warning Circuit

To check the fire warning circuit, proceed as follows:

1. Connect test panel ПП-1 to the system (i.e. to the pick-up and to the aircraft frame).

2. Turn on switch BATTERY, AIRCRAFT - GROUND, and switch on circuit breaker FIRE-FIGHTING EQUIPMENT, SHUT-OFF VALVE.

3. Insert a resistor of 5 to 6 megohms into the air gap between the pick-up and the aircraft frame by shifting the panel switch into either position "5" or "6". Let the amplifier warm up for 2 min., and see that warning light FIRE goes on at light panel T-107.

Note: If warning light FIRE fails to go on, check the pick-up circuits for contacting the aircraft frame or for discontinuities.

4. Insert a resistor of 8 megohms by setting the test panel switch in position "8" and make sure that warning light FIRE does not burn.

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3. Disconnect the test panel and restore the fire warning system.

Checking Circuit between Button and Discharge Bonnet

To check the circuit, proceed as follows:

1. Disconnect the discharge bonnet connector.

2. Turn on switch BATTERY, AIRCRAFT - GROUND and switch on circuit breaker FIRE-FIGHTING EQUIPMENT, SHUT-OFF VALVE.

3. Use tester TT-1 to check the value of voltage supplied to the cone contact when button FIRE EXTINGUISHER is depressed. To do this, connect one terminal of the tester probe to the discharge bonnet connector cone contact and couple the other to the discharge bonnet connector body. Make sure that the voltage is not less than 18 V.

In case the tester does not indicate the above voltage, the circuit is faulty.

Checking Insulation Resistance of Electric Circuit between Amplifier and Pick-Ups

To check the insulation resistance of the electric circuit between the amplifier and pick-ups, observe the following priority:

1. Disconnect the two-terminal connector from the ПС-2ЭС amplifier.

2. Measure the resistance between terminal КШ1 and the aircraft frame, and between terminal КШ2 and the frame.

While checking, make use of a megger rated for either 500 V or 1000 V. Make sure that the resistance is not less than 20 megohms.

3. Connect the connector to the amplifier.

Discharging Fire Extinguishers

In the course of use of the fire extinguishers, a necessity may arise to discharge them either completely or partly.

The cases requiring discharging of the fire extinguishers are listed below:

(a) if the tightness of the cylinder has been disturbed and part of the mixture has been exhausted as a result; in this case the remaining charge should be removed to repair the trouble;

(b) after the guaranteed term of service of the cylinder has expired; in this case the fire extinguisher must be discharged and sent for recertification;

(c) when the fire extinguisher requires repair, as well as in some other cases not specified herein.

When discharging the fire extinguisher, meet the following requirements:

1. Fix the fire extinguisher in a holding arrangement which in its turn must be reliably secured on a base, or must be heavy enough to resist the shock and not to fall down when the fire extinguisher is discharged.

2. Prior to discharging, fit the fire extinguisher operating pipe connection with a plug (having holes) delivered together with the fire extinguisher set.

It is strictly forbidden to discharge the fire extinguishing mixture (no matter how small amount of it there remains in the bottle) when there is no plug on the operating plug connection or by means of the discharge lever, unless a reliable holding arrangement is employed.

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3. To discharge the fire extinguisher, slowly turn off the thrust screw with the help of hand wheel 218. The mixture will be exhausted through the plug holes at a slow rate and no danger will be caused in the case of incidental opening of the discharge bonnet.

4. Discharge the fire extinguisher into the atmosphere. Never discharge the fire extinguisher inside a room.

5. Prior to discharging, make sure that nobody gets in the way of the released jet within a range of 10 metres.

6. To discharge the fire extinguisher, do not fail to put on a gas-mask.

7. After discharging the fire extinguisher, spread a layer of sand all over the place where the mixture has been spilled.

To charge the fire extinguishers with mixture "7", follow the instructions on charging the fire extinguishers at a charging station.

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Chapter XII
DEMOUNTING AND INSTALLATION

After jointing or installation of a new unit or engine, perform a complete inspection of all systems and units engaged during jointing or replacement.

1. DISJOINTING AND JOINTING OF FUSELAGE

In order to disjoint the fuselage tail portion, proceed as follows:

1. Set the aircraft on a level ground to prevent breakage of the units and pipelines of the engine or aircraft when the tail portion is removed.
2. Jack up the aircraft till the wheels are clear off the ground.
3. Place the cart under the aircraft to attach the tail portion of the fuselage.
4. Open the access hatches to get reach to the joints and connectors.
5. Deflect the stabiliser nose completely down.

CAUTION. To prevent damage of pick-up ЕСУ-2, never deflect the stabiliser through angles exceeding 13° upward and 28° downward.

6. Demount the tail fairing by driving out the attachment screws from the anchor nuts and disconnecting the drain pipe.
7. Disconnect the НОС plug connector and six rods used to attach the cylinders to the afterburner flap suspension flange, disconnect two hydraulic pipes, remove the upper cylinder blow-off branches and remove the ring with the nozzle flap control hydraulic cylinders.
8. Disconnect the afterburner telescopic stirrup sump drain pipeline.
9. Take out the container with the drag chute, and remove the jacket screen and screen fairing.
10. Remove the МРП-56П frame to make an access to the thermocouples.
11. Disconnect four thermocouple pick-ups and remove them from the pipe connections.
12. Disconnect the conductor from the engine afterburner igniter plug.
13. Disconnect the pressurization pipeline of the main fuel tanks, reading 40 from the left.
14. Disconnect four joints of the hydraulic pipeline coupled to detachable valves, and disjoint two air pipes after releasing the pressure from the hydraulic and air systems.
15. Disconnect the stabilizer and rudder control rods housed inside the superstructure.
16. Disconnect the electric and radio plug connectors. Disjoint the connectors carefully, the connector bodies being not secured to the aircraft structural members.
17. Unlock the engine afterburner attachment joints near frame No. 33 (Fig. 118) by removing the roller access doors.

[redacted]

Note: To prevent fouling of the disjointed connectors and pipelines, wrap them with a clean cloth or cellophane.

18. Remove the intake and the generator blow-off pipe.

19. To disjoint the fuselage tail portion, proceed as follows:

(a) screw 18 nuts off the joining studs on frame No. 28;

(b) insert the drifts into the hatch holes along the aircraft centre line both on the starboard and port sides, and using the drift as a lever, move the tail portion carefully off.

CAUTION. 1. When splitting off the fuselage tail portion, take care to prevent contact between the parts of the fuselage and the engine, since this may cause damage.

2. When the fuselage tail portion is moved off to about 200 mm and the afterburner attachment rollers get out of the afterburner rails, screw the rollers off to allow the tail portion to move through the nozzle flaps. To do this, screw off bolts 3 and remove them together with the locking devices (Fig. 113).

To joint the fuselage, follow the reverse priority. To fix the anchor nuts installed on frame No. 28, tighten them evenly by driving home the opposite nuts in a crosswise succession.

When the fuselage tail portion is still 80 to 100 mm away, screw in the afterburner attachment rollers so as to fit them into the rails without jamming while the tail portion is moved further forward.

Before the actuating ring carrying the nozzle flap control hydraulic cylinders is mounted on the afterburner, and prior to installing the tail fairing on the fuselage, fasten the afterburner attachment rollers and check whether the afterburner has been attached properly to the telescopic joint. To do this, proceed as follows:

1. Set the roller at the length B specified by the inscription on the fuselage port side near the roller access door. The length B, used to screw the roller into the sleeve on fuselage joint, is measured between the sleeve butt end and the roller butt end (Fig. 114, Section A - A).

2. Install the right-hand roller. Use a special feeler 76-7004-1495, 9.5 ±0.5 mm thick, to check that the roller is installed so that it just touches the feeler but does not jam it.

3. In case no special feeler is available, or after the fuselage has been already jointed, the right-hand roller can be checked for proper installation by measuring the length A (Fig. 115). To do this, proceed as follows:

(a) install the locking plug into the roller body without screwing in bolt 3;

(b) use sliding calipers to measure the length K between the outside surface of the locking plug and the vertical side of the roller guide;

(c) measure the length N between the outside surface of the locking plug and the roller body butt end (to see that the length N is equal to B plus the thickness of the plug cover):

$$A = K - N = 101 \pm 2 \text{ mm}$$

In case the estimated length A is not equal to that indicated above, screw the roller in or out to change the length N so as to make the length A equal to 101 ±2 mm.

If the sliding calipers leg gets into the Manufacturer's access hole of the afterburner guide, measure the length limited by the afterburner wall. Then, subtract the value N from the length estimated by this method and check that the result is 112 ±2 mm.

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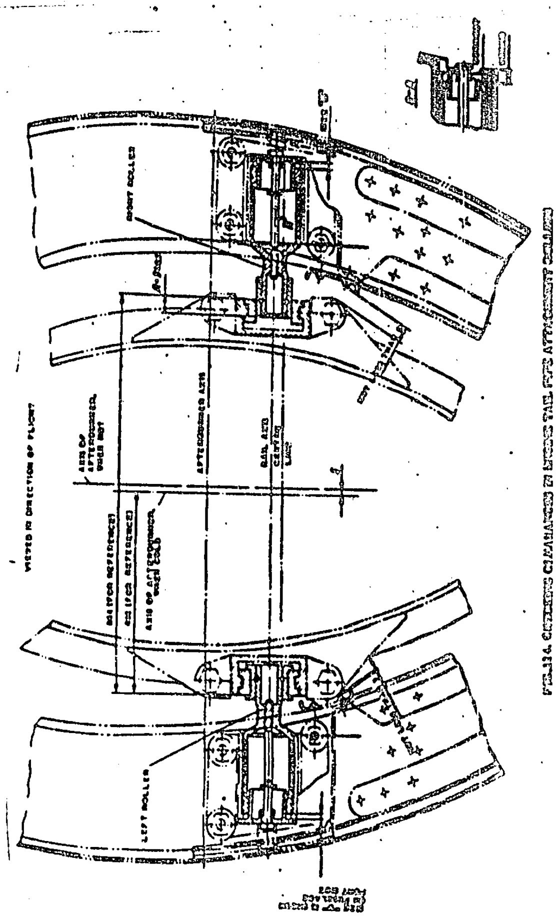

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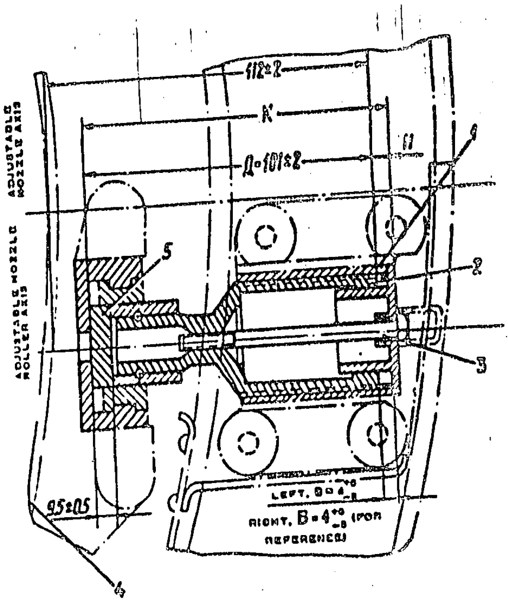

FIG.115. CHECKING ROLLER SETTING WITH FEELER GAUGE
1 – bushing; 2 – roller body; 3 – bolt and locking plug; 6 – fuselage joint.

Should the result be different, screw the roller in or out changing the length H so as to obtain the required value of 118 ± 2 mm.

After installation of the afterburner, check the length Г (Fig. 115) which is actually the value of the telescopic joint cocking. The value Г should be measured in four opposite points (on the top, bottom and on the sides). The difference in values measured in two opposite points should not exceed 4 mm, while the value Г measured on the left side should be 1.5 to 4 mm less than the value Г measured on the right side.

Check the travel of the afterburner by acting upon it with a force of about 100 kg. Determine the value Г by taking measurements inside the tail pipe.

Notes: 1. After tightening the rollers, lubricate the thread with grease УСИА (State Standard ГОСТ 3333-55).

2. In case the lengths Б and В have been adjusted properly, all lengths specified in Fig. 114 are set to correspond to the required values so that the hot afterburner keeps clear off the fuselage structural members and the right-hand roller neither disengages the rail nor gets jammed.

Mind that departure from the lengths and clearances specified in Fig. 114 may lead to deformation of the afterburner, to disengagement of the right-hand roller from the rail and to aircraft jittering (caused due to joggling of the afterburner against the fuselage parts).

3. After the first check of the engine operation as well as after the first flight (made after disjointing the fuselage or after replacing the engine), measure the engagement of the right-hand roller with the guide (length Д), and readjust it, if necessary.

4. After adjustment and fastening of the afterburner rollers, close the roller access doors so that the hexagonal head of bolt 3 sinks in the cover bracket to a depth not less than 3 mm.

When jointing the fuselage, assemble the electric connectors inside the superstructure near frames Nos 25 to 28 in compliance with the inscriptions on the jacket.

When packing the electric connectors, take care not to twist the cord wires in the jacket, not to pack the free portion of the cord wire into the jacket or to overlap the cord wires inside the jacket. Arrange the free portion of the cord wire in the form of a loop outside the place where the connectors have been packed.

While closing the cover of the superstructure, take care to avoid deformation of the superstructure sheave arranged above the control rods.

The jointing of the fuselage over, check operation of the fuel system, aircraft control system and units installed in the tail portion of the fuselage.

2. DISJOINTING AND JOINTING OF WING

The wing is attached to the fuselage by means of five joints arranged along frames Nos 13, 16, 22, 25 and 28 (Fig. 117).

To disjoint the wing, proceed as follows:

1. Extend the wing flap (to make access to the joint arranged on frame No. 28).
2. Operate the control stick to reduce the hydraulic pressure to zero.
3. Reduce the pilot and engine oxygen supply system pressure to zero.
4. Reduce the air pressure to zero (both in the main and emergency air systems).
5. Remove the fairings and fillets from the nose and middle sections of the wing.
6. Open the hatches at the wing nose near the fuselage.
7. Jack up the aircraft till the wheels are clear off the ground and roll a cart under the wing to be disjointed.

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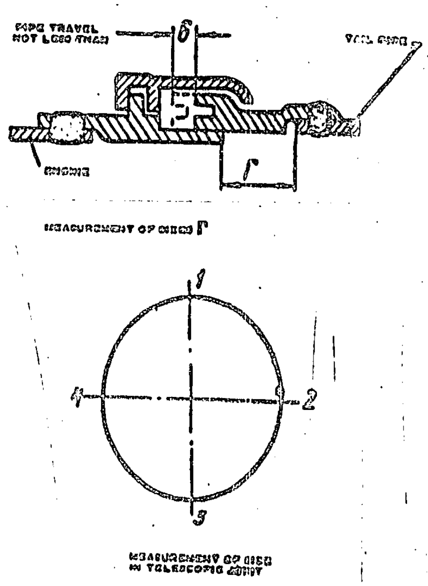

FIG.116. CHECKING CLEARANCES IN EXTENDED TUBE TELESCOPIC JOINT

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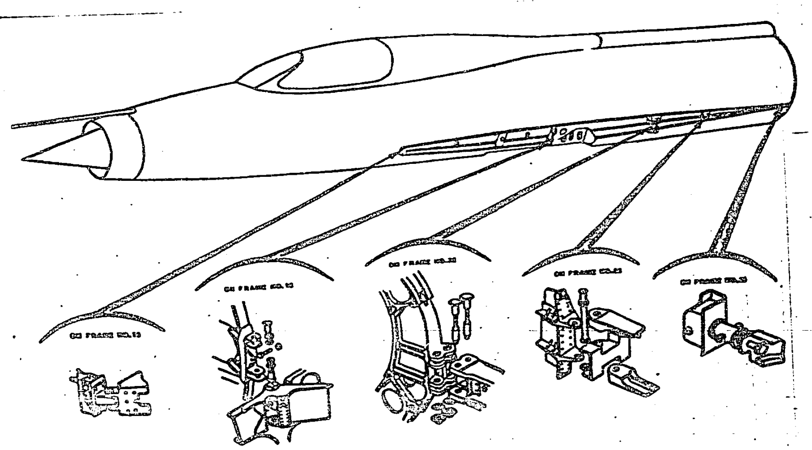

FIG.237. WING-TO-FUSELAGE ATTACHMENT JOINTS

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8. Disconnect the aileron rod from the bell-crank near the wing joint.

9. Disconnect the wing axle to disjoint the L.G. main strut up-lock emergency release cable.

10. Disjoint the hydraulic and air system pipelines and stop them with plugs.

11. Disjoint the fuel system pipelines from the wing fuel compartment (after the fuel has been drained down from the compartment). Stop the pipelines with plugs.

12. Disjoint the oxygen system pipelines.

13. Disjoint the electric and radio connectors.

Note: Wrap the electric and radio connectors with clean cloths or cellophane.

14. Unlock and screw off the nuts of the wing attachment bolts.

15. Drive out the wing-to-fuselage attachment bolts by means of pullers.

CAUTION. When disassembling the joint near frame No. 16, first drive out the lower vertical bolt, and then remove the one installed horizontally. After the above bolts have been removed, use a special wrench to screw off the upper vertical bolt. The last joint to be disassembled is the one situated near frame No. 13.

16. Roll the cart from under the aircraft by carefully pulling the wing end.

The procedure of jointing the wing is the reverse of disjointing. Mind that only special tools should be employed.

After jointing the wing, check the operation of the control elements, landing gear and all systems and units installed in the wing.

3. DEMOUNTING AND INSTALLATION OF ENGINE

To demount the engine from the aircraft (Fig. 116), first perform interior slushing of the engine as is prescribed by the Engine Operating Instructions, and then proceed as follows:

1. Close the fuel shut-off valve.

2. Disjoint the fuselage tail portion as described above.

3. Demount the afterburner from the engine as is prescribed by the Engine Operating Instructions.

Note: When demounting the engine afterburner, mind that the carrier installed on the afterburner tube hydraulic drive shroud and used to displace the plate carrying the hydraulic pipe connections should be removed before disjointing the fuselage and installed after jointing.

4. Listed below are the elements to be disconnected from the engine:

(a) electric connector of the cord running to the engine;

(b) engine oxygen supply pipeline;

(c) aircraft engine control rod to be disconnected from the lever installed on the engine.

5. Remove the fairing, the fairing pressure balance chamber air bleed right-hand pipe and rear bearing chamber air bleed pipe.

6. Listed below are the elements to be disconnected from the engine:

(a) drain pipes to be disjointed from two spiders installed below on the heavy beam;

(b) hose and two pipes to be disjointed from the right-hand pump [illegible];

(c) power wires to be disconnected from the starter generator block and from the A.C. generator, type CTO-8;

(d) remove the blow-off pipe of the starter generator and generator CTO-8.

7. Disconnect the following elements installed on the left-hand side of the engine:

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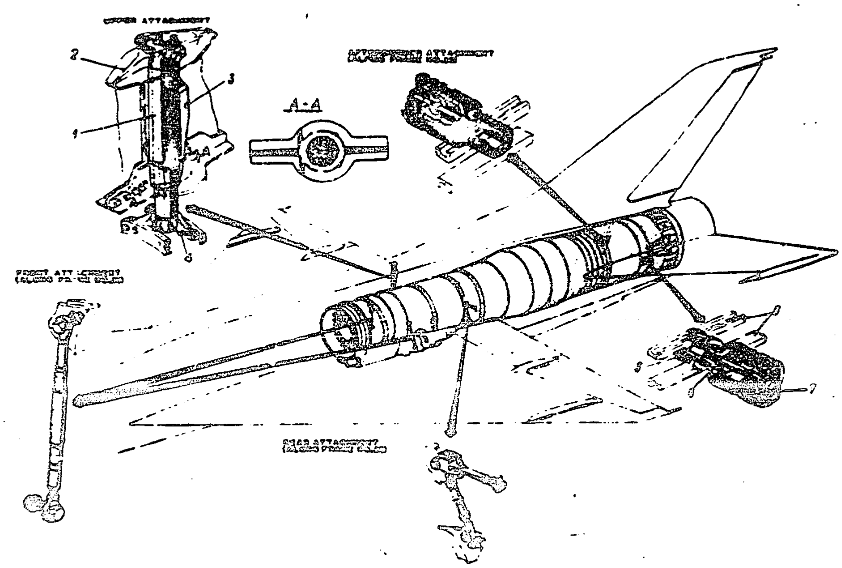

FIG.113. ENGINE ATTACHMENT

1 – [illegible]; 2 – [illegible] attachment joint; 3 – wedge; 4 – engine attachment joint; 5 – [illegible]; 6 – [illegible]; 7 – [illegible]; 8 – [illegible].

(c) hose and two pipes to be disconnected from the left-hand pump НШ-34-1Т;

(b) fuel system pressurization pipes to be disconnected at frame No. 27 where the check valve is installed.

8. Remove the fairing and fairing pressure balance chamber air bleed left-hand pipe.

9. Disconnect the engine fuel supply pipeline from the engine pump after unlocking and screwing off four nuts.

10. Disconnect the cabin supply pipe from the pipe branch installed on the engine and disjoint the НВО system pipe.

11. Bring a special cart to the engine, and fasten the engine to the cart.

12. Remove the cover from top of the superstructure near frame No. 25, move the cord wires aside, remove the cover from the hatch in the chassis, disconnect the control rods, drive out the bolt used to fix the engine upper attachment spindle to the fuselage joint, unlock the spindle and drive it out.

13. Unlock two rods of the engine front attachment and disconnect them from the fuselage joints near frame No. 25.

14. Unlock two rods on the left side and one rod on the right side of the engine additional attachment (near frame No. 28) and disconnect them from the fuselage joints.

15. Roll the cart backwards and move the engine out of the fuselage nose portion.

CAUTION. 1. As the fuel-oil radiator is being moved through frame No. 29, take care to maintain clearance between the airframe parts and the engine top and bottom.

Move the engine carefully out; in doing so, see to it that the engine units do not touch the airframe parts or fittings. For this, move the engine up or down on the cart, whenever necessary. After demounting the engine, examine the compartment.

2. To avoid levelling after installation of the engine, do not change the length of the side attachment rods.

3. While removing the engine, immediately stop all pipelines with special plugs and close the compressor inlet and air intake holes. Wrap the electric connectors with clean cloth or cellophane.

4. To protect the fuel system parts against corrosion, perform the exterior slushing of the engine units not later than 3 hours after draining down the fuel.

When mounting a new engine on the aircraft, observe the following sequence:

1. Unpack the new engine and perform its exterior unslushing as prescribed by the Engine Operating Instructions.

2. Install the engine on the cart.

CAUTION. When hoisting and installing the engine, take care to prevent damage of the pipelines and to keep the hoist ropes off the units and assemblies of the engine.

3. Fit the new engine with the following parts either removed from the demounted engine (provided their service life term allows it), or delivered from the group set:

(a) two hydraulic pumps НШ-34-1Т;

(b) generator СТО-3;

(c) engine attachment rods;

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(d) two tachometer generators ДТЭ-1 (the high-pressure rotor generator being installed on the engine already mounted on the aircraft);

(e) oil pressure pick-up ЭД-8Т;

(f) two pipe branches supplied with the pressure balance chamber air bleed gauge;

(g) oil system centrifuge pipe branch (to be installed on the engine already mounted on the aircraft);

(h) cabin supply air inlet pipe branch and ИКО transducer air inlet pipe;

(i) fuel system pressurization pipe;

(j) pipe branch carrying the boost pump fuel supply drain valve;

(k) fuel system drain pipes;

(l) engine boost oxygen supply pipe;

(m) carrier of movable plate attachment to hydraulic pipe connections (the carrier should fix the movable plate so as to make a clearance of 8^{+1} mm between the front pipe connection edge and the front edge of the guide shape cut-out).

4. Before mounting the engine, check whether the engine oxygen supply system pipelines are clean.

5. The procedure of mounting the engine is the reverse of demounting. When installing the engine, take care to maintain clearances between the engine and fuselage inside skin, pipelines and units installed in the engine compartment.

Take care that the pressure balance chamber pipes are reliably attached and their shape is intact, that the pipeline joints are pressure-tight, etc. Check the attachment of the engine pressure balance chamber air bleed pipes to the aircraft pipes.

While mounting the engine, make sure whether the nose sealing rubber shape has been installed into the desired position and has not bee nipped up (Fig. 119).

6. In order to install the shape and the engine nose sealing rubber ring correctly, proceed as follows:

(a) check whether the shape and the rubber ring have been properly arranged in the air-cooler trough. In case the ring protrudes from the trough, fit it into its place;

(b) after the engine has been finally installed, check that the clearance between the engine snout and air-cooler edge is 6 ± 2 mm.

Adjust the clearance between the fuel filter and frame No. 22 to obtain a length of not less than 6 mm.

The engine installed, perform the interior unslushing and flushing of the connection lines as prescribed by the Engine Operating Instructions.

Prior to connecting the engine oxygen boost supply pipeline to the check valve installed on the engine, make sure whether the check valve and pipe have not been clogged with grease or oil. After this, connect the pipelines to the check valve.

Set a fuel and nozzle flap time delay of afterburner control box КАБ-1ВА as specified by the record made in the Engine Log.

After the engine has finally been installed and attached, examine its sealing. No nipping by the air-cooler edge or protrusion of the sealing rubber shape sealing rubber shape is permissible.

While assembling the connecting lines, check whether the centrifuge breather line has been installed properly, i.e.:

(a) the oil breather line must be attached reliably and there should be no rolling of the line;

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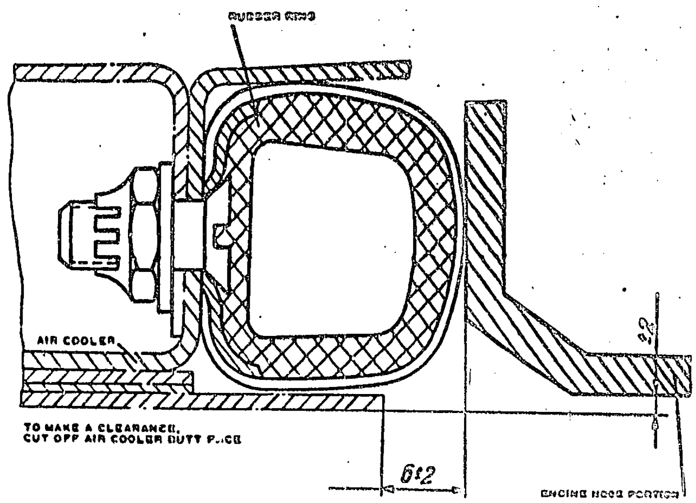

FIG.119. ENGINE COMPARTMENT SEALING SHAPE ATTACHMENT

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(b) the packing at the end of the line must necessarily fit the cylindrical portion of the pipe branch installed in the rear left-hand hatch of the engine compartment with minimum possible cocking.

Adjust a clearance of not less than 2 mm between the fuel filter clamp and the air-cooler edge.

After the afterburner has been secured, check whether it travels freely by displacing it in the vertical and horizontal planes.

Take care to achieve airtight attachment of the drain system pipelines and outlet drain pipes passed through the fuselage skin. In order to prevent leakage of fuel from the telescopic joint into the fuselage, replace the sealing gasket inserted under the telescopic joint fuel pan pipe connection whenever the engine is replaced.

4. DEMOUNTING AND INSTALLATION OF FUEL TANKS

Demounting and installation of the fuel tanks must not be performed if the ambient temperature is below -10°C. In case the temperature is less than that specified above, heat up the fuel tanks being demounted or installed with hot air delivered by an airfield heater at a temperature of up to +60°C. Prior to feeding the hot air, disconnect a given tank from all pipelines and remove all units installed on the tank (such as the fuel meter pick-up, float valves, pumps, etc.). Before demounting the tank, drain the fuel down.

After demounting, unfold the fuel bags neatly and hang them up inside the respective packing containers.

<u>Note</u>: Demount the fuel bags only when it is indispensable or if the bags are leaky.

Before installation of each bag-type tank into the aircraft, treat the outside surface of the tank and inside surface of the container with talc powder, having checked up the condition of fabric glued over the container rivet seams. Seat the open rivet seams with calico fabric glued in with glue AK-20, and cover them with aluminium paint A-11.

Stop the open ends of tank and aircraft system pipelines and connections with plugs and wrap them with cellophane.

Stop the holes and pipe connections of the demounted tank with plugs removed from the new tank installed.

To achieve convenience in installation of the tanks, secure a piece of wire KC-1.2, 0.4 to 0.5 m. long, to each dowel eye and remove the wire after the installation is over.

Smear all union nuts and threaded parts with paste ГУ and lock them.

To replace tank No. 1, proceed as follows:

1. Remove the front portion of the superstructure arranged immediately after the canopy.
2. Remove tank No. 7.
3. Disjoint the pipelines, remove the tank attachment dowels and take the tank out of the fuselage container.
4. Install a new tank into the fuselage container, pull the supporting wire to fit the tank inside the container and fasten all dowels. Remove the supporting wire from the dowels.
5. Joint the pipelines.
6. Install tank No. 7.

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7. Install the front portion of the superstructure.

To replace tank No. 2, proceed as follows:

1. Remove the front portion of the superstructure.

2. Remove tank No. 7.

3. Remove the rear portion of the superstructure situated between frames Nos 13 to 16.

4. Disconnect the pipelines from the tank, and remove the special valve, float valve and pump 495A-2.

5. Disengage the tank attachment dowels.

6. Take the tank out of the fuselage container.

7. Install a new tank into the fuselage container, drive it inside the container by means of supporting wire and fasten the dowels. Remove the supporting wire from the dowels.

8. Joint all pipelines and install the units previously removed.

9. Install tank No. 7.

10. Install the rear portion of the superstructure situated between frames Nos 13 to 16.

11. Install the front portion of the superstructure.

To replace tank No. 3 (which consists of two compartments - upper and lower), proceed as follows:

1. Remove tank No. 7.

2. Remove the rear portion of the superstructure located between frames Nos 16 to 20.

3. Disconnect the pipelines from the tank.

4. Remove the pipes used to connect the tank upper compartment to the lower one. Disconnect the special valve.

5. Remove the negative-g valve. Remove pump 495-A2 and pressure warning unit CA-3. Disengage the tank attachment dowels.

6. Take both compartments of tank No. 3 out of the fuselage container.

7. Install a new tank into the fuselage container, pull it inside the container by means of supporting wire and fasten all dowels. Remove the supporting wire.

8. Charge the tank with air delivered at a pressure of 0.1 kg/cm^2, examine the tank through the transparent plugs installed in the tank units and make sure that the tank fits the container sides. Bleed the air.

9. Install the negative-g valve on the tank, mount all units previously removed and joint the pipelines. Install pump 495-A2 and pressure warning unit CA-3.

10. Install tank No. 7.

11. Install the rear portion of the superstructure situated between frames Nos 16 to 20.

Note: Prior to installing the negative-g valve into the tank, make sure that the tank has no folds; mind that folds in places where the weight is shifted are impermissible.

In order to replace tank No. 4, proceed as follows:

1. Remove the rear portion of the superstructure located between frames Nos 20 to 23.

2. Screw off the filler neck attachment bolts.

3. To facilitate demounting of tank No. 4, disengage the dowels used to attach tanks Nos 5 and 6 and arranged on the left- and right-hand sides of the hatch covers.

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4. Remove the attachment dowels of tank No. 4.

5. Disjoint the pipelines from the tank and remove the drain manifold.

6. Demount pump 495-A2.

7. Take the tank out of the fuselage container.

8. Install a new tank into the fuselage container, pull it inside by means of supporting wire and secure all dowels.

9. Connect all pipelines previously disjointed.

10. Install pump 495-A2 and the drain manifold.

11. Fasten the dowels used to attach tanks Nos 5 and 6 and arranged on the right- and left-hand hatch covers.

12. Secure the filler neck by means of bolts.

13. Install the rear portion of the superstructure located between frames Nos 20 to 28.

Note: While mounting new pump 495-A2, remove the gasket from the electrical connector and install washers between the cover and body as specified by the pump technical description.

In order to replace tank No. 5, proceed as follows:

1. Remove the locking wire from the dowels and screw off the nuts of the upper hatch cover situated between frames Nos 20 to 28.

2. Remove the rear portion of the superstructure situated between frames Nos 20 to 24.

3. Disengage the attachment dowels of tank No. 5.

4. Disjoint the pipelines from the tank. Remove emergency fuel remainder warning unit C3-1637H.

5. Take tank No. 5 out of the fuselage container.

6. Install tank No. 5 into the fuselage container, pull it inside by means of supporting wire and fasten all dowels.

7. Joint the pipelines initially disconnected. Install warning unit C3-1637H.

8. Close the upper hatch cover situated between frames Nos 20 to 28 and fasten the tank attachment dowels arranged on the cover.

9. Install the rear portion of the superstructure situated between frames Nos 20 to 24.

In order to replace tank No. 6, proceed as follows:

1. Remove the locking wire from the dowels and screw off the nuts arranged on the hatch cover of tank No. 6.

2. Remove the rear portion of the superstructure situated between frames Nos 24 to 28.

3. Disengage the attachment dowels of tank No. 6.

4. Disjoint the pipelines from the tank.

5. Remove tank No. 6 out of the fuselage container.

6. Install tank No. 6 into the fuselage container, pull it inside by means of supporting wire and fasten all dowels.

7. Joint the pipelines initially disconnected. Install warning unit C3-1637H.

8. Close the upper hatch cover situated between frames Nos 20 to 28 and fasten the tank attachment dowels arranged on the cover.

9. Install the rear portion of the superstructure situated between frames Nos 24 to 28.

To remove tank No. 7, proceed as follows:

1. Remove the superstructure in front of and behind tank No. 7.

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2. Disjoint the pipelines of the fuel, drain and control pressure system from the front portion of the tank.

3. Remove the float and drain valves from the tank, if necessary.

4. Disconnect the tank pipe installed in the middle of the tank bottom and used to couple tanks Nos 7 and 2.

5. Disconnect the pipeline arranged in the rear part of the tank.

6. Remove the tank by screwing off four nuts used to attach the tank to the fuselage.

Note: To prevent stress upon the tank caused due to fuselage sagging, the rear joints of the tank are provided with holes of oblong shape.

After mounting tank No. 7, check that there is a clearance of 2 to 3 mm between the attachment bolt and the hole in the tank joint behind the tank.

Tighten the nut at the rear joint until the clearances between the fuselage and washer with rubber gasket are zero, and turn in the nut through 0.5 to 1 turn.

All tanks should be removed through the respective hatches after all fittings have been demounted.

The tanks installed, check the containers and tanks for absence of foreign objects in them, and the detachable joints and attachment units for safe locking; also, make sure that there is no fuel leakage.

5. DEMOUNTING AND INSTALLATION OF CONTROL ELEMENTS AND TAKE-OFF AND LANDING EQUIPMENT

Demounting and Installation of Stabilizer

In order to remove the stabilizer (left- and right-hand halves), proceed as follows:

1. Open the hatch between stabilizer ribs Nos 2 and 2A.
2. Remove the upper and lower fairings from the stabilizer.
3. Deflect the stabilizer nose downwards as far as it will go and open the hatch on the stabilizer butt end.

CAUTION. To prevent damage of pick-up ДСУ-2, never deflect the stabilizer through angles exceeding 13° upward and 20° downward.

4. Knock out the stabilizer-to-beam attachment horizontal bolt.
5. Remove the safety locking brackets (8 pieces) arranged on the dorsal and ventral skins, drive out the vertical bolts (4 pieces) and knock out the internal-thread bolts (4 pieces).

Note: The bolts carry the notches punched so that bolt 1 is closest to the fuselage.

6. Demount the stabilizer from the beam by shaking the stabilizer slightly.

The procedure of mounting the stabilizer is the reverse of demounting.

Demounting and Installation of Wing Flaps

In order to demount either the left- or right-hand wing flap, proceed as follows:

1. Remove the wing fairing at the end of the rail.
2. Let the wing flap down.
3. Drive out the bolt used to secure the hydraulic cylinder with the wing flap joint.

4. Roll the wing flap back till the carriages move out of the rails.

The procedure of installing the wing flap is the reverse of demounting.

Demounting and Installation of Aileron

To remove either the left- or right-hand aileron, proceed as follows:

1. Remove the fairing installed on the wing in the rear part near rib No. 6.
2. Disengage the bolt used to connect the control rod to the aileron joint and disconnect the bonding link.
3. Open the hatches to make access to the aileron hinge joints securing the aileron to the wing edge.
4. Deflect the aileron and remove two bolts installed on the central hinge joint to connect the aileron shackle to the wing bracket.
5. Deflect the aileron down until the central hinge joint shackle moves out of the wing bracket.
6. Pull the aileron toward the wing edge and disengage the root hinge attachment.
7. Remove the aileron.

The procedure of installing the aileron is the reverse of demounting.

Note: When the control rod is disconnected, the aileron lowers by gravity with its leading edge down. But when the rod is attached, the aileron must move in the horizontal position.

Demounting of Rudder

In order to demount the rudder, proceed as follows:

1. Remove the fillet installed on the left-hand side.
2. Open the hatch on the right-hand side of the fin.
3. Drive out four bolts installed in the lower hinge joint to attach the flange to the bell-crank.
4. Remove the bolt from the upper hinge joint and drive out the safety bolt.
5. Drive the rudder axle from the upper hinge joint.
6. Turn the disengaged rudder somewhat backward to disengage the middle hinge joint and remove the rudder.

The procedure of installing the rudder is the reverse of demounting.

Demounting and Installation of L.G. Struts

To demount the L.G. main strut, proceed as follows:

1. Jack up the aircraft until the wheels are clear off the ground.
2. Disconnect the hydraulic cylinder rod from the strut.
3. Disjoint the air hoses from the strut after releasing pressure from the air system.
4. Detach the electric connector.
5. Remove the fuel pipeline used to connect the two fuel compartments and make access to the strut attachment axle (before this, drain the fuel down, if need be).
6. Supporting the strut, drive the pivot out by means of a special remover.

To demount the L.G. nose strut, proceed as follows:

1. Jack up the aircraft until the wheels are clear off the ground.
2. Disconnect the hydraulic cylinder rod from the strut.
3. Disconnect the strut position indicator cable.

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4. Disjoint the air hose after the air system pressure has been released.

5. Detach the electric connector.

6. Drive out the strut hinge axle screw (accessible through the right-hand hatch).

7. Use a special remover and drive out the strut hinge axle (accessible through the left-hand hatch).

The procedure of mounting the struts is the reverse of demounting. Prior to installing the struts, grease all rubbing surfaces.

After the struts have been installed, check the axial clearances between the strut hinge joint bearings and measure the lateral and longitudinal play of the wheel axles. Adjust the length of the hydraulic cylinder rods.

Check the adjustment of the sequence valve and operation of the strut and doors up-locks. Check the clearances between the doors, between the wheel and the strut when the strut is in the extended and retracted positions, when it is compressed and also when it is being extended.

Check the operation of the electrical and mechanical nose strut position indicators.

After the mounting operations are over, make check retraction and extension of the landing gear by the ground pump, and check the emergency extension.

6 REPLACEMENT OF AIRCRAFT CONTROL SYSTEM UNITS

When replacing units, rods or bell-cranks of the stabiliser control system, provide the following:

(a) gaps between the control system units and aircraft structural members;

(b) easy rotation by gravity. The axial play of the hinge joint or attachment should not exceed 0.3 mm when lever arm R = 100 mm;

(c) gap between the control system units and aircraft structural members;

(d) sufficient tightening of the adjusting end-piece threads inside the rod sleeves (estimated by matching the reference holes in the sleeves);

(e) free travel of the rods at the sealed joints;

(f) unstrained attachment of the rods and units.

Demounting and Installation of Boosters

In order to remove the stabilizer booster, proceed as follows:

1. Reduce the hydraulic pressure to zero.
2. Open the booster access hatch covers situated in the fin.
3. Disconnect the control rod attached to the booster slide valve.
4. Disconnect the rods coupling the booster to the stabilizer.
5. Disjoint the hydraulic pipelines from the booster pipe connections.
6. Screw off the nuts of six bolts used to attach the booster to frame No. 30.
7. Drive out the bolts and remove the booster.

The procedure of installing the booster is the reverse of demounting.

While mounting a new booster, leave a gap of not less than 3 mm between the bell-crank and the edges of holes in the fin beam and frame No. 34.

<u>Note</u>: When a new booster БУ-51МС is installed, take care to set the axis of rod 5 (Fig. 32) normally to the booster axis (the allowable departure of one of the joints of rod 5 from the vertical plane is ±0.5 mm). To achieve coaxiality of rod 5 and booster, adjust the thickness of washers installed on the bolt connecting rod 5 to the bell-crank of frame No. 30.

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In order to remove the aileron booster (either the left or right one), proceed as follows:

1. Reduce the hydraulic pressure to zero.
2. Open the booster access hatches arranged on the wing.
3. Disconnect the booster rod from the aileron rod bell-crank.
4. Disconnect the rod attached to the booster slide valve.
5. Disjoint the pipelines connected to the booster.
6. Screw off the nuts of four cross-member attachment studs.
7. Remove the booster together with the cross-members.

The procedure of installing a new booster is the reverse of dismounting.

When installing a new booster and securing it to the bell-crank, mind that no strain leading to booster rod tension is permissible (take care to observe precise coaxiality of the booster and the bell-crank in the chordwise plane).

Replacement of Rods

When replacing rods, take care to adjust their initial length (corrected by means of the lugs). After the replacement is over, check the maximum stabiliser deflection angles at the АРУ controller longer arm.

Replacement of Electric Mechanism МП-100МА

When replacing electric mechanism МП-100МА, take care to adjust its initial length both in the neutral and extreme positions.

After the replacement of mechanism МП-100МА, check its operation and proper setting of the trimming effect mechanism in the neutral position indicated by the signal light.

Replacement of Spring Feel Mechanism

When replacing the spring feel mechanism, take care to adjust its initial length. For this purpose make use of the rod lug. To make fine adjustment, turn the feel mechanism flange (provided with flats) at the adjustment lug.

After installation, check the operation of the feel mechanism by shifting the control stick into the extreme positions and ascertain proper setting of the trimming effect mechanism in the neutral position by the signal light.

Replacement of АРУ Controller Units

The complete set of controller АРУ comprises the following units:

(a) actuating (servo) mechanism;
(b) control (computing) unit;
(c) indicator.

The actuating mechanism and the control unit are part and parcel of the controller assembly: in case any of them fails both units must be replaced, while the controller position indicator needs not be replaced.

In replacing the actuating mechanism, take care to avoid maladjustment of the stabiliser control system.

To remove the actuating mechanism, proceed as follows:

1. Lock the control stick in place by means of a special retainer and make sure that the stabiliser control system electric units is de-energised.
2. Disconnect the actuating mechanism rod from the rod attached to the booster.

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3. Disconnect the actuating mechanism rod attached to the bell-crank between frames Nos 27 and 28.

4. Disconnect the feel mechanism.

5. Screw off the nuts used to attach the side brackets fitted on the studs, and remove the brackets and the actuating mechanism from the studs.

6. Remove the control unit installed inside the cockpit.

The procedure of installing a new automatic unit is the reverse of demounting.

Note: To ensure the strength of attachment, see to it that the length of unscrewed threading of the APУ-3B controller stem at the place of attachment to the feel mechanism does not exceed 15 mm when the trimming effect mechanism neutral position is being adjusted.

After the actuating mechanism has been installed, check the stabilizer control system and adjust it, if necessary; check operation of the controller during speed and altitude adjustment as specified by the Levelling Diagram.

Demounting and Installation of Air Intake Cone

In order to remove the radio-wave transparent cone, proceed as follows:

1. Extend the cone.
2. Drive out six self-locking screws by means of a special screw-driver.
3. Remove the outside ring.
4. Drive out the cone attachment bolts by means of a special screw-driver and remove the cone.

Note: When mounting the cone, tighten the screws in a criss-cross manner.

Demounting and Installation of Air Brakes

To remove a front air brake (either the left or right one), proceed as follows:

1. Open the lower hatch cover.
2. Open the side hatch covers (one of these being situated between the air brake beams, the other being located above the upper beam).
3. Extend the air brake.
4. Drive out the air brake cylinder attachment bolt situated in place where the air brake cylinder is connected to the universal joint.
5. Drive out the air brake-to-fuselage attachment bolts (2 pieces).

The procedure of installing the air brake is the reverse of demounting.

To remove the third (lower) air brake, proceed as follows:

1. Let the air brake down.
2. Open the engine inspection hatches.
3. Release the bracket lock of the air brake to disconnect the hydraulic cylinder rod.
4. Drive out two air brake attachment bolts.
5. Remove the air brake.

The procedure of installing the air brake is the reverse of demounting.

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3. Disconnect the actuating mechanism rod attached to the bell-crank between frames Nos 27 and 28.

4. Disconnect the feel mechanism.

5. Screw off the nuts used to attach the side brackets fitted on the studs, and remove the brackets and the actuating mechanism from the studs.

6. Remove the control unit installed inside the cockpit.

The procedure of installing a new automatic unit is the reverse of demounting.

<u>Note</u>: To ensure the strength of attachment, see to it that the length of unscrewed threading of the APV-3B controller stem at the place of attachment to the feel mechanism does not exceed 15 mm when the trimming effect mechanism neutral position is being adjusted.

After the actuating mechanism has been installed, check the stabiliser control system and adjust it, if necessary; check operation of the controller during speed and altitude adjustment as specified by the Levelling Diagram.

<u>Demounting and Installation of Air Intake Cone</u>

In order to remove the radio-wave transparent cone, proceed as follows:

1. Extend the cone.
2. Drive out six self-locking screws by means of a special screw-driver.
3. Remove the outside ring.
4. Drive out the cone attachment bolts by means of a special screw-driver and remove the cone.

<u>Note</u>: When mounting the cone, tighten the screws in a criss-cross manner.

<u>Demounting and Installation of Air Brakes</u>

To remove a front air brake (either the left or right one), proceed as follows:

1. Open the lower hatch cover.
2. Open the side hatch covers (one of these being situated between the air brake beams, the other being located above the upper beam).
3. Extend the air brake.
4. Drive out the air brake cylinder attachment bolt situated in place where the air brake cylinder is connected to the universal joint.
5. Drive out the air brake-to-fuselage attachment bolts (2 pieces).

The procedure of installing the air brake is the reverse of demounting.

To remove the third (lower) air brake, proceed as follows:

1. Let the air brake down.
2. Open the engine inspection hatches.
3. Release the bracket lock of the air brake to disconnect the hydraulic cylinder rod.
4. Drive out two air brake attachment bolts.
5. Remove the air brake.

The procedure of installing the air brake is the reverse of demounting.

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Appendices

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APPENDIX 1

CORROSION-PREVENTIVE TREATMENT OF AIRCRAFT

In case the aircraft is put out of flights for a period exceeding 30 days, as well as when packing the aircraft for transportation, the aircraft must undergo corrosion-preventive treatment.

Prior to slushing the aircraft, clean dust, dirt, moisture and old grease from the surfaces of parts by wiping them with a cloth soaked with non-ethylated gasoline, and then drying the parts and assemblies with a clean cloth.

For corrosion-preventive treatment, use grease ЦИАТИМ-201 and petrolatum. The parts coated with varnish need not be slushed.

In slushing, observe the following requirements:

1. Apply slush to all aircraft mechanisms, ball bearings of the disconnected rods and bell-cranks, and cables.
2. For transporting the aircraft, coat all unpainted parts and assemblies with petrolatum heated up to 60° to 80°C.
3. Slush the L.G. wheel bearings with lubricant НК-50.
4. To slush the parts and assemblies, apply a thin uniform layer of grease spread over by means of a soft hair brush.
5. Wipe with talc such rubber parts as the sealing hose, hydraulic, fuel and air system hoses, rubber packings installed on the hatch edges, etc.
6. In case the painting of parts has been damaged during corrosion-preventive treatment of the aircraft, apply fresh paint to the affected places.
7. After slushing, wrap the ball bearings of the disconnected rods first with two layers of paraffine paper and then with fabric and bind the packs with twine (in case the aircraft is to be transported).
8. Stop all open ends of pipelines with rubber caps or plugs, and affix the seals.
9. After the units of the aircraft have been disjointed, close tightly all openings in the fuselage and wings with dense fabric or glue them (to prevent fouling of the interior parts).
10. While slushing, never grease the oxygen system fittings.
11. Charge the hydraulic and fuel systems completely (but do not charge for transportation).
12. Coat the canopy with a soft cover.
13. Stop the engine intake duct and jet nozzle with plugs, and affix the seals.
14. To treat the ready-made articles, proceed as prescribed by the instructions supplied with them by the Manufacturer.
15. After the slushing is over, put on protective canvas.

After unslushing, the aircraft should be subjected to scheduled maintenance depending upon the time of storage. While the aircraft is stored, do not perform any scheduled maintenance whatsoever. The time term of storage of the slushed aircraft is 3 months.

APPENDIX 2

CARE OF MAGNESIUM ALLOY PARTS

Some parts and units of the aircraft are produced from magnesium alloy. As far as corrosion is concerned, these parts are less resistant than other parts

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made of different materials, and therefore they demand thorough and regular maintenance.

Described below are the conditions that favour corrosion of magnesium alloy parts:

(a) damage of protective coating;

(b) condensation of moisture due to lack of airing or sharp variation of temperature at daytime and at night;

(c) getting of water on the parts;

(d) effects produced by salt water, salts, acids, alkalis or active gases.

Corrosion of the magnesium alloy parts is revealed by bulging of the varnish-paint coating and by formation of wet deposit of light-grey colour.

While inspecting the aircraft, check whether the corrosion has not affected the magnesium alloy parts, particularly under the bending links.

All magnesium alloy parts are identified by blue paint, except the L.G. wheel parts painted in green, control foot bar rests painted in black and instruments painted in grey.

In case salt water, salt solutions, acids, alkalis or fire extinguisher foam gets on the magnesium alloy parts, wash the affected places with warm water, let them dry up and wash with pure gasoline.

The corrosion of the magnesium alloy parts may be removed and clean places varnished either directly in the aircraft, or outside (depending upon accessibility or extent of corrosive effects).

Those parts where the varnish coating has bulged or where spots of light rust on the surface have been detected should be cleaned of corrosion as follows:

1. Clean the damaged place thoroughly with glass paper No. 180 or No. 230, and in the case of pits of rust use a scraper to remove the traces of corrosion completely.

2. Degrease the corroded place with non-ethylated gasoline.

3. Treat the clean place with 10 per cent solution of selenious acid and let the place dry up.

Note: In case ready solution of selenious acid is not available, it can be prepared by dissolving 20 gr of selenious acid and 10 gr of sodium dichromate in 1 litre of water.

4. Coat the clean place with primer AЛГ-1, let it dry up at a temperature of +25° to +35°C for a period not less than 24 hours, or for not less than 36 hours when the temperature is +12° to 17°C.

In case quick primer AЛГ-10 is used, the period required to dry the primer at 18° to 35°C is 3 to 4 hours.

5. Coat the given area with enamel A-9 or A-99 to be applied to the interior parts of the aircraft or with enamel A-24Г to be applied to the L.G. wheels, and let the enamel dry for 24 hours when the temperature is 18° to 35°C or for not less than 36 hours if the temperature is 12° to 16°C (the time of drying being increased with decrease of temperature).

In case the part gets dirty while drying up, wipe the area treated with enamel with a clean cloth soaked with non-ethylated gasoline prior to applying another coat of enamel.

Take care to prevent the effect of moisture on the part under treatment.

Replace those parts which have been badly attacked by corrosion so that there are plenty of deep pits spread over the entire surface, as well as the parts affected by single deep pits of rust.

The parts affected in places where the bearings are press-fitted, must also be replaced.

Never mate the magnesium alloy parts with chrome-plated, silvered or copper-coated parts. The parts manufactured from steel, bronze or brass which are mated with the magnesium alloy parts should be zinc- or cadmium-coated whereas the parts made of alluminium alloys should be anodized. It is allowed that ball bearings without coating the races with zinc may be used, but then they must be coated with grease ЦИАТИМ-201.

The cleaned places of magnesium alloy parts which are not closed by the bonding links should be coated with primer АЛГ-1.

CAUTION. Since selenious acid vapours affect the human organism, take care to prevent getting of solution on inprotected skin or clothes.

APPENDIX 9

CARE OF AIRCRAFT OUTER SURFACES

In order to protect the metal parts against corrosive effects and to improve the aerodynamic properties of the aircraft, varnish-paint coating is employed.

The protective properties of the varnish coating are impaired due to effects of fuels, oils, acids and alkalis or mechanical damage.

While servicing the aircraft, mind that breaking the rules listed below leads to premature deterioration of protective properties of varnish-paint coating and to decrease of its endurance.

Listed below are the aircraft parts most of all affected by corrosion:

(a) lower skin of the wing, fuselage and empennage;

(b) skin in the area of exhaust gases outlets;

(c) skin near the aircraft storage batteries.

Most often corrosion attacks the aircraft parked for long periods between flights.

In order to protect the outer surfaces against mechanical damage, sunrays and precipitation, observe the following measures:

1. While working, cover the skin with fabric or rubber mats which should be cleaned of dust and dirt prior to starting the work.

2. Do not place on the skin parts, tools or cloths soaked in kerosene, oil, etc.

3. Use only service ladders coated with rubber or fabric.

4. Never use heavy or dirty footwear to walk over the aircraft skin as this may cause damage to the varnish and oxidation-proof coating.

5. When the aircraft are parked in the open, they should be covered with canvas no matter what the season may be.

6. Never coat the aircraft with dirty or wet canvas covers.

7. Keep the covers clean and regularly check that they are intact since use of broken covers is impermissible.

8. In the case of moisture accumulated on the skin underneath the covers, take the covers off, dry the skin with cloths and coat the aircraft with the covers again.

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9. When installing or dismounting the aircraft storage batteries take every measure of precaution, spilling of alkalis or acids being impermissible. All operations required for maintenance of the storage battery must be performed outside the aircraft.

In case some alkali is spilled on the skin or other parts of the aircraft, measures should be immediately taken to wash the affected area with warm water thoroughly several times and to dry the area with a clean cloth. The places where the spilled alkali might be trapped, e.g. gaps in seams, should undergo intensive washing and be subsequently flushed with compressed air.

In the event of spilling the alkali, make a respective record in the Aircraft Log, and regularly check the condition of the affected surface during three months. If corrosion due to alkali has been detected, immediately report the case to the unit engineer.

10. If oil gets on the skin, immediately rub the oiled surface with a clean cloth soaked with non-ethylated gasoline.

11. On detecting corrosion-attacked areas on the skin, do as follows:

(a) rub the damaged area with a clean cloth soaked with non-ethylated gasoline;

(b) clean the place with hair or bristle brushes, and in case the products of rust still remain after flushing, clean the place with emery powder No. 200 applied to a cloth soaked in gasoline;

Note: While removing the products of rust, do not seek to eliminate pits of corrosion completely since it is quite sufficient to remove the products of rust.

(c) clean the damaged place again with a cloth soaked in gasoline and let it dry;

(d) use a spray gun or a brush to coat the place with primer АЛГ-1 with 9 per cent of aluminium powder;

(e) let the priming coating dry for 24 hours at a temperature of 12° to 17°C;

(f) coat the dry primed surface by spraying or brushing varnish 170A containing 10 per cent of aluminium powder when applied to the outer airframe surfaces (colourless skin), or containing no aluminium powder when applied to the inner surfaces (hence, golden colour);

(g) let the varnish coating dry for 36 hours at a temperature of 12° to 17°C, or for 24 hours, if the temperature is 18° to 35°C.

12. To restore the varnish coating of parts not yet damaged by corrosion, use varnish 170A.

13. To repair the varnish coating, observe the following priority:

(a) remove the damaged varnish film with cloths soaked in special oil СД;

(b) use a spray gun or a brush to apply a layer of varnish 170A;

(c) let the layer dry for 36 hours at a temperature of 12° to 35°C.

14. To restore the damaged coating in the tail portion of the fuselage located behind frame No. 35, use heat-resistance enamel К-1. Freshly applied enamel К-1 requires two to three hours to dry at a temperature not below 12°C.

15. Prior to starting to paint, place the aircraft at a site protected against dust, and sprinkle the ground about the place with water.

16. To reduce the time taken to dry the oil prime paint or enamels, it is allowed to use local heating with the air preheated to 80°C.

17. Never apply varnish or dry it up in the hot sun, fog, dew or strong wind.

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18. Oil enamels should be applied to the aircraft surfaces at a relative humidity of air not above 60 per cent and at a temperature not below 12°C.

19. The aircraft may be exposed to rain or fog not earlier than 12 hours after the coating has dried up.

20. In order to preserve the protective coating of the skin, care should be taken to prevent accumulation of dust by regularly dusting the aircraft with soft brushes which leave no scratches.

It is advisable that the entire skin surface of the aircraft should be washed not less than once a month. To do this, proceed as follows:

(a) first wash the oxidation-proof film coated with varnish with a solution of liquid soap (350 to 400 gr of soap per 10 lit. of water), then wash them with clean water;

(b) wash the unprotected oxidation-proof film surface with clean water only.

Prior to washing the surface with soft brushes, wipe the dust off.

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COCKPIT CONTROLS LAYOUT (Figs 120, 121, 122)

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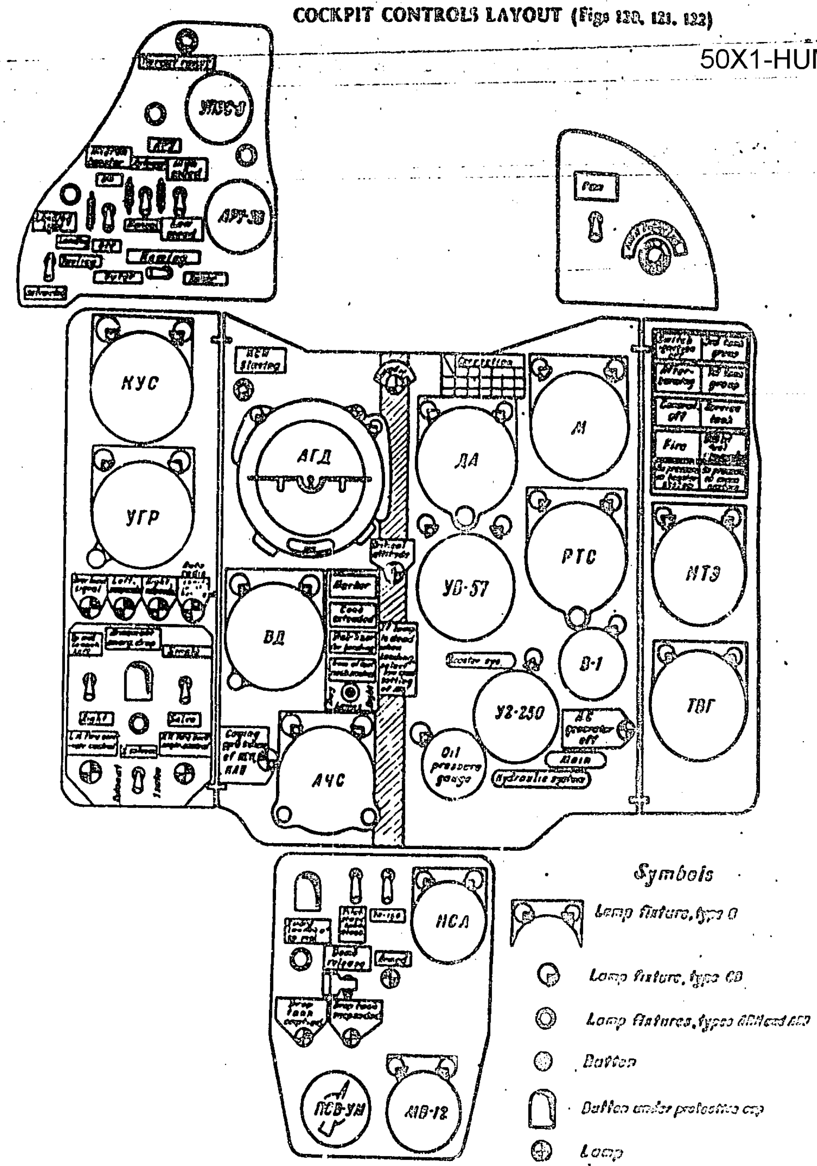

FIG.120. INSTRUMENT PANEL

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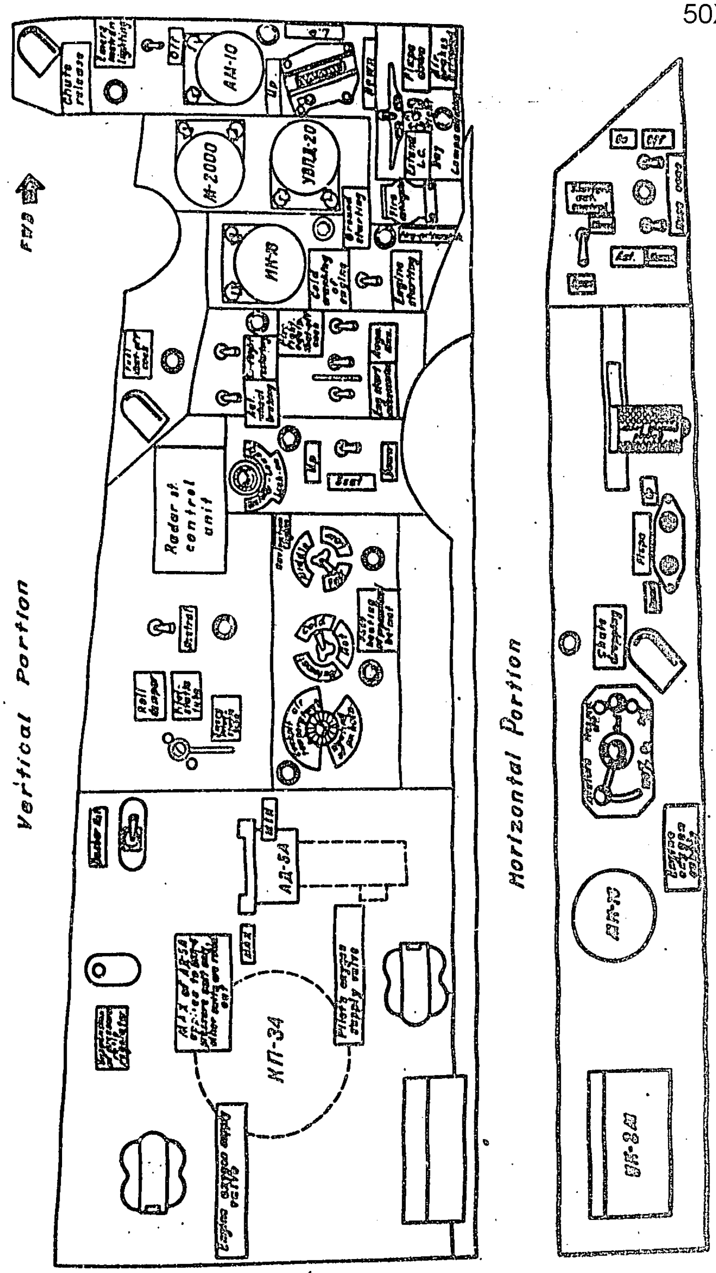

FIG.181. LEFT-HAND CONSOLE

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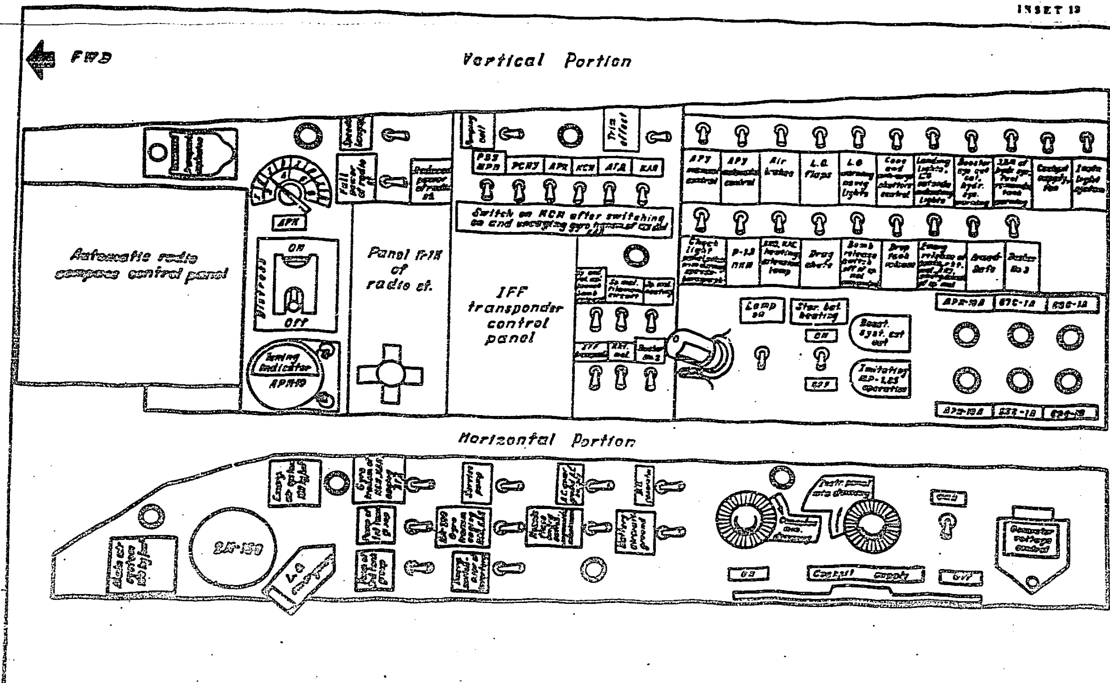

FIG. [illegible] RIGHT-HAND CONSOLE

FUSELAGE AND WING SERVICE HATCHES (Figs 123, 124, 125)

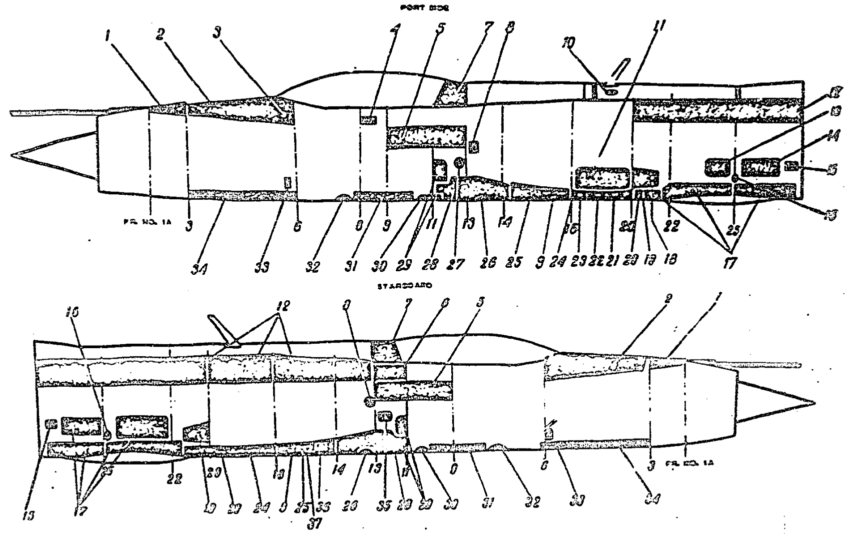

FIG. 123. ARRANGEMENT OF SERVICE HATCHES IN FUSELAGE NOSE SECTION

[illegible] – de-icing system alcohol tank; 2 – radio and special equipment units; 3 – [illegible] compressor; 4 – canopy emergency jettison handle group [illegible] lock; 5 – power distribution units; 6 – electrical equipment units; 7 – [illegible]; 8 – radio and electrical wires, [illegible] control [illegible]; 9 – adjustment screw of box [illegible]; 10 – units APT-13 and [illegible]; 11 – unit No. 2; 12 – tanks Nos 2, 3, 4, 5 and 6; 13–14 – engine units; 15 – ground hydraulic pump connections; 16 – engine attachment; 17 – engine units; 18 – [illegible] pump sediment drain; 19 – hydraulic units; 20 – [illegible] electric connections; 21 – fire-fighting shut-off valves; 22 – fuel system pump sediment drain; 23 – sediment drain from the 2nd and 3rd fuel tanks; 24 – fuel system pumps; 25 – electric equipment units; 26 – fuel drainage from the 1st group of tanks; 27 – airfield supply [illegible]; 28 – air bottle; 29 – air brake [illegible]; 30 – airfield supply [illegible]; 31 – [illegible] battery; 32 – APK radio compass; 33 – L.G. nose [illegible]; 34 – L.G. nose [illegible]; 35 – electrical equipment; 36 – unit checking connections; 37 – sediment drain from pump of tank No. 2.

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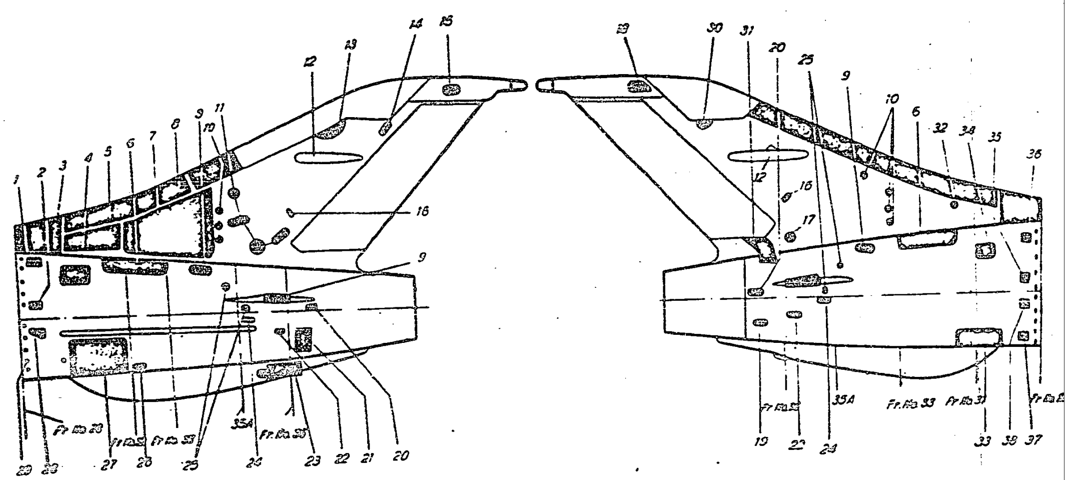

FIG.124. ARRANGEMENT OF SERVICE HATCHES IN FUSELAGE TAIL SECTION

1 – filling of hydraulic reservoir; 2 – kerosene pipeline connection; 3 – APY-3B automatic unit; 4 – thermocouple; 5 – artificial feel mechanism; 6 – booster system hydraulic accumulator; 7 – marker receiver, stabilizer angle pick-up; 8 – electric wiring attachment; 9 – stabilizer control bell-cranks; 10 – booster attachment; 11 – rudder bell-crank; 12 – ПС-2 pick-up; 13 – electric wiring attachment; 14 – rudder axle; 15 – service hatch; 16 – fin bolting lug; 17 – rudder bell-crank control; 18 – electric wiring; 19 – vent pipe joint; 20 – engine jet nozzle cylinder; 21 – jet nozzle hydraulic pipes; 22 – fastening of afterburner extension pipe support roller guides; 23 – drag chute lock; 24 – stabilizer beam grease fitting; 25 – stabilizer control bell-crank fastening bolts; 26 – telescopic joint venting; 27 – drag chute, thermocouple; 28 – detachable hydraulic valves; 29 – jointing bolts on frame No.28A; 30 – electric wiring; 31 – rudder control bell-crank; 32 – МРП-56П marker receiver plug; 33 – МРП-56П marker receiver antenna; 34 – thermocouple; 35 – safety valves of fuel tank pressurization system; 36 – filling of hydraulic reservoir; 37 – thermal detector; 38 – detachable hydraulic valves.

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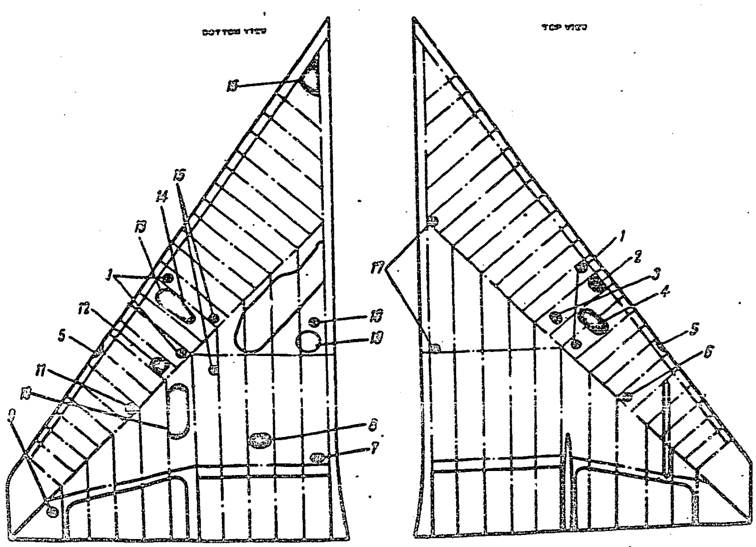

FIG. 12[illegible]. ARRANGEMENT OF SERVICE HATCHES IN WING

1 = special [illegible]; 2 = [illegible] connections; 3 = L.G. [illegible]; 4 = fuel pipeline; 5 = navigational lights; 6 = [illegible]; 7 = [illegible]; 8 = flap cylinder; 9 = [illegible]; 10 = [illegible]; 11 = [illegible]; 12 = [illegible]; 13 = special [illegible]; 14 = L.G. [illegible]; 15 = fuel [illegible]; 16 = [illegible]; 17 = [illegible]; 18 = [illegible] of landing light [illegible]; 19 = landing light.

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APPENDIX 6

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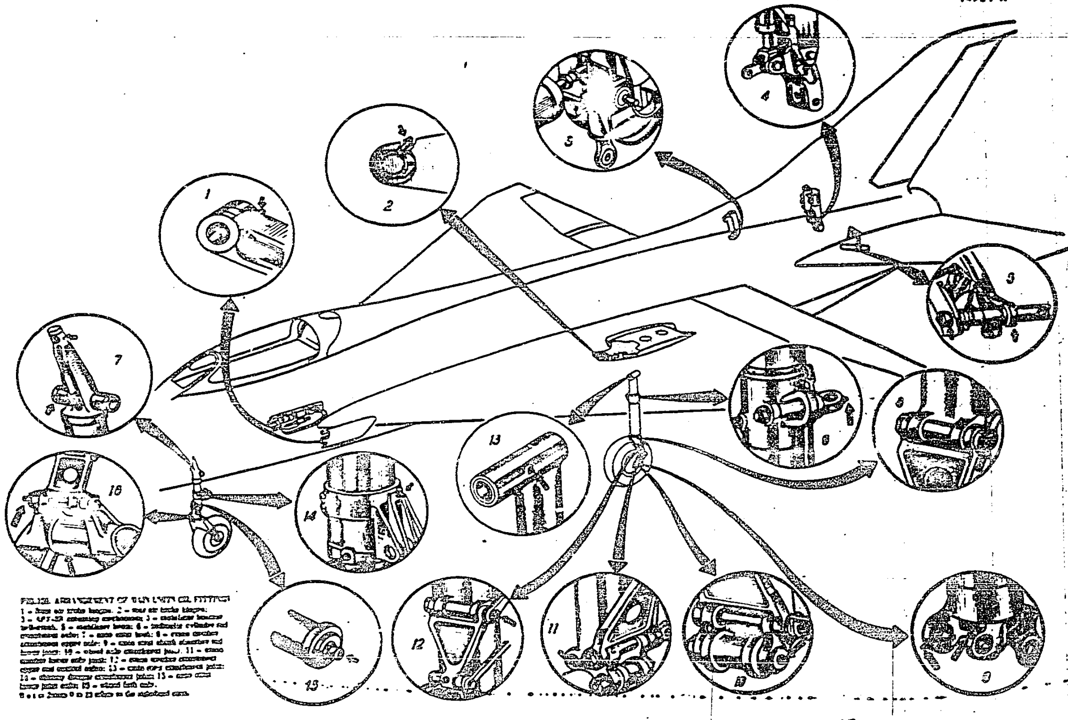

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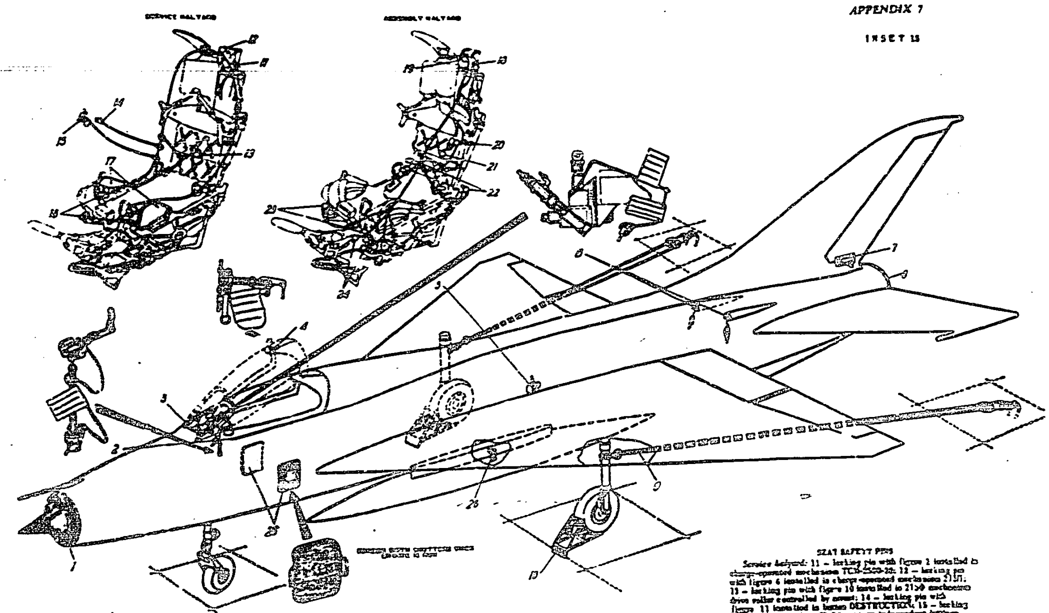

FIG. 137. GROUND LOCKING SYSTEM

1 – intake duct plug; 2 – canopy ground locking pin and canopy [illegible]

SEAT SAFETY PINS

Service halyard: 11 – locking pin with figure 1 installed in [illegible]

Assembly halyard [illegible]

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AIRCRAFT MIG-21FL
SERVICE MANUAL
Book II
ARMAMENT

50X1-HUM

SECRET

GROUP 1
Excluded from automatic downgrading and declassification

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AIRCRAFT МиГ-21ФЛ

SERVICE MANUAL

Book Two

ARMAMENT

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S-E-C-R-E-T

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This Manual contains information about operation and maintenance of the aircraft and consists of three separate books listed below.

Book I - Aircraft and Power Plant;

Book II - Armament;

Book III - Electrical, Radio and Oxygen Equipment and Instruments.

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INTRODUCTION

МиГ-21ФЛ front-line multipurpose interceptor (Figs 1 and 2) is a light single-seat all-weather aircraft having high flight performance characteristics and equipped with missiles, rockets and bombs.

The aircraft is designed for flights at a speed exceeding Mach-2 and altitude of the order of 20 km. Apart from the fact that the aircraft can be based at earth airfields, it has a great advantage of other types of interceptors in structural weight, fuel consumption per flight and power level of engines.

Depending upon the mission assigned, the aircraft may carry either special missiles with infrared homing heads, non-guided rocket missiles in rocket pods, or bombs, calibre up to 500 kg (Fig. 3).

Most frequently the aircraft is equipped with self-homing missiles.

The self-homing missile armament of the aircraft is intended for carrying and firing two self-homing missiles type P-3C. The missiles are suspended from БДЗ-60-21УМ underwing racks in special launchers АПУ-3С.

The P-3C missile is designed to kill air targets by day and at night under simple weather conditions, at all speeds and altitudes of flight of the interceptor with due account for limitations given in Pilot's Instructions. Employment of self-homing missiles during flights at dynamic ceiling has led to a considerable increase in combat altitude of the aircraft.

The missile is homed by the control equipment comprising an infrared passive homing head and control actuator.

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As a target is locked on by the homing head and the missile is ready for launching, a sound signal is fed to the pilot's headphone.

The aircraft radar is employed to guide the missile into an attack position and to aim during target engagement.

To determine the relative position of target and aircraft, and the safe launching zone, the pilot estimates the nature and position of pips displayed on the radar indicator.

When the aircraft enters the danger zone, the warning lamp BREAK OFF (ВЫХОД ИЗ АТАКИ) lights up on the radar indicator.

The non-guided rocket missile armament provides for carrying two rocket pods УБ-16-57У, each pod charged with 16 rocket missiles of С-5М or С-5К type.

The fire control system is designed for simultaneous firing of two pods, each of those launching either one rocket missile, two rocket missiles, or a salvo continued until the full ammunition unit is used up.

The bombing armament of the aircraft consists of two bombs from 50 to 500 kg which are suspended directly from the ДЗ-57Д locks of underwing racks.

The fire control system is used to drop two ARMED (ВЗРЫВ) or SAFE (НЕВЗРЫВ) bombs simultaneously.

The aircraft is equipped with a system of emergency release of bombs, launchers or rocket pods, and with a system of emergency release interlocks.

The missile and rocket launching systems are interlocked through retracting of the L.G. nose strut.

The aircraft is rather simple in operation and can therefore be readily mastered both by flight and maintenance personnel who have undergone respective training in handling the supersonic jet aircraft equipped with modern weapons.

Sound knowledge and proper maintenance of the weapon systems, as well as sufficient experience in operations related to pre-flight and preliminary preparation will guarantee reliable and trouble-free functioning of the aircraft armament.

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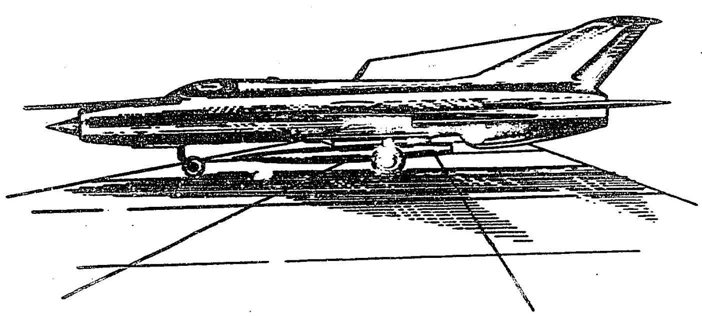

FIG. 1 AIRCRAFT [illegible] (SIDE VIEW)

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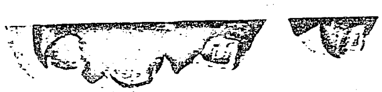

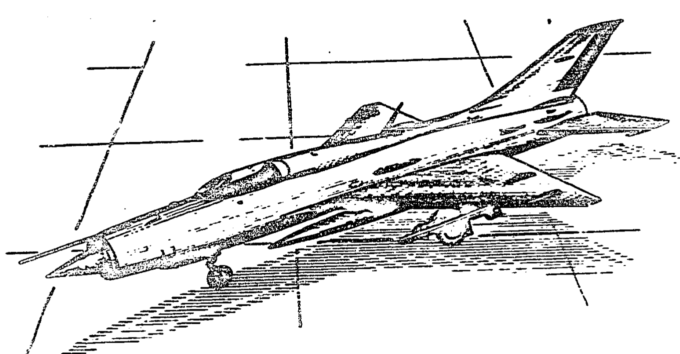

FIG.2. AIRCRAFT [illegible] (THREE-QUARTER FRONT AND TOP VIEW)

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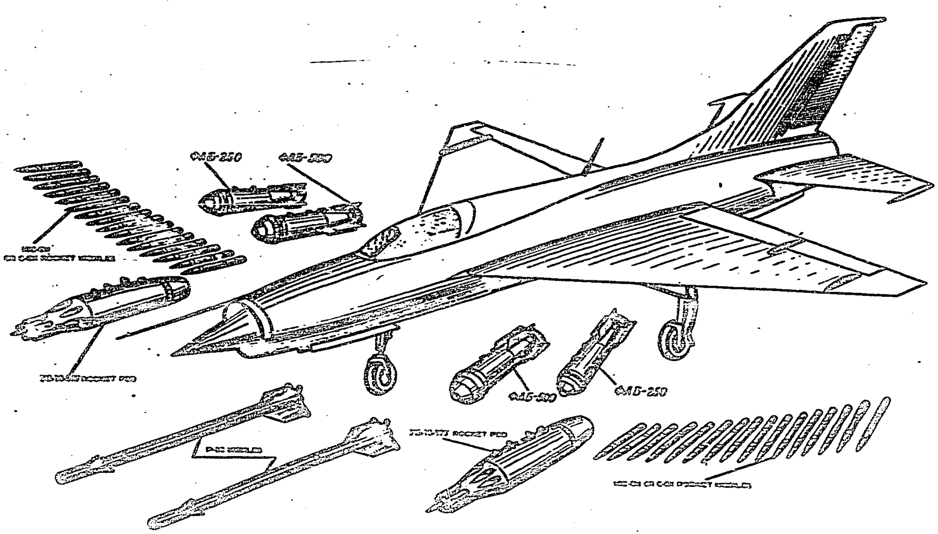

ARMAMENT LAYOUT

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PART I

PREPARATION OF ARMAMENT FOR USE

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Chapter 1

PRELIMINARY PREPARATION

1. GENERAL

The preliminary preparation constitutes the main element in preparation of the aircraft armament for battle. Hence, adequate preparation provides for opportune detection and repair of troubles as well as for keeping the weapons in constant combat readiness.

The preliminary preparation consists in:

(a) post-flight inspection of armament units and checking them for proper functioning;

(b) repair of troubles detected during flight or post-flight inspection;

(c) removal of unfired missiles and undropped bombs and unloading of rocket pods УБ-16-57У.

To start with, remove unused ammunition after checking that all circuit breakers of the fire control system circuit and storage battery are cut off.

ATTENTION! Never check the fire control systems unless a ground D.C. and A.C. power supply is used. Employed as a supply of this type is the АПА ground source.

To couple the D.C. supply to the aircraft, use a wire cord connected to receptacle ШРА-250ЛШК on the fuselage

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port side. For switching the D.C. supply, turn on switch AIRCRAFT OR GROUND BATTERY (АККУМ. БОРТОВОЙ, АЭРОДРОМ.) arranged in the cockpit.

Mind, that while coupling the ground D.C. supply, the switch should be previously turned off.

To check the self-homing missile control circuits as well as to make a general check of the aircraft radar for functioning, the aircraft should also be supplied with A.C. voltage. To this end, couple the second wire cord of the АПА supply to the ШРА-200ДК receptacle on the fuselage belly.

For switching on the A.C. supply aboard the aircraft, turn on switch A.C. GENERATOR. GROUND SUPPLY (ГЕНЕРАТ. ПЕРЕМЕННОГО. АЭРОДРОМНОГО ИСТ.).

Prior to disconnecting the ground power supply, check that both switches mentioned above are turned off.

2. REMOVAL OF UNUSED AMMUNITION

Unused missiles, bombs and rockets are removed from the aircraft in case of:

(1) a postponed flight;

(2) a change of flying mission;

(3) any troubles in the signal, suspension or fire control (bomb release) systems;

(4) a landing with unused ammunition.

Trouble shooting and removal of unused ammunition after a combat mission will be performed in places specified by the Operating Instructions adopted for the given airfield.

While removing the ammunition, follow the prescribed priority and observe safety measures.

Before landing the aircraft with unused bomb load, turn off switch BOMB RELEASE (ТАКТИЧ. СБРОС), and after firing the rocket pods, turn off circuit breaker RKT MSL (РС).

In case of unfired missiles, turn off circuit breaker SP. AND RKT MSL LAUNCH. BOMB RELEASE (ПУСК СС, РС, БОМБЫ).

It is desirable that the suspended missiles, bombs or loaded rocket pods be removed from the aircraft after flight.

[redacted]

To remove the bombs whose calibre exceeds 50 kg, a cart should be used.

Never dismount the rocket pods from the aircraft unless the rocket missiles have previously been unloaded from the pods.

In case of a long interval in use, the special launchers and rocket pods should be dismounted and the ДЗ-57Д underwing rack locks should be released.

The procedure of removing various unused ammunition from the aircraft is discussed in the respective Sections of the present Manual (Part II).

3. POST-FLIGHT INSPECTION AND PREPARATION OF ARMAMENT SYSTEMS

The post-flight inspection of armament is the principal element of inspection aimed at close examination of the weapons condition and detection of troubles and faults which have occurred during flight.

Inspection of the armament units after flights should not be started until the unused ammunition has been removed from the aircraft.

The scope of work required for inspection depends on the type of ammunition involved.

In case the same carrier is intended to be used in further flights, the post-flight inspection and checking of operation should cover only the units engaged during the present flying day.

Subjected to most careful inspection are:

(a) units whose operation has appeared abnormal or doubtful to the pilot;

(b) parts and assemblies damaged while accomplishing the mission;

(c) parts and assemblies subjected to maximum wear.

While carrying out the preliminary preparation, all operations required to achieve absolute reliability and combat readiness of the weapons should be accomplished so as to reduce the time of the pre-flight preparation to a minimum.

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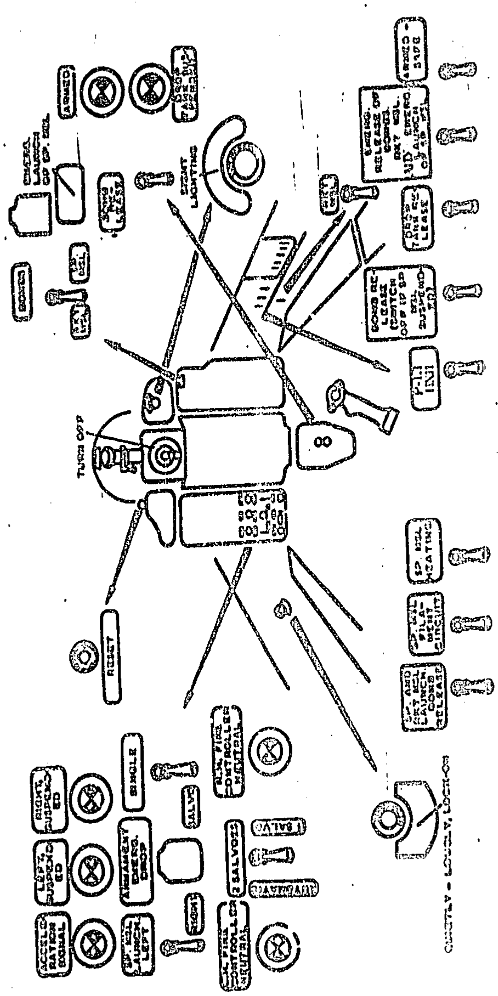

FIG.4 ARRANGEMENT OF ARMAMENT CONTROL EQUIPMENT UNDER COCKPIT

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Inspection of Armament Units Inside the Cockpit (Fig.4

While inspecting the armament units inside the pilot's cockpit, check the following:

1. Presence of mechanical damage, distinct reading of inscriptions and locking of the armament control circuit breakers in positions ON (ВКЛ.) and OFF (ВЫКЛ.). The check is made visually with the storage battery cut off.

2. Condition of the firing button arranged on the aircraft control stick and of the buttons used for emergency launching, emergency release of suspensions from the underwing racks and emergency jettison of the drop fuel tank. Check that the button sleeves are not cracked or split, that the buttons travel easily and are not jammed inside the sleeves, and that the colours of the button caps are sufficiently bright.

3. Smooth change-over and reliable locking of the rocket pod fire selector switch in positions 1 SALVO (1 ЗАЛП), 2 SALVOES (2 ЗАЛП) and AUTOMATIC (АВТОМАТ), and matching between the positions of armament selector switch RKT. MSL - SP. MSL - BOMBS (РС - СО - БОМБЫ)and respective armament prepared for fire.

4. Reliable locking of the launching selector switches in operating positions, and condition of the volume control of signals supplied from the missile infrared homing head to the pilot's headphone.

5. Presence and condition of all pilot lamps installed in the firing circuit indication system.

6. Appearance of the elements arranged on the check console, control panel and indicator unit of the aircraft radar. (A duty of the radio mechanics).

7. Condition and readiness of the ПКИ collimator sight.

Preliminary preparation of the collimator sight amounts to an external examination. When a certain kind of weapon is prepared for use, the sight is checked simultaneously with checking the condition of circuits controlling the weapon employed.

While checking, examine the appearance of the following elements:

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(a) the canopy armour glass, reflector and object glass. Make sure that these are intact, reliably attached and clean. In case of dust, dirt or oiling, clean the parts with a flannel moistened in rectified alcohol;

(b) smooth rotation of the sight reticle illumination intensity rheostat knob;

(c) reliable attachment of the sight to the bracket. Check that the mark lines notched on the attachment bracket during fire adjustment should coincide.

NOTE: The armament circuit elements arranged in the cockpit are checked simultaneously with checking the condition of circuits controlling the weapon prepared for use.

Preparation of Self-Homing Missiles

While preparing the missiles for use, proceed as follows:

1. Clean and inspect visually the БДЗ-60-21УМ underwing racks and АПУ-3С launchers. Make sure the suspension system parts are intact and cracks, scores or dints are not present. Check the attachment of fairings and the condition of rack rubber packing.

2. Check for reliable attachment between the underwing racks and the wing elements, and between the lock and the rack, check the condition of electric connectors, and of the front and rear stops, and make sure whether the attachment of the fairings, suspension taper bolt access hatch covers and plug connector hatch covers is reliable.

3. Remove the launcher and check the operation of the ДЗ-57Д lock by the emergency release electric circuit.

NOTE: To check the operation of the lock with the launcher removed, proceed from the necessity, weather conditions and frequency of employment, and combine the check with routine maintenance.

4. Make sure the lock is fixed reliably, as can be observed through the inspection holes in the underwing rack.

5. Clean and inspect the launchers. While inspecting check the following:

(a) condition of the plug connector;

(b) condition of the ignition contacts;

(c) presence of dints on the launching beams;

(d) condition and operation of locking snap and vibration damper straps;

(e) condition of the suspension stops and yokes;

(f) condition of attachment of the front fairing and bracket secured to the shear connector;

(g) proper tightening of the launcher suspension yokes secured to the ДЗ-57Д lock (to be checked with the help of a calibration wrench).

6. Use the ЗУС-13 testing device to measure the missile getaway force. The getaway force should be measured not less than once after every ten rounds as well as each time during routine maintenance.

7. Inspect and check the sighting equipment for functioning.

8. Inspect the switches, circuit breakers and other elements of the armament control system which are installed inside the cockpit.

Set the armament selector switch into position SP. MSL (CC).

9. Check the functioning of supply, launch and system operation checking circuits by means of two ИМ-13А simulators.

In case the underwing racks have been prepared to carry either bombs or rocket pods, proceed as follows to start preparation of the system:

(a) dismount from the underwing rack the bomb clamps or stops used for suspension of rocket pods;

(b) fit the rack with the adapter beam and stops used for suspension of launchers;

(c) check the operation of the ДЗ-57Д lock, examine the launcher and suspend it;

(d) check the accuracy of laying by means of a bore sighting gauge and a portable target. The check is required in the event of the first suspension. To facilitate the procedure, the underwing racks should be fitted only with those stops and launchers which are permanently attached to

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them. After the check is over, follow the instructions on preparation of the self-homing missile system.

Preparation of Rocket Missiles

In order to prepare the rocket missiles for use, proceed as follows.

1. Make an external examination of the БДЗ-60-21УМ underwing racks to check the following:

(a) fouling of parts of the racks and ДЗ-57Д locks;

(b) reliable attachment of underwing racks to wing elements and of the lock to the rack;

(c) secure closing of the rack attachment taper bolt access hatch covers on the wing and service hatches.

2. Remove the bomb clamps from the underwing racks.

3. Fit the racks with the adapter beam to cover the gap between the rack and УБ-16-57У rocket pod.

4. Fit the rack with the front stop, base 120 mm, and the rear stop, base 108 mm, intended for mounting the rocket pods.

5. Check the actuation of the ДЗ-57Д locks by the mechanical release.

6. Check the condition of the emergency release system lock release control, emergency release interlock and suspension indication system.

7. Fix the underwing rack locks, suspend the rocket pods from the locks and connect the pods to the small size electric connectors.

Prior to suspending the pods, unslush them, inspect them visually and check whether the yokes travel easily.

8. Use a bore sighting gauge and a portable target to check for accurate laying of the rocket pods. The check is required in the event of the first suspension. To facilitate the procedure, the underwing racks should always be fitted only with those stops and pods which are permanently attached to them.

<u>NOTE</u>: The operations described in the above Items should be accomplished only in case the underwing racks have been employed for suspension of bombs or launchers.

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9. Engage the ПКИН-1 check console (Fig. 5) and check the output voltages at the contact jacks of the rocket pod wire cord plugs.

In case the rocket pods have been used during flight, proceed as follows to start preparing.

1. Make sure there are no rocket missiles inside the barrels.

If there are any unused rocket missiles inside, unload the pod.

2. Remove the rear fairing of the rocket pod, take rocket holders out of the barrels and drive the rocket plugs and charge cords out of the traps.

To drive the holders out, use a swab which will simultaneously remove fouling from the barrels.

3. Make an external examination of the rocket pod. Clean fouling from the rocket holders, barrels and rear fairing, and apply grease.

While inspecting the rocket pod, check the following:

(a) presence of breaks, cracks, dents or nicks which may hinder handling the pod;

(b) condition and reliable attachment of the barrels inside the rocket pod body. Check that the barrels are not affected by dents, bellying, nicks or play.

The side barrel muzzle must be fixed flush with the front fairing skin.

No projection or sinking of the barrel, or dints on the fairing skin or barrel muzzle are permissible;

(c) reliable attachment of the rocket pod body skin and condition of the rear fairing locking snap.

The rocket pods affected by considerable troubles must be sent over to workshops for repair.

It is permissible that under the airfield maintenance conditions burrs may be removed by means of smooth file and bulging may be cut away, unless the basic metal is filed off.

Minor dents in the rocket pod skin which do not affect the operation of its mechanisms need not be repaired.

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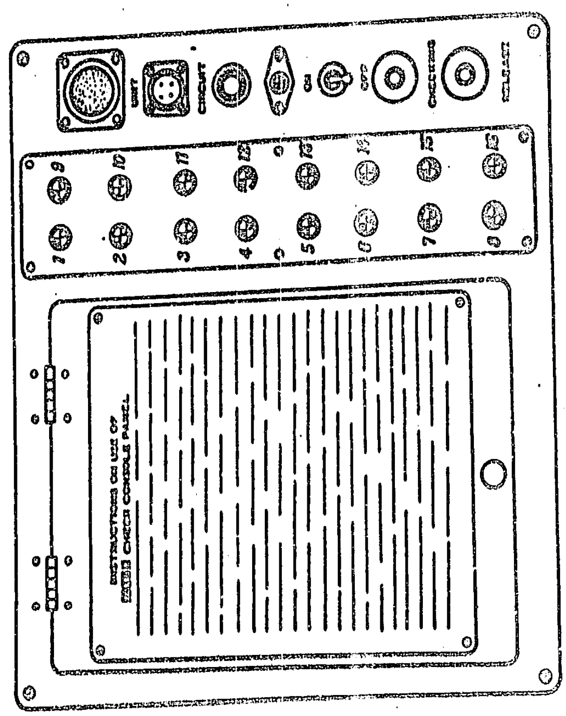

FIG.4 [illegible] CHECK CONSOLE PANEL

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4. Check the condition of the rocket pod fire control circuit.

After checking is over, set the НУС-36ЛМ into the neutral position, indicated by glow of pilot lamps, and cut off the electric power supply.

Preparation of Bombs

In case the bomb weapons are to be employed, it should be prepared as follows.

1. Make an external examination of the underwing rack. While inspecting, check the following:

(a) fouling of the rack parts;

(b) reliable attachment of the underwing racks to wing elements and of the lock to the rack;

(c) reliable closing of the rack attachment taper bolt access hatch covers on the wing and pulse feeding mechanism access hatch covers;

(d) mechanical damage on the rack parts.

2. Check the condition of the fuze vanes arming rods and repair the troubles caused by dropping of bombs.

In case electric squib cocking fuses are employed, examine the pulse feeding mechanisms and check the voltages fed to them.

3. Closely examine the exposed portions of the ДЗ-57Д lock levers and make sure that it is effectively actuated by the mechanical release. In case of fouling, clean the parts.

4. Check the operation of the lock by the tactical control circuit ARMED and by the emergency system ARMED and SAFE.

5. Check the condition of the emergency release interlocking circuits, bomb suspension indication circuit, and ARMED release control circuit switching.

In case the special missiles or rocket missiles have been employed during flight, the following operations are required to prepare bomb weapons apart from the operations mentioned above.

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1. Dismount and handle the rocket pods or launchers used,

2. Dismount the front and rear stops and the adapter beam.

3. Close the small size electric connector with the protective cover and fit the connector inside the rack.

4. Install the bomb clamps on the rack and prepare them to carry the bombs of the respective calibre.

5. Set the armament selector switch into position BOMBS (БОМБЫ).

While preparing, proceed in accord with requirements specified in the Chapter on maintenance of bomb weapons.

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Chapter II

PRE-FLIGHT PREPARATION OF ARMAMENT

1. GENERAL

The pre-flight preparation is accomplished directly before a given flight.

The scope of preparation of aircraft armament to flight is governed by the nature of mission assigned and degree of readiness of weapons for use.

The Sections on pre-flight preparation for all types of armament define only operations to be performed during preparation of the aircraft to combat use.

To reduce the pre-flight preparation to a minimum, a number of Items contained in the list of external examination of units should be accomplished during preliminary preparation.

If the pre-flight preparation is carried out directly after preliminary preparation, no repeated checkout on operation of the armament units and control systems is required.

In each particular case the scope of pre-flight preparation depends upon how far distant is the preceeding pre-flight preparation, upon the conditions of storage of armament and upon the experience of personnel using the armament.

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The pre-flight preparation of armament should actually be limited to checking the condition of armament control circuits and combat equipment of the aircraft.

The preparation of armament for flight should be started from checking the operation of sighting devices and testing the armament control systems in general, performed from inside the cockpit, after which the combat equipment can be checked.

To check the condition of the armament control circuits, it is necessary that a ground electric power supply should be used.

CAUTION: Never should the missiles be suspended, bombs attached or rocket pods loaded while the engine is running or there is anybody in the cockpit.

Prior to starting the preparation, the following operations will invariably be accomplished.

1. Open the pilot's canopy. Install the ground kit locking pins into the canopy elevating cylinder ports.

2. Check whether the safety studs have been installed in the ejected seat and in the independent canopy jettison handle.

The safety studs must be removed only after the pilot gets into the cockpit.

3. Inspect the cockpit and make sure all circuit breakers and buttons installed in the armament control systems are turned off, and the release, firing and launching buttons are covered by protective caps.

4. While the rocket pods are being loaded, or when the missiles are being suspended, there should always be red warning flags installed at a distance of 3 to 5 m. in front of and behind the aircraft to mark a prohibited zone dangerous for crossing. To mark the zone at night, red lights should be used instead.

Never forget to remove the danger marks as soon as the above operations are accomplished.

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2. PREPARATION OF SELF-HOMING MISSILES

The operations including preparation of self-homing missile weapons for use may be performed both at a parking place, or at a preparatory starting line site.

While preparing, proceed as follows.

1. Perform an external examination of suspension assemblies. Take care to check:

(a) reliable engagement of the ДЗ-57Д lock bearing levers;

(b) fouling and condition of launcher guides;

(c) fouling of ignition contacts. Check the spring action of the contacts and presence of grease;

(d) reliable connection between the underwing rack plug connector socket and the АПУ-30 connector branch plug;

(e) functioning of the locking snap used to fix the rocket front guide beam to the launcher; make sure the front stop roller revolves freely;

(f) functioning of the vibration damper straps;

(g) condition of the launcher front fairing attachment joint;

(h) condition of front folding bracket springs and snaps used to fix the bracket to the missile shear connector.

2. Make a general checkout on functioning of the sighting devices.

3. Check the condition of supply, launching and checking circuits by means of the ИМ-13А simulator.

4. Disconnect the storage battery and install a safety pin in the launcher.

5. Make an external examination of the missile, check its serviceability proceeding from the respective technical papers and suspend the missile from the launcher.

6. Check for reliable locking of the missile on the launcher, which can be determined by the position of the reference lines seen through the beam side inspection holes covered with plugs.

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Check whether the reference line of fixing snap mechanism two-arm lever is positioned between the mark lines notched on the bosses of the front vibration damper straps.

7. Check if the homing head of the suspended missile operates normally to feed a sound signal to the pilot's headphone. Proceed as follows:

(a) make sure the safety pin is installed in the launcher, and couple the aircraft to an airfield power supply;

(b) remove the protective cowl from the homing head;

(c) connect the storage battery and the cockpit circuit breakers SP. MSL HEATING (ОБОГР. СС), SP. MSL FILAMENT CIRCUIT (НАКАЛ СС) and РСИУ . Make sure that after circuit breaker SP. MSL FILAMENT CIRCUIT has been switched on, the lamps LEFT, SUSPENDED (ПОДВЕШ. ЛЕВ.) and RIGHT, SUSPENDED (ПОДВЕШ. ПРАВ.) light up on the board in the left lower part of the instrument panel.

<u>CAUTION</u>: Never cut in the missile supply circuit before the protective cowl is removed from the homing head.

(d) set the launch selector switch into position SINGLE (ОДИНОЧНО) and shift the separate launch switch SP. MSL LAUNCH, LEFT – RIGHT (ПУСК СС ЛЕВ. – ПРАВ.) into the position determined by the launcher under check;

(e) expose the homing head to emission of an extension lamp at a distance of 0.1 to 1 m. from the aircraft and check if a sound signal is fed to the pilot's headphone. Adjust the signal volume by means of the volume control;

(f) make a similar checkout of the homing head installed in the missile suspended from the other wing.

8. Prior to flight, remove the protective cowl from the homing head and from the optical proximity fuze compartment, take out the rubber caps installed on the missile fins, and drive the safety pin out of the launcher.

The ground assigned for suspension of missiles should be sufficient to install the aircraft prepared so as to turn it towards a direction where there are no buildings, equipment or other objects.

The operations on suspending the missiles may be started only after testing the engine and preparing other systems of

[redacted]

the aircraft. It is strictly prohibited to use open fire, to smoke or employ non-standard or striking tools.

It is absolutely forbidden to perform any electrical mounting operations on the aircraft unless the missiles have been removed.

If a necessity arises to tow the aircraft equipped with missiles, each launcher must be locked with a safety pin and positions of the switches and circuit breakers arranged in the cockpit should be checked. All missile launch control circuit breakers and switches must be set into the OFF (ВЫКЛ.) position.

The ground power supply should not be coupled to the aircraft equipped with missile before making sure that the missile launch control circuit breakers are switched off and that there is nobody in front of, and behind the aircraft. NEVER should any maintenance be performed in the cockpit after the missiles have been suspended and the ground power supply coupled to the aircraft.

3. PREPARATION OF ROCKET MISSILES

To prepare the rocket missiles for combat use, observe the following sequence.

1. Make an external examination of the suspension assemblies.

While inspecting check the following:

(a) fouling of the suspension assemblies, reliable closing of the service hatches and bearing levers of the underwing rack lock;

(b) proper fastening of the rocket pod yokes with the help of a calibration wrench;

(c) reliable attachment of the underwing rack plug connector to the suspended pod connector;

2. Connect the power supply and use the check console to test the output voltages across the contact jacks of the rocket pod, which are intended for coupling the rocket wire cord plugs.

3. Set the ПУС-36ЛМ fire controller to zero position, turn the fire selector switch into a position determined by the fire mission and cut the power supply off.

4. Examine the rocket missiles and fuses ready for loading the rocket pods.

5. Load the rocket missiles into the pods and observe the prescribed safety measures.

6. Make sure the rocket pod rear fairing attachment (Fig. 6) is reliable.

While preparing the armament, follow the instructions contained in the Chapter on maintenance of rocket missiles.

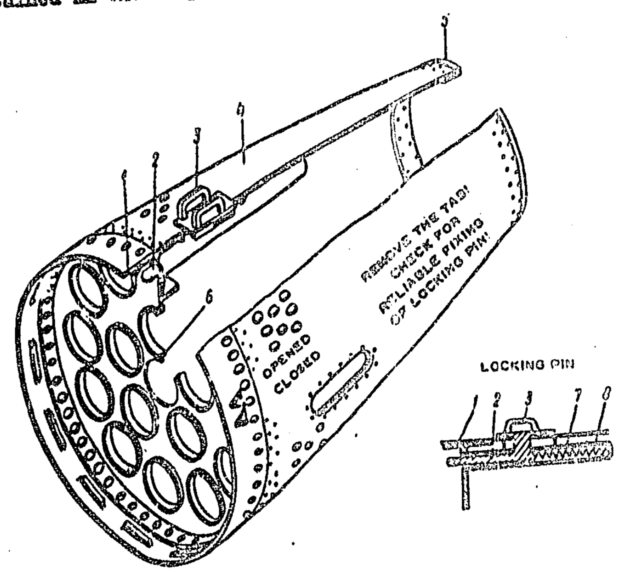

FIG.6. REAR FAIRING OF ROCKET POD УБ-16-57У

1 – ring; 2 – locking pin; 3 – ball; 4 – skin; 5 – ring; 6 – lock disc; 7 – locking pin body; 8 – spring.

4. PREPARATION OF BOMBS

In order to prepare the bomb weapons for combat use, proceed as follows.

1. Perform an external examination of the underwing rack and exposed parts of the ДЗ-57Д lock.

2. Check the condition of the tactical and emergency bomb release circuits.

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3. Check the condition of the emergency release interlocking and suspension indication circuits.

4. In case the electric squib cocking fuzes are employed, examine and check the serviceability of the pulse feeding mechanism to be used in the given suspension.

5. Examine the bombs and prepare them for suspension, examine the fuzes, time-delay mechanisms and arming rods of the fuze arming vanes.

6. Fix the locks and check them for reliable engagement.

7. Suspend the bombs, adjust the bomb clamp screws and fuze the bombs in accord with the relevant Instructions and the bombing mission.

8. Lock the fuze arming vanes with the УВП-МС arming rods or couple the fuze electric squib wire cord plugs to the respective МПМ pulse feeding mechanisms.

9. Make an external examination to check the proper attachment of the suspension assembly.

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Chapter III

PREPARATION OF ARMAMENT FOR REPEATED FLIGHT

1. GENERAL

Time allotted for preparing the armament for repeated flight should be limited to a minimum.

Yet the time assigned to prepare for a repeated flight, must be sufficient for making the armament serviceable and ready for use in compliance with the mission assigned.

The aircraft armament can be prepared for a repeated flight both at the start line and at the parking place. It comprises.

1. Post-flight inspection whose scope is governed by the mission to be accomplished.
2. Checking the condition of armament and repair of troubles detected during flight and post-flight inspection,
3. Loading of ammunition in compliance with the mission assigned.
4. Pre-flight inspection of the armament prepared.

Prior to starting the inspection, consult the pilot about operation of armament during flight, and whenever necessary, unload the rocket pods and remove the unused bombs or missiles from the underwing racks or launchers respectively.

The post-flight inspection should involve only weapons which can probably be used in flight, and should be carried out in the scope required to guarantee trouble-free operation of the weapon to be employed.

Preparation and inspection of ammunition allotted for a repeated combat mission should be accomplished beforehand while the aircraft is still in flight.

2. PREPARATION OF SELF-HOMING MISSILES

To prepare the missiles for use, proceed as follows.

1. Make an external examination of the suspension assemblies.

While inspecting, take care to check:

(a) reliable attachment of the launcher to the underwing rack;

(b) condition of the launching beams, snaps and vibration damper straps of the launcher;

(c) fouling of ignition contacts and reliable attachment of the rack electric connector to the launcher.

2. Open the launcher front fairing and disconnect the shear connector of the used missile from the ШР-М20 connector.

3. Make a general checkout of the radar operation.

4. Check the condition of supply, launch and ИМ-13А simulator checking circuits.

CAUTION: In case one unused missile is suspended from the suspension assembly, the control circuits must not be checked before removing the missile from the launcher.

5. Suspend the missiles and check them for reliable attachment to the launcher.

6. Make sure the homing head of the missile suspended is serviceable by listening to the sound signals fed to the pilot's headphone.

7. Prior to takeoff, remove the protective cowl from the homing head and optical proximity fuse compartment, take out the rubber caps installed on the missile fins and drive the safety pin out of the launcher.

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3. PREPARATION OF BOMBS

To make the bomb weapons ready for use, proceed as follows:

(a) inspect the bomb control system units installed in the pilot's cockpit;

(b) check whether the ARMED - SAFE rods are present, remove them from the underwing racks, and make sure the arming rods are intact;

(c) make an external examination of underwing racks and bomb clamps;

(d) check the condition of tactical and emergency bomb release control circuits. While checking, make use of the inserts. Make sure the suspension indication and switching of the ARMED release circuit are normal;

(e) fix the locks, check them for reliable engagement and suspend the bombs;

(f) fuze the bombs and connect either ННМ pulse feeding mechanisms or УВП-ИС arming rods depending on the type of safety locking.

4. PREPARATION OF ROCKET MISSILES

To make the rocket missiles ready for use, proceed as follows:

(a) inspect the underwing rack and check the rocket pods for reliable attachment to the suspension assembly;

(b) remove the rocket pod rear fairing;

(c) pull the charge wire cord plugs out of the contact jacks and drive the rocket holders out of the rocket pod barrels. Remove the rocket plugs and charge cords from the holder traps and make sure the parts are intact;

(d) examine the rocket control units installed in the cockpit;

(e) check the condition of the fire control circuit and set the ПУС-36ДМ to zero position;

(f) cut off the electric power supply and load the pod with rockets;

(g) check the rocket pod rear fairing for reliable closing.

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5. PREPARATION OF SIGHT

This consists in an external examination and implies the following:

(a) make an external examination to check fouling of the cockpit armour glass, reflector and object glass. Clean the parts when necessary;

(b) check the sight head assembly for reliable attachment to the bracket. Make sure that the reference lines, notched during fire adjustment, are aligned.

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PART II

MAINTENANCE OF ARMAMENT SYSTEMS AND UNITS

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Chapter I

MAINTENANCE OF SELF-HOMING MISSILES

1. GENERAL

The guided missile weapon system includes:

1. P-3C self-homing missiles equipped with an infrared homing head of day-and-night action.
2. Missile suspension and launching unit.
3. Launch, feeding, control and checking circuit units.
4. P-1Л aircraft radar set.
5. Test equipment and ground facilities.

P-3C Self-Homing Missile

The P-3C air-to-air missile is designed for killing the air targets by day and at night under simple weather conditions within the entire service speed range starting from Mach-0.8, and at all altitudes of flight of the interceptor with due account for limits set forth in Pilot's Instructions.

To achieve interchangeability and convenience in assembling and disassembling, the main parts of the missile are designed as four separate compartments mated to each other (Fig. 7).

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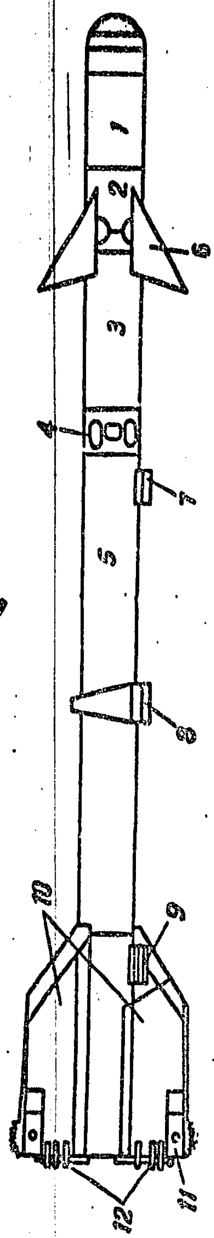

Missile Suspension and Launching Unit Design

The P-30 self-homing missiles are suspended from the БДЗ-60-21УМ underwing racks with the help of the АПУ-30 launcher. The pulling effort of the launcher exerted upon the underwing rack is within 900 to 1,200 kg.

Installed in the front stop of the snap is a roller intended to provide a stable getaway effort of the missile equal to 420 ±40 kg.

To move the snap up for removing the missile, a box wrench is fitted on the opening lever axle square end.

In order to preclude a getaway of the missile in a backward direction which may occur in case of a high longitudinal accelerations the launcher is provided with a special lever used for fixing the snap rear stop.

The assembly is unlocked automatically by a special opening lever which acts upon the fixing lever through a buckle welded to it and pulls the fixing lever off the snap rear stop when the snap is moved up for suspension of the missile.

The aircraft may be fitted with launchers designed so that the snap fixing lever is set into either position CLOSED (ЗАКРЫТО) or OPEN (ОТКРЫТО) with the help of a stopper secured outside the beam body.

FIG.7. MISSILE BLOCK DIAGRAM

1 - homing head; 2 - control actuator compartment; 3 - warhead; 4 - optical proximity fuse; 5 - powder rocket engine; 6 - fins; 7 - front guide; 8 - central guide; 9 - rear guide; 10 - wings; 11 - ailerons; 12 - locking studs.

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In this case, to move the snap up for maintenance, the stopper should be shifted from the screw and turned into position OPEN so as to set the fixing lever spindle into the upper end of the oval-shaped groove in the beam.

After the missile has been suspended from the launcher and the snap has been moved down, the snap should be locked by setting the lever stopper into position CLOSED and fixing the stopper reliably with a screw. The fixing lever spindle should travel into the lower end of the oval-shaped groove.

While removing the missile, it is expedient to move the missile over the launcher somewhat forward in flight direction before unlocking the snap.

The lever is at the same time used for sending the snap home to achieve complete fixing of the snap after the missile is suspended.

Two pairs of vibration damper straps mounted on the launcher are intended to take up the play which is apt to occur between the launching beam and missile guides.

The check of the snap for reliable fixing is made against reference lines on the two-arm lever and front bosses of vibration damper straps.

Press-fitted into the snap body are two insulation bushes carrying two contacts. One of the contacts is inserted into the engine squib circuit and the other is connected into the optical proximity fuse thermal cell ignition circuit.

Arranged in the tail part of the launcher under the removable fairing is the ЭПУ-13ТБ electric launch unit.

To couple the wire of the missile shear plug connector СР-20Д, the front portion of the launcher is fitted with the ШР-М20 plug connector installed on a bracket beneath the hinged fairing.

To check whether the fairing is fixed in the front position, there are two matched reference lines notched on the fairing locking axles and washers.

In order to prevent occasional launching of missiles on the ground, a safety pin with a warning tab is installed

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into the launcher body holes so that the engine squib and optical proximity fuse cell circuits are broken.

The safety pin is removed before flight.

Feeding, Launch Control and Checking Circuit Units (Fig. 8)

The feeding, launch control and checking circuit of the missile armament comprises the following elements:

1. ЭПУ-13ТБ electric launch units designed for feeding the missiles in the suspension system and switching over the electrical equipment during launching.

2. МП-28А acceleration pickup.

In the case of an acceleration exceeding 2 at altitudes up to 14,000 m. or exceeding 1.6 at altitudes over 14,000 m., the acceleration pickup feeds a signal to the red warning lamp ACCELERATION SIGNAL (СИГНАЛ ПЕРЕГР.). The altitude signal supplied to the МП-28А pickup relay of changing the acceleration from 2 to 1.6 is fed by the radar altitude pickup when an altitude of 14,000 m. is reached.

3. Selector switch RKT MSL - SP. MSL - BOMBS installed behind the right upper board of the instrument panel.

4. Installed in the left lower part of the instrument panel are:

(a) missile launch sequence switch SP. MSL LAUNCH, LEFT - RIGHT;

(b) launch selector switch SALVO - SINGLE (ЗАЛП - ОДИНОЧНО) used for changing the launching modes;

(c) emergency release button ARMAMENT EMERG. DROP (АВАР. СБРОС ПОДВЕСОК);

(d) suspension indication system pilot lamps LEFT, SUSPENDED (ПОДВЕШ. ЛЕВ.) and RIGHT, SUSPENDED (ПОДВЕШ. ПРАВ.). The lamps are of a green colour.

CAUTION: While checking the condition of P-3C missile control and launching circuits, the circuit breaker BOMB RELEASE (ТАКТИЧ. СБРОС) must be switched off and safety-wired, otherwise the sound signal and second missile preparation automatic circuit is out of opera-

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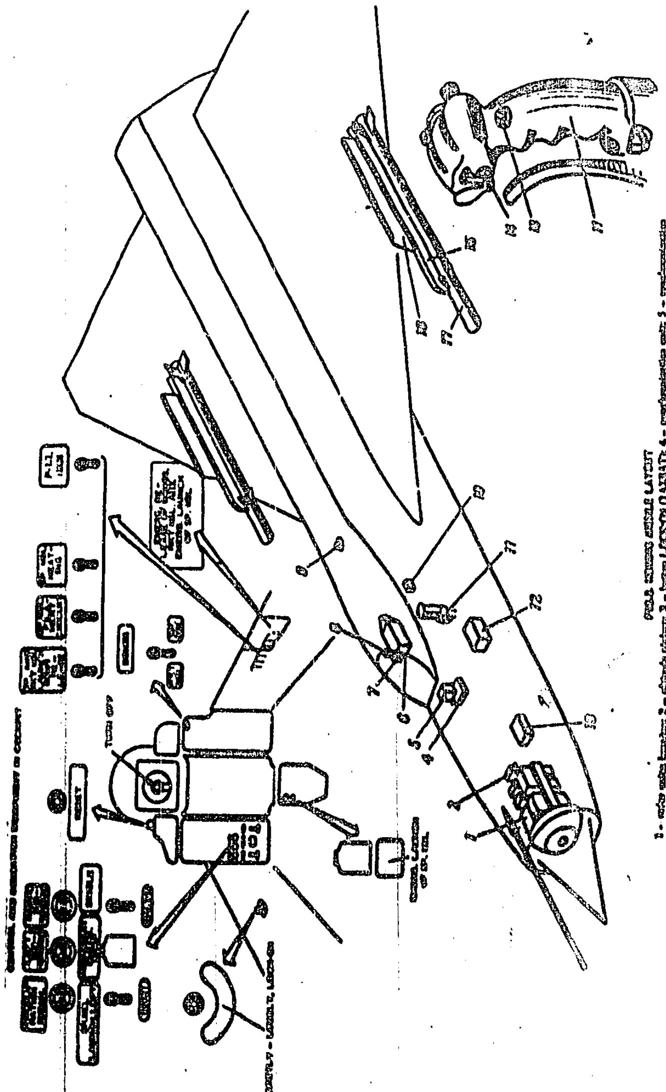

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tion and the pilot lamps indicate that the launcher is suspended from the underwing rack lock instead of indicating the presence of missiles suspended from the launcher.

5. Sound signal volume control used to adjust the volume of signals fed to the pilot's headphone from the missile infrared homing head.

The volume control is arranged on the port side in the cockpit and carries the inscriptions LOCK-ON, QUIETLY - - LOUDLY (ЗАХВАТ, ТИШЕ - ГРОМЧЕ).

6. Button EMERG. LAUNCH OF SP. MSL (АВАР. ПУСК СО). The button is arranged on the central board in the lower part of the instrument panel.

7. Arranged on the right-hand electric panel are circuit breakers SP. AND RKT MSL LAUNCH. BOMB. SP. MSL FILAMENT CIRCUIT, SP. MSL HEATING and РСИУ.

8. Installed on the right-hand rear electric panel are circuit breakers RADAR SET (Р-1Л), SIGHT (ПКИ), and EMERG. RELEASE OF BOMBS, RKT MSL, АПУ. EMERG. LAUNCH OF SP. MSL (АВАР. СБРОС БОМБ, РС, АПУ. АВАР. ПУСК СО). The rheostat SIGHT LIGHTING.(ПОДСВЕТ ПКИ) is situated on the right-hand board in the upper part of the instrument panel.

9. ДЗ-57Д locks with electromagnetic release mechanism used for emergency release of the launchers.

10. Box housing the sound signal circuit automatic engagement and second missile launch circuit preparation relay.

Р-1Л Radar Set

The Р-1Л aircraft radar is used as a part of the system used for interception of air targets and aiming the self-homing missiles carried by the МиГ-21ФЛ interceptor.

Regardless of the visibility, the radar set automatically scans a space in the front hemisphere within $\pm 30^{\circ}$ in azimuth and $\pm 12^{\circ}$ in elevation at a range of 20 km. and provides aiming by means of the radar electronic indicator, which employs automatic indication of P-30 missile launching zones.

When an aircraft gets into the radar search zone the radar operates in the sweep mode and its indicator displays a bright target blip.

The azimuth position of the blip with respect to zero azimuth represents the target azimuth bearing in space.

As the target is approached to a range within 10 km. and when the interceptor gets into a position where the target moves within a zone of $\pm 5^{\circ}$ in azimuth and vertical markers are situated above and beneath the target blip, the pilot will depress the button LOCK-ON (ЗАХВАТ) arranged on the aircraft control stick and thereby lock into the target.

In case the level of a signal echoed from the target is sufficiently high to activate the automatic lock-on unit, the target is locked in range and the radar indicator is changed over to the sighting mode. This brings about a change in nature of the target blip displayed on the screen. Now the target blip is shaped as a "V" with vertical markers denoting the present range and a gap between the sides representing the permissible launching zone (on scale).

When the target is not locked and the button is released, the radar set changes over to the search mode.

In the event of locking into a false target (e.g. the earth) or into a target other than the one tracked, the target can be abandoned by depressing the button RESET (СБРОС ЦЕЛИ) situated above the left-hand upper board of the instrument panel.

Combat Launching of Missiles

When the simulated target blip centre is retained inside the radar indicator smaller circle, the aircraft moves into a position where the heat homing heads of the missiles lock into the target.

At the instant when the target range becomes equal to a value which corresponds to the threshold sensitivity of the homing head, the latter locks into the target and sends a sound signal of different tone to the pilot's headphone.

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The missile must not be launched until a missile homing head lock-on sound signal is fed to the headphone, the target range vertical markers on the radar set indicator are situated within the permissible launching zone, the acceleration is normal and the interceptor speed does not exceed the limits specified in the Pilot's Instructions.

For single launching of the missiles, the launch sequence switch must be set into either position LEFT (ЛЕВЫЙ) or RIGHT (ПРАВЫЙ) depending upon the fire mission.

In this case, no resetting of the switch into another position is required for listening to sound signal and preparation for launching of the second missile after the first one has been launched.

The launching button should not be depressed for firing the second missile unless the first one gets away. The get-away time is 0.5 to 1 sec. The time to keep the button depressed during launching should not be less than 2 seconds.

When the interceptor approaches the danger target range equal to 1.65, the breakoff warning lamp "O" lights up on the radar indicator. After this the pilot should break off.

In case the missiles have not been fired till the aircraft gets to the danger range, no firing of missiles is permissible, since the aircraft may be damaged by the splinters of its own missile.

Emergency Release

The missiles are released on emergency together with the launchers when a voltage is applied to the electromagnet of the ДЗ-57Д lock installed in the underwing rack.

To feed the voltage, circuit breaker EMERG. RELEASE OF BOMBS, RKT MSL, ARV. EMERG. LAUNCH OF SP. MSL should be switched on and the emergency release button ARMAMENT EMERG. DROP should be depressed.

The emergency release circuit breaker must be switched on before flight.

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Emergency Launching

Whenever a necessity arises, the missiles can be launched by depressing the emergency launching button EMERG. LAUNCH OF SP. MSL.

After the emergency launching button is depressed, a voltage is applied to start the solid-propellant engine and to the electric igniter of the optical proximity fuse thermal cell, regardless of readiness of other circuits of the missile for launching.

The voltage is supplied similarly as in the case with the emergency release effected by depressing circuit breakers EMERG. RELEASE OF BOMBS, RKT MSL, АПУ. EMERG. LAUNCH OF SP. MSL.

2. SUSPENSION AND DISMOUNTING OF АПУ-3С LAUNCHER

The procedure of suspending the launchers from the underwing rack locks is similar to that of suspending the rocket pods.

The procedure of suspending the rocket pods is described in the Chapter dealing with the maintenance of rocket missiles.

For suspending the launchers the front and rear stops used to attach the rocket pods are to be replaced by the stops for attachment of the АПУ-3С devices, base 52 and 60 mm, which are permanently allotted to be used with the given underwing racks.

Each time before suspending the launcher, the threaded portion of the yoke eyes, nuts and washers must be greased with ЦИАТИМ-201 lubricant.

Tightening of launcher yokes must be checked by a triple turnover (clicking) of a calibration wrench (Fig. 9). The wrench should be turned smoothly and without cocking.

After tightening the yokes with the calibration wrench, and prior to checking the force applied to release the snap of the ЗУС-13 testing device, check the free passage of the ТИП-13 bore sighting gauge through the entire guide groove

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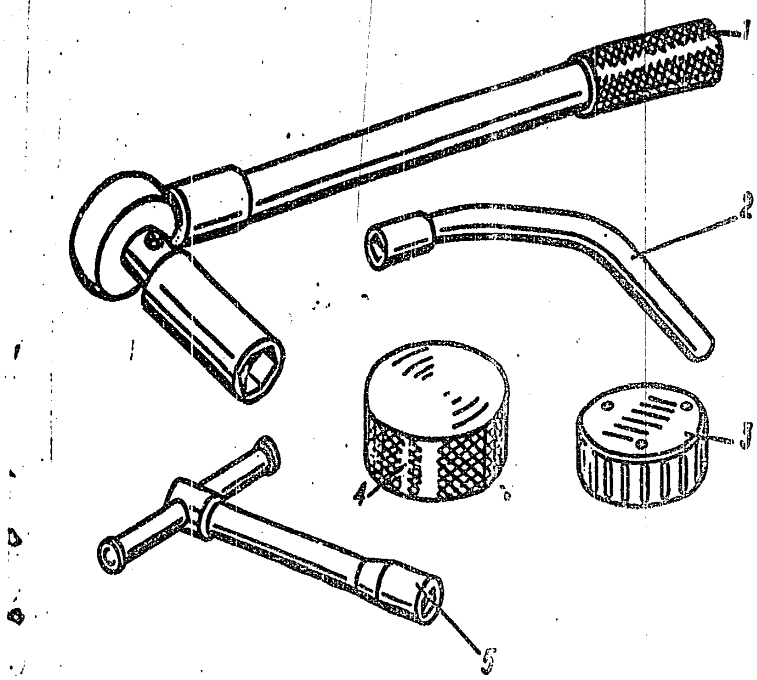

FIG.9. АПУ-3С LAUNCHER TOOLS AND ACCESSORIES

1 – calibration wrench for tightening the launcher; 2 – wrench for opening the vibration dampers and front fairing; 3 – ШР-32) connector choke; 4 – 2PN connector choke; 5 – getaway force adjustment wrench.

of the launcher. To this end the guides of the gauge must be fitted into the groove of the launcher and the gauge moved forward through the groove so that the front guide of the TKП-13 gauge be set near the front vibration damper. The TKП-13 gauge bush should be directed similarly to the getaway motion of the missile.

In the event of jamming of the gauge in the guide groove, loosen the yokes, tighten them again, this time with another wrench, and repeat checking with the TKП-13 bore sighting gauge.

If the gauge is jammed again, the launcher and wrenches need testing.

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After suspension is over, accurate laying, getaway force of the missile, and condition of feed, launch and checking circuits should be checked. 50X1-HUM

While dismounting the launchers from the underwing rack, proceed as follows:

(a) make sure the storage battery and circuit breakers used for emergency release are cut off;

(b) fit the wrench on the lever axle square end, turn the axle in the direction indicated by the arrow and disengage the underwing rack plug connector socket from the launcher connector plug;

(c) insert a stud under the lever by driving it through the bomb clamp front attachment bolt, and thereby lock the disengaged plug connector;

(d) hold the launcher up to prevent its falling down, release the ДЗ-57Д lock levers with the wrench and separate the launcher from the underwing rack.

3. *TESTING THE FEED, LAUNCH AND CHECKING CIRCUITS BY MEANS OF SIMULATORS ИИ-13А*

In order to test the condition of the feed, launch and checking circuits by means of the ИИ-13А simulators (Fig. 10), proceed as follows.

1. Couple the aircraft to the ground D.C. and A.C. power supplies.

2. Suspend the ИИ-13А simulators from the launchers so that the boards carrying the pilot lamps and band change-over knobs should be turned away from the fuselage.

For suspending the simulators, drive the contact insert of the simulator into the front slot (hole) in the launcher and move the simulator along the launching beam groove as far as it will go after the snap with the contact pins have been moved up by means of a special wrench.

3. Couple the connector plugs of the simulator connecting wires to the ШР-М20 connectors of the launcher.

4. Connect the storage battery and read the voltmeter to check that the aircraft mains voltage is 27 V ±10 per cent.

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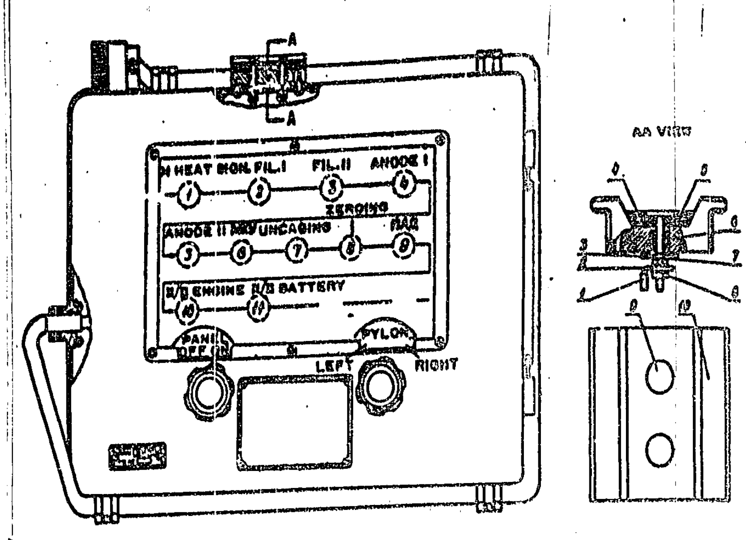

FIG.10. ИЭ-13А SIMULATOR TOP PANEL.

1 – sheet; 2 and 3 – washers; 4 – gasket; 5 – patch; 6 – bush; 7 – washer; 8 – nut; 9 – contact bolt; 10 – guide.

5. Check the condition of the control circuits when the launch selector switch is in position SALVO (ЗАЛП). To do this, proceed as follows:

(a) set the armament selector switch into position SP. MSL (СС);

(b) switch on circuit breakers SP. MSL HEATING, SP. MSL FILAMENT CIRCUIT, SP. AND RKT MSL LAUNCH. BOMB RELEASE, (ПУСК СС, РС, БОМБЫ), РСИУ, L.G. WARNING NAVIG. LIGHTS (СИГН. ШАССИ АНО) and A.C. GENERATOR. GROUND SUPPLY (ГЕНЕРАТОР ПЕРЕМЕННОГО АЭРОДР. ПОТ.);

(c) set the simulator knob PANEL – OFF – ON (ПУЛЬТ – ВЫКЛ. – ВКЛ.) into position ON, shift the left simulator knob PYLON – LEFT – RIGHT (ПИЛОН – ЛЕВ. – ПРАВ.) into position LEFT and the right simulator knob into position RIGHT and make sure that:

– six pilot lamps listed below light up on each simulator panel:

"1" lamp ЛI, HEATING (ОБОГРЕВ), M SIGNAL (M СИГН.)

"2" lamp Л2, FILAMENT I (НАКАЛ I)

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"3" lamp Л3, FILAMENT II (НАКАЛ II)

"4" lamp Л4, ANODE FEED I (АНОДНОЕ ПИТАНИЕ I)

"5" lamp Л5, ANODE FEED II (АНОДНОЕ ПИТАНИЕ II)

"6" lamp Л6, МКУ (МКУ I and МКУ II)

– missile suspended indication lamps LEFT, SUSPENDED and RIGHT, SUSPENDED light up on the instrument panel board;

– a sound signal is fed to the pilot's headphone with the launch sequence switch SP. MSL LAUNCH, LEFT – RIGHT set to both positions.

While listening to the signals, check the adjustment of the sound signal volume by turning the volume control knob arranged on the left-hand panel inside the cockpit;

(d) push the button on the ППС-2МК panel and make sure that all lamps arranged on the simulator panels, apart from the six mentioned above, go out. Glow of any other lamps on one of the panels observed before the firing button is depressed, is indicative of an unserviceable condition of the respective launcher;

(e) keep the ППС-2МК panel button depressed and push the firing button to make sure five more lamps light up on each panel of the ИМ-13А simulators. The five lamps discussed are:

"7" lamp Л7, UNCAGING (РАЗАР.) UNCAGING I (РАЗАР. I) and UNCAGING II (РАЗАР. II)

"8" lamp Л8, ZEROING (ОБНУЛЕНИЕ)

"9" lamp Л9, ПАД

"10" lamp Л10, П/П ДВИГ.

"11" lamp Л11, П/П АКК.

<u>CAUTION</u>: Never should the ИМ-13А simulator housing be knocked to stimulate actuation of the simulator circuits;

(f) release the firing button and the ППС-2МК panel button, install the safety pins into the special holes in the launchers and make sure lamps 10 П/П ДВИГ. and 11 П/П АКК. go out on both simulator panels;

(g) drive the safety pins from the holes in the launchers, first switch off the circuit breakers SP. MSL FILAMENT CIRCUIT and SP. MSL HEATING, and then switch them on.

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Check that all pilot lamps arranged on the simulators should go out when the circuit breakers are switched off, and only six initial lamps should light up as the circuit breakers are switched on again.

6. To check the condition of the control circuits when the launch selector switch is set into position SINGLE, proceed as follows:

(a) set the launch sequence switch into position SP. MSL LAUNCH, LEFT;

(b) make sure the six initial lamps 1 through 6 still glow on both simulator panels;

(c) push the ППС-2МК panel button and keep it depressed, then push the firing button and check that five more lamps 7 through 11 light up on the left-hand simulator panel while the respective lamps installed on the right-hand simulator should not glow;

(d) to check the automatic engagement of the sound signal and second missile launching circuits for normal actuation, proceed as follows.

Keep the firing button and the ППС-2МК panel button depressed, and set the left-hand simulator knob into position OFF. Check whether all pilot lamps and the left-hand missile suspension indication lamp arranged in the cockpit go out and whether only six initial lamps still glow on the right-hand simulator panel. Release the buttons.

Make sure that when the launch sequence switch is set to SP. MSL LAUNCH , LEFT, a sound signal is fed from the right-hand missile to the pilot's headphone, and lamps 7 through 11 light up on the right-hand simulator panel when the ППС-2МК and firing buttons are depressed;

(e) switch on the left-hand simulator, set the sequence switch into position RIGHT, and proceed in a manner described above to check the [illegible]ition of the right-hand missile launch control circuits as well as of the sound signal engagement circuit and left-hand missile launch circuit while the sequence switch is kept in the same position.

7. Switch off the circuit breakers engaged for checking the control circuits.

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CAUTION: Never test the launch control circuits in the event of short-circuiting between the ground and the contacts arranged inside the launcher snap housing as may be the case when dummy missiles, 3УС-13 and other devices are suspended. Short-circuiting may cause a burnout of resistors inserted in the missile launch control circuits.

8. To check the emergency launch circuit for normal operation, proceed as follows:

(a) make sure that knobs PYLON - LEFT - RIGHT arranged on the ИМ-13А simulators are set into the positions corresponding to the respective pylons;

(b) switch on the circuit breaker EMERG. RELEASE OF BOMBS, RKT MSL, АПУ. EMERG. LAUNCH OF SP. MSL;

(c) push the emergency launch button and make sure that this causes lamps 10 П/П ДВИГ. and No. 11 П/П АВК. light up on the ИМ-13А simulator panels. After checking, switch off the emergency release circuit breaker and insert safety pins into the holes in the launcher.

9. Set the simulator knobs into position OFF and disconnect the connector plugs from the ШР-М20 connectors of the launcher.

10. Disconnect the storage battery and the ground electric power supply, then remove the simulators from the launchers following the procedure reverse to that of installing the devices.

In case only a part of pilot lamps lights up during checking the control circuits, the launch circuit is faulty. The number and inscription under the lamp which fails to light up indicate the faulty circuit.

If the ИМ-13А simulator indicates that the launch circuits are faulty, use the ИМ-13Т simulator to check the launcher.

If it has been found that the launchers with the 3ПУ-13ТВ electric launch units are fed with the generator output launching voltages different from those indicated in the Certificate by ±6.5 V, the launchers are said to be serviceable and fit for suspending the missiles.

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NOTE: Under normal conditions, the generator launching output pickup should be actuated by:
(a) 116 V ± 3 V A.C. voltage;
(b) $62.5^{+3.5}_{-2.5}$ V D.C. voltage;
(c) voltage of 140 ± 7 V supplied by turbo-generator.

In case the first or any central lamp does not glow, while the rest light up, proceed as follows:

(a) switch off the simulator and all circuit breakers;

(b) remove the simulator from the launcher under test;

(c) replace the burnout lamp;

(d) repeat checking of the same launcher.

To replace the lamp, drive out the attachment screws and remove the front board from the simulator.

NOTE: As is prescribed by the simulator description, the simulator must be checked not less than once every three months.

4. TESTING THE CONDITION OF FEED, LAUNCH AND CHECKING CIRCUITS BY MEANS OF ИИ-13T SIMULATOR

The ИИ-13T simulator (Fig. 11) is intended for checking the missile feed and launching circuits performed during routine maintenance. Whenever necessary, the simulator can be used for testing the control circuits prior to suspending the missiles to the launchers.

To make a check, proceed as follows:

1. Couple the aircraft to a ground electric power supply.
2. Install the ИИ-13T simulator under the aircraft, open the cover and pull out the connecting wire.
3. Couple the simulator plug connector to the ШР-М20 connector of the launcher by the connecting wire.

Drive the contact insert of the wire into the launching beams and move the insert in as far as it will go after the snap with the contact pins has previously been unlocked and moved up. While installing the insert, check that the arrow on the contact insert points the direction of flight.

4. Set the simulator checking selector switch and switches U GENERATOR 30 (U ГЕН. 30) and APY into position OFF.

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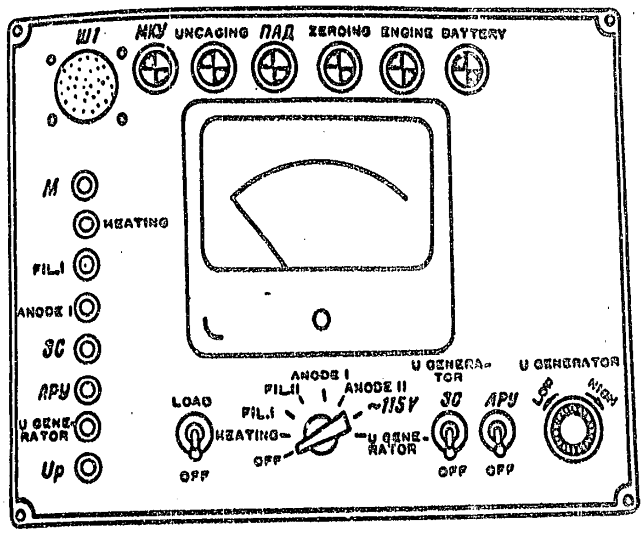

FIG.11. И4-13T SIMULATOR TOP PANEL

5. Turn on the right-hand panel storage battery switch and read the voltmeter to make sure the aircraft mains voltage is 27 V ±10 per cent. Switch on the circuit breaker A.C. GENERATOR. GROUND SUPPLY.

6. To check the ПАД heating circuit, proceed as follows:

(a) switch on the circuit breaker SP. MSL HEATING;

(b) set the simulator selector switch into position HEATING;

(c) read off the simulator voltmeter to check that the output voltage is within 27 V ±10 per cent.

Apart from this, see that the lamps МКУ (lamp Л1) and UNCAGING (lamp Л2) light up on the simulator panel when the circuit breaker SP. MSL HEATING is switched on.

7. Set the armament selector switch into position SP. MSL and shift the launch selector switch SP. MSL LAUNCH, LEFT - RIGHT into the position corresponding to the respective launcher.

8. Turn on the simulator switch LOAD (НАГРУЗКА).

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9. To check the filament and anode feed circuit, proceed as follows:

(a) switch on circuit breaker SP. MSL FILAMENT CIRCUIT and check whether the lamp indicating that a missile has been suspended from the APU-30 launcher connected to the simulator should light up inside the cockpit;

(b) make sure that the voltmeter reads 25 V ±10 per cent when the simulator selector switch is set in either position FILAMENT I or FILAMENT II;

(c) make sure that the voltmeter reads 160 V ±10 per cent when the simulator selector switch is set into either position ANODE I or ANODE II.

NOTE: 1. Mind that switch LOAD should be engaged for measuring the filament and anode voltages only, and should not be kept switched on for more than 3 minutes.
2. When the temperature is below -30°C, switch LOAD should be turned on for 10 min. to heat up the simulator prior to measuring the voltages of the launcher circuits.

10. To check the launch control circuits for normal operation, proceed as follows:

(a) switch on circuit breakers SP. AND RKT MSL LAUNCH, BOMB RELEASE and L.G. WARNING NAVIG. LIGHTS;

(b) set the simulator selector switch into position 115 V (115 B) and check whether the voltmeter pointer settles within the red sector (at a voltage of 115 V ±5 per cent);

(c) turn on the simulator switch U GENERATOR 30 switch on, the circuit breaker PCWY installed inside the cockpit and listen into the headphone to the sound signal when the launch switch is set to SALVO and SINGLE positions;

(d) turn on the simulator switch AFY and make sure that this effects amplification of the sound signal fed to the headphone;

(e) check whether the volume of the sound signal varies as the volume control knob is turned;

(f) push the IIIC-2HK panel button, keep it depressed and push the firing button.

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Check whether this causes the simulator panel lamps ПАЛ (Л3) and ZEROING (Л4) to light up, while lamp UNCAGING (Л2) goes out;

(g) set the simulator selector switch into position U GENERATOR;

(h) turn the knob U GENERATOR smoothly to the right and increase the voltage till lamps ENGINE (ДВИГ.) (Л5) and АКК. (Л6) light up. Read the voltmeter to know the generator launching output voltage value;

(i) keep the firing and the ППС-2МК buttons depressed, insert a safety pin into the АПУ-3С launcher and make sure lamps ENGINE and АКК. arranged on the simulator panel are off.

NOTE: Glow of the lamps ПАЛ, ENGINE and АКК. observed before the firing button is depressed, is indicative of faulty operation of the launch control circuits under test.

11. Switch off the circuit breakers engaged for checking the feed and launch circuits.

12. To check the condition of the emergency launch circuit, proceed as follows:

(a) drive the safety pin out of the hole in the launcher;

(b) turn on circuit breaker EMERG. RELEASE OF BOMBS, NET MSL, АПУ. EMERG. LAUNCH OF SP. MSL;

(c) push the emergency launch button and make sure that lamps ENGINE (Л5) and АКК. (Л6) light up on the ИМ-13Т simulator panel.

13. Set the simulator panel switches U GENERATOR 3С and АПУ into the OFF position, turn knob U GENERATOR all the way to the left and switch off the emergency launch circuit breaker.

14. Pull up the launcher snap and remove the simulator insert from the launcher.

15. Disconnect the simulator wire from the launcher connector.

Proceed in a similar manner to check the feed, launch and missile suspension indication circuits of the other wing for normal operation.

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5. MEASURING THE MISSILE GETAWAY FORCE

To evaluate the effort applied during missile getaway, the 8УО-13 testing device (Fig. 12) is employed each time the missiles have been fired for ten times and in case of routine maintenance.

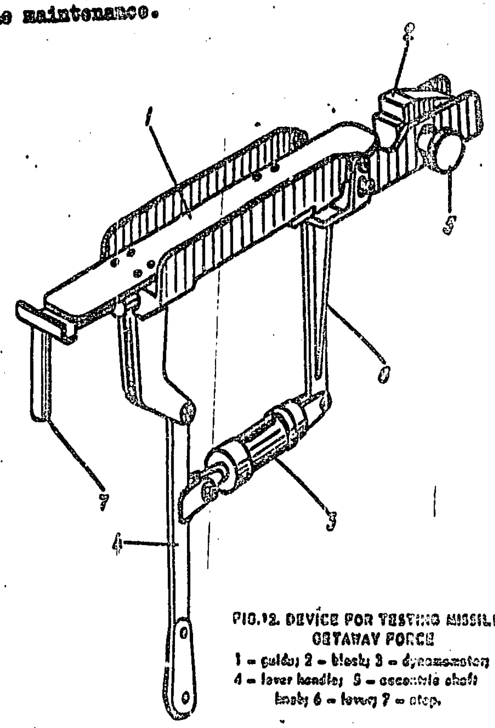

FIG. 12. DEVICE FOR TESTING MISSILE GETAWAY FORCE
1 – guide; 2 – block; 3 – dynamometer; 4 – lever handle; 5 – eccentric shaft knob; 6 – lever; 7 – stop.

The operations performed to measure the getaway force should be accomplished as follows.

1. Check the working surfaces of the testing device for condition, and use fine emery paper to remove dents, burrs or scores, if any.

2. Make sure the launching beams are in good condition.

3. Fit the steel plate of the testing device into the guides of the АПУ-30 launching beams and move the device forward till the bracket of the plate stops against the beam end.

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CAUTION: Before using the 3УС-13 testing device make sure the launcher is de-energized.

4. Set the dynamometer ring to zero.

5. Turn the eccentric shaft knob clockwise as far as it will go and make sure the block of the testing device has mated the launcher snap front roller stop.

6. Turn the testing device lever smoothly in the direction of getaway motion unless the block presses the snap on and moves behind the roller stop, which should occur when the force applied is 420 ±40 kg.

To check the getaway force observe the position of the dynamometer ring relative to its scale graduated in numbers from 280 to 500 in each twenty division.

After checking, remove the testing device from the launcher.

NOTE: The testing device should undergo calibration performed with the help of ПТ-3УС-13 calibrating arrangement not less than once every six months.

6. PREPARATION AND SUSPENSION OF MISSILES

The special missiles are prepared for combat use at a missile preliminary preparation position in compliance with the relevant operating instructions.

Prior to suspending ready missiles, proceed as follows.

1. Inspect the armament units housed in the cockpit.

2. Take measures required to prevent premature launching or other accidents that may occur during suspension of missiles.

3. While the missiles are being suspended, there should be red warning flags (or red warning lights at night) installed in front of, and behind, the aircraft to mark off the space dangerous to pass near the aircraft in a given direction.

4. Examine and check the condition of the suspension system units.

5. Check the condition of the launch control system with the help of the ПУ-13А panel. After checking, cut off all control system circuit breakers.

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6. Make an external examination of the missiles. Check the parts of the missiles for various mechanical damage and the launching beams for serviceable condition.

7. Clean the launching beams and install a safety pin with a warning tab into a hole in the launcher.

8. Turn the launcher front fairing locking axle and fold the fairing up. The locking axle should be turned in the direction indicated by an arrow.

9. Move the snap up by means of a wrench and fix it in position with a stud inserted through a special hole in the launcher housing.

10. Lift the missile and align its front and central guides with the grooves of the launcher, fit the guides into the grooves and move the missile forward along the launching beams till it rests against the front roller stop of the snap.

11. Drive the safety stud from the snap and check whether the rear stop of the snap travels down and stops behind the launching beam so that the missile is locked in the launcher.

12. Couple the connector plug of the missile to the plug connector socket of the launcher.

13. Fasten the bracket installed in the launcher front fairing by fixing the bracket to the CP-20Л shear plug connector with the help of snaps.

14. Close the front fairing and make sure it is reliably locked by noting whether the reference lines CLOSED coincide.

While closing the fairing, first turn the axles with a wrench in the direction indicated by an arrow.

Upon closing the fairing turn the axle with a wrench in the opposite direction till the reference lines coincide.

15. Sway the missile vertically and make sure there is no play between the launching beams and missile guides.

When the missile is fixed, the front end of the missile guide should rest upon the roller and the rear end should stop against the snap boss bevel.

The play produced while pushing the missile along the aircraft axis should not be less than 0.2 mm.

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16. Check whether the missile guide is locked reliably by noting the position of reference lines notched on the two-arm lever and on the launcher front vibration damper strap bosses. In case of displacement of the line on the lever from the lines on the vibration damper strap, turn the opening lever counter-clockwise with a wrench and fix the snap. If this does not yield desirable results, the launcher snap and the missile guide need be checked over again.

7. PROCEDURE OF REMOVING THE UNUSED MISSILES

The cases of removing the unused missiles from the launcher are the following:

(a) when any faults have been detected in the launch control system;

(b) in case of landing with missiles unused;

(c) in case of repeated flight postponed;

(d) when the missile instruments are to be checked.

To remove the missiles from the aircraft, proceed as follows.

1. Take safety precautions.

2. Make sure the storage battery and missile feed and launch control circuit breakers installed in the cockpit are disconnected.

3. Install a safety stud into the hole in the launcher.

4. Install a protective cowl on the missile homing head, cover the optical proximity fuse compartment with a protective cowl and install rubber caps on the missile fins.

5. Open the front fairing of the launcher and uncouple the plug connector.

6. Use a wrench to move the locking snap up and fix it with a stud.

7. Push the missile smoothly back by hands, drive the missile guides out through the launching beam grooves and place the missile on the TT-13 cart.

Mind that the missile must be checked regularly at a preliminary preparation position as is specified in the missile Certificate. The time terms of checking are:

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(a) after a period of 30 days, if the missile is kept suspended from the launcher;

(b) after five landings of the aircraft with missiles unused;

(c) not later than 24 hours after the missile has been exposed to rain or snow.

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Chapter II

MAINTENANCE OF ROCKET MISSILES

1. GENERAL

Apart from the Р-3С self-homing missiles or bombs, the underwing racks БДЗ-60-21УМ with lock ДЗ-57Д can be used for suspending two УБ-16-57У rocket pods, each loaded with 16 rocket missiles, type С-5М or С-5К.

To control the launching of rockets loaded in the rocket pods, the ПУС-36ДМ fire controllers are employed.

Zero position of each controller (i.e. its readiness for operation) is indicated by glow of pilot lamps.

Each time when the button is depressed, the control system can be engaged for:

(a) single-shot fire by launching one rocket missile from each pod;

(b) burst of two rockets fired at intervals of 50 msec. from each pod;

(c) continuous fire by launching the rocket missiles from each pod in succession till the missiles are completely used up.

Rocket launching is interlocked by retraction of the nose strut.

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The aircraft is equipped with a rocket pod emergency release system and with a system interlocking both rocket pods and rockets loaded in the pods.

ПУС-36ДМ Fire Controller

The ПУС-36ДМ fire controller (Fig. 13) is designed for successive generation of 36 pulses of electric current and feeding them to the consuming circuits in a certain sequence.

Basic Specifications

1. Operating voltage .... 27 V ±10 per cent
2. Consumed current .... 1.6 A
3. Time interval between pulses 20 to 30 msec.
4. Pulse duration .... 5 to 17 msec.
5. Service temperature range ... from −60°C to +60°C
6. Time required to keep the firing button depressed to guarantee complete cycle of 36 pulses .... not less than 1 sec.

CAUTION: To prevent burnout of the instrument windings, never keep the button depressed for over 15 sec.

Installed in the centre of the distributor is a slip ring and a rivet. Taken off the slip ring the current is fed from the inside lamellas array to the relay winding contacts, and from the rivet the current is applied to the outside array lamellas.

Initially, wiper No. 1 rests upon the first lamella of the outside array and wiper No. 2 is set between the lamellas of the inside array. Contact K1 is coupled to contacts K2 and K3. Contact K4 is connected to the ratchet gear contact. In this position, the ПУС-36ДМ initial position pilot lamp should glow.

When a series of two pulses is applied, the switch is set into position 1 SALVO. As the button is pushed, the aircraft mains current is applied to all lamellas of the

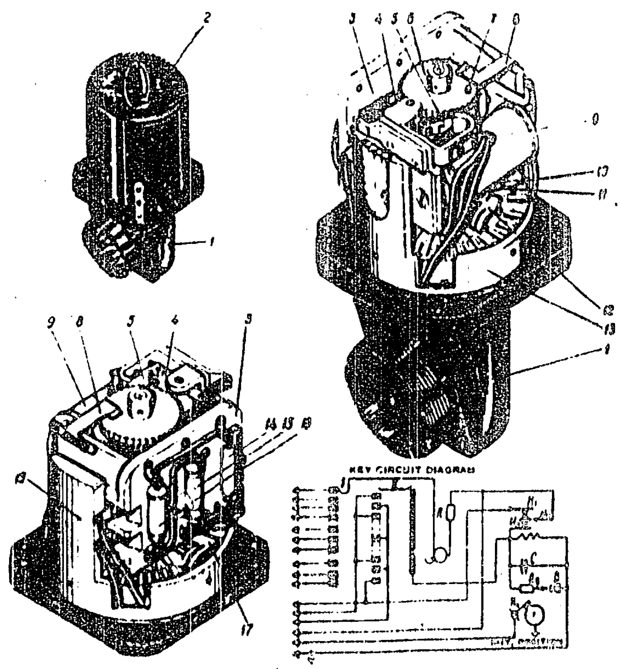

FIG. 13. [illegible] FIRE CONTROLLER

1 – plug connector housing; 2 – cover; 3 – plates; 4 – [illegible]; 5 – pawl; 6 – ratchet gear; 7 – rotator gear contact; 8 – contact plate; 9 – coil; 10 – distributor outside array lamellas; 11 – distributor inside array lamellas; 12 – slide wiper; 13 – sleeve; 14 – capacitor; 15 – adjustment resistor; 16 – germanium diode; 17 – slide wiper.

distributor inside array, and via contacts K1 and K2, resistor R and wiper No. 1 is fed to the first lamella which supplies the first consuming circuit.

Simultaneously, the positive of the aircraft mains is applied to the relay core winding via contacts K1, K2 and K3. As the relay is actuated, it picks up the armature which shifts the pawl and meshes it to the next tooth of the ratchet gear and acts upon a dowel to release a three-lug contact spring used to break circuit K1, K2 and K3.

After this, no current is fed to the core winding and outside array first lamella.

As the relay drops out, the armature travels to its initial position. The pawl turns the ratchet gear, mates the next tooth and displaces wiper No. 1 and wiper No. 2 to the second lamella of the outside array and to the inside lamella respectively. Due to this, the contact spring closes contacts K1, K2 and K3 again. The positive of aircraft mains is now fed from the second lamella of the outside array to the next consuming circuit and to the relay winding connected through contacts K1, K2 and K3.

<u>NOTE:</u> The aircraft circuitry is arranged so that the consumer is connected via one lamella to odd lamellas of the distributor outside array. Due to this, only one pulse is fed to the consumer from each couple irrespective of the launch sequence switch position. Hence, the intervals between subsequent shots are increased to 50 msec.

Simultaneously the positive of aircraft mains is applied to the relay winding from the inside array lamella via wiper No. 2 and distributor slip ring.

The relay is actuated again and breaks the circuit of contacts K1, K2 and K3. As a result, the current supply to the second lamella is interrupted, while the current fed via wiper No. 2 from the inside array lamella is still supplied to the core winding. Hence, the armature is kept picked up as long as the button is depressed.

When the button is released, the current supply to the relay winding is cut off, the armature forced by the spring is caused to travel into the initial position, wiper No. 1

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is set to the third lamella of the outside array, wiper No. 2 is set between the lamellas of the inside array and contacts K1, K2 and K3 are closed.

As the button is depressed 18 times in succession, 36 pulses of current are delivered. The ratchet gear executes a complete turn, its contact reaches contact K4, and after the button is released, the two contacts are closed so that the instrument initial position pilot lamp is cut in.

To produce a series of four pulses, the switch is set into position 2 SALVOES.

When the button is pushed, the positive is applied to even lamellas of the inside array. The controller produces four pulses and stops. After the button is pressed 9 times in succession, the controller forms 36 pulses and comes to the initial position.

To produce a series of thirty six pulses, the switch is set into position AUTOMATIC.

As the button is pushed, the positive is applied to the last lamella of the inside array alone. The instrument forms 36 pulses and stops.

After the button is released, the instrument returns into the initial position.

CAUTION: While testing the instrument on the ground, an interval of not less than 1.5 min. is required after every three complete cycles.

Control Circuit Units (Fig.14)

The rocket missile control circuit comprises:

1. Pod suspension indication lamps.
2. Circuit breaker BOMB RELEASE.

The circuit breaker is employed in the rocket missile control circuit only for feeding the voltage to the pod suspension indication lamps.

3. ДЗ-57Д locks with electromagnetic release mechanism and МБСВН-57 interlocking and indication mechanism. As is the case with the bomb armament control circuit, the ДЗ-57Д lock electromagnetic release mechanism emergency winding is

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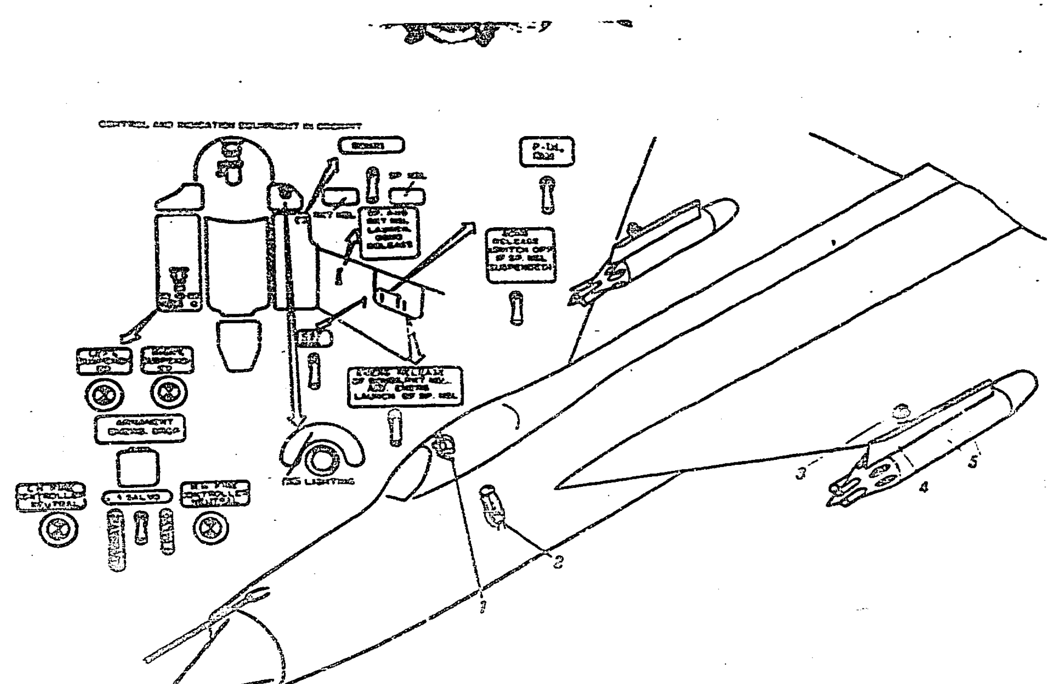

FIG. 14. C-5M AND C-5K ROCKET [illegible] LAYOUT

1 – [illegible], 2 – firing button; 3 – [illegible] controller, 4 – [illegible], 5 – [illegible] rocket pod.

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connected through the interlocking contacts to the release circuit, so that an automatic dropping of one pod is effected should the other pod get accidentally torn off the rack. The MECBH-57 mechanism contacts are used to apply the negative to the pod suspension indication lamps.

4. Circuit breaker EMERG. RELEASE OF BOMBS, RKT MSL, ANY. EMERG. LAUNCH OF SP. MSL and button ARMAMENT EMERG. DROP which is used to release both loaded or empty rocket pods in cases of emergency.

CAUTION: Whenever the aircraft carries the rocket weapons, switch BOMB RELEASE must be turned off and locked with wire for safety.

5. Circuit breaker SP. AND RKT MSL LAUNCH. BOMB RELEASE.

6. Selector switch RKT MSL - SP. MSL - BOMBS.

7. Two fire controllers ПУС-36ПМ, one per each rocket pod. The controllers are made accessible through a hatch in the wing between the rack attachment joints.

8. Circuit breaker RKT MSL installed on the right-hand front panel. The circuit breaker is used for feeding the current to the fire relay contacts and to the controller zero position indication lamps.

9. Rocket fire selector switch installed on the left-hand lower part of the instrument panel. The switch can be set into either position: 1 SALVO, 2 SALVOES or AUTOMATIC.

10. Controller zero position indication pilot lamps. The lamps are used to indicate setting of the fire control instrument into the initial position, which the instrument must acquire before loading the rocket pod. When the instrument is set into its initial position, the lamps glow.

11. The rocket pod provided with contact jacks for coupling the missile ignition wire plugs and with a control connector to couple to the ПКПМ-4 panel. The numbers shown in the unit diagram indicate the priority of launching the missiles during fire (Fig. 15).

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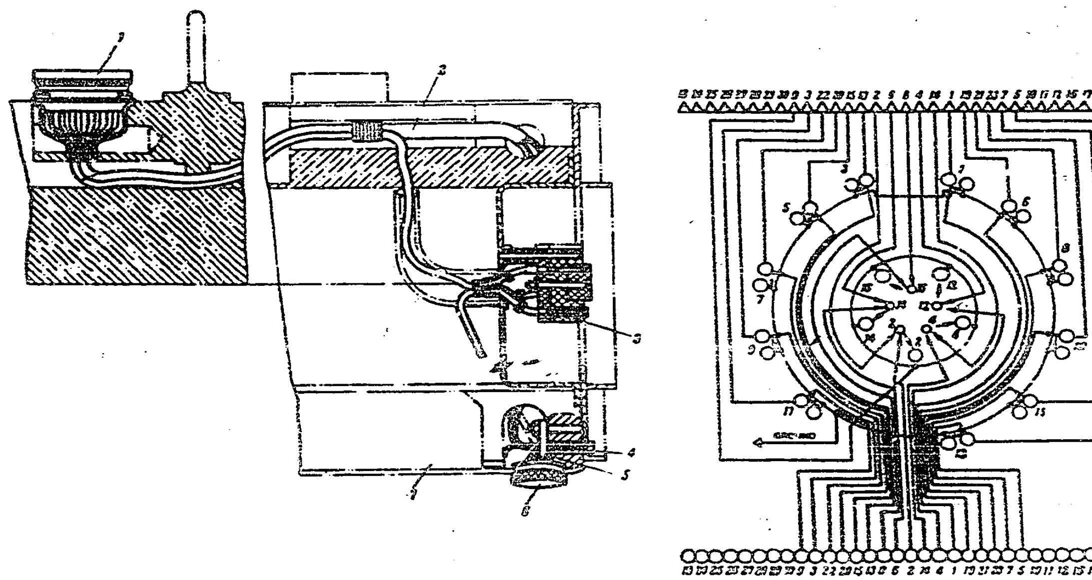

Fig. 13. WIRING DIAGRAM OF [illegible] ROCKET POD

1 - plug; 2 - [illegible] wire; 3 - socket; 4 - jack; 5 - [illegible]; 6 - control connector, 7 - [illegible]

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2. CHECKING THE CONDITION OF FIRE CONTROL CIRCUIT

The rocket missile fire control circuit must be checked for normal operation each time before use.

The procedure of checking is the following.

1. Fix the lock levers, make sure that the levers are locked reliably, fit the pod yokes on the lock bearing levers, drive them home with calibration wrench and couple the pod plug connectors to those of the wing racks.

2. Make sure the selector switch is set into position RKT MSL.

3. Switch on the storage battery and circuit breakers RKT MSL, SP. AND RKT MSL LAUNCH. BOMB RELEASE and L.G. WARNING NAVIG. LIGHTS and make sure the suspension indication pilot lamps are good and do not fail to glow.

4. Set the fire selector switch into position AUTOMATIC.

5. Push the ППС-2МК panel button and fire control button. 1 to 2 sec. later, release both buttons and see if the pilot lamps indicate that the ПУС-36ДМ fire control instrument is set to zero, since in zero position of the controller the lamps should glow.

6. Set the fire selector switch into position 1 SALVO.

7. Couple the ПКПМ-1 connecting wire plug to the rocket pod control socket, or remove the rear fairing and insert the ПКПМ-1 panel wire pins into the contact jacks.

8. Push the lamp condition checking button arranged on the ППС-2МК panel and keep it depressed as long as the checking is made.

9. First push and then release the firing button and see whether the panel control lamp lights up so as to make sure that the first rocket contact jacks are energised. Check that the controller zero position indication lamps are off.

10. Similarly, check the voltages at the ignition wire plug contact jacks of all other barrels of the rocket pod.

<u>NOTE</u>: Checking the control circuits for normal operation performed when the fire selector switch is set into positions 1 SALVO and 2 SALVOES should be accomplished during trouble-shooting or in the case of routine maintenance.

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11. Set the ПУС-36ПМ controller to zero position and check the voltage fed to the ignition wire plug contact jacks, when the fire selector switch is set to 2 SALVOES and AUTOMATIC (АВТОМАТ).

12. Disconnect the panel wire plug from the control socket. Pull the test panel contact pins from the jacks arranged in the rocket pods and install the rear fairing in place.

Shut the control socket with a protective cover.

13. Proceed similarly and check the conditions of circuits used to control the other pod rocket launching.

14. Set the ПУС-36ПМ controller into the initial position and switch off the circuit breakers and storage battery.

3. CHECKING THE ROCKET POD EMERGENCY RELEASE CIRCUIT

The rocket pod emergency release circuits are checked each time when new rocket pods are suspended from the underwing racks.

To make a check, proceed as follows:

1. Make a close examination of exposed parts of the ДЗ-57Д lock levers. Check if the levers are reliably fixed and effectively actuated by the mechanical release.

2. Switch on the storage battery and the circuit breakers EMERG. RELEASE OF BOMBS, RKT MSL, ANV. EMERG. LAUNCH OF SP. MSL and BOMB RELEASE.

3. Fix the lock and fit the lock insert on the bearing lever for control release.

4. Check the interlocking circuit for normal functioning as is described in the Chapter "Maintenance of Bomb Armament." Make sure that as the MECBH-57 mechanism rods are pressed all the way upward, the pod suspension indication lamps light up on the instrument panel. Check if the lamps go out after the levers are released.

5. Push button ARMAMENT EMERGENCY DROP and check if the lock bearing levers are disengaged and if the insert suspended from the levers drops down.

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6. Make a control jettison of the rocket pod. While releasing the rocket pods, hold them by hands.

When making a control jettison, do not couple the underwing rack plug connector to that of the rocket pod.

7. Switch off the storage battery and circuit breakers.

4. SUSPENSION OF ROCKET PODS

In order to suspend the rocket pods from the underwing rack locks, observe the following priority.

1. Examine the underwing rack and ДЗ-57Д lock.

2. Check the actuation of the lock effected by the tactical and emergency release systems. Make sure the emergency release interlocking circuit is in good repair.

3. Remove the bomb clamps from the rack.

4. Install the front stop (base 120 mm) and rear stop (base 108 mm) into the rack.

5. Secure the adapter beam to the rack frame lower part.

6. Fix the ДЗ-57Д lock and make sure it is fixed reliably.

7. Prepare the rocket pod for suspension. Never should the pod be suspended unless it is unloaded.

8. Remove the protective cap from the rack plug connector, move the connector up with a wrench and lock it in the retracted position with the help of a stud inserted under the clamp attachment front bolt.

9. Screw off the suspension yoke eyes (Fig. 16) from pods through 10 to 15 mm, drive the yokes into the mouths of the lock bearing levers and use a wrench to pull the pod up to the rack to achieve contact sufficient to joint the 2PM electric connector.

10. Couple the underwing rack plug connector to the pod mating connector of the rocket pod. To do this, proceed as follows:

(a) drive the locking stud from the hole in the front clamp attachment, hold the connector with a wrench fitted on the lever axle square end, and move the connector smoothly down to set it against the pod connector;

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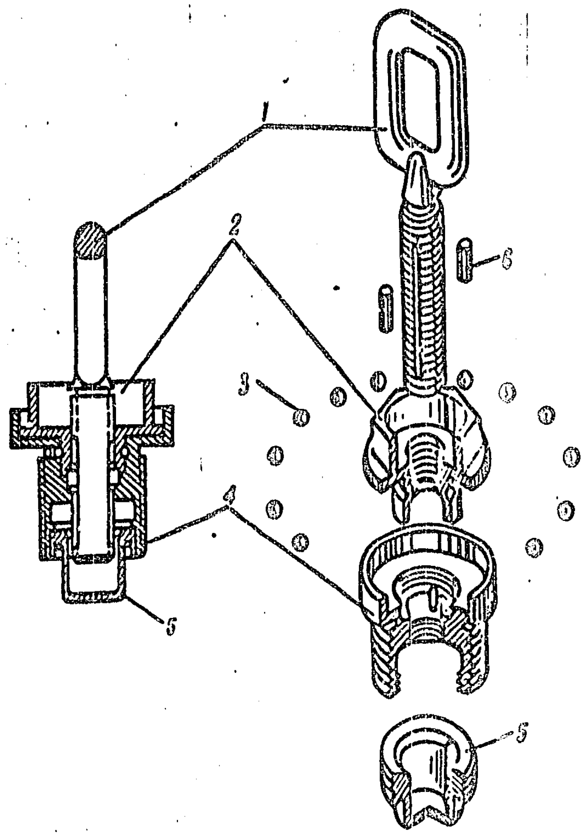

FIG.16. SUSPENSION UNIT

1 — eye-bolt (yoke); 2 — bushing; 3 — ball; 4 — sleeve; 5 — nut; 6 — pin.

(b) use special tongs inserted through the access hole in the adapter beam and move the socket so that the key of the pod plug connector body should fit into the groove of the socket body;

(c) turn the lever axle with a wrench and press the underwing rack connector socket on to fit it completely on the pod connector plug.

11. Check whether the pod stop assemblies fit precisely into the underwing rack mating stops, and screw up the pod

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to the rack till the calibration wrench (Fig. 17) operates completely.

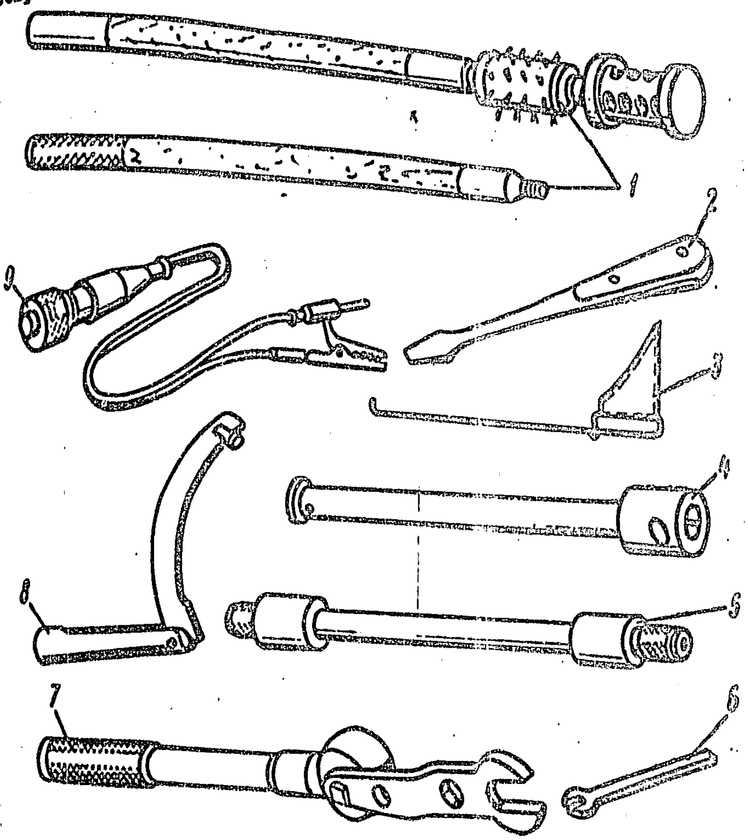

FIG.17. УБ-16-57У ROCKET POD TOOLS AND ACCESSORIES

1 – swab; 2 – screw-driver; 3 – fairing locking pin key; 4 – tappet; 5 – bore sighting gauge adapter; 6 – wrench; 7 – calibration wrench; 8 – fairing wrench; 9 – testing lamp.

12. Check the control circuits for normal operations by means of the test panel and check the weapon fire adjustment with the help of a bore sighting gauge.

Bore sighting is required in case the pod is suspended for the first time.

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5. LOADING OF ROCKET PODS

The rocket pods are loaded after accomplishing an external examination of the suspension system, checking the fire control system and preparation of other weapons. Described below is the procedure of loading the rocket pods.

1. To remove the pod rear fairing, proceed as follows:

(a) use a special wrench with a warning tab, displace the locking pin back till it gets completely out of the clip and fix the locking pin opening wrench by securing it to the pod fairing;

(b) insert another wrench into a hole in the fairing rim, turn the fairing till the lines OPENED coincide and separate the fairing from the rocket pod.

2. Drive the rocket holders from the pod barrels.

3. Wipe grease and dirt off the rocket holders.

4. Couple the aircraft to the ground electric power supply, switch on the circuit breakers installed in the fire control circuit, and use the testing panel to check the voltage fed to the pod socket jacks.

After checking, switch off the storage battery and the circuit breakers of the fire control circuit.

5. Examine and check the rocket missiles and fuses for readiness as is prescribed in the instructions on use.

Preparation and fusing of the rocket missiles should be accomplished beforehand in a place specially assigned for the purpose. Special care is required for checking reliable tightening of the fuzes in the rocket fuze holes.

6. Move the casing a little off and fit the rocket missile into the barrel so as to feed a part of its fins inside the barrel before removing the casing completely.

<u>CAUTION</u>: It should not be forgotten that the stabiliser fins are caused to straighten violently due to action of springs. Therefore, great care is required to move the casing off completely by keeping the casing base portion at straight hands and driving the casing off only after a part of fins has entered the barrel.

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7. Break the thread used to tie up the contact wire and unfold the wire. Inspect the wire and the plug, check them for defects, then pass the plug through the trap hole and fit it into the rocket holder key cut.

8. Slide the holder (Fig. 18) on the rocket missile so that the ring boss of the rocket cement bushing should compress the holder spring and get into the groove.

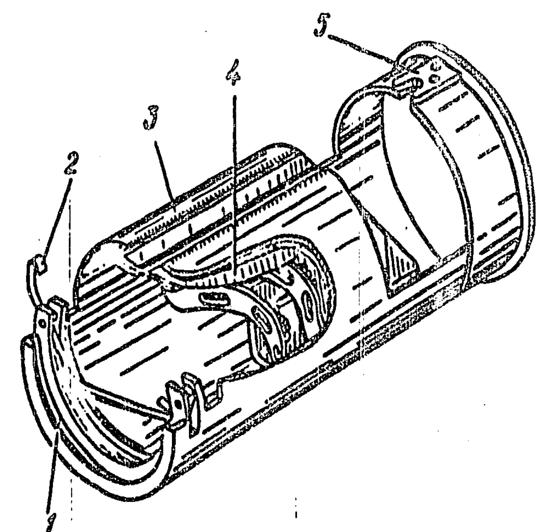

FIG. 18. ROCKET MISSILE HOLDER
1 – groove for plastic bushing boss guide; 2 – spring; 3 – holder body; 4 – trap; 5 – key

9. Move the rocket missile into the barrel till the holder rim stops against the barrel end. Check that wire of the rocket missile and the holder key fit into a special groove in the barrel.

10. Insert the rocket missile wire plug into the respective contact jacks in the rocket pod body.

Repeat the procedure described and check all barrels of the pod.

CAUTION: After loading a rocket missile insert the plug wires carefully between the barrel ends so as to prevent shearing of wires while mounting the pod rear fairing.

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11. To install the rear fairing of the pod in place, proceed as follows:

(a) fit the rim bosses into the gaps between the respective bosses of the pod clip. Check that the reference line OPEN notched on the fairing coincides with the reference line on the pod skin;

(b) insert a wrench into one of the fairing rim holes, and turn the wrench till the line CLOSED coincides with the line on the pod skin;

(c) remove the wrench from the lug and make sure the pin has completely entered the seat in the pod frame bracket.

Turn the fairing so as to open it and make sure it is closed reliably.

6. UNLOADING OF ROCKET PODS

In the event of a postponed flight, or in case the aircraft has landed with rockets unused, proceed as follows to unload the pods.

1. Make sure that the storage battery switch and circuit breakers installed in the armament control circuit are off.

2. Remove the pod rear fairing.

3. Drive the rocket ignition wire plugs from the contact jacks of the pod.

4. Move the holder and the rocket missile 60 to 80 mm out of the barrel so as to avoid straightening of the stabiliser fins.

5. Pass the rocket missile wire plug through the hole of the choke trap and separate the holder from the rocket missile.

6. Pull the casing over the portion of the stabiliser fins extending out of the barrel.

7. Drive the rocket completely out of the barrel and simultaneously pull the casing over the rocket missile.

8. Screw off the fuze, replace it with a fuze hole plug, examine the wire and pack the rocket missile into a packing case.

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All barrels are unloaded similarly. To start unloading, any barrel will do.

9. Clean and lubricate the barrels, install the holders into the barrels and install the rear fairing in place.

While installing empty holders, press the holder spring with a finger and release it after the holder gets into the barrel.

7. REMOVING OF ROCKET PODS

In the case of a long interval in using the rocket pods, they should be removed from the underwing racks and the Д3-57Д locks should be released.

Dismounted rocket pods should be stored on a rack in a dry storehouse or slushed with preventive grease and packed.

In case of long-term storage (exceeding 3 months), the rocket pods should undergo corrosion-preventive treatment.

To remove a rocket pod, proceed as follows:

1. Make sure the pod is unloaded.

2. Disjoint the holder connector from that of the pod in a manner described below:

(a) fit a wrench on the lever axle square end, turn it in the direction indicated by the arrow DISJOINT (РАССТЫКОВКА) and disengage the socket of the underwing rack plug connector from the plug of the pod connector;

(b) insert a stud under the lever by moving the former through the bomb clamp front attachment bolt and fix the rack plug connector in retracted position.

3. Hold the pod by the hands to prevent its falling, release the levers of the Д3-57Д lock with a wrench and separate the pod from the underwing rack.

<u>CAUTION</u>: Never dismount a loaded rocket pod. While removing the pod, mind that an unloaded pod УБ-16-57У weighs over 50 kg and that it falls down immediately after the lock is released.

The emergency release control circuits should be cut off both when removing and when installing the pods, since when

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the storage battery is engaged, releasing of one lock leads to actuation of the interlocking system due to which the other pod falls down on the ground.

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Chapter III

MAINTENANCE OF BOMB ARMAMENT

1. BOMB ARMAMENT SYSTEM. GENERAL

The bomb armament of the aircraft is intended for carrying two bombs, calibre from 50 to 500 kg.

To suspend the bombs each wing is fitted with the underwing rack, type БДЗ-60-21УМ and ДЗ-57Д locks installed on the underwing surface at a distance of 1,975 mm from the axis of symmetry.

The bomb armament control system is designed for tactical dropping of bombs ARMED as well as for emergency release of bombs both ARMED and SAFE executed irrespective of the kind of safety locking employed.

To effect tactical dropping, the firing button arranged on the aircraft control stick is depressed.

The indication system is used to warn about the presence of bombs carried by the suspension assemblies and to engage the armed bomb release control.

Inasmuch as the ДЗ-57Д locks are fitted with interlocking mechanisms, no pilot's activities are required for emergency release of the second bomb in case of occasional dropping of the bomb by one of the racks.

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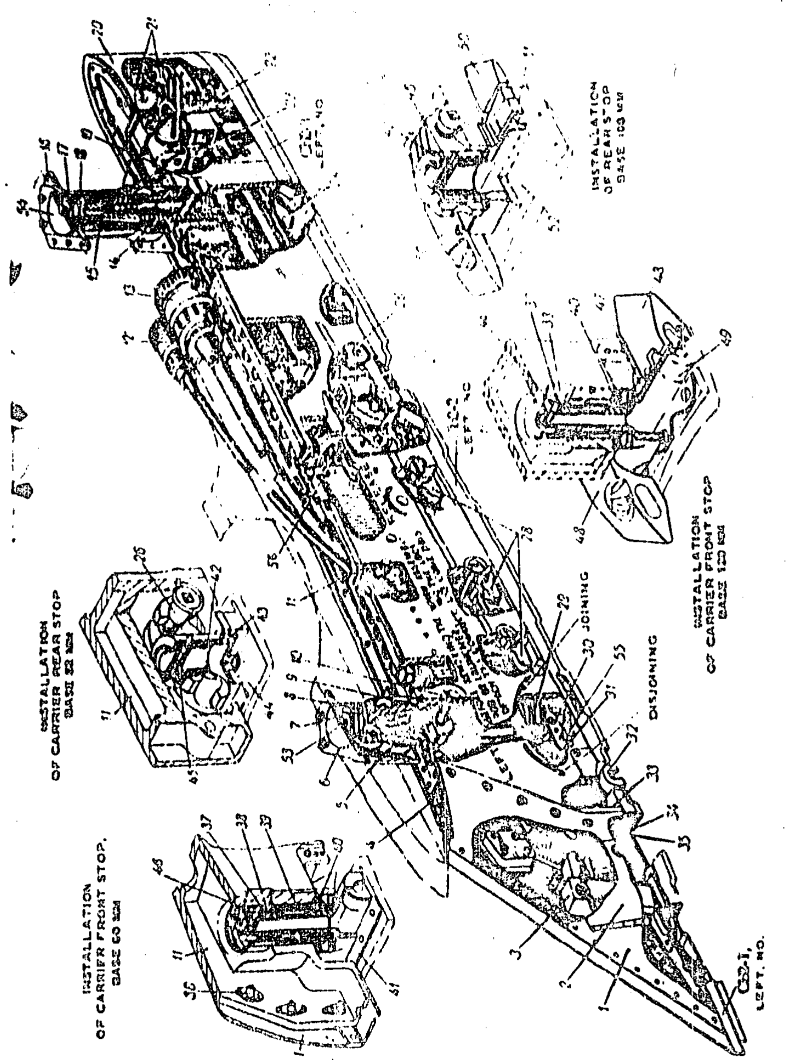

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FIG. 19. GENERAL VIEW OF БДЗ-60-21УМ RACK

1 – front fairing; 2 – hatch cover; 3 – front pulse feeding mechanism; 4 – rubber seal; 5 – split ring bush; 6 – wing front joint; 7 – lock-nut; 8 – nut; 9 – front attachment taper bolt; 10 – bolt; 11 – rack beam; 12 – ШР32 plug connector; 13 – ШР55 plug connector; 14 – split ring bush; 15 – rear attachment taper bolt; 16 – wing rear joint; 17 – lock-nut; 18 – nut; 19 – bolt; 20 – rear fairing; 21 – ohmic resistor; 22 – hatch cover; 23 – rear pulse feeding mechanisms; 24 – plate springs; 25 – adapter beam; 26 – rear stop adjustment bolt; 27 – rear stop; 28 – ,Д-57,Д lock bearing levers; 29 – 2PM plug connector; 30 – joining lever; 31 – spring; 32 – front stop; 33 – access hatch of front stop adjustment bush; 34 – stud; 35 – adaptor beam telescopic joint; 36 – nut; 37 – taper bolt; 38 – bush; 39 – fastening bush; 40 – nut; 41 – suspension front branch stop; 42 – body; 43 – taper bolt; 44 – suspension branch seat; 45 – spring loaded stud; 46 – spring-loaded stud; 47 – taper bolt; 48 – fairing; 49 – suspension front branch stop; 50 – fairing; 51 – taper bolt, 52 – suspension branch seat; 53 – front attachment hatch cover; 54 – rear attachment hatch cover; 55 – joining lever axle; 56 – pulse feeding mechanism interlock switch.

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БД3-60-21УМ Underwing Rack

The БД3-60-21УМ underwing rack (Fig. 19) is actually a streamlined beam intended for suspending various combat loads.

The underwing rack complete set comprises.

1. Front and rear bomb clamps used to prevent lateral motion of bombs. Each clamp is secured to the rack with two bolts.

The distinction between the front and rear clamps is that there are two pairs of seats in rear clamp, used to install the clamping bolts with thrust journals.

When bombs of a calibre exceeding 100 kg are suspended, the clamping bolts are installed into the rear seats of the clamp.

2. Two pairs of quick-detachable stops designed to prevent end and side play of launchers or rocket pods and to adjust them when firing for adjustment.

The rear stop is used to adjust the launchers and rocket pods in horizontal plane within a range of ±25'.

When the weapon suspended is to be replaced with a weapon of another type, the stops should be replaced accordingly with new ones also organic of the given rack and the former laying should not be disrupted.

3. Adapter beam composed of three separate parts attached to the bottom of the rack. The beam is intended for taking up the clearance between the rack and either launcher or rocket pod suspended. To suspend the bombs, the beam is removed from the rack.

4. Set of arming rod devices УВП-МС Nos 1, 2, 3, 4 and 5 used to control the mechanical fuses.

To suspend the bombs equipped with the fuse arming electric squib, the front fairing of the rack houses one pulse feeding mechanism and the rear fairing carries two similar mechanisms.

The rack is fitted with a microswitch used to interlock the rack lock release pulse of current supplied to the pulse feeding mechanism for releasing the bombs.

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To provide cocking, mechanical release and cocked position control of the ДЗ-57Д lock, the rack body faces are supplied with respective holes. The right face hole is marked with an arrow and an inscription COCK (ВЗВОД) to indicate the direction for turning the wrench while cocking the lock. Similarly the left face hole has an arrow and an inscription DROP (СБРОС) indicating the direction of turning the wrench for mechanical release of the lock.

The tools used for handling the rack are depicted in Fig. 20.

ДЗ-57Д Lock

The ДЗ-57Д lock with an electromagnetic release mechanism is employed to suspend bombs, launchers or rocket pods.

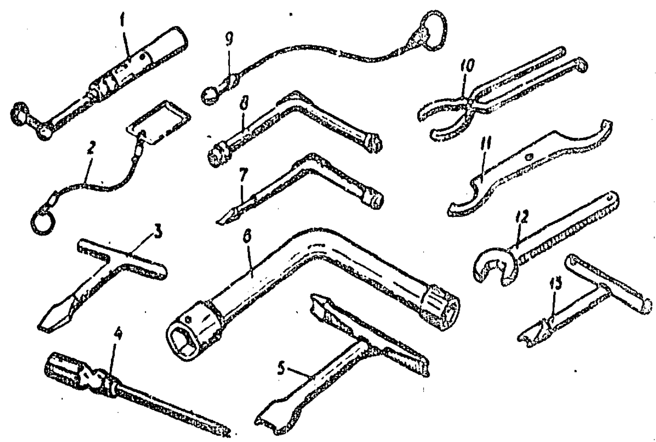

FIG. 20. БДЗ-60-21ЭМ RACK TOOLS AND ACCESSORIES

1 – tester; 2 – ВЗ inset; 3 – screw-driver; 4 – crosswise screw-driver; 5 – wrench for stop and taper bolt lock; 6 – wrench for front and rear taper bolts; 7 – wrench for adapter beam; 8 – wrench for bomb clamps and for adjustment joint of rear attachment and ШР connector joining; 9 – control ball; 10 – tongs for ШР2РМ12 plug connector; 11 – wrench for front stop; 12 – wrench for bomb stop lock-nuts; 13 – wrench for rear horizontal bolt.

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Basic Specifications

1. Voltage .... 27 V ±10 per cent
2. Minimum operating voltage ...... 20 V
3. Current consumed at voltage of 24 V and temperature of +20°C:
   for tactical operation .... 6.3 A
   for emergency operation .... 6.9 A
4. Service temperature range ...... from +60°C to -60°C
5. Weight .... 4 kg

The following elements are meshed simultaneously to fix the lock levers (Fig. 21) in closed position:

(a) smaller thrust lever mated with cocking lever;

(b) thrust lever mated with rear bearing lever;

(c) intermediate lever mated with electromagnet armature gear tooth. The mesh length of the armature gear tooth should lie within 2.2 - 2.5 mm.

The other arm of the armature gear is used to actuate the lock mechanical release.

To cock the lock, turn the bearing levers towards the flight direction by means of a special wrench, keep the levers pressed up, and drive the cocking key to turn the cock axle in the direction indicated by the arrow until the intermediate lever mates a tooth of the electromagnetic gear. As a result, a specific click can be heard.

When the lock bearing levers are released, the plate spring expands and causes the rack microswitch to cut in the voltage applied to the pulse feeding mechanism.

The MECBH-57 interlocking, indication and ARMED - SAFE mechanism is intended:

(a) to warn about the suspended load;

(b) to interlock the emergency release electric circuit;

(c) to arm the mechanical fuze bombs during release.

When the weapons are suspended, the MECBH-57 mechanism rod sinks and closes the contacts of the indication circuit and the upper contacts of the interlocking system which engage the emergency release system.

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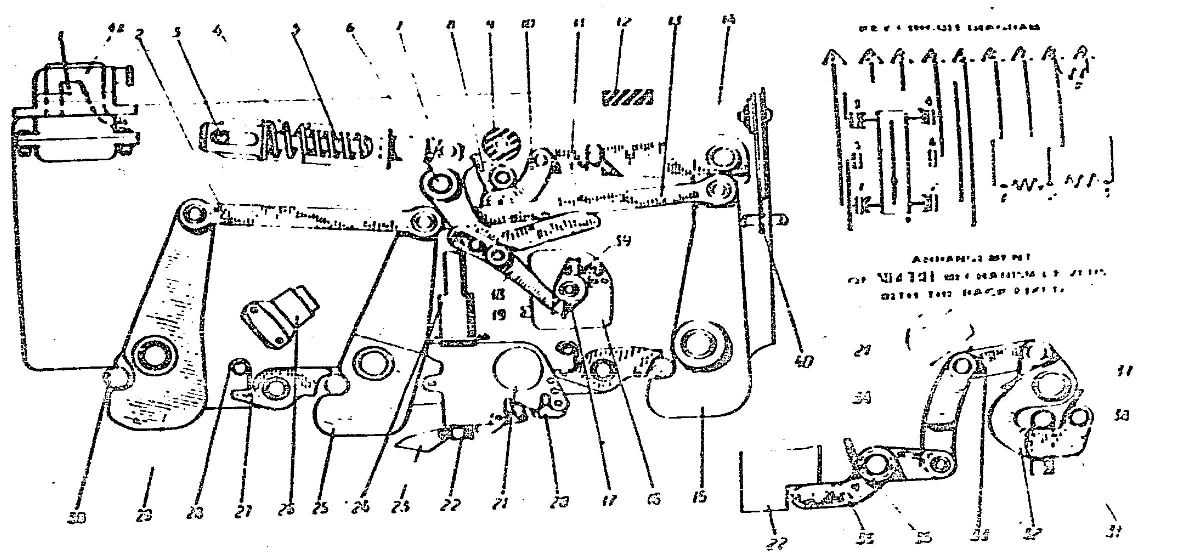

FIG.21. /Б-57/ LOCK GEARING AND WIRING DIAGRAM. FIXED POSITION

1 – plug and socket; 2 – front tie-rod; 3 – shaft; 4 – release spring; 5 – release spring rod, 6 – cocking axis, 7 – cocking lever, 8 – charter thrust lever; 9 – shock absorber; 10 – shackle; 11 – thrust lever; 12 – shock absorber; 13 – rear tie-rod; 14 – body; 15 – rear bearing lever; 16 – release mechanism electromagnet, 17 – release lever; 18 – intermediate lever; 19 – screw for adjusting electromagnetic release mechanism armature team; 20 – ARMED – SAFE lock, 21 – ARMED – SAFE lock electromagnet; 22 – interlocking and indication mechanism rod tip; 23 – fork; 24 – interlocking and indication mechanism stationary contacts housing, 25 – central bearing lever; 26 – shock absorber; 27 – stop; 28 – stop spring; 29 – front bearing lever; 30 – suspended load yoke; 31 – ARMED – SAFE mechanism panel; 32 – ARMED – SAFE lever; 33 – tie-rod; 34 – shackle; 35 – lever; 36 – spring; 37 – spring; 38 – spring; 39 – release lever retracting spring, 40 – plate spring; 41 – bracket.

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At the instant of dropping a bomb, the rod moves down so that its tip turns the intermediate lever which acts upon the shackle and tie-rod of the system when the МБСВН-57 mechanism electromagnet is de-energised and releases the ARMED - SAFE lever so that the SAFE action is initiated.

If the electromagnet is energized, the released bomb is ARMED, since the end of the electromagnet armature does not limit the travel of the shackle and the ARMED - SAFE lever carrying the УВП-МС arming rod ring is maintained fixed.

When in the initial position, the rod closes the interlocking contacts of the system used for automatic lock release without depressing the button if the load suspended from one of the racks is occasionally dropped.

Bomb Armament Control System

The lay-out of the bomb armament is shown in Fig. 22.

The bomb armament control system comprises the following units and instruments:

1. БДЗ-60-21УУ racks with pulse feeding mechanism installed under each wing cantilever.

2. ДЗ-57Д locks provided with electrical release mechanism and МБСВН-57 interlocking and indication mechanism.

3. Button ARMAMENT EMERG. DROP arranged under the cap in the left-hand lower part of the instrument panel. The button is used for emergency release of SAFE bombs and for combat dropping effected when the tactical control system fails.

4. Switch BOMB RELEASE installed in the middle of the instrument panel lower part.

The switch is used to engage the control system for tactical release and for release of ARMED bombs by the emergency release system. When the switch is cut off, it disconnects the circuit from circuit breaker ARMED - SAFE so that emergency release of SAFE bombs is possible.

5. Red lamp of ARMED action indication which is arranged beside the tactical release switch in the lower part of the instrument panel. The lamp indicates engagement of ARMED action by the МБСВН-57 mechanism.

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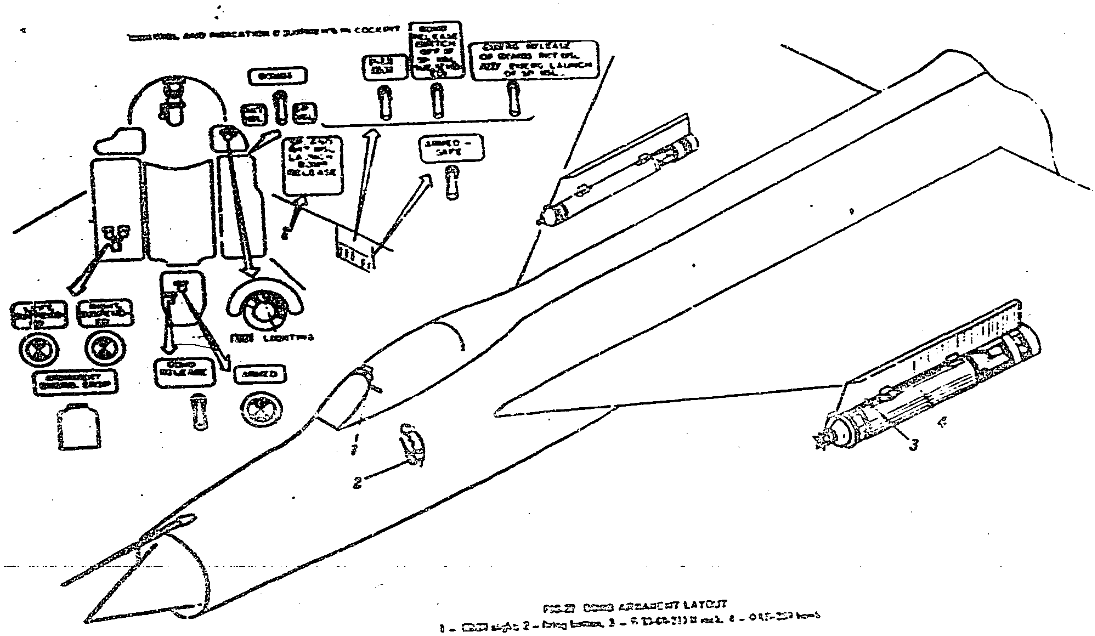

FIG.27 [illegible] ARMAMENT LAYOUT

1 - [illegible] sight; 2 - firing button; 3 - [illegible]; 4 - [illegible] bomb

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6. Two suspension indication green lamps LEFT, SUSPENDED-RIGHT, SUSPENDED placed on the left lower part of the instrument panel. The lamps indicate suspension from ДЗ-57Д locks. If bombs are suspended from the locks, the lamps light up, and after the bombs are dropped, the lamps go out.

7. Circuit breaker SP. AND RKT MSL LAUNCH. BOMBS RELEASE used for feeding relay winding of the bomb tactical release circuits when the firing button is pushed. The circuit breaker is installed on the rear electric board on the starboard inside the cockpit.

8. Selector switch RKT MSL - SP. MSL - BOMBS installed behind the instrument panel.

9. Circuit breaker BOMB RELEASE used to engage the circuit feeding the lock electromagnet for dropping the bombs when the firing button is pushed and to switch on the relay of bomb or rocket pod suspension indication lamps.

10. Circuit breaker ARMED - SAFE used to switch the ARMED - SAFE mechanism electromagnet feed circuit, pilot lamp ARMED and the pulse feeding mechanism of the fuze electric squib device. To engage the feed circuit by the circuit breaker, the tactical release switch is operated.

11. Circuit breaker EMERG. RELEASE OF BOMBS, RKT MSL, ANY. EMERG. LAUNCH OF SP. MSL installed in the emergency suspended load release and emergency missile launch circuit. As the button ARMAMENT EMERG. DROP is depressed, the current passes from the circuit breaker to the МБСВН-57 mechanism upper contacts and thereby to the emergency windings of the ДЗ-57Д lock electromagnets. The МБСВН-57 mechanism rod is set into the retracted position as it is pressed by the body of the bomb suspended.

When the lock is released or when the load suspended from the rack drops occasionally, the МБСВН-57 mechanism rod forced by its spring is caused to return into the initial position and therefore to close the second pair of interlocking contacts. These engage the emergency release circuit of the rack lock installed at the other wing. The lock is now opened and the suspended load is dropped without any activities on the part of the pilot. It should be

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noted, that in case the tactical release switch is turned on, the bomb is dropped ARMED.

To prevent release of ARMED bombs, the tactical release switch must be turned off during flight so that the bombs are released SAFE.

CAUTION: It is allowed to cut in the tactical release switch only before bomb dropping.

Prior to landing, the tactical release switch must be cut out.

The principal control circuit is that of the ARMED tactical release actuated by the firing button.

Red lamp ARMED which lights up when the tactical release switch is turned into position ON, should continue to glow after dropping the bombs unless the switch is turned into the initial position.

SAFE bombs can be released by depressing the firing button only in case circuit breaker ARMED - SAFE is off. This cannot be effected during flight since all circuit breakers of the bomb release control system are situated on the cockpit starboard rear panel.

Differently from the tactical release circuit, the emergency control circuit is used for dropping both SAFE and ARMED bombs.

The emergency dropping of ARMED bombs is employed when the tactical control circuit fails.

In case of ARMED bomb emergency release effected by the emergency system, the tactical release switch should be off.

The emergency release system operates independently, hence the position of the selector switch does not affect the emergency dropping.

The bombs are released by pushing button ARMAMENT EMERG. DROP. From the circuit breaker the current is supplied via the button and MSCBH-57 mechanism interlocking contacts to the emergency winding of the rack lock release electromagnet.

To drop SAFE bombs on emergency, the same procedure is employed, though now the tactical release switch must be off.

When the switch is off, no current is supplied to the MSCBH-57 mechanism electromagnet and to the pulse feeding

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mechanism, hence, irrespective of the ... locking, the bombs are released SAFE.

When circuit breaker BOMB RELEASE is on, the bomb suspension indication lamps glow as long as the lock is closed. After the bombs are dropped, the lamps go out, since when the lock opens, the МБОВН-57 mechanism rod travels back to the initial position and breaks the indication system contacts.

2. CHECKING THE BOMB RELEASE CONTROL SYSTEM FOR FUNCTIONING

The bomb release control system should be checked every time when the bomb armament is prepared for use. The checking procedure is the following.

Tactical Release of ARMED Bombs

1. Couple to a ground electric power supply and turn on the switch AIRCRAFT OR GROUND BATTERY (АККУМ. БОРТОВОЙ АЭРОДРОМ).
2. Turn on circuit breakers SP. AND RKT MSL LAUNCH. BOMB RELEASE, BOMB RELEASE and ARMED - SAFE.
3. Set the selector switch into position BOMBS.
4. Make sure bomb suspension indication lamps are good and glow when the МБОВН-57 rods are pressed up and the circuit breaker BOMB RELEASE is on. If the rods are released, the lamps should go out.
5. Fix the underwing rack locks, suspend the lock testing devices from the bearing levers and fit the rings of the arming rods into the ARMED - SAFE levers of the lock (Fig. 23).
6. Turn on the twin switch BOMB RELEASE and make sure this causes pilot lamp ARMED to light up.
7. Fold up the safety bracket, push the firing button and make sure the lock bearing levers are opened, the devices suspended from them are dropped down and the arming rod rings are fixed securely on the ARMED - SAFE levers of the lock.

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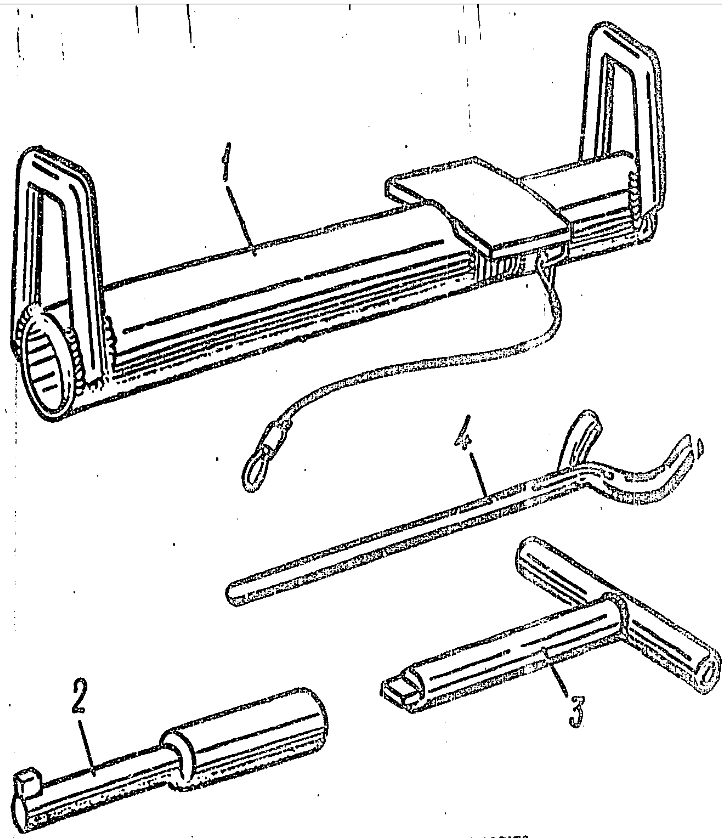

FIG.23. ДЯ-57Д LOCK TOOLS AND ACCESSORIES

1 – lock testing device; 2 – wrench for manual release; 3 – trigger wrench; 4 – wrench for turning the bearing levers.

<u>CAUTION</u>: Never should the firing button be kept depressed for over 10 sec.

8. Set the tactical release switch into the initial position and make sure this causes pilot lamp ARMED to go out.

After checking, disconnect the storage battery and circuit breakers.

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Emergency Release of ARMED Bombs

1. Fix the underwing rack locks, suspend the testing device from the bearing levers and insert the arming rod rings into the ARMED - SAFE levers of the locks.

2. Connect the storage battery.

3. Switch on circuit breakers EMERG. RELEASE OF BOMBS, RKT MSL, ADV. EMERG. LAUNCH OF HP. MSL, ARMED - SAFE and BOMB RELEASE. The latter circuit breaker should be engaged only for feeding the bomb suspension indication lamps. The lamps should light up when the rods of the MBCBH-57 mechanism are pressed up.

4. Turn on the twin switch BOMB RELEASE and make sure red lamp ARMED lights up.

5. Push the button ARMAMENT EMERG. DROP and check if the lock bearing levers open, the insert suspended from them drops down, and the arming rod ring is fixed securely on the ARMED - SAFE lever.

As has been the case, the lamp ARMED should remain glowing as long as the tactical release switch is on.

After checking the ARMED bomb emergency release circuit for functioning, switch off the circuit breakers and tactical release switch.

Emergency Release of SAFE Bombs

The procedure of checking is similar to that for emergency release of ARMED bombs the only difference being in that the tactical release switch need not be turned on.

After the emergency release button is pushed, both rack bearing levers and ARMED - SAFE lever (Fig. 24) are released so that the insert arming rod ring suspended from the latter is disengaged.

Checking the Emergency Release Interlocking Circuit for Functioning

1. Fix the beam rack locks.

2. Switch on the emergency release circuit breaker and storage battery.

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3. P.ess up the tips of the MSCBH-57 mechanism rod and make sure the bearing levers of the given lock have opened without depressing the release button. After this, release the rod tip.

4. Make an analogous check of the other rack.

CAUTION: Do not suspend the device from one rack alone, since the suspended bomb, rocket pod or launcher will be dropped when the storage battery is cut in (while the emergency release circuit breaker is on).

Checking the Pulse Feeding Mechanism for Functioning

The pulse feeding mechanisms MПM are checked for normal operation if they are engaged to actuate the fuses equipped with electric squib arming devices. The check is performed during routine maintenance.

The operations should be combined with checking the tactical release circuit and performed as follows.

1. Open the front and rear pulse feeding mechanisms access hatch covers.

2. Use a test ball for checking each MПM mechanism in succession and measure the force required to pull out the ball plug of the electrical squib launch wire. Make sure the force is equal to 15 to 25 kg, otherwise adjust it by compressing the spring through driving the MПM mechanism lower choke in or out.

To connect the test ball with the MПM mechanism, make use of the cross groove in the body. Never should the ball be fitted in from below through the lengthwise groove in the MПM mechanism body, since this may cause damage to the contact plates.

To check the force, pull the test ball out through the lengthwise groove in the MПM mechanism body.

3. Fix the Д3-57Д locks.

4. Connect the storage battery, and turn on the circuit breaker ARMED - SAFE and switch BOMB RELEASE.

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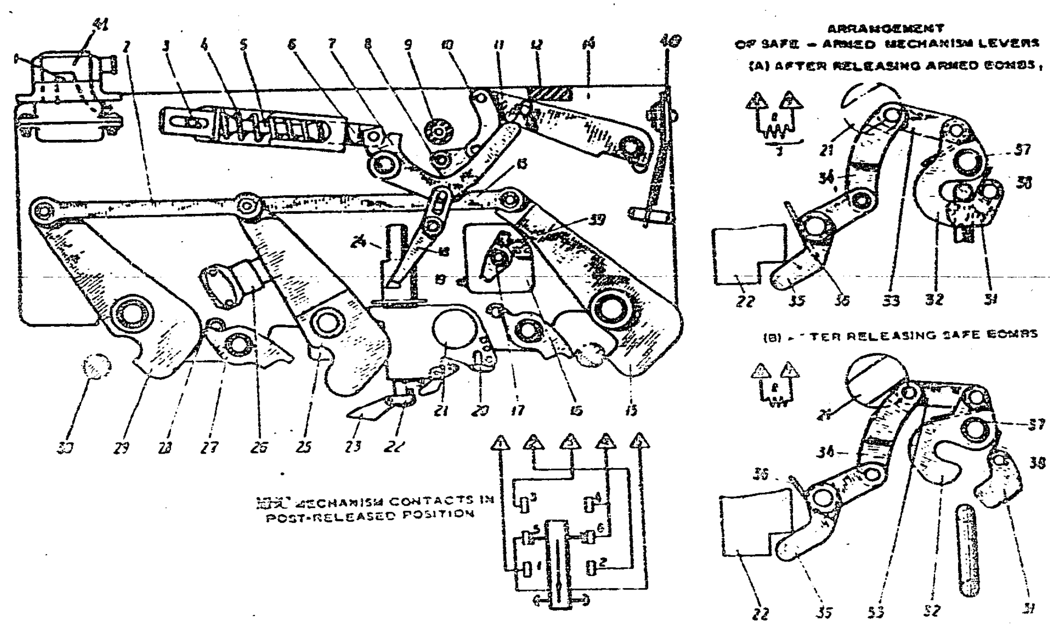

FIG.24. LOCK IN POST-RELEASED POSITION
a – after releasing ARMED bombs; b – after releasing SAFE bombs (Position are same as in Fig.21).

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5. Use a test lamp to check that no voltage is fed to the МПМ mechanism contact plates. While using a tester, mind that the rack body should be contacted for grounding.

6. Release the ДЗ-57Д locks and use the tester to check if a voltage is applied to the МПМ mechanism contact plates. While the locks are released, see if the micro-switches installed in the racks are actuated and remove interlocking of the МПМ mechanism contact plates voltage supply.

7. After checking, fasten securely the covers of the МПМ mechanism access hatches, and switch off the circuit breaker, battery and tactical release switch.

3. PREPARATION OF BOMBS, FUZES, MAB TIME-DELAY ARMING MECHANISMS AND УВП-ИС ARMING ROD DEVICES

Bombs, fuzes and time-delay arming mechanisms should be prepared in compliance with the instructions pertaining to a given type of ammunition.

The following should be accomplished directly before suspending and fusing the bombs.

1. Make an external examination of the bombs. While inspecting, check the following:

(a) condition of threading in the fuze holes;

(b) condition of suspension yoke eyes. Before inspecting the eyes, clean them from slush and dirt;

(c) condition of stabilizer.

2. Make an external examination of the fuses. While inspecting, check the following:

(a) dirt or oxidation of the fuse parts;

(b) condition of threads for screwing the fuse into the fuse hole;

(c) condition of fuse vanes with mechanical safety locking;

(d) condition and cleanness of electric squib arming wire ball plugs of the fuses with electric squib arming device.

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3. Check general condition of the time-delay arming mechanisms.

Bombs, fuses and time-delay arming mechanisms should never be used if any defects have been detected.

4. Examine the arming rods and make sure they are in good condition after the grease has been removed from their surface.

The arming rods with bent branches, clasps where the clearance between the spring arm and nose exceeds 0.5 mm, ARMED - SAFE rings of deformed oval shape or broken caps must be replaced.

Bent arming rods and ARMED - SAFE rings of oval shape can be unbent.

4. SUSPENSION AND FUZING OF BOMBS

The bombs are suspended after the external examination of the suspension assemblies, checking the release control system and preparation of other kinds of armament have been accomplished.

To suspend the bombs, proceed as follows.

1. Make sure the storage battery and the armament control system circuit breakers are off.

2. Trigger the lock and check through the inspection holes in the underwing rack that the lock is fixed reliably.

3. Remove the adapter beam and drive the front and rear stops out of the rack.

4. Install a protective rubber cap on the electric connector and move the connector inside the rack.

5. Install the clamps into the rack and fasten them with bolts.

NOTE: Items 3, 4 and 5 pertain to cases when the rack is used to suspend the bombs after it has been employed to suspend the rocket pods.

6. Install the clamp stops employed for a given calibre into the rear clamp holes. The stops used to suspend the bombs whose calibre exceeds 100 kg are installed in the rear holes of the clamp, while the stops for fixing the bombs from 50 to 100 kg are installed into the front holes.

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7. Mesh the УВП-МС arming rod ring into the ARMED - SAFE lock. Mind that the size of an arming rod should correspond to the type and calibre of the bomb suspended.

8. Suspend the bomb from the lock bearing levers.

The bombs fitted with a single eye are suspended from the central bearing lever of the lock, and those provided with two eyes are suspended from the front and rear bearing levers.

While suspending a bomb, pack the УВП-МС rods between the clamp and the bomb body.

Fifty-kilogram bombs should be suspended manually. If the calibre exceeds 100 kg, a bomb cart is required.

NOTE: Prior to suspending bombs of 500-kg calibre, remove the detachable sectors of the L.G. main strut doors.

9. Adjust the position of the bomb suspended so that its longitudinal axis (the stabilizer fin) is aligned with the axis of the rack. Fix the bomb in this position by means of the clamp stops.

To adjust the bomb position and fix it with the clamp stops, screw off the nuts through some turns and drive the bolts of the stops in successively until the thrust journals touch the bomb body.

Sway the bomb lightly by pulling the stabilizer and make sure that the bomb fixed with the clamp stops does not play.

Never should be force applied to fix the bombs with the stops.

10. Screw the fuze hole plugs out and fuze the bombs in compliance with the bomb complete set instructions and the bombing mission assigned.

Check the fuze vanes for reliable locking by the MHB time-delay arming mechanism bushing.

11. Remove the protective caps from the time-delay arming mechanisms and mate the arming rod clasps with the MHB mechanism arming shackles. Check that the rubber caps cover the arming rod clasps.

The protective caps of the MHB mechanisms should be preserved till the aircraft returns after mission.

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NOTE: Items 9 through 11 pertain to cases when the bomb fuses have mechanical safety locking.

12. Couple the electric squib arming wire ball fork to the pulse feeding mechanism.

To couple the electric squib arming wire plug of the nose fuse, proceed as follows:

(a) open the front fairing hatch cover;

(b) pull the ball plug and wire through the hatch-way into the fairing;

(c) through the fairing hatch drive the plug into the pulse feeding mechanism cross groove so that the plug should stop between the balls and the electric arming wire should fit into the lengthwise groove;

(d) shut the rack front fairing hatch cover.

In order to couple the plug of the base fuse electric squib arming device wire, proceed as follows:

(a) open the rear fairing hatch covers;

(b) pull the ball plugs and electric squib wires through the bracket port inside the fairing;

(c) to couple the ball plugs of the wires to the pulse feeding mechanism, follow the procedure similar to that performed for the nose fuse;

(d) shut and lock the rear fairing hatch covers. In case the bombs with base fuse hole are employed, make use of any rear pulse feeding mechanism.

5. REMOVAL OF UNUSED BOMBS

In the event of a postponed flight or when the aircraft lands with the bombs unused, proceed as follows and dismount the bombs.

1. Disconnect the storage battery and the armament control circuit breakers.

2. Separate the clasp of the ЭВП-М0 device from the shackle of the time-delay arming device and pull a protective cowl over the time-delay arming mechanism.

CAUTION: When the clasps are disengaged from the shackles of the arming device, never should anybody stay in front of the time-delay arming mechanism.

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3. Hold the device by the hand, screw off the fuze and time-delay arming mechanism from the bomb fuze hole (first turning the fuze with a wrench and then by the hand), remove the mechanism from the fuze stem, turn the fuze arming vane till it stops against the unlocking device, and place the time-delay mechanism and fuze into the packing boxes. Stop the fuze hole with a plug.

4. Screw off the rack clamp stops to drive them up and move them off the way for removing the bombs.

5. To dismount the bombs over 50 kg, make use of the cart.

Insert a wrench into the hole RELEASE (CHYOK) and turn it to release the lock mechanically, lower the bomb carefully, put it on the cart and roll from under the wing.

For removing bombs of calibre 50 kg, the cart is not required. While releasing the lock, hold the bomb carefully by keeping the nose and tail portions of the bomb with the hand.

6. Remove the ARMED - SAFE arming rods from the locks. To remove rods after dropping the ARMED bombs, press on the MECBH-57 mechanism tip as far as it will go upward, release the tip and then pull out the arming rod ring from the lock.

Prior to screwing off the electric arming squib fuzes, disconnect the ball plugs of the electric squib arming wires from the pulse feeding mechanisms.

The ball plugs of the nose and base fuze wires are disconnected from the pulse feeding mechanisms through the hatch-ways in the rack front and rear fairings respectively.

The ball plugs should be driven out through the pulse feeding mechanism cross groove in a manner reverse to installation of the plugs.

CAUTION: Never should the ball be pulled down all the way through the pulse feeding mechanism lengthwise groove.

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6. REMOVAL AND INSTALLATION OF UNDERWING RACK AND A3-37A LOCK. DISASSEMBLING AND CLEANING

The underwing racks are removed from the aircraft when they need repair as well as after the time-terms of routine maintenance expiry.

While removing the racks, proceed as follows.

1. Open the covers of the rack front and rear taper bolts access hatches.

2. Open the cover of the plug connectors access hatch situated between the rack attachment taper bolts.

3. Detach the rack plug connectors.

4. Hold the rack up to prevent its falling down, turn the nuts off the front and rear attachment taper bolts and move the rack down.

5. Close the rack attachment hatch covers.

6. To drive the lock out of the rack, proceed as follows:

(a) dismount the adapter beam. To screw off the attachment bolts, reach them through special holes in the beam bottom;

(b) screw off the bolts and nuts used to fasten the lock to the rack;

(c) let the lock down carefully, disjoint the electric connector and move the lock out of the rack body.

After the lock has been removed, install the bolts and nuts into the former places.

The procedure of installing the lock into the rack and of the rack into the aircraft is the reverse of dismounting them.

Before installing the rack, fairly coat the attachment taper bolts with grease and fit the spacing rings on the bolts. Mind that the spacing rings are not interchangeable and carry the numbers similar to those of the respective racks.

Apart from the lock, the following elements can be removed from the underwing rack.

1. Front and rear fairings.

To remove the front fairing, proceed as follows:

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(a) turn off the attachment bolts securing the fairing to the rack frame;

(b) move the fairing 50 to 60 mm forward, screw off the nuts used to secure the wire to the front ohmic resistor, disconnect the wire and separate the fairing from the rack.

To remove the rear fairing, proceed as follows:

(a) turn off the attachment bolts used for securing the fairing to the rack frame;

(b) move the fairing 50 to 60 mm back, screw off the nuts used to secure the pulse feeding mechanism wiring, disconnect the wire and separate the fairing from the rack.

2. Front and rear clamps.

After the rear clamp has been removed, the front bolt used simultaneously to attach the clamp and to fasten the lock, should be installed into its former place.

3. Front and rear stops..

To remove the stops, make use of special holes in the rack frame to press on the spring-loaded studs and drive the taper bolts from the adjustment assemblies.

The rack should not be stripped and cleaned more completely unless in repair workshops.

The outer surfaces of the rack should be maintained clean and dry. The rubbing surfaces of the parts which are not coated with corrosion-proof films or the parts where the film is damaged, should be coated with a thin layer of lubricant.

Never will the current conducting or insulating parts be greased.

The scope and nature of cleaning and lubrication depend upon the extent of fouling of the rack parts and mechanisms. Time terms for cleaning and lubrication of the rack are same as those specified for cleaning the artillery weapons.

To remove moisture or rime accumulated due to condensation of ..mospheric moisture, use a cloth lightly moistened in grease.

To remove sand from inside the rack body, blow it through with compressed air.

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The racks removed from the aircraft must be kept on racks in a dry storehouse or subjected to corrosion-preventive treatment and preserved in packing chests. To store the racks for long periods (exceeding 3 months) they should be subjected to cold corrosion-preventive treatment.

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Chapter IV

FIRE ADJUSTMENT OF ARMAMENT

1. GENERAL

The cases of fire adjustment of the aircraft weapons are the following.

1. Reception of aircrafts from repairs.
2. Replacement or repair of attachment and adjustment assemblies.
3. Replacement of launchers or rocket pods.
4. Replacement and maladjustment of sight.
5. Replacement of armour glass installed in front of the sight.
6. Routine maintenance.
7. The pilot is not certain that fire adjustment is precise.

Firing for adjustment is commonly checked with the help of a bore sighting gauge and portable target when the aircraft is parked.

2. AIMING SCHEME

The testing target is employed to lay all kinds of aircraft weapons at a shortened range of 25 m. (Fig. 25).

The underwing racks and the sight are installed in the aircraft in such a way that they form an angle of -1°30'

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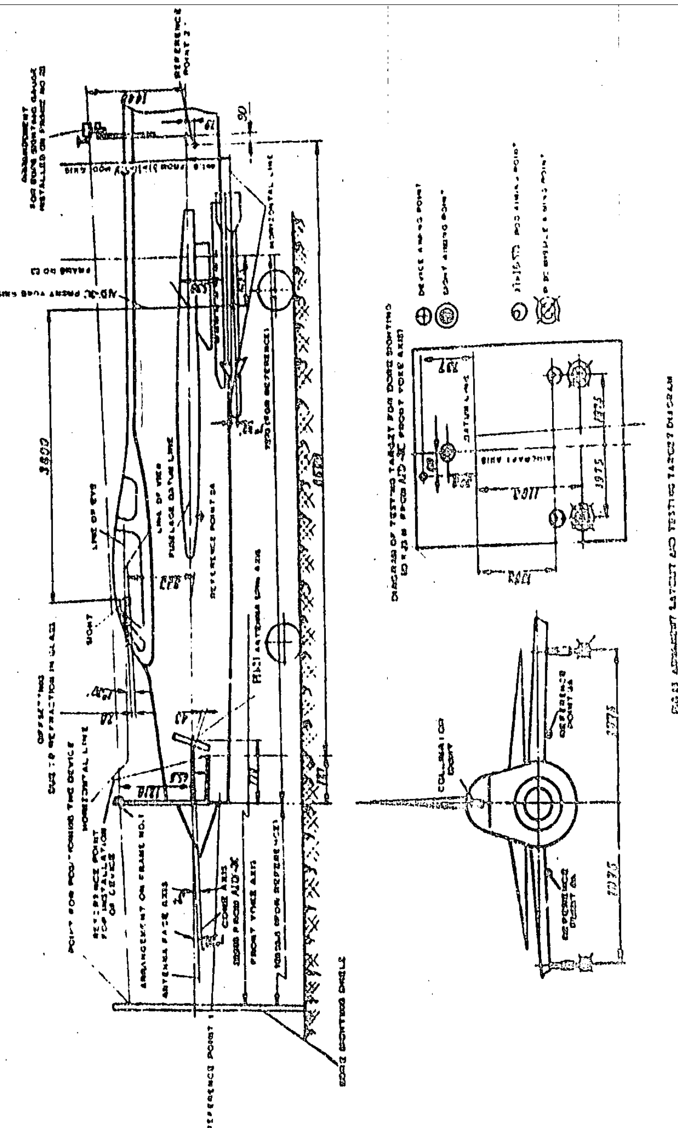

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with the datum line. Fire adjustment for all kinds of suspensions in the horizontal plane is done in parallel with the aircraft axis.

The aiming point of the sight is coincident with the aircraft axis of symmetry. The point for laying the sighting device is situated 60 mm to the left of the axis of symmetry.

The aiming points of the rocket pods and launchers in the horizontal plane correspond to the position of pods and launchers in the aircraft and lie 1,975 mm apart from the axis of symmetry.

In the vertical plane, the aiming points of the rocket pods, launchers and sight are plotted on the testing target so that they form an angle of $-1^{\circ}30'$ with the datum line to compensate for weapons tilt and elevation of the line of sight due to refraction of the cockpit armour glass.

On the testing target set at a range of 25 m., the points described are located as follows (relative to the datum line):

(a) the point for aiming the device, 737 mm above;

(b) the point for sight, 308 mm above;

(c) the point for aiming the inside upper barrel of the rocket pod, 1,088 mm below;

(d) the point for aligning the axis of the AHV-30 gauge, 1,193 mm below.

3. AIRCRAFT AND TESTING TARGET LOCATION WHEN CHECKING FIRE ADJUSTMENT

The fire adjustment can be accomplished either at the aircraft parking place or at an airfield site specially assigned for the purpose.

When firing for adjustment proceed as follows:

(a) install the aircraft on trestles placed under frames Nos 2 and 28, and on safety trestles arranged under the wings so that the aiming points of the weapons lie on the testing shield. Mind that the safety trestles should be used as supports only;

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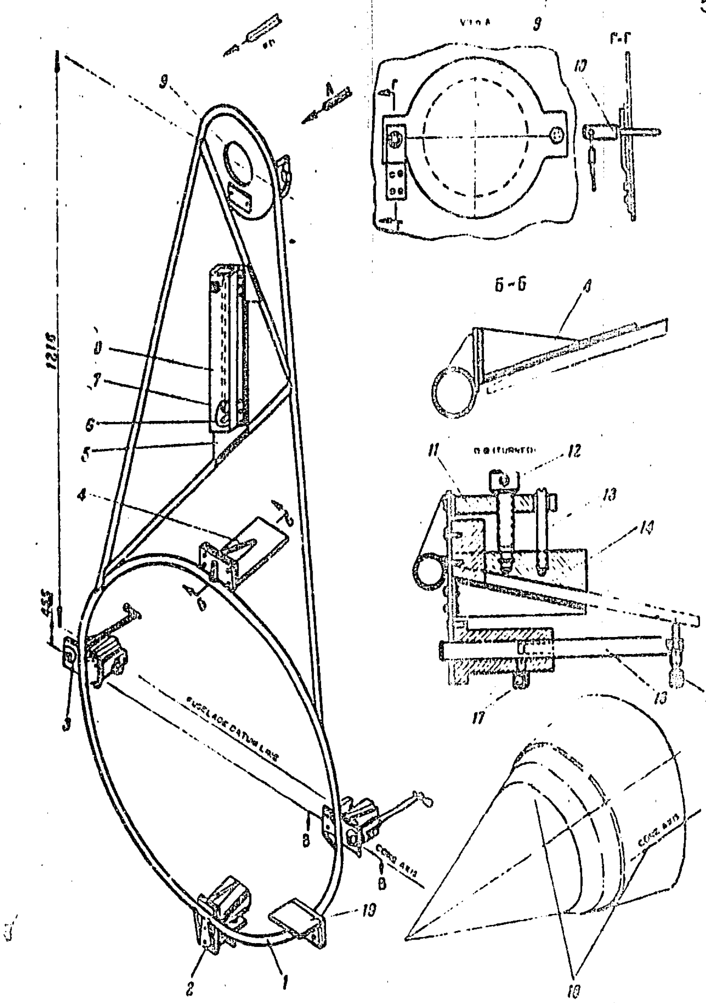

FIG.76. DEVICE FOR "TYING IN" TESTING SHIELD TO AIRCRAFT (TO BE MOUNTED ON FUSELAGE NOSE EDGE)

1 – device frame; 2 – lower clamp; 3 – side clamps with needle holders; 4 – upper supporting plate; 5 – pendulum base; 6 – index; 7 – pendulum; 8 – housing; 9 – folded plate with cross-hairs; 10 – locking stud; 11 – body; 12 – clamping screw; 13 – stud; 14 – clamp; 15 – needle; 16 – needle holder; 17 – locking screw; 18 – reference points; 19 – shelf for level indicator.

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(b) install the aiming device at the nose fairing (by reference points) and eliminate bank by sighting the device (Fig. 26);

(c) install the device for bore sighting gauge on the fuselage coupling bolts of frame No. 28 (Fig. 27);

(d) insert the bore sighting gauge into the device and operate the adjustment mechanism to align the crosshairs of the gauge with those of the device installed on the nose fairing;

(e) place the testing target at a range of 25 m. away from the АПУ-30 launcher front yoke axle, align the crosshairs of the bore sighting gauge of the device installed on frame No. 28 and the respective point on the target.

In case no ready-made target is available, make use of an ordinary shield on which the reference point of the device is plotted using the bore sighting gauge. The reference point thus obtained is used as a basis for drawing the rest of the aiming target.

In case no sighting device is available the aiming scheme should be plotted on the target by drawing the points relative to the axis of symmetry and the datum line of the aircraft, which can be marked off on the target shield with the help of a levelling instrument.

While levelling, the aircraft axis is adjusted horizontally by the fuselage reference points 1 and 2 of the port side of frames Nos 2 and 28.

For cross levelling, two reference points 8a and 8a which are the wing nose points closest to the fuselage, must be aligned.

4. AIMING AND ADJUSTMENT OF УБ-16-57У ROCKET PODS

When firing for adjustment, the accuracy of aiming the rocket pods should be checked in the first place and, whenever a necessity arises, the УБ-16-57У pods should be readjusted. To check the aiming of the rocket pods, observe the following priority.

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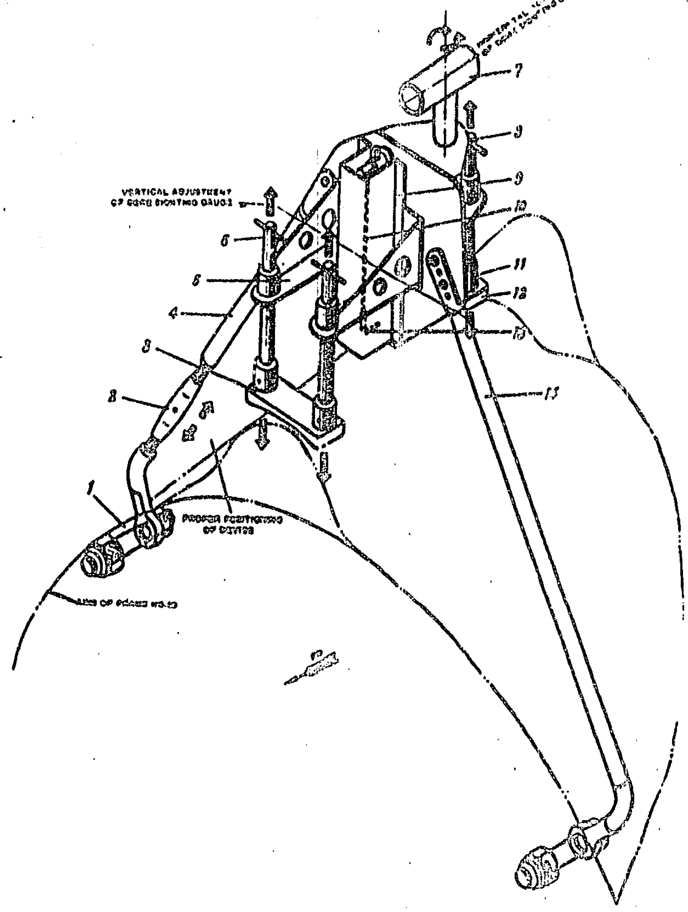

FIG.[illegible]. DEVICE FOR "[illegible]" TESTING [illegible] TO AIRCRAFT ([illegible])

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1. Set the aircraft on the trestles and eliminate bank.

2. Install device used for setting the testing shield and levelling the aircraft when firing for adjustment.

3. Install a shield or testing target in front of the aircraft at a distance of 25 m. away from the АПУ-3С launcher front yoke axle.

4. By using the bore sighting gauge plot the reference point on the shield and use the point thus obtained to draw the rest of the testing target.

If a portable testing target is used, align the reference point and the device bore sighting gauge line of sight by displacing the target towards the desired direction.

5. Aim the sight.

6. Suspend the rocket pod after installing the front and rear stops, base 120 and 108 mm respectively, into the underwing rack.

7. Install an adapter with the bore sighting gauge into the central upper barrel of the УБ-16-57У pod and check whether the gauge crosshairs coincide with the respective point on the target.

The УБ-16-57У pod is said to be laid correctly in case the bore sighting gauge crosshairs are within a circle dia. 75 mm at a range D = 25 m.

To meet the above requirement, the rocket pod needs adjustment.

For adjustment of the rocket pods, proceed as follows:

1. Open the rack front assembly bush access hatch and screw off the lock-nut.

2. Turn the front assembly bush with a wrench and adjust the rocket pod laying in elevation.

3. Tighten the adjustment bush lock-nut and close the hatch.

CAUTION: While adjusting the rocket pod laying in elevation, the yokes should be somewhat released. After the adjustment is over tighten the yokes again by means of a calibration wrench and check the laying again.

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4. Turn the rear assembly adjustment wrench to align the bore sighting crosshairs with the respective reference point on the testing target, plotted with the view of laying the rocket pod in azimuth.

5. Check the sight to make sure the aircraft has not been displaced from the initial position during adjustment.

5. AIMING AND ADJUSTMENT OF АПУ-30 LAUNCHER

Firing for adjustment from the АПУ-30 launchers, the bore sighting gauge used for checking the aiming of the rocket pods is employed.

The gauge is installed into the ТХН-13 adapter which is arranged on the launching beams so that the adapter axis is aligned with the axis of the missile suspended (Fig. 28).

Prior to suspending the АПУ-30 launcher, the front and r[illegible] stops should be replaced with different front and rear stops, base 60 mm and 52 mm, respectively.

When the stops are replaced, care should be taken to avoid maladjustment in aiming, as has been stated in the Chapter on maintenance of bomb armament (the Section on disassembling the rack).

This does not require readjustment, since the aircraft is provided with organic launchers which satisfy the requirements of accurate aiming if no maladjustment has been caused when the УБ-16-57У pods were replaced to install the launchers.

The launchers are said to be layed correctly if the bore sighting gauge crosshairs are within a circle dia. 175 mm on the target installed at a range of 25 m.

Hence, fire adjustment of the launchers amounts to checking the satisfaction of the above requirement alone.

If the crosshairs lie outside the reference circle, readjustment similar to that performed in case of the rocket pods should be carried out.

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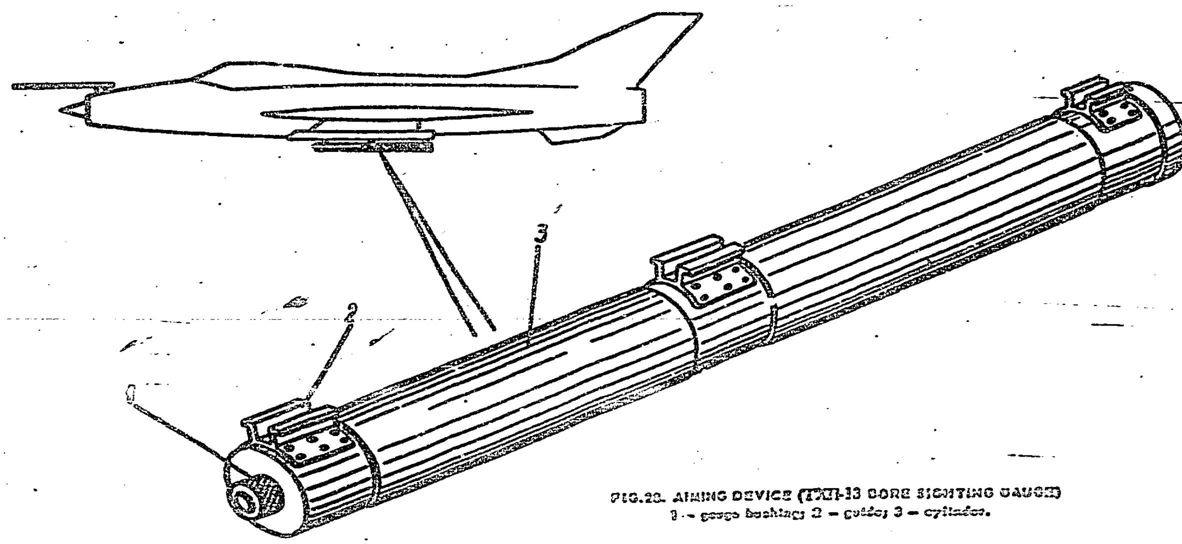

FIG.22. AIMING DEVICE ([illegible]-13 BORE SIGHTING GAUGE)
1 - gauge bushing; 2 - guide; 3 - cylinder.

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6. AIMING AND ADJUSTMENT OF ПКИ COLLIMATOR SIGHT

The ball joint installed in the sight attachment mount is intended for displacing the sight in whatever direction to aim it on the target.

The aiming lies in alignment of the sight reticle centre with the respective point on the testing target.

The reference point in question is plotted on the target shield with an account for refraction of the line of sight through the front armour glass and tilt of the sight through an angle of $-1^{\circ}30'$ relative to the datum line.

To check the fire adjustment, proceed as follows.

1. Turn on switch AIRCRAFT OR GROUND BATTERY and circuit breaker RADAR SET, SIGHT (Р-1Л, ПКИ).

2. Use a rheostat to adjust the sight reticle illumination intensity.

3. Make sure the sight reticle crosshairs coincide with the reference point on the target. If otherwise, proceed as follows to readjust the sight:

(a) loosen the bolt used to clamp the sight attachment mount brackets;

(b) turn the sight in the spherical joint and align the reticle centre with the aiming point on the testing target;

(c) tighten the mount bracket clamping bolt and check whether this has not caused maladjustment;

(d) disconnect the sight circuit breaker and storage battery.

Chapter V

MAINTENANCE OF DROP FUEL TANK PYLON

1. GENERAL

The drop fuel tank pylon is secured by means of two pintlos which fix it along the aircraft axis to frames Nos 16 and 20 on the fuselage bottom (Fig. 29).

The pylon is fitted with the БДЗ-56Е lock intended to suspend the drop fuel tank from the pylon. The bearing lever of the lock is used to hang the eye-bolt.

The front and rear stops of the tank are fitted into the respective seats in the pylon thruct assemblies to prevent side or end play of the tank.

Installed in the pylon nose and near the back pintle are the coupling pipelines used to joint the fuel delivery and drop fuel tank pressurisation pipelines with the respective pipes in the fuselage. The pipelines can be displaced forward and backward to facilitate joining of the pylon to the fuselage and to the drop fuel tank.

A special squib actuator installed in the pylon is used to provide forced jettison of the tank during flight. The squib actuator cylinder is connected through a pipeline to the jettison gun anchored to the pylon by means of detachable stirrup.

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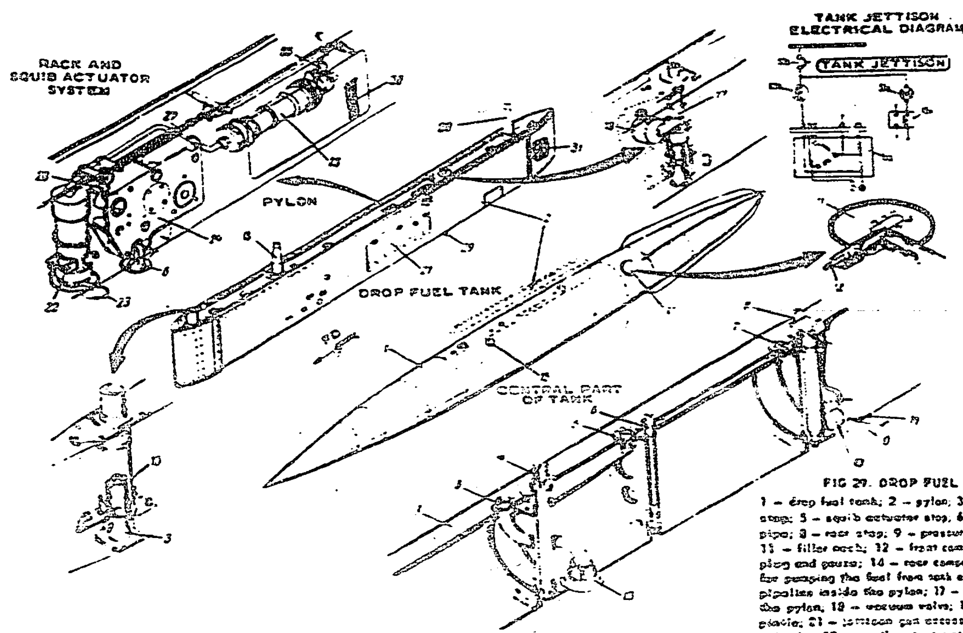

FIG 27. DROP FUEL TANK AND PYLON

1 – drop fuel tank; 2 – pylon; 3 – fuel delivery pipe; 4 – front stop; 5 – squib actuator stop; 6 – eye-bolt; 7 – pressurization pipe; 8 – rear stop; 9 – pressure bulkhead; 10 – check valve; 11 – filler neck; 12 – front compartment drain pipe; 13 – drain plug and gauze; 14 – rear compartment drain plug; 15 – neck for pumping the fuel from tank on the ground; 16 – fuel delivery pipeline inside the pylon; 17 – pressurization pipeline inside the pylon; 18 – vacuum valve; 19 – front pintle; 20 – rear pintle; 21 – jettison gun access hatch; 22 – squib actuator cylinder; 23 – squib actuator stud; 24 – [illegible] neck; 25 – [illegible] gun; 26 – fork; 27 – spring mechanism; 28 – dowel; 29 – limit switch; 30 – ground kit safety pin; 31 – electric connectors.

[redacted]

[redacted]

The jettison gun is loaded with a two-primer squib, type ПИ-3М-1. The gun striker is cocked by a spring mechanism actuated only in case the БДЗ-56Е lock bearing lever is opened at the instant of tank jettison.

The spring mechanism is triggered by turning the spring mechanism lever axle with a wrench.

The triggered spring mechanism is safety-locked with a dowel which is moved up and kept in the upward position by the БДЗ-56Е lock bearing lever. When a check of the drop fuel tank jettison is made, the lock bearing lever is opened mechanically with the help of a wrench inserted through a hole on the right-hand side of the pylon.

To jettison the tank during flight, the button TANK JETTISON (СБРОС БАКА) situated on the aircraft control stick is depressed.

Through the jettison button the current is fed to the lock release electromagnetic mechanism emergency winding from the circuit breaker TANK JETTISON. The circuit breaker is situated on the rear starboard electric panel inside the cockpit.

Installed on the lower board of the instrument panel is the pilot lamp TANK SUSPENDED used to indicate suspension and jettison of the drop fuel tank.

The negative of the suspension indication circuit is connected by means of a microswitch arranged in the pylon and pressed downward when the tank is suspended. When the microswitch is pressed upward, it also provides interlocking of the central brake flap controlled by the presence of the jettison tank.

The pylon has a hatch to make an access to the jettison gun. The hatch cover is provided with a hole used to insert a ground kit safety pin.

2. БДЗ-56Е LOCK

Basic Specifications

1. Actuating service voltage ....27 V ±10 per cent
2. Minimum actuating voltage ....20 V

[redacted]

[redacted]

3. Service temperature range .... from +50 to -60°C
4. Weight .... 3,370 kg
5. Type of plug connector ШР28П7НГ9

The lock is secured to the pylon by means of two bolts (Fig. 30).

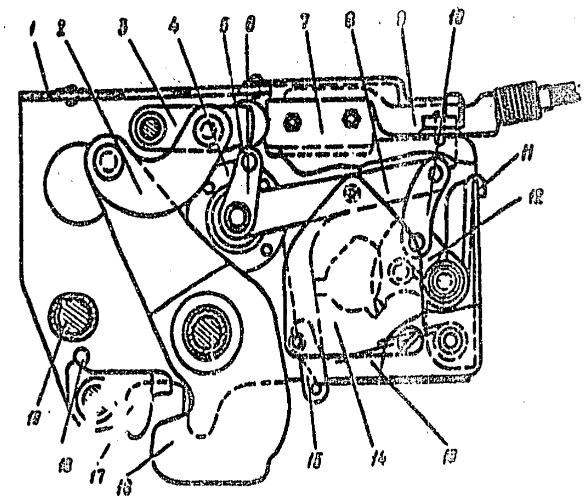

FIG.30. BOMB RACK БДЗ-63Е

1 – body; 2 – shackle; 3 – intermediate lever; 4 – ball bearing; 5 – roller; 6 – thrust lever; 7 – BK1-140 microswitch; 8 – lever; 9 – patch; 10 – tie-rod; 11 – spring; 12 – intermediate lever; 13 – control bar; 14 – electromagnetic release mechanism; 15 – trigger lever; 16 – bearing lever; 17 – stop; 18 – spring; 19 – tube.

To fix the lock bearing lever in the closed position, the sear tooth of the electromagnetic mechanism is meshed with the sector lever. The complete length of gearing between the sector bearing surface and the sear tooth should not be less than 2.5 mm or more than 3 mm.

To fix the lock by the cocking lever, a wrench is employed.

When the current flows through the winding, the electromagnetic mechanism armature is turned through an angle of 10 to 11.5°.

[redacted]

1. Before installing the pylon on the aircraft, perform the following operations on the fuselage:

(a) remove the plug used to stop the fuel pipeline outlet and make sure the pipe is clean and the packing ring installed inside the pipe branch is not missing;

(b) remove the microswitch electric wires and lock outlet hatch cover. Drive out the microswitch electric connector socket and the БДЗ-56Б lock plug from the locks arranged on the fuselage (starboard) having disengaged the microswitch and lock electric wires from the stirrup and clip, and pull the electric connectors out through the hatchway;

(c) examine the pressurization pipeline outlet and make sure it is clean and the packing ring installed inside the pipe branch is not missing;

(d) screw the plugs out of the pylon attachment pintle front and rear seats and make sure they are clean and their threading is good.

2. To check the spring mechanism for jamming in the dowel, proceed as follows:

(a) use an opening in the upper side of the pylon to loosen the spring, disconnect the tie-rod from the bell crank and drive it together with the spring.

CAUTION: Before slackening the spring, first measure the compression value L of the spring (Fig. 31);

(b) make sure there are no sharp edges, burrs or scores in the tie-rod slots, and file them off if any;

(c) grease the tie-rod and dowel, press on the dowel spherical part (when the lock is removed) and make sure the dowel travels without jamming.

If the dowel travels tightly, remove it from the pylon, wash, lubricate and install it back into its place.

In case spacing washers have been installed under the dowel bracket legs, place them back under the same legs when assembling the dowel;

(d) install the tie-rod without spring, turn the bell crank with a wrench and check the co-axiality between the

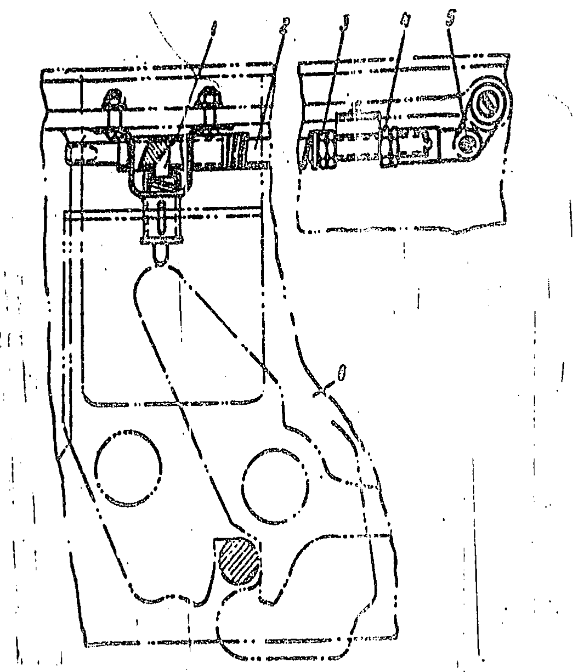

FIG.91. SPRING MECHANISM LOCKING

1 – locking dowel; 2 – tie-rod; 3 – nut;
4 – lock nut; 5 – shaft; 6 – lock housing

tie-rod fork and the eye of the bell crank which is indispensable for easy travel of the tie-rod without jamming;

(c) remove the tie-rod, install the spring, adjust its compression proceeding from the value measured before disassembling, and assemble the spring mechanism.

NOTE: Item 2 relates to 100-hours routine maintenance.

3. Examine the pylon and make sure it is serviceable. While inspecting, perform the following:

(a) remove the rubber plugs from the ends of the fuel and pressurization pipelines. Make sure the pipes are clean and the rubber ring gaskets installed at the lower ends of the pipeline are not missing. Check if the above-mentioned pipelines can be displaced (within 6 mm) along the longitudinal axis of the pylon;

(b) make sure the seats of the fuel tank front and rear stops are clean and intact;

(c) screw off the captive nut, remove the plug from the squib actuator cylinder (Fig. 32) and check if the cylinder is clean inside;

(d) install the БД3-56E lock. In case the lock has not been removed, check it for reliable attachment and actuation by the mechanical release.

CAUTION: Do not trigger the lock bearing lever before the spring mechanism has been triggered;

(e) press the microswitch rod and listen if a click is produced which accompan[illegible] making and breaking of the microswitch circuit. After this, check the extension of the microswitch rod and see if it is equal to 25 mm, the travel being measured between the pylon lower edge and the rod head;

(f) open the hatch and check the [illegible]able attachment of the jettison gun, condition of the pipeline, attachment and safety locking of the rods to the spring mechanism bell cranks, and condition of the electric wiring connected to the limit switch;

CAUTION: Never should the pylon be installed until the jettison gun is unloaded.

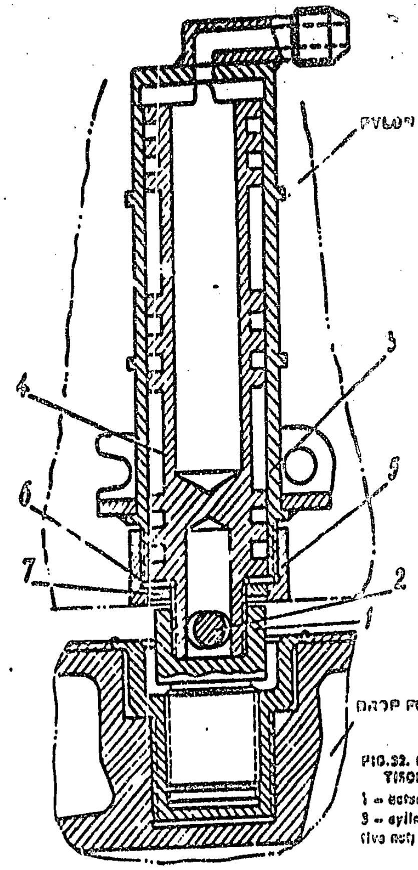

FIG.32. DROP FUEL TANK JETTISON SQUIB ACTUATOR
1 - actuator stop; 2 - stud; 3 - cylinder; 4 - piston; 5 - captive nut; 6 - special washer; 7 - nut.

(g) make sure the vacuum valve inlet pipe branch is clean. Check for easy opening and closing of the valve by pressing on the valve with a bent wire inserted through the inlet pipe.

4. Remove the front and rear pintles from the pylon by turning off the respective nuts with a wrench;

5. Install the front and rear pintles into the respective seats in the fuselage and drive them home by tightening up the nuts.

6. Remove the pylon back fairing by turning off the attachment screws.

7. Pull the electric wires cord used for feeding the pylon out of the fucelage, and disconnect the socket of connector ШР-4 (arranged on the fuselage) from a special plug with a jumper, and uncouple the plug of connector ШР-4 and the choke.

8. Bring the pylon up to the fuselage, match the pintle holes and the pylon pipeline branches with the pintles and pipelines of the fuselage.

Pack the aircraft wire cords with ШР-4 connector and fit them into the retainers on the pylon to avoid catching the wires.

Install steel washers at the ends of the pintles, screw on the nuts, tighten them with a box wrench and fix them with lock nuts.

<u>CAUTION</u>: When the pylon is finally secured, care should be taken to arrange the wire cords properly and avoid nipping of wires between the edge of the pylon and fuselage.

9. Couple the aircraft mains wires to the electric connectors installed on the bracket in the rear portion of the pylon and mount the rear fairing.

10. Check the operation of the jettison gun by loading the gun with a dummy cartridge or a washer with primers and pushing the tank jettison button.

11. Load the jettison gun with a ПК-3М-1 squib and install a ground kit safety pin.

12. Before suspending the tank, trigger the spring mechanism and fix the БДЗ-56Е lock.

The procedure of removing the pylon from the aircraft is the reverse of installing it.

After the pylon is removed, install the plug with a jumper and the choke, fix them to the fuselage and safety-lock the choke used to stop the fuel pipeline outlet with КОК-0.8 wire.

<u>NOTE</u>: To install or remove the pylon, assistance of the aircraft technician is necessarily required.

[redacted]

When the tank is not suspended, the lower portion of the pylon should be closed with a protective cover and the fuel delivery pipe connection should be stopped with a plug. 50X1-HUM

4. INSTALLATION OF БАЗ-56E LOCK

Before installing, check the complete set and the condition of the lock and pylon.

To install the lock into the drop tank pylon, observe the following priority.

1. Screw off two lock attachment bolts from the pylon.
2. Pull the wire cord and the lock electric connector inside the pylon and make use of the jettison gun hatch to couple the connector to the branch of the wire cord running from the fuselage. After this secure the connector with the lock.
3. Install the lock into the pylon and fix it with the bolts screwed out of the pylon.
4. Check the actuation of the lock by the mechanical release and by the electric control arranged inside the cockpit.

5. TRIGGERING OF JETTISON GUN SPRING MECHANISM AND БАЗ-55E LOCK

In case no tank is suspended, the spring mechanism and the lock should be released and the jettison gun should be unloaded.

The spring mechanism (Fig. 33) and the lock must be triggered before suspending the tank and after loading the jettison gun.

To do this, proceed as follows.

1. Fit a wrench into the axle spline TRIGGER (ВЗВОД) situated on the left-hand side of the pylon, and turn the axle counter-clockwise to trigger the spring mechanism.
2. Fix the triggered spring mechanism by means of coupling the spring mechanism fork with the eye of the gun bolt bracket with the help of a stud.

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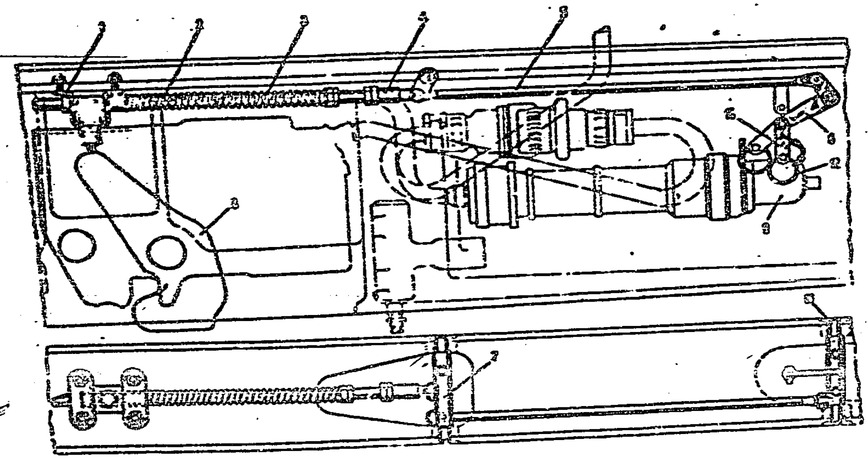

FIG.33. SPRING MECHANISM OF DROP FUEL TANK JETTISON SYSTEM

1 – locking pin; 2 – tie-rod; 3 – spring; 4 – bushing; 5 – tie-rod; 6 – bell crank; 7 – lever; 8 – lock bearing lever; 9 – jettison gun, 10 – fork; 11 – trigger axle; 12 – stud.

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CAUTION: If the lock is not released, never trigger the spring mechanism.

3. Trigger the bearing lever of the lock. See that the upper part of the bearing lever presses against the spring mechanism dowel and locks the triggered spring mechanism.

To fix the lock proceed as follows:

(a) engage the lower protruding part of the bearing lever and turn it in the direction of flight;

(b) retain the turned bearing lever and turn the locking lever with a wrench fitted upon it all the way in the reverse direction;

(c) make sure the lock levers are fixed reliably by noting the position of the intermediate lever in the pylon inspection hole as is shown on the reference plate attached beside the hole (Fig. 34).

4. Drive the stud out of the eye of the jettison gun bolt bracket and make sure the spring mechanism is fixed. To do it, act upon the fork with a little force in the direction of motion of the released parts of the system.

5. Check if the ground kit safety pin is installed in the jettison gun bolt and couple the spring mechanism fork with the firing cotter.

6. Close the jettison gun hatch cover and fasten a warning tab to the ground kit safety pin.

If training flights are performed during a flight day, it is allowed that the pylon jettison gun may not be unloaded before removing or suspending the drop fuel tank.

To remove and install the fuel tank without unloading the jettison gun, all safety measures should be taken and the following priority observed.

1. Disconnect the warning tab from the ground kit safety pin and open the cover of the pylon jettison gun access hatch.

2. Drive the stud out and disconnect the spring mechanism fork from the firing cotter of the bolt.

3. Drive the ground kit safety pin from the port in the cock and replace it with a stud coupling the bolt firing cotter to the spring mechanism fork.

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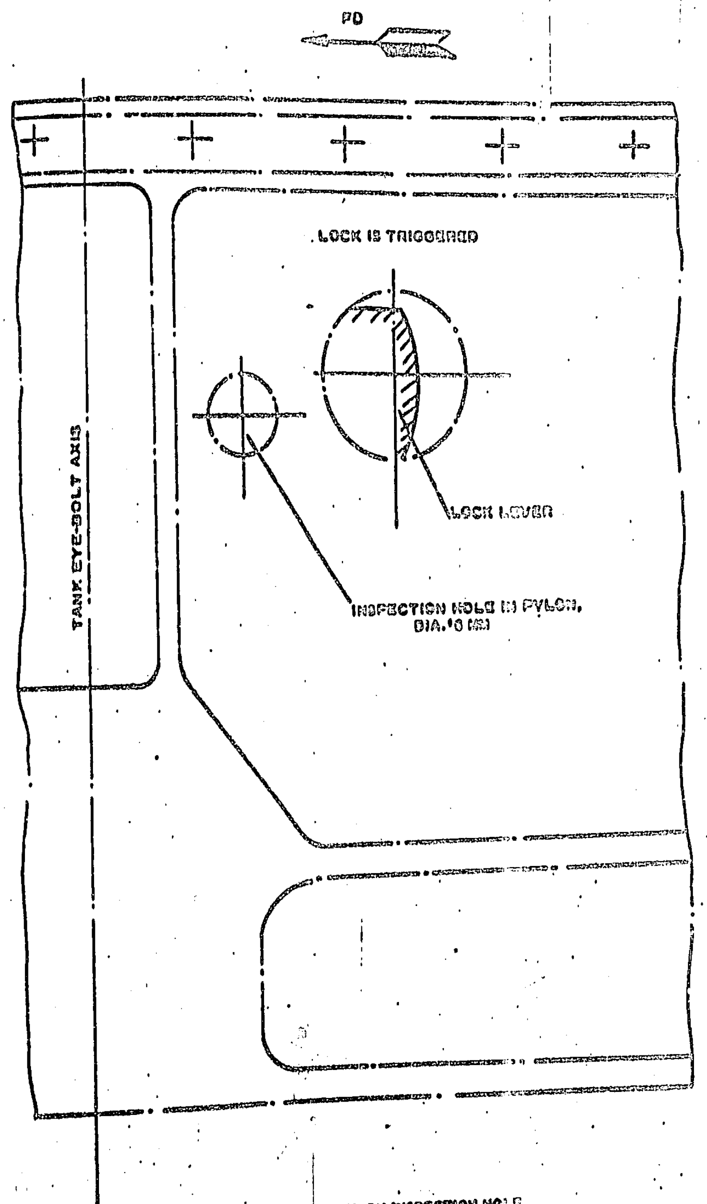

FIG.24. VIEW ON PYLON INSPECTION HOLE

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4. Close the jettison gun access hatch cover.

5. Observe the procedure prescribed by the Instructions and remove the drop fuel tank.

6. Close the lower portion of the pylon with a protective cover and stop the fuel delivery pipe connection with a plug.

The procedure of suspending the tank specified by the Instructions is the reverse of dismounting. To fix the triggered spring mechanism before suspending the tank, use the stud employed for coupling the fork with the firing cotter.

While suspending the tank, lock the gun bolt cock with the ground kit safety pin instead of the stud.

6. CHECKING THE TANK SUSPENSION AND JETTISON CONTROL SYSTEM FOR FUNCTIONING

If the drop fuel tank has not been suspended for a long time, the operation of the jettison control system should be checked immediately before suspending the tank.

To make a check, observe the following sequence.

1. Install a ground kit safety pin into the gun bolt cock, disconnect the spring mechanism fork from the firing cotter of the bolt and load the jettison gun in compliance with the prescribed procedure.

2. Make an external examination of the pylon and check the following:

(a) reliable attachment of the pylon and tight contact between the pylon and the fuselage;

(b) condition of the pylon stop seats for the respective stops of the drop fuel tank;

(c) release of the БДЗ-56Б lock bearing lever by the mechanical system. Check if the lock is fixed reliably and the springs are acting effectively.

If dirt has been detected in the levers, remove the lock from the pylon and wash it;

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(d) condition of the exposed parts of the spring mechanism and attachment of the jettison gun.

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3. Load the gun with a testing cartridge or a washer with primers.

4. Trigger and fix the spring mechanism.

5. Trigger the lock bearing lever and make use of the inspection hole on the left-hand side of the pylon to check if the lock is fixed reliably. Disconnect the spring mechanism fork from the jettison gun bolt bracket and make sure if the spring mechanism is fixed securely with the dowel displaced upward by the upper arm of the lock bearing lever.

6. Couple the spring mechanism fork with the gun bolt firing cotter.

7. Switch on the storage battery and circuit breaker TANK JETTISON.

8. Press the microswitch rod upward and check if this causes the tank suspension indication pilot lamp to light up. See that after the rod is moved downward, the lamp goes out.

9. Push the tank jettison button and make sure the lock bearing lever opens, the spring mechanism acts efficiently and pulls out the firing cotter so that the jettison gun bolt striker is released.

10. Unload the jettison gun and check both primers of the washer for proper impression.

11. Make a control checkout of the system operation and jettison of the empty tank. However, no loading of the gun for repeated checking of impression of the primers is required.

The operations involved in the control checkout of jettison, suspension and maintenance of the tank should be accomplished by the aircraft technician in accordance with the procedure described in Book One.

On completing the checking, disconnect the storage battery and circuit breaker, and load the jettison gun if necessary.

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NOTE: A checkout of the tank jettison control system same as that described above should also be completed during 25-hours maintenance.

7. UNLOADING OF JETTISON GUN

To unload the jettison gun (Fig. 35) proceed as follows.

1. Disconnect the warning tab from the ground kit safety pin and open the gun access hatch cover situated on the left-hand side of the pylon.

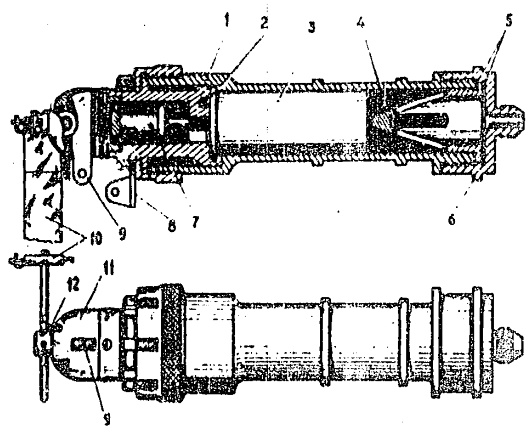

FIG. 35. DROP FUEL TANK JETTISON GUN

1 – body; 2 – centring pin; 3 – squib; 4 – bor; 5 – gasket; 6 – cover and pipe connection; 7 – two-pin striker; 8 – setting bracket with eye; 9 – firing cotter; 10 – safety cotter; 11 – gun bolt; 12 – stud for checking loaded position.

2. Drive out the stud and disconnect the cotter of the gun bolt from the spring mechanism fork. Install the stud into a hole in the fork.

3. Loosen the gun bolt lock-nut, screw off the captive nut and drive the gun bolt from the pylon.

CAUTION: Never should the jettison gun be unloaded before the ground kit safety pin has been installed.

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4. Separate the squib from the gun bolt by means of turning the squib about the face dowel to move the cartridge rim from the tooth and remove the squibs from the dowel.

Clean and check the gun bolt for normal operation.

The same procedure should be observed to unload the jettison gun after dropping the tank. Besides, powder fouling of the firing mechanism parts must be thoroughly cleaned. To do this, proceed as follows.

1. Screw off the captive nut and disjoint the pipeline from the jettison gun body.

2. Remove the gun attachment stirrup and drive it out of the pylon.

3. Remove the squib wad from the gun cylinder and clean the cylinder from fouling. For convenience in cleaning, the nut may be screwed off and the bar driven out.

4. Screw off the squib actuator cylinder captive nut, remove the fragments of the shear washer and clean the actuator cylinder.

5. Pull a bristle scourer through the pipe pushing it at both ends to clean the pipe from fouling and soot, then blow through the pipe with compressed air at the end connected to the jettison gun.

6. Install a new actuator from the drop fuel tank complete set, install the gun body, connect it to the pipe, check the tank jettison control system and load the gun if necessary.

8. LOADING OF JETTISON GUN

In order to load the jettison gun, observe the following priority.

1. Trigger the gun bolt by pressing the striker back so that its end gets out of the gun bolt body.

Insert a ground kit safety pin into a hole in the striker stem end and install the firing cotter into the gun bolt head pulled all the way in.

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2. Turn the squib about the dowel on the bolt face and fit the cartridge rim under the bolt tooth. When installing the squib into the bolt, hold the bolt so that the striker is directed upward.

3. Install the gun bolt and squib into the jettison gun body without removing the ground kit safety pin.

4. Drive the bolt captive nut home and fix it securely with the lock-nut. Set the bracket eye used to attach the spring mechanism fork into a position where the fork can be connected to the eye after the spring mechanism is triggered.

<u>CAUTION</u>: When tightening the jettison gun bolt captive nut, take care to provide free coupling between the fork eye and gun bolt firing cotter. To check whether this requirement is observed, remove the fork from the firing cotter and install it back again.

5. Trigger the spring mechanism and lock EM3-56E.

6. Make sure the spring mechanism is securely locked.

7. Connect the firing cotter with the spring mechanism fork.

8. Make sure the loaded position indicator (of red colour) protrudes from the gun bolt body and does not sink when forced.

9. Close the hatch cover and fasten a warning tab to the ground kit safety pin.

<u>CAUTION</u>: The ground kit safety pin should be removed from the loaded jettison gun only before a flight.
Prior to removing the ground kit safety pin, make use of the inspection hole on the left side of the pylon to check whether the EM3-56E lock is triggered, since the jettison gun may fire and cause a premature release of the tank in case the lock is not fixed.

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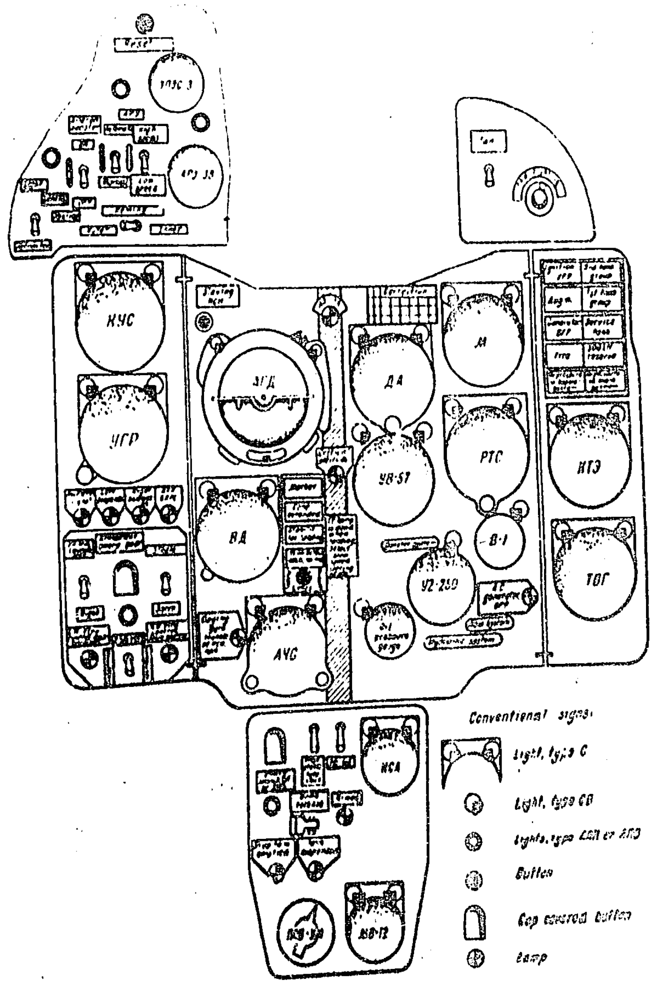

FIG 33. LAYOUT OF INSTRUMENT PANEL ELEMENTS

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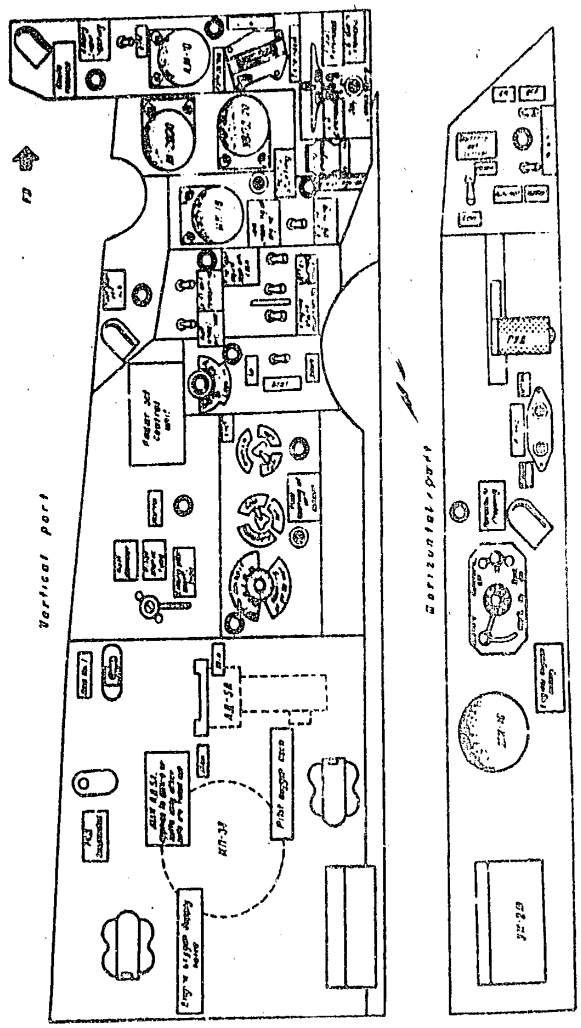

FIG 17 LAYOUT OF LEFT-HAND PANEL ELEMENT

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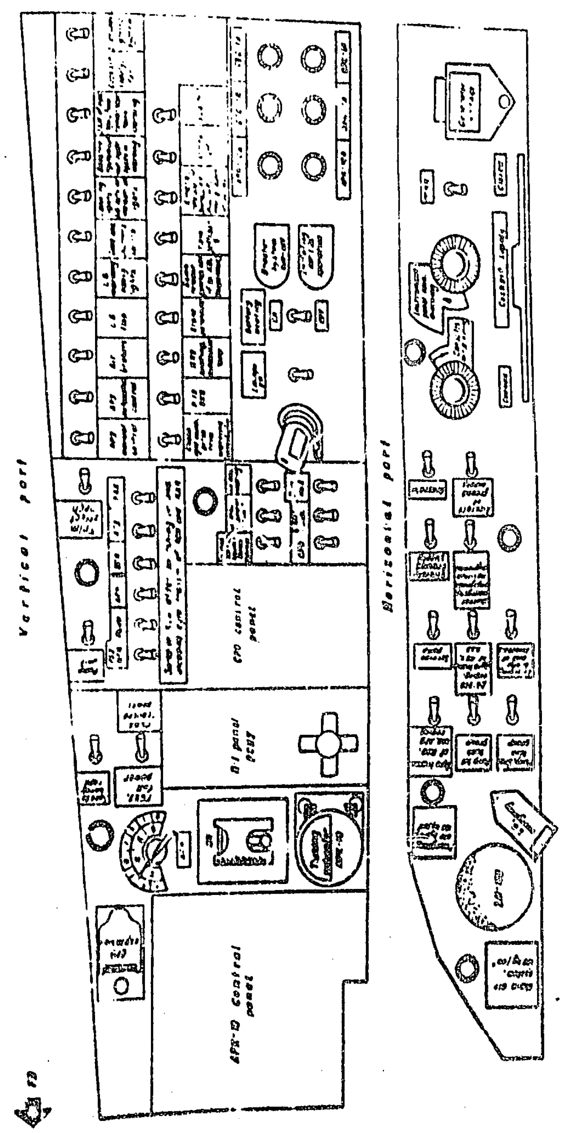

FIG.32 LAYOUT OF RIGHT-HAND PANEL ELEMENTS

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