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MIG-21 F-13

AIRCRAFT, TYPE МиГ-21 Ф-13

OPERATING AND MAINTENANCE INSTRUCTIONS
(No. ГК-021-Б)

Book I

Operation of Aircraft and Aircraft Power Plant

30

The Book contains 350 pages and 6 sheets of insets.

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C O N T E N T S

Appendices

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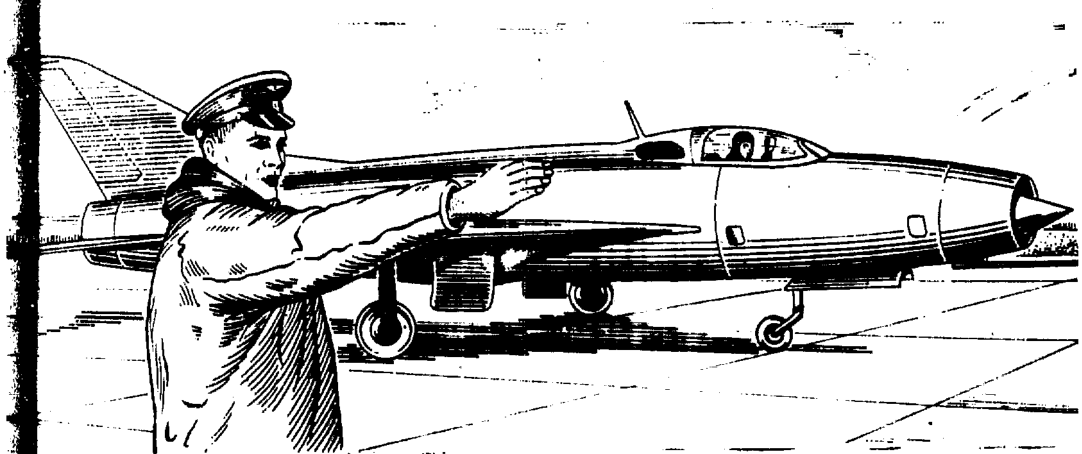
The present Operating and Maintenance Instructions consist of three books:
Book I - Operation of Aircraft and Aircraft Power Plant
Book II - Operation of Aircraft Armament
Book III - Operation of Electrical, Radio, Instrument, and Oxygen Equipment
The present Instructions are valid for aircraft beginning with series number 1601.



PREFACE

The МиГ-21Ф-13 aircraft (Figs 1-4) is a single-seat, light, all-weather day-and-night fighter of a high performance. The aircraft is designed for flying at hypersonic speeds and high altitudes.

Combined in the aircraft design are a modern small-size engine and an air-frame of minimum possible dimensions. At the same time the aircraft possesses high thrust-to-weight ratio though it is the lightest among the front-line fighters.

If compared with heavy fighters, the МиГ-21Ф-13 fighter has a number of economic, operational, and tactical advantages due to its small weight, low fuel consumption during one sortie, and ability to operate from rolled airfields.

The aircraft is powered by a turbojet engine, type ТРДР11Ф-300, having a two-shaft axial compressor and an afterburner.

The МиГ-21Ф-13 aircraft has effective control surfaces and possesses good stability.

Acceleration forces, generated at high altitudes, provide maneuverability that is required of a modern first-rate fighter.

The aircraft can execute aerobatics, such as loops, half-rolls, rolls, half-loops, etc., within the entire range of airspeed, its stability and controllability remaining quite satisfactory.

The aircraft recovers from a spin normally.

The МиГ-21Ф-13 aircraft can take off and land on second-rate and soil airfields, which considerably widens its combat employment.

Stable operation of the Р11Ф-300 engine during its acceleration and throttling within the high-altitude performance up to the aircraft ceiling, reliable operation and control of the afterburner, as well as adequate thrust-to-weight ratio, provide for the aircraft high combat performance.

The МиГ-21Ф-13 aircraft carries cannon and rocket armament which allows multipurpose combat employment of the aircraft.

The aircraft carries modern instrument and radio equipment which makes both day and night flying possible.

Good all-round visibility from the cockpit, automatic control of oxygen supply and cockpit air temperature, as well as the layout of instruments, ensuring easy visibility, create convenient conditions for the pilot.

The МиГ-21Ф-13 aircraft is easy to handle both in flight and on the ground.

To ensure reliable operation of the aircraft in flight the pilots and technicians should be well aware of the fact that to operate a modern hypersonic fighter one should possess good knowledge of the aircraft and engine, proper understanding of the aircraft systems operation and their servicing, and thorough knowledge of all the procedures involving pre-flight and preliminary preparation for flight.

Admitted for servicing the МиГ-21Ф-13 aircraft are only those of the personnel who have been qualified for the jobs.

Described below are basic design features of the МиГ-21Ф-13 aircraft.

The airframe is an all-metal delta-midwing construction with swept back empennage and controllable stabilizer. The fuselage is divided into nose and tail portions which are jointed along frame 28. Such connection ensures easy removal and installation of the engine. The nose and tail portions of the fuselage are provided with a number of hatches to facilitate access to the aircraft and power plant units.

To reduce losses in pressure at the air intake the front part of the air intake is provided with a three-position retractable cone, automatically extended at airspeeds equal to 1.5 and 1.9 M.

To avoid the air intake surge when flying at M=1.5 and higher airspeeds with the engine being throttled, or at great angles of attack, automatically controlled anti-surge shutters are installed on the fuselage next to the nose air intake.

The shutters are interlocked with the throttle control and relative to the stabilizer deflection angle.

With the same purpose the engine control lever during engine low rating operation is interlocked relative to M=1.5.

Provided symmetrically on both sides of the fuselage at the engine inlet are two shutters for additional air intake . These shutters operate on the principle of pressure difference inside the air intake and the atmospheric pressure. Their purpose is to supply additional air for the engine during take-off.

The P11Ф-300 two-shaft turbojet engine comprises a six-stage two-rotor axial compressor, ten separate cannular combustion chambers, arranged circularly and enclosed in a common casing, a two-stage gas turbine, an afterburner chamber with a two-position jet nozzle, a system of fuel supply and automatic control of the engine. The engine oil system is autonomous. The ГСР-СТ-12000ВТ starter-generator provides for automatic engine starting.

The cockpit canopy offers non-obstructed side and forward view.

Installed on the fuselage are three air brakes (two on the fuselage front part and one on its rear bottom). Mounted in the fuselage tail portion is a drag parachute container.

The aircraft has a delta wing with the leading edge swept back at 57° and the trailing edge making a 90° angle with the fuselage fore-and-aft line. The wing is furnished with ailerons and takeoff-and-landing flaps. Provided inside the wing are sealed compartments for fuel tanks.

The МиГ-21Ф-13 aircraft carries cannon and rocket armament.

The cannon armament consists of one cannon, type НР-30, installed in the lower part of the fuselage. A cartridge belt, containing 60 cartridges, is placed in the circular chute (guiding sleeve) secured between the fuselage skin and tank container. When firing the links remain in the chute, while the cartridge cases are ejected.

Installed on the bottom surface of each wing is the БДЗ-68-21У bomb rack, which permits to suspend two rocket pods УБ-16-57У each containing 16 С-5М or С-5К rockets.

The aircraft is equipped with two homing air-to-air К-13 rockets.

The fuel system comprises three groups of fuselage and wing compartments for fuel tanks with a total capacity of 2510 lit. and one drop tank with a fuel capacity of 490 lit. Provided on the aircraft is a starting fuel system intended for ground and mid-air engine starting.

The aircraft has a retractable tricycle landing gear. The nose leg which is stowed in the front lower portion of the fuselage retracts up and forward.

The landing gear main struts are installed in the wing. When retracting the main struts, the wheel axles are being turned by a specially provided mechanism, the wheels are retracted in the fuselage while the struts are stowed in the wing. The main struts carry the KT-82M wheels, 660x200, while the nose strut carries the KT-38 wheel, 500x180. To prevent skidding the wheels are equipped with an automatic brake-release system. The emergency brake system is intended for braking the main wheels only.

The aircraft is provided with a drag parachute which is used to reduce the landing roll.

The aircraft hydraulic system consists of two autonomous hydraulic systems: the booster hydraulic system and main hydraulic system.

Pressure in each of the hydraulic systems is created by the НП-34-2Т variable displacement pump which builds up maximum operating pressure of 210 kg/sq.cm.

The main hydraulic system actuates: the landing gear, flaps, air brakes, anti-surge shutters, retractable cone of the air intake, adjustable jet nozzle, and one chamber of the stabilizer БУ-51-МС booster.

The booster hydraulic system actuates two БУ-45А aileron boosters and one chamber of the БУ-51МС two-chamber booster of the controllable stabilizer.

The main hydraulic system may serve as a duplicating system for the aileron boosters in case of booster system failure.

If one of the hydraulic systems fails, the power of the remaining chamber of the stabilizer booster is sufficient to complete the flight.

In case the engine stops and cannot be started in flight, with the engine autorotation r.p.m. being normal, the pressure, created by the hydraulic pumps operating at the autorotation r.p.m., is sufficient to land the aircraft.

In case of engine jamming at low autorotation r.p.m., the aircraft landing is ensured by operation of the automatically actuated НП-27Т pumping station supplied from the aircraft storage battery or hydraulic accumulators, if the booster hydraulic system is in good repair.

The ailerons are controlled through the rod-and-lever linkage.

Great effectiveness of the ailerons made it necessary to fit in the system a non-linear mechanism which is placed ahead of the БУ-45А booster and changes the gear ratio.

The stabilizer is controlled by means of the control stick through the БУ-51МС two-chamber booster switched on in a non-reversible cycle.

The stabilizer control system includes the АРУ-3В automatic booster control unit which automatically changes the control stick-to-stabilizer ratio (and at the same time to the spring feel mechanism ratio) depending on the indicated airspeed and flight altitude.

The spring feel mechanism serves to create efforts on the control stick when the latter is deflected from the neutral position.

The stabilizer control system includes also the trimming effect mechanism which allows for the aircraft longitudinal balancing in flight proportionate to the efforts on the control stick.

The air supply system comprises the main system and the emergency system. The main system is intended for braking the wheels, opening and pressurization of the cockpit canopy, reloading of the cannon, release and dropping of the drag parachute, emergency removal of the canopy and operation of the de-icing system. The emergency system is designed for emergency extension of the landing gear and emergency wheel braking.

The air used to supply the pressurized cockpit is branched off behind the compressor and directed to the cockpit. The cockpit altitude is adjusted and the cockpit is ventilated with the aid of the АРД-57В valve. A rubber hose is used to pressurize the cockpit. The pre-set air temperature inside the cockpit is maintained automatically.

To ensure normal operating conditions for the pilot when flying at high altitudes the aircraft is provided with the ККО-3 oxygen supply system.

The pilot is equipped with the ВКК-3М pressure suit and the ГШ-4М pressurized helmet or the КМ-30М mask.

The МиГ-21Ф-13 aircraft is provided with an ejection system for the pilot. The ejection system may be used at any flying speed.

Mounted on the aircraft is the canopy liquid (alcohol) de-icing system.

Used as a permanent source of power supply on the aircraft is the ГСР-СТ-12000ВТ starter-generator installed in the engine. Two silver-zinc storage batteries 15СЦС-45 are used as the sources of emergency power supply.

In engine starting the generator is used as an electric starter for engine spinning. Provision is also made for autonomous engine starting from the aircraft storage batteries. The ground engine starting is performed with the power supplied in two steps (24 - 48 V). The aircraft carries the following radio equipment : the РСИУ-5Г transceiver radio set, the СРД-5МК radio range finder, IFF transponder (СРО-1), МРП-56П marker receiver, АРК -10 automatic radio compass and РВ-УМ radio altimeter.

AIRCRAFT WEIGHT, DIMENSION AND ADJUSTMENT DATA

I. Engine Performance Data

1. Engine, type Р11Ф-300.
2. Mid-air engine starting up to H=12,000 m. is ensured due to oxygen supply.
3. Afterburner switching-on is reliable up to H=16,000 m. and $V_{indicated}$ = 450-500 km/hr.
4. Engine operating ratings: low speed, normal, maximum, and augmented.

2. Weight and C.G. Data

(a) No Drop Tank

1. Take-off weight	7370 kg
2. Empty weight	4980 kg
3. Payload	2390 kg
crew	100 kg
fuel (γ= 0.83)	2080 kg
ammunition (60 cartridges)	56 kg
rockets (2)	154 kg
4. C.G. (centre-of-gravity) with take-off weight of 7370 kg (landing gear extended)	32.7%
5. C.G. operating, fore limit (landing gear up)	31.4%
6. C.G. operating (with 7% fuel remainder, initial total fuel supply being 2510 lit., without rockets and missiles, landing gear extended)	35.4%

(b) Drop Tanks Suspended

1. Drop tank, 480-lit. capacity, with pylon . . . . 70 kg
2. Fuel in 480-lit. drop tank (γ=0.83) . . . . 400 kg
3. Aircraft take-off weight, drop tank included . . . . 7840 kg
4. C.G. with take-off weight of 7840 kg (landing gear extended) 32.3%
5. C.G. fore limit 31.4%

3. Dimensions

1. Wing span . . . . 7.15 m.
2. Mean aerodynamic chord . . . . 4.002 m.
3. Wing dihedral . . . . -2^{o}
4. Tailplane span . . . . 3.74 m.
5. Fuselage length . . . . 12.177 m.
6. Landing gear tread . . . . 2.692 m.
7. Landing gear base . . . . 4.81 m.
8. Wing area (ailerons included) . . . . $23\ m^2$
9. Area of two ailerons . . . . $1.18\ m^2$
10. Area of two flaps . . . . $1.87\ m^2$
11. Area of stabiliser movable part . . . . $3.94\ m^2$
12. Area of vertical empennage . . . . $4.08\ m^2$
13. Rudder area . . . . $0.975\ m^2$
14. Wing sweepback angle (leading edge sweepback). . . . . 57^{o}
15. Horizontal stabilizer sweepback . . . . 55^{o}
16. Vertical fin sweepback . . . . $60^{o}30'$
17. Area of air brakes:
    - two front air brakes . . . . $0.76\ m^2$
    - one rear air brake . . . . $0.47\ m^2$
18. Dihedral of horizontal stabilizer . . . . 0^{o}

4. Adjustment Data

1. Angle of wing setting . . . . 0^{o}
2. Angle of fin setting . . . . 0^{o}

5. Controls and Control Surfaces Deflection Data (deflection being measured relative to the axis of rotation)

1. Ailerons: up - down . . . . $\pm 20^{o}$
2. Stabiliser:
    - nose end up . . . . 13^{o}
    - nose end down . . . . 28^{o}
3. Rudder: to the left - to the right . . . . $\pm 25^{o}$
4. Flaps (right and left) . . . . $24^{o}30'$
5. Control stick travel:
    - forward . . . . 96 mm
    - backward . . . . 220 mm
6. Foot pedals travel . . . . 87.5 mm
7. Retractable cone travel . . . . 170 mm
8. Air brakes:
    - front . . . . 25^{o}
    - rear . . . . 40^{o}

1. GENERAL

1. In order to ensure proper operation of the aircraft and prevent failure of its units and systems it is necessary:

(a) to get thoroughly acquainted with the design and operating principle of all aircraft systems and units;

(b) to follow the directions on the aircraft operation and maintenance set forth in the present Instructions;

(c) that the aircraft should be serviced by personnel adequately trained for the purpose.

2. The first part of the Instructions is devoted to directions on preparation of the aircraft for flight, as well as to information concerning the aircraft fuelling and filling with hydraulic oil and gases.

The second part of the Instructions deals with aircraft checking, scheduled maintenance, and general information on design and operation of respective systems.

3. Operation and maintenance of the engine, as well as of separate units and instruments having Technical Papers of their own, should be carried out in conformity with these Papers.

4. All operations on the aircraft should be carried out with serviceable and properly marked tools and appliances.

Upon finishing the maintenance operations check to make sure that no tools have been left inside the aircraft.

2. PRECAUTIONARY MEASURES

1. Prior to inspection or any work which is to be performed on the aircraft take all necessary precautions to prevent accidental firing, tank dropping, landing gear retraction or switching-on of electrical units. To this end after opening the canopy fit safety locks in the L.G. actuating cylinder rod and in the bell crank of the canopy emergency jettisoning system, after which make sure that:

(a) the seat armrests are fitted with protective enclosures;

(b) the ground safety lock pins are inserted in the heads of the ejection seat firing mechanisms, drogue parachute, seat ejection levers, and canopy autonomous jettison handle;

(c) the landing gear control lever is set to the neutral position and locked;

(d) all switches and circuit breakers of the cockpit electrical equipment (except for those locked) are set to OFF (ВЫКЛЮЧЕНО); however, the circuit breakers under the right panel cover of organic glass may be in the ON (ВКЛ.) position;

(e) a safety lock pin with a red thumbpiece is inserted in the drop tank firing mechanism.

2. To prevent accidents while working on the aircraft proceed as follows:

(a) before inspecting the air brakes open and lock the cross-feed cock of the air brakes by a distance clip with a thumbpiece provided for the purpose;

(b) to inspect the air brake wells extend the air brakes only manually, with no pressure in the hydraulic system;

CAUTION: It is strictly prohibited to remain in the cockpit during inspection of the wells of the air brakes and flaps with the hydraulic system under pressure.

(c) prepare and adjust the mechanisms for seat ejection, canopy jettison, and drop tanks jettison with the cartridges removed;

(d) when removing or replacing the cockpit canopy, insert a safety lock pin in the lever of the firing mechanism. When working in the cockpit, insert a safety lock pin in the membrane valve of the canopy remover gun;

(e) with the engine running, see to it that the personnel keeps away from the aircraft intake duct, the jet nozzle (its rear side) and does not approach the additional air intake shutters (Fig.5).

3. To prevent failure of the aircraft see to it that:

(a) additional air intake shutters are fitted with protective screens (Fig.6) used in case of engine ground testing and removed before take-off;

(b) while testing the engine with the afterburner on, the aircraft wheels are chocked and the aircraft is moored with the help of cables whose ends should be fastened to the landing gear struts and special mooring posts on the site;

(c) the cross-feed cock should be closed before starting the engine and aircraft taxiing;

(d) a special cover is placed on the canopy to protect the glass panels from sunrays.

4. IT IS FORBIDDEN:

(a) To place any objects on the aircraft wings or other parts of the airframe;

(b) to fill the aircraft systems with fuel and oil when the aircraft is in the wake of other taxiing aircraft or close to other aircraft with running engines, the latter being on the leeside;

(c) to leave open the pipe connections, unit connections, and plug connectors; they should be plugged while performing any dismantling operations on the aircraft.

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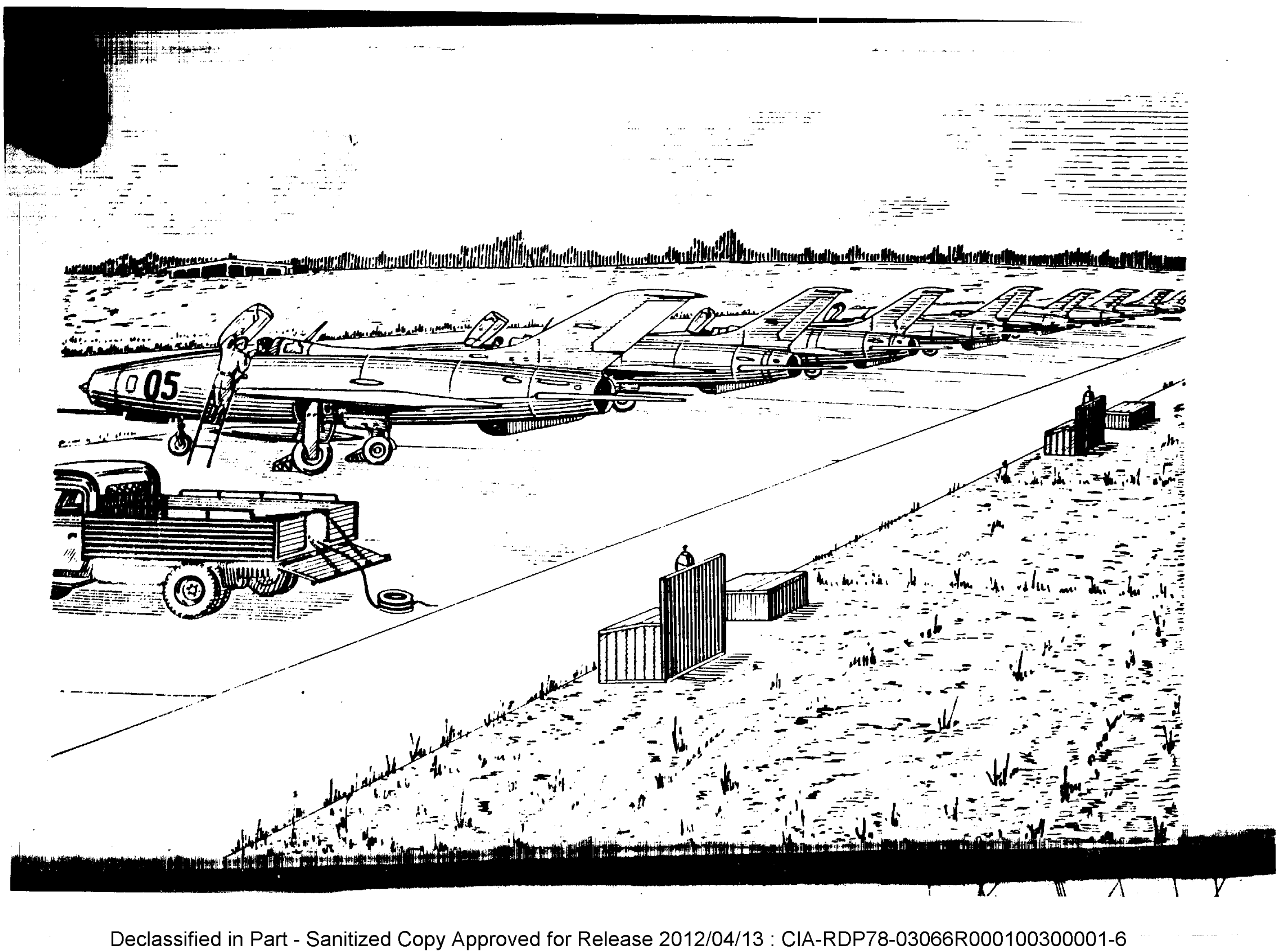
Part One

OPERATION OF МиГ-21Ф-13 AIRCRAFT



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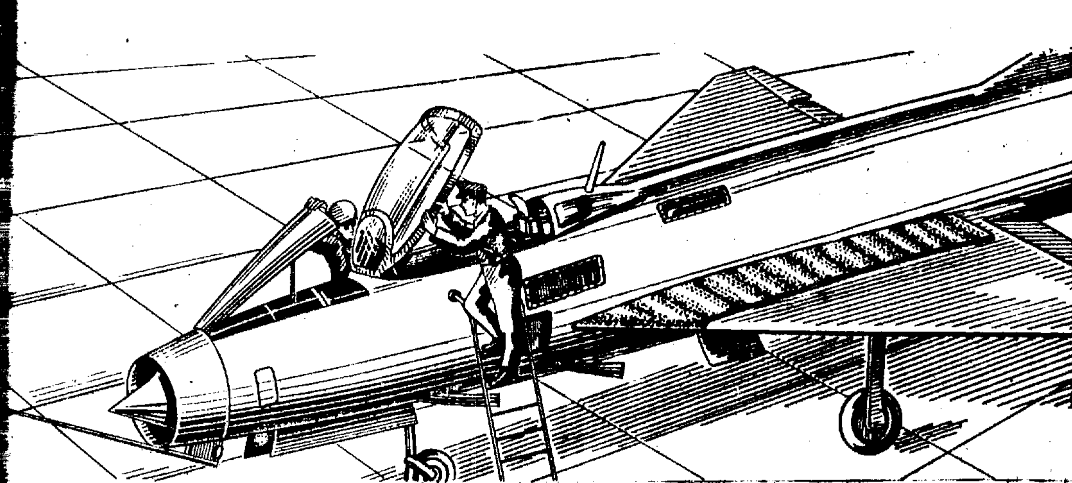


Chapter I

PRELIMINARY PREPARATION OF AIRCRAFT

Preliminary preparation is the basic type of the aircraft preparation for flight.

Preliminary preparation, involving various kinds of operation and checking, should be carried out in the following sequence:

1. After the flights are over, make sure that the engine operates normally, without any unusual noise, and see to it that no smoke comes out of the jet nozzle.

In case of engine smoking connect an available ground power supply source to the engine and perform spinning of a cold engine.

2. Insert a ground safety lock pin in the head of the drop tank firing mechanism.

3. After the canopy has been opened and before the pilot leaves the cockpit, place protective casings on the armrests of the pilot's seat and insert ground lock pins in the following places:

(a) left rod of the canopy actuating cylinder;
(b) bell crank left unit of the canopy emergency removal system;
(c) head of the seat ejection gun;
(d) head of the drogue parachute firing mechanism.

4. When leaving the cockpit, the pilot should insert ground lock pins :

(a) in the seat armrests and
(b) handle of autonomous canopy jettison system.

5. Close valves KB-2MC.

6. Check the spherical hydraulic accumulators for filling with nitrogen and for proper operation making use of the pressure in the hydraulic systems after the engine has been stopped.

The control stick movement should result in a gradual pressure drop down to 50 kg/sq.cm. with the following abrupt drop to zero, which will prove that the hydraulic accumulators are serviceable and charged to capacity.

7. Place covers on the engine air intake and on the additional air intake (Fig.7). Close the outlet duct 15 - 30 min. after stopping the engine (depending on the ambient temperature).

8. Receive the pilot's report on in-flight operation of the engine and aircraft equipment.

9. Ground the aircraft and check to see that the aircraft electrical system is disconnected. Fill the aircraft systems with air and oxygen, and refuel the aircraft. Check the aircraft systems for proper filling with oil, alcohol, and AMT-10 fluid. Fill them additionally, if necessary.

Set the fuel flowmeter according to the available amounts of fuel in tanks.

CAUTION: 1. During priming, see to it that no foreign objects get in the fuel, oil, and the АМГ-10 fluid.

2. If the tanks are still pressurized (after engine stop), open the filler neck covers with care, reducing the pressure to zero, to prevent the liquid from spilling out.

The filling over, proceed to the aircraft inspection. While doing this, inspect and check the following:

Inlet Ducts

10. Check condition of the radiotransparent cone and inlet duct walls to make sure that they are intact, have no bulges, loose or scored rivets, and foreign objects.

Fuselage Nose Portion

11. Check condition and attachment of the boom for securing the ПВД tube and the ТП-156 Pitot tube, the condition of the ДУАС-8М angle-of-attack-and-slip transmitter vanes.

Placing the boom in the flying position, make sure that the boom lock is in good repair, upon which raise the boom.

12. Check the skin of the fuselage nose portion, anti-surge shutters and additional air intake shutters to make sure that they are free from deformation and damage. Check the additional air intake shutters for easy movement by deflecting them manually, after which cover them.

13. Open the front hatch, inspect the well and check the locks of the hatch door for sound operation.

14. Check all vent holes in the fuselage bottom.

Landing Gear Nose Strut

15. Inspect the doors of the nose strut, their attachment units, and bonding. Wash and lubricate the hinged connections of the nose strut doors, if necessary.

16. Inspect the pipelines and units of the hydraulic and air systems in the nose strut well for reliable attachment, leakage of АМГ-10 fluid, rubbing of pipes against each other; see that the units are intact.

17. Check condition of the cable linkage and nose strut position indicator. Make sure that the nose strut lock is closed and the strut lock pin is pressed upward (check by shifting of the landing gear position indicator to the upper part of the slit in the strut arm).

18. Check the nitrogen pressure in the shock absorber (by its compression) and see that no АМГ-10 fluid leakage occurs in the shock absorber.

19. Inspect the strut actuating cylinder for airtightness and serviceability of connections.

20. Check the nose strut, fork, and universal joints for absence of cracks in the welded seams and for proper locking. Inspect the shimmy damper, check the damper filling by the length of the projecting portion of the indicator and make sure that АМГ-10 fluid does not leak.

21. Check the nose strut wheel and pneus for condition and pressure (by deflection). The tire is allowed to be worn down to the outer layer of cord.

22. Make sure that the tire does not slip relative to the marks on the wheel.

Main L.G. Right Strut

23. Check the strut doors, their attachment fittings, and bonding. See that the doors are not damaged or strained. Wash and lubricate the hinged joints of the doors.

24. Inspect the strut uplock and the door lock, check them for cleanliness. With the locks opened lubricate them, if necessary. Check the lock cabling to make sure that the strands are sound and free of corrosion.

25. Check the pipelines and units of the hydraulic and pneumatic systems in the strut well for reliable attachment and absence of the AMT-10 fluid leakage, see that the pipes are intact and do not rub against each other.

26. Check the actuating cylinders of the strut and wheel door, attachment fittings of the cylinders, strut, and door. Make sure that the locking nuts of the rods are properly tightened. Check the cylinder seals and hoseless connections for leakage.

27. Check the strut for cracks in the welded seams and leaks of the shock absorber seals. Check the wheel turning mechanism for sound condition.

28. Check the nitrogen pressure in the shock absorber (by the shock absorber compression). If necessary, re-fill the strut with nitrogen.

29. Check the strut wheel, condition of the tire and its inflation (by the tire deflection). It is allowed that the tire be worn down to the outer cord layer.

30. Make sure that the tire does not slip relative to the marks on the wheel.

Starboard Wing

31. Check condition of the wing bottom skin. Make sure that the AMT-10 fluid does not leak from under the hatches of the aileron boosters and flap actuating cylinder; see that no fuel leaks from the wing tank compartments.

32. Check the wing fillet and make certain that all screws are present and properly tightened (check the heads of the screws for proper pressing to the surface).

33. Check condition of the wing upper surface skin, aerodynamic fence, and static electricity discharger.

34. Check condition of the aileron, flap, and flap trim tab. Make sure that the wing-to-fuselage attachment bolt is properly locked.

Note: It is forbidden to bend the flap trim tab.

Fuselage Starboard Side

35. Check the vent pipes and air intake branch pipes of the fuel system, as well as of cooling system for generator and nozzle cylinders, for cleanliness of their inlets.

Make certain that the cooling system disc valves can be opened and closed manually without any difficulty.

36. Inspect the fuel drop tank (if it is suspended). Make sure that it is not leaky, that the tank shell is not damaged, and the drop tank is reliably secured. The checking should be made by bringing the tank nose and then its tail, down several times.

37. With the pressure in the hydraulic system reduced to zero and the crossfeed valve open, deflect the air brakes, inspect their wells, hydraulic cylinders, hinged and hoseless connections. If necessary, feed ЦИАТИМ-201 lubricant in the grease cups of the air brake mechanisms.

38. Check to see that the hole of the sump in the fuel tank pressurisation system, located in the well for the starboard wheel, is clean. Remove the hatch and check with the help of a portable lamp:

(a) the engine inlet duct for damage, loose or scored rivets, deformation and foreign objects;

(b) the strainers of the air cooler to see that they are not soiled;

(c) the steel sheet for cracks at the fillet continuous weld of the cooler;

(d) the member serving for sealing the engine nose end for trapping and jamming;

(e) the compressor blades for damage.

39. Check the turbo-driven cooler blower for free rotation.

40. Check the pressure by the pressure gauge installed in the discharge bonnet of the fire extinguisher and attachment of the fire extinguisher (at temperatures ranging from -35° to $+35^{\circ}$ variations of pressure should be within 40 to 90 kg/sq.cm. See Table included in the Chapter "Fire Fighting Equipment").

41. Open the hatches of the engine compartment and check:

(a) the units and piping of the fuel, oil, and hydraulic systems for proper attachment, locking and absence of damage;

(b) the pipelines and units for fuel, oil and fluid AMГ-10 leakage.

(c) the pipelines for rubbing against each other, the engine, and the aircraft structural parts.

Note: To perform any maintenance work in the engine compartment (elimination of faults, etc.) it is advisable to facilitate access that the drop tank should be removed and the rod of the hydraulic cylinder of the rear air brake should be disconnected.

42. Check the engine control rods and bell cranks for reliable connection and proper locking.

43. Inspect the fuselage skin for condition, hatches for proper attachment, locks and packing rubber for sound condition, fastening screws for proper tightening (i.e., see that the heads of the screws are properly pressed to the skin).

44. Check condition of the belly fin and tightening of the screws fastening its radiotransparent part as well as condition of the drag parachute cable attachment fitting.

Empennage

45. Inspect the stabilizer, fin, rudder, and check attachment of balance weights on the stabilizer and rudder. Check condition of the rudder tab and static electricity discharger on the tailplane. Make sure that the hatches are reliably secured.

46. Check to see that the stabilizer root edges are not jammed relative to the fuselage edges.

47. Check the outer skin of the tail cone for burns and cracks.

Jet Nozzle

48. Check the inner side of the tail cone, afterburner chamber and jet nozzle flaps for cracks, burns, deformation and deposited metal.

49. Check (using a portable lamp) the position of the flap ring, condition of the second-stage turbine blades and bandages. It is not allowed to perform maintenance operations on the electrical equipment and hydraulic system simultaneously.

50. Check the seals of the hydraulic cylinders of the jet nozzle flap control system for traces of AMГ-10 fluid leakage.

Fuselage Port Side

51. Inspect the fuselage port side in the same way as the fuselage starboard side. Besides, check:

(a) charging of the cylindrical hydraulic accumulators (by the pressure gauge)

(b) reliable closing of the drag parachute hatch doors, fixing of the door lock, stowing of the cable in the bracket holders, condition of the holders and lock for engaging the drag parachute cable;

(c) the hole of the sump in the hydraulic tank pressurization system for cleanliness.

Port Wing

52. The inspection procedure for the port wing is similar to that used case of the starboard wing. In addition it is necessary to check bending of aileron tab according to the inscription made on it.

L.G. Port Strut

53. Inspect the port strut in the same sequence as the starboard strut.

Aircraft Cockpit

54. Check the cockpit organic glass canopy for cracks, silvering or dimming the cockpit frame for damage. Check to see that the cockpit glass sealing is act.

55. Make certain that the canopy emergency jettison system is not shifted ards opening. Check to see that the moving parts of the system are locked, na-y:

(a) canopy emergency jettison handle and canopy firing mechanism release lev-;

(b) lock pin of the canopy firing mechanism;

(c) bell cranks located next to the cylinders of the emergency system for nopy locks release;

(d) hooks of the rear grip-type locks;

(e) cotter pin of the canopy toss system diaphragm valve.

56. Make sure that the following elements of the seat are locked and sealed:

(a) lock pin of the drogue parachute firing mechanism and cotter pins for the rachute pack attachment;

(b) nut of the ejection seat gun bolt;

(c) adjustable rod of the ejection gun control (located in the upper part of e seat);

(d) lever of the harness restraint firing mechanism (located behind the seat llapsible panel);

(e) holder of the pilot's restraint lock emergency opening (the holder being ocated on the seat);

(f) driving shaft of the restraint lock release system control.

57. Open the doors on the seat back and check condition of the rods and cables the seat firing mechanisms as well as condition of the firing mechanism attach-nt rods.

Check to see that the bolt nut and the restraint firing mechanism release ver are lockwired.

58. Inspect the de-icer manifold for damage of piping and reflecting plate; eck to see that the holes in the manifold are not soiled.

59. Check operation of the canopy control valve to make certain that the cano-y opens and closes smoothly; check the canopy control valve lever for sealing.

Make sure that the canopy control valve lever is locked with the canopy in the losed position; see that the canopy de-icing system manifold is properly ointed with the inlet pipe connection.

60. With the canopy opened, check:

(a) the loops of the canopy emergency side locks for damage;

(b) condition of the pressurising hose and its proper attachment.

61. When inspecting the seat, check:

(a) the container of the drogue parachute for serviceability and proper at-achment to the clip;

(b) cable of the drogue parachute firing mechanism lock pin for proper attach-ent to the lock pin and to the fuselage, as well as for proper stowage in the groove, nd reliable locking;

(c) cable of the ОРК-2 common connection for proper attachment to the lower block and to the fuselage;

(d) snaphook of the cable of the АД-3 safety harness automatic unlock mechanism for proper attachment to the lug on the starboard side of the fuselage and the АД-3 automatic unlock mechanism for operation 1.5 sec. after actuation;

(e) cable of the control shaft of the collapsible supports designed to engage the canopy front locks for proper attachment to the shaft rocker and cockpit floor.

62. Check operation of the shoulder harness for which purpose:

(a) open the lock of the shoulder harness by moving the handle on the left-hand armrest to the right and back; this will bring the harness strap into the lock;

(b) release the handle; the spring will set the handle to its initial position; this will lock the harness strap in the retracted position; next pull the strap to make sure that it has been securely locked;

(c) unlock the shoulder harness restraint once more and pull it out of the lock by hand, after which release the handle keeping the strap pulled out, and lock the strap in this position.

63. Check operation of the waist belt restraint, for which purpose:

(a) push the handle on the starboard armrest to the fullest extent and, while holding it in this position, pull out the waist restraint cables (if they have not been pulled out) by the buckles, then release the handle, after which make sure that the spring has brought the handle to the extreme back position;

(b) retract the cables of the waist belt restraint by moving the handle back and forth several times, after which pull them out as indicated in Item (a) and leave them in this position.

Note: If the handle would not deflect forward with the cables fully retracted, press the pawl of the ratchet gear.

64. Check operation of the seat adjusting mechanism, for which purpose change over the pressing switch on the port side of the cockpit up and down to make certain that the seat pan moves in response and the electric motor is switched off in the extreme positions by the limit switches.

65. Inspect the flexible casing and cables of the wheel brake control from the control stick to the ПУ-7 valve for broken strands and corrosion; check to see that the cable casing is not in contact with the guides of the seat footrests.

66. Make sure that the wheels can be properly braked and released with the pedals in the neutral position.

Smoothly deflect the pedals to the extreme positions in succession to check (against the pressure gauge) each wheel for complete release.

67. Check to see that the landing gear emergency release control and emergency braking control valve are closed and locked.

68. Check the ailerons deflection (with the hydraulic boosters disconnected) and rudder deflection by operating the control stick and pedals; see that no knocking and jamming occur in the hinged connections of the rods and bell cranks.

69. Extend the flaps, check for condition the flaps and their actuating mechanisms to see that the working surfaces are not soiled; lubricate these surfaces if necessary. The checking over, retract the flaps.

70. Check operation of the АРУ-3В automatic transmission ratio controller depending on the changes of the total pressure in the Pitot-static tube system with the help of the КПУ-3 unit according to the instructions given in Chapter "Aircraft Control"; participating in the checking should be technicians on aircraft equipment.

Note: If any malfunctions have been noticed by the pilot in flight, concerning operation of the stabilizer or ailerons, do not fail to find and eliminate the defects and then to check the stabilizer and ailerons with the hydraulic systems and the hydraulic tank pressurized from the ground hydraulic unit.

71. Check the engine control lever for smooth movement, the lever and panel stops for reliable attachment; check to see that no knocking occurs in the hinged connections of the engine control system and the lever is properly fixed by the stops.

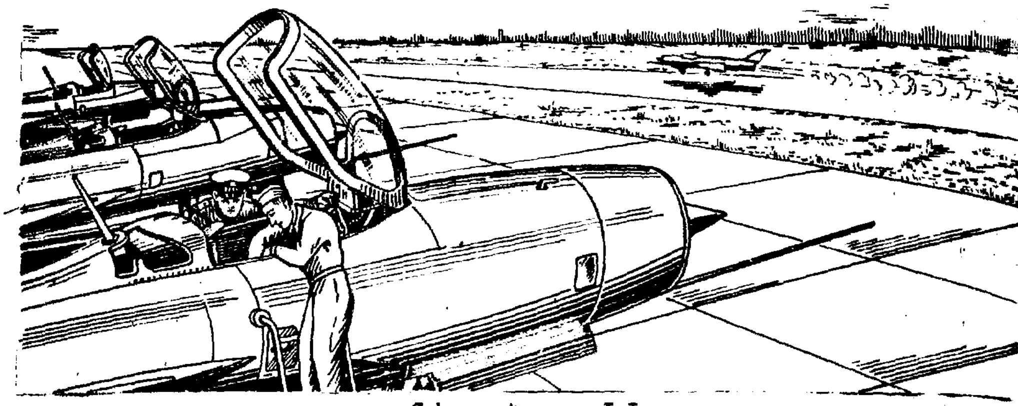
72. Check to see that no foreign objects have been left in the cockpit; in winter make sure that there is no ice in the cabin, especially under the pilot's seat.

73. The inspection over and all defects eliminated, switch off all circuit breakers and the storage battery in the cockpit (that were switched on for preliminary preparation) and close the canopy; take care not to switch off the circuit breakers under the organic glass panel on the starboard side of the cockpit.

CAUTION: To avoid discharging of the aircraft storage batteries during preliminary preparation all consumers should be fed from the ground power supply source. Disconnect the ground power supply source from the aircraft only after the circuit breaker inscribed STORAGE BATTERY: AIRCRAFT, GROUND has been switched off.

74. Make sure that no foreign objects have been left in the inlet ducts and jet nozzle, that the aircraft has been grounded and the wheels chocked.

Install a clamp on the rudder, plug the inlet ducts and jet nozzle, check to see that the hatch covers that were removed during inspection are replaced, cover the aircraft with canvas and seal the covers.



Chapter II

PRE-FLIGHT PREPARATION OF AIRCRAFT

Pre-Flight Inspection

Remove the canvas cover from the aircraft, set up the wing catwalks, remove the covers from the air intake, jet nozzle and additional air intake shutters; remove the clamp from the rudder, prepare the ground equipment and tools.

This done, perform the following:

Air Intake 1

1. Check to see that no foreign objects have got in the air intake duct, that the duct inner surfaces and the retractable cone are not damaged. After inspection cover the air intake.

Fuselage Nose Portion 2

2. Check the skin, anti-surge shutters, and additional air intake shutters for distortion and damage. The inspection completed, install protective screens on the additional air intake shutters.
3. Check condition and attachment of the Pitot-static tube and the ТП-156 Pitot tube.
4. Check the vanes of the ДУАС-8М angle-of-attack-and-slip pickup unit for damage and sticking.
5. Check to see that the locks of the cover of the fuselage front upper compartment are closed.

Landing Gear Nose Strut 3

6. Check to see that the wheel tire is properly inflated (the tire deflaction should be equal to 25 - 30 mm). Stow the grounding cable in the wheel axle.
7. Check nitrogen pressure in the shock absorber (by closure).
8. Check the strut well to be sure that it is free of foreign objects and dirt.

Main L.G. Starboard Strut 4

9. Check to see that the tire is properly inflated (the tire deflaction should be equal to 40 - 45 mm).
10. Check nitrogen pressure in the shock absorber (by compression).
11. Check the adjusting bush of the wheel turning mechanism rod for proper locking and matching of the marks.

Be sure that the uplocks of the strut and wheel doors are opened.

12. Inspect the strut well to make sure that it is free of foreign objects, dirt, and sand. Check to see that the cross-feed valve is closed.

Starboard Wing 5

13. Check to see that the screws on the hatch panels are tightened up.
14. See that the wing and aileron skin is intact and the flap guide rails are free of dirt.

15. Inspect the glass of the navigation lights for damage.

Fuselage Starboard Side 6

16. Check the skin of the fuselage lower portion close to the engine and l tanks for traces of fuel and oil leakage.

17. Check to see that the inlets of the vent pipes, fuel system air intake nches, generator cooler and engine nozzle cylinder are free of dirt.

18. Make sure that the screws of the fuselage hatch panels are properly htened.

19. Inspect the drop tank for proper attachment.

Empennage 7

20. Check the rudder, its tab, stabilizer, static electricity discharger, belly fin for damage.

21. See that no foreign objects are present between the stabilizer and fu-lage.

22. Check to see that the tail navigation light is not damaged.

Jet Nozzle 8

23. See that no foreign objects and fuel have accumulated in the engine out-t duct.

Fuselage Port Side 9

24. The fuselage port side is inspected in the same way as the fuselage arboard side. Besides, it is necessary to make sure that:

25. The drag parachute compartment doors are closed and locked.

26. The cable of the drag parachute is stowed in the bracket holders on the uselage and is not loose; see that the lock of the drag parachute cable is clos-d.

27. Ground safety pin (a pin provided with a red thumbpiece) is inserted in he drop tank firing mechanism head.

Port Wing 10

28. Inspect in the same way as the starboard wing. In addition, check the ngine oxygen supply system for charging using the pressure gauge.

Main L.G. Port Strut 11

29. The inspection procedure is similar to that used in the case of the starboard strut.

Checking Fuel Quality

30. Discharge the fuel sediment from the 3rd (service) tank through the drain ook of the 495-A pump. Make certain that the fuel contains no water, ice (in winter) and foreign matter.

CAUTION: If water, ice crystals or foreign particles are found in the fuel sediment, drain some more fuel through this cock and through the rest drain points of the system until it becomes pure; in case of necessity replace the fuel in the aircraft completely.

Checking Aircraft Systems for Proper Filling 12

Open the appropriate hatches and filler necks and check the following:

31. The aircraft fuelling. The fuel level in the tank should be not more than 20-30 mm short of the lower edge of the filler neck in summer and 10-20 mm, in winter.

32. The amount of starting fuel. The fuel level in the tank should be not more than 40 mm short of the lower edge of the filler neck in summer as well as in winter.

33. The amount of oil in the oil system which is determined with the help of the dip stick.

34. The amount of fluid in the booster and main hydraulic systems under serv pressure with the flaps and air brakes retracted. The fluid level in both sectio of the hydraulic tank should come to the notches on the dip sticks.

35. The de-icer system for filling with rectified alcohol.

36. Re-fill the aircraft systems with fuel, oil, and alcohol, if necessary. Close and lockwire the filler caps, close the hatch panels.

Cockpit 13

37. Check to see that the canopy glass is clean and has no cracks.

38. Open the canopy and insert ground safety lock pins in the left rod of the canopy toss cylinder and in the left bell crank assembly of the canopy emergency jettison system.

39. Make sure that the ground safety lock pins are inserted into:

(a) the seat firing mechanism;

(b) the drogue parachute firing mechanism;

(c) the release levers for seat ejection (arm rests should be provided with casings);

(d) the handle for autonomous canopy removal.

40. Check to see that the following parts of the canopy emergency jettison system are properly locked and wired:

(a) the hinged handle for the canopy emergency jettison and canopy firing mechanism release drive lever;

(b) the safety pin of the firing mechanism;

(c) the hooks of the rear engaging locks.

41. Check to see that the following parts of the seat are properly locked and sealed:

(a) the safety pin of the drogue parachute firing mechanism and fastening pins of the parachute container;

(b) the adjustable rod of the seat ejection gun;

(c) the handle of the harness restraint firing mechanism (located on the back side of the seat collapsible panel);

(d) the holder for emergency opening of the locks intended to fix the pilot in position.

42. Check to see that the canopy is readily opened and closed: to this end remove the ground safety pins from the rod of the canopy left actuating cylinder and from the left bell crank assembly.

Make sure that the red marks on the hooks of the rods do not come out of the forks of the double-arm bell cranks and the canopy control valve lever is locked in the recess of the cockpit panel (the handle for canopy opening from outside should be stowed in a groove provided for the purpose).

43. Check the pressurization hose for proper charging with air with the canopy closed and the pressurization thumbpiece shifted forward; make sure that pulling of the canopy control handle backward will bleed the air and cause normal opening of the canopy. Install the ground safety lock pins that have been removed.

44. Make sure that the engine control lever travels smoothly and is properly fixed at the intermediate stops. Check to see that the lock wire on the button for engine control lever position-to-M-number interlock is not broken.

45. Check to see that the function switches for the anti-surge shutters, cone and APY-3B mechanism are set to the AUTOMATIC (ABTOMAT.)position.

46. Be sure that the Pitot-static tube switch is set to the OPERATION (РАБОЧ.) position and properly locked.

47. Check operation of the de-icer system by pressing for a while the connection button.

48. Check the main braking system for proper operation by pressing the wheel brake lever and operating the pedals. Check the pressure in the brake system against the MB-12 pressure gauge. Maximum pressure should be within the range of 10.5±0.5 kg/sq.cm.

49. Check the instruments and fittings for condition.

50. Check to see that the fuel flowmeter indicator is set to the amount of fuel available in the fuel tanks.

51. Check the main and emergency air systems for proper charging. The pressure in the air bottles should equal 110-130 kg/sq.cm.

52. Check the voltage of loaded aircraft storage batteries, with the engine inoperative and the following circuit breakers on: PUMP No.2 (НАСОС №2), PUMP No.3 (НАСОС №3), and RADIO SET, OIL PRESSURE GAUGE (РАЦИЯ., МАНОМ. МАСЛА); the rest of the consumers should be disconnected. The voltage should be equal to at least 21.5 V.

53. Make sure that the landing gear emergency braking and release valves are closed and locked.

54. Make sure that the cockpit air supply valve is easy to operate and does not jam in the middle position.

55. Check to see that the handle of the АРД-57В pressure regulator is in the ON (ВКЛЮЧЕНО) position and locked.

56. Make sure that the АД-3 automatic time-release mechanism on the ejection seat is cocked and set to operate with a 1.5 sec. delay upon actuation, while the rip cord of the АД-3 automatic time-release mechanism is secured to the clamp on the cockpit starboard side.

57. Check the shoulder straps and waist belt restraint mechanisms for serviceability and proper operation.

58. Make certain that the seat is adjusted to fit the pilot's height.

59. Tow the aircraft to the holding area (if the parking site is not provided with shields protecting from gases and is not intended for engine testing) start the engine and test it in compliance with the Maintenance Instructions. Check the aircraft units in the sequence indicated below.

Preparation for Engine Starting

60. Chock the main landing gear wheels to fix the aircraft in position while the engine is being tested at engine ratings including the maximum rating.

To test the engine under augmented conditions the aircraft should be additionally secured by the mooring cables with their ends fastened to the landing gear struts and to the mooring posts on the site.

61. Make sure that no ground equipment and foreign objects are present in front of, and rear of, the aircraft; see that the site in front of the aircraft inlet duct is cleared.

62. Be sure that the site is provided with fire-fighting equipment.

63. Place the Pitot-static tube boom in the working position (if it has been raised).

64. Remove covers from the air intake and pipes for cooling engine accessories. See that protective screens are installed on the additional air intake shutters.

65. Make sure that protective covers have been removed from the Pitot-static tube, the ТП-156 Pitot tube and the П-5 tube.

66. Remove the cover off the jet nozzle and make sure the flaps of the jet nozzle are fully open (which corresponds to the engine augmented rating).

CAUTION: If the flaps position does not comply with the engine augmented rating, it is recommended, for the purpose of their opening to the fullest extent, that before starting the engine should be spinned by means of the ground equipment (with the AUGMENTATION circuit breaker on). This is necessary because the engine starting with the flaps position other than fully open is greatly impeded.

67. Connect the АПА-2М ground starting unit equipped with the КПА-4 starting unit box.

To provide for proper contact connect the bunched wire plug of the АПА-2М ground starting unit to the aircraft receptacle after which lock it in position by turning the lock handle left to the fullest extent.

Checking Aircraft Units during Engine Starting

68. Climb in the cockpit, leaving the canopy open, and make sure that all circuit breakers located on the cockpit starboard side under the organic glass panel are on. Switch on the AUGMENTED (ФОРСАЖ) circuit breaker on the left panel.

CAUTION: To avoid changing-over of the jet nozzle flaps from the AUGMENTED position to the MAXIMUM RATING (МАКСИМАЛ) position (with the hydraulic system under pressure) observe the following: switch on the AUGMENTED (ФОРСАЖ) circuit breaker prior to switching on the STORAGE BATTERY: GROUND, AIRCRAFT (АККУМ.БОРТ.АЭРОДРОМН.) circuit breaker, and switch it off only after the storage battery has been switched off.

69. Switch on the circuit breakers located on the right-hand panel and inscribed: STORAGE BATTERY: AIRCRAFT , GROUND (АККУМ. БОРТ. АЭРОДРОМН.), GENERATOR (ГЕНЕРАТ.), TRIM. EFFECT (ТРИМ.ЭФФЕКТ) and RADIO SET, OIL PRESSURE GAUGE (РАЦИЯ, МАНОМ. МАСЛА).

As a result, light inscriptions STAB. FOR LANDING (СТАБИЛИЗ. НА ПОСАД) and TRIM. EFFECT NEUTRAL (ТРИМ. ЭФ. НЕЙТР.) will flash up on the T-4 light panel; besides, two lights on the instrument panel will illuminate inscriptions BOOSTER (БУСТЕРНАЯ) and MAIN (ОСНОВНАЯ) whose purpose is to indicate absence of pressure in the hydraulic systems; finally, lights L.G. DOWN (ШАССИ ВЫПУЩЕНО) on the ППС-2К flight-and-landing mechanisms warning panel will flash up.

70. Switch on the circuit breakers located on the left vertical panel and bearing the following inscriptions:

Upper line: 3rd and 1st GROUP TANKS PUMPS (НАСОСЫ 3 и 1), ЭДМ GAUGE OF HYDRAULIC SYSTEM, DROP AND SERVICE TANK WARNING SYSTEM (ЭДМ ГИДР., СИГН. ПОДВ. РАСХ. БАКОВ), FIRE EXTINGUISHING EQUIPMENT, CANOPY DE-ICER, SHUT-OFF COCK (ПОЖАР. АНТИОБЛ. ФОНАРЯ, ПЕРЕКР. КР.).

Lower line: GENER. SIGN. (СИГН. ГЕНЕРАТ), ЭУП, КПС , STARTING ACCESSORIES (АГРЕГАТЫ ЗАПУСКА), 2nd GROUP TANKS PUMP (НАСОС №2).

After the above circuit breakers have been switched on, the GENERATOR OFF (ГЕНЕРАТ. ВЫКЛЮЧЕН) inscription on the T-6 panel will flash up, the inscription SERVICE TANK (РАСХ. БАК)will light up and go out, and lights, illuminating the inscription 3rd and 1st GROUP TANKS PUMPS (НАСОСЫ 3 и 1) on the instrument panel, will flash up and then go out. This will indicate that pressure has been set up in the fuel system by respective pumps.

A light inscription LOW LEVEL (ВЫРАБОТКА) will flash up on the middle panel.

With the drop tank suspended, the signal light SUSPENSION will also flash up. After the engine has been started and pressure in the drop tank set up, the LOW LEVEL light should go out.

71. Make sure that the engine function switch is set to the GROUND START (ЗАПУСК НА ЗЕМЛЕ) position, and start the engine in compliance with the Engine Operating Instructions. As a result, the ENGINE START (ЗАПУСК ДВИГАТЕЛЯ) inscription will flash up on the T-6 light panel.

72. With the engine spinning, aileron boosters disconnected and control stick held in position, check operation of the НП-34-2Т hydraulic pumps (in the main and booster systems) by increasing hydraulic pressure.

By the moment the high-pressure rotor gains 25% of rated speed, the pressure in the hydraulic systems should grow from 0 to 210^{-10}_{+5} kg/sq.cm., the BOOSTER (БУСТЕРНАЯ) and MAIN (ОСНОВНАЯ) light inscriptions will go out.

After checking the pumps switch on the aileron boosters.

73. After the engine speed has reached low r.p.m. disconnect the АПА-2М ground starting unit; the light GENERATOR OFF (ГЕНЕРАТОР ВЫКЛЮЧ.) on the T-6 light panel will go out.

CAUTION: In case the engine fails to start, do not disconnect the АПА-2М ground starting unit from the aircraft and try to start the engine again as is prescribed by the Engine Operating Instructions.

Checking Aircraft Units during Engine Testing

74. While testing the engine, check the generator's voltage against the voltmeter. The voltage should be equal to 28.5 + 0.5 V.

75. After testing the engine at maximum engine r.p.m. check the НП-34-2Т pumps at r.p.m. equal to 50% of the high-pressure rotor r.p.m.

Moving the control stick diagonally with a maximum speed possible will result in a drop of pressure in the booster system, the pressure remaining not less than 180 kg/sq.cm. as read off the pressure gauge.

Having switched off the booster system by pressing the BOOSTER SYSTEM DISCONNECTION (ОТКЛ. БУСТЕР. СИСТ.) button on the right-hand electric panel, check operation of the НП-34-2Т pump in the main system and operation of the booster from the main system.

76. By deflecting the control stick to the right and left extreme positions as well as by pushing and pulling it, check aileron and stabilizer control; make sure that the control stick deflects freely, without jamming and jerks and that the effort imposed by the artificial feel mechanism is felt on the control stick.

When let free, the control stick should return to the neutral position.

77. Check operation of the trimming effect mechanism. By moving the button on the control stick forward and backward make certain that the control stick, when let free, follows the button movement.

After checking set the trimming effect mechanism neutral watching the TRIM. EFFECT NEUTRAL (ТРИМ. ЭФ. НЕЙТРАЛЬНО) signal flash up.

The neutral position of the trimming effect mechanism should be determined only with the button shifted backward.

78. Check the flaps for proper release; check the flap signal system.

79. Check the air brakes for proper extension and serviceability of their signal system.

80. Check the cockpit air supply system for proper operation. To this end:

(a) pressurize the cockpit;

(b) set the COCKPIT HEATING (ОБОГРЕВ КАБИНЫ) selector switch to the WARM (ГОРЯЧИЙ) position and check to see that the warm air is being supplied to the cockpit;

(c) set the selector switch to the COLD (ХОЛОДНЫЙ) position and make sure that the cold air is being fed to the cockpit;

(d) set the selector switch to the AUTOMATIC (АВТОМАТ) position.

81. With the engine running check the fuel, hydraulic and oil systems for sealing having made sure that no fuel, fluid or oil leaks are present on the bottom of the fuselage skin close to the engine and fuel tanks.

Checking Aircraft Units when Cutting Off the Engine

82. Before stopping the engine check the in-flight start system. To this end:

(a) by checking against the pressure gauge make sure that the pressure in the oxygen supply low pressure line is equal to 9 - 16 kg/sq.cm.;

(b) close the КВ-2МС valve in the oxygen supply system;

(c) increase the engine r.p.m. up to 80%;

(d) smoothly shift the engine control lever to the STOP (СТОП) position;

(e) after the engine has gained 30 - 35% of the low-pressure rotor r.p.m., set the engine control lever to the idle rating position with simultaneous switching of the IN-FLIGHT START switch for some 10 - 12 sec.

CAUTION: After the checking turn off the IN-FLIGHT START (ЗАПУСК В ВОЗДУХЕ) switch.

(f) when the engine has reached the idle rating r.p.m., keep it running at this rating for 5 - 7 sec.

The engine oxygen supply system is considered sound if, following the in-flight starting system check, the oxygen pressure in the cockpit (as read off the pressure gauge) is equal to zero (with the valve closed).

83. After the engine has been stopped and before the pilot enters the cockpit, open the КВ-2МС valve. As a result, the pressure will rise up to 9 - 10.5 kg/sq.cm. (when the aircraft is at the parking site the pressure may increase up to 16 kg/sq.cm. as indicated by the pressure gauge).

84. Stop the engine by moving the engine control lever to the STOP (СТОП) position, having previously obtained and maintained 85% of the high-pressure rotor r.p.m. for 10 sec. (with below zero temperature the engine should be run at the above rating for at least 1 min. for cooling purposes); run the engine at idle rating r.p.m. for 10 - 12 sec. to lock the jet nozzle flaps in the AUGMENTED position.

85. After the engine has been stopped, check the pump unit for automatic switching on and operation by using pressure remaining in the booster system; to do this, switch off all consumers, except for the PUMP No.2 and AUGMENTATION circuit breaker, and switch on the PUMP UNIT (НАСОСНАЯ СТАНЦИЯ) circuit breaker on the right-hand circuit-breaker panel.

While relieving pressure in the system by slow and smooth movements of the handle back and forth, note the pressure at which the pumping unit is switched on; this pressure should be equal to 165^{+10}_{-5} kg/sq.cm. as read off the left-hand scale of the hydraulic system pressure gauge.

The moment when the pumping unit is being switched on should be determined by ear (by the noise of the motor) and by flashing up of the BOOSTER (БУСТЕРНАЯ) light.

Pump unit disconnection should be also determined by listening and by going-out of the BOOSTER light; the pressure at the moment when the pumping unit is being switched off should be read off the pressure gauge; this pressure should be not over 195 kg/sq.cm.

The pressure difference at the moment of the pumping unit connection and at the moment of disconnection should be at least 12 kg/sq.cm.

The checking over, switch off circuit breakers PUMP UNIT, PUMP No.2 and STORAGE BATTERY: GROUND, AIRCRAFT.

The last to be switched off is the AUGMENTATION circuit breaker.

86. After all the specialists have completed their part of pre-flight preparation inspect the cockpit for presence of foreign objects.

87. Refuel the aircraft and charge its systems with air, if necessary. Set the fuel flowmeter to indicate the quantity of fuel available in tanks.

Pre-Flight Preparation of the Cockpit

88. Check to see that the upper and lower blocks of the OPK-2 common connector are properly connected to its middle part and the emergency disconnection cable is properly connected to the ring of the lower block lever.

89. Before the pilot climbs in the cockpit remove the ground safety pins from the seat armrests leaving the protective casings in place.

90. Stow the parachute in the seat pan, arrange the seat straps by placing the shoulder harness on the seat controls and the leg straps on the brake lever of the control stick.

Secure the upper block of the OPK-2 common connector with the harness and parachute by a special caprone strap and shock-absorbing cord in the following sequence:

(a) by means of a snaphook insert the strap attached to the third pipe connection of the common connector upper block into the leg strap of the harness and, leaving the hoses free, catch the ring attached to the strap by the snaphook;

(b) pull the strap to stretch it full way out and tuck in the strap free end under the parachute strap;

(c) pass the shock-absorbing cord connected to the right-hand attachment loop of the КП-27М oxygen-breathing apparatus under the left-hand attachment loop of the КП-27М oxygen-breathing apparatus and catch the eye on the upper block of the OPK-2 common connector by the hook secured to the shock-absorbing cord.

91. Connect the oxygen supply hose running from the КП-27М to the РСД-3 pressure ratio regulator; connect by means of a union nut the flexible hose of the КП-27М oxygen-breathing apparatus to the pipe union on the upper block of the OPK-2 common connector, having previously passed the eyed bush through the pipe union and connected the eye with the lever on the upper block.

92. Connect the snaphook rip cord of the КАП-3 parachute automatic release time mechanism to the ejection seat cramp (on the seat left side).

CAUTION: When connecting the snaphook of the rip cord to the cramp, see that the snaphook is placed with its spring up to avoid accidental disengagement of the snaphook by the pilot.

93. After the pilot has climbed in the cockpit proceed as follows:

(a) help him in putting on the parachute harness; while doing this:

- pass the harness leg straps through the loops of the parachute harness and through the rings of the waist restraint belts; see that the cables of the waist restraint do not get crossed;

- secure the shoulder and leg straps with the master lock;
- fasten the strap of the shoulder harness to the buckle of the harness chest strap;

(b) connect the feed lines of the pressurized helmet and pressure suit to the appropriate pipe unions of the РСД-3 pressure-ratio regulator; by means of the quick-release coupling connect the air supply hose on the upper block of the ОРК-2 common connector to the anti-G device of the pressure suit.

CAUTION: Be sure that the lever of the АД-5А mechanism is set to the position which corresponds to the type of the pressure suit: in the case the ВКК-3М pressure suit the АД-5А automatic time release mechanism should be set to the MIN.(МИН.) position.

94. Check to see that the selector switches on the УК-2М amplifier are set in the following positions

(a) PRESSURIZED HELMET (ГШ) and MICROPHONE (М) in case the pilot is wearing the pressurized helmet;

(b) OXYGEN MASK(КМ) and THROAT MICROPHONE (Л).

95. Check to see that the КВ-2МС valves are open.

96. Assist the pilot in starting the engine and check to see that before taking-off he switches on all the necessary units; be sure that the respective circuit breakers and selector switches are set to the operating positions.

97. Remove the safety lock pins from the canopy autonomous jettison handle and from the heads of the seat ejection gun and drogue parachute firing mechanisms.

CAUTION: When removing the safety lock pins, see that the locking springs are intact.
A broken tab, when left in the firing mechanism head, may cause failure of the firing mechanism.

98. Remove the protective casings from the seat armrests.

99. Before the pilot closes the canopy, remove the safety lock pins from the rod of the canopy tossing lifting cylinder and from the left bell crank assembly in the canopy emergency jettison system.

After the pilot closed the canopy, make sure that the canopy closing handle is in the extreme forward position and locked; see that the cockpit is pressurized.

100. Before taxiing remove the protective screens from the additional air intake shutters and the ground safety pin from the head of the drop tank firing mechanism; make sure that both flaps have been completely extended, after which take away the chocks from under the aircraft wheels.

Aircraft Towing

1. Aircraft are towed over the airfield with the help of towcars or trucks provided with a special drawbar.

The fork of the drawbar is connected with the nose wheel axle by a locking pin and with special lugs of the main landing gear struts by the hooks of the towing cables.

The drawbar is attached to the towcar or to the truck with the help of the lug provided on the drawbar.

2. Towing the aircraft, a pilot or a technician should assist the aircraft towing from the cockpit to check the procedure and to timely apply brakes, if necessary.

During towing the aircraft canopy should be closed and locked to avoid damaging the canopy front attachment fittings. The Pitot-static tube boom should be raised.

3. Maximum permissible speed when towing the aircraft on concrete runways is 15 - 20 km/hr; when towing it over the soil airfield - 10 km/hr and when towing it close to the parking sites or other obstacles - not more than 5 km/hr.

CAUTION: 1. Under poor visibility (in mist, in night time, etc.) the aircraft should be towed with the navigation lights on to avoid collision with other aircraft.

The towing speed in this case should be not over 10 km/hr.

2. It is not allowed to tow the aircraft if its air system is not charged or its brake system is unserviceable.

3. Besides, during towing it is forbidden:

(a) to connect the drawbar to the towcar when the latter is at an angle of 40% to the aircraft fore-and-aft axis;

(b) to pull the aircraft by sharp movements, particularly when towing it on muddy or snowy roads;

(c) to drive the towcar backward, especially when the aircraft wheels are braked.

4. If necessity arises to roll the aircraft by pushing it manually, it is not allowed to grasp the trailing edges of the wing, flaps, and ailerons to avoid distortion of the airframe members and disturbing the aircraft balance.

In such cases roll the aircraft with its tail forward pushing the aircraft by hand against the wing leading edge and simultaneously maintaining direction of the aircraft movement with the help of the drawbar.

If the aircraft is rolled by hand with its nose forward push the aircraft against the landing gear struts and tail cone.

When rolling the aircraft, see to it that the canopy is closed and locked.

Inspection before Take-Off and Prior to Another Flight

1. Right after the engine has been stopped check to see that no fuel is burning in the jet nozzle and that the engine rotors rotate without any unusual noise. In case of fuel burning in the jet nozzle spin the engine by connecting the ground power source to it.

2. Receive information from the pilot as to the aircraft operation in flight and take measures to eliminate the faults.

3. Check to see that the air intake cone is retracted; inspect for damage and distortion the wing and fuselage skin, the inlet ducts, flaps, L.G. strut doors, air brakes, jet nozzle and belly fin; make sure that the parts of the afterburner chamber which can be inspected visually are not damaged; make certain that the nozzle flap ring is properly adjusted.

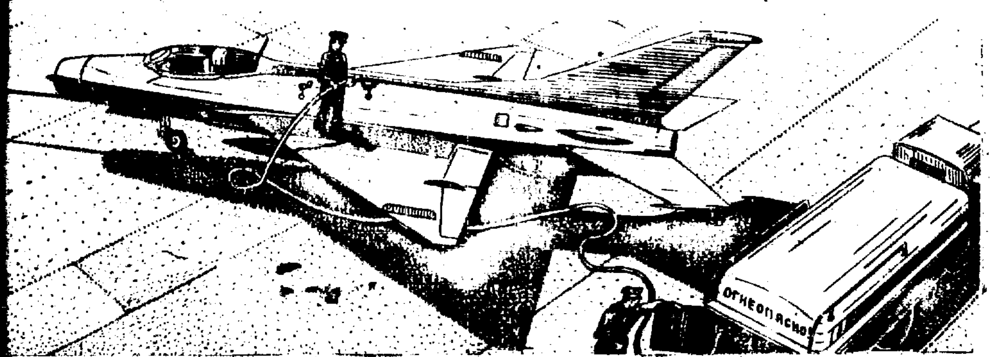
4. In case the drag parachute has been used during landing, replace the parachute with a new one and check to see that the lock of the drag parachute cable is closed.

5. By inspecting the fuselage and wing bottom skin externally make sure that no traces of fuel, oil and AMT-10 fluid leaks are present.

6. Make sure that the wheel rims and pneus are sound and the tire covers do not slip. Check pressure in the pneumatic tires by their compression and in the shock absorbers by their closure.

7. Refuel the aircraft and charge it with compressed gases. Check the engine oil system for filling with oil; check the level of AMГ-10 fluid in both sections of the hydraulic tank (having previously released pressure in the hydraulic system).

8. Set the fuel flowmeter indicator in compliance with the amount of fuel in the tanks. Check the storage battery capacity by the integrating ampere-hour computer.



Chapter III

FILLING AND DISCHARGING AIRCRAFT SYSTEMS

Fuelling

The aircraft engine is run on grade T-1 fuel, St. Std (ГОСТ) 4138-49, or ТС-1, St. Std (ГОСТ) 7149-54. Both grades of kerosene (or their mixture) are allowed for use in the engine fuel system.

Before fuelling, switch off the storage battery and ground the aircraft and the refuelling truck.

Fill the aircraft tanks with kerosene only from refuelling trucks provided with special four-layer filters.

Filling Procedure

1. Fill kerosene in the fuselage tanks of the 1st and 2nd groups and the wing tank compartments through the filler neck of tank No.2.
2. Service the 3rd group of tanks through the filler neck of tank No.4 (Fig. 9). The filling over, wait a few minutes and top up the tank, if necessary.
3. Fill the drop tank through the back filler neck (Fig. 10).

After filling, the filler neck lower edge should be at least 20 - 30 mm off the fuel level in summer and at least 10 - 20 mm away in winter.

The filling over, tightly close the filler necks. When closing, insert the cross-piece of the cap in the slots made in the tank body and turn it home, after which press the filler cap by tightening the screw.

4. With the help of the rack place the pointer of the fuel flowmeter to comply with the quantity of fuel in the tanks (with the drop tank filled up, the quantity of fuel equals 2960 lit.; without the drop tank its amount is 2470 lit.).

Fuel Drain

Fuel is drained from any of the fuselage tanks through the discharge cock installed in the main fuel line supplying fuel to the engine.

To drain fuel:

1. Remove the plug from the discharge cock.
2. Connect the suction hose of the refuelling truck to the discharge cock.
3. Open the discharge cock with a 24-mm wrench.
4. Open the filler caps of the tanks.
5. Connect the ground power supply source to the engine.
6. Ground the aircraft and the fuel truck (or a container) in which the fuel is to be discharged.
7. Switch on the pump for the 2nd group of service tanks and the pump for the group of tanks from which fuel is to be discharged.

Draining is considered completed when the warning light of the group of tanks involved will flash up.

To drain fuel from all the fuselage tanks, switch on the pumps for all the tanks simultaneously. In this case the time necessary for discharging of fuel will be minimum.

Fuel draining from the entire fuel system, including the wing group tanks, is effected through the master drain cock. In this case the fuel from the wing tanks is forced into tank No.2 for which purpose air compressed to not over 0.3 kg/sq.cm. is fed to the wing tank compartments through the E6-9820-00 device provided for the purpose.

The air supplying hose is connected to the tee-piece installed in the wing tank compartment pressure-feed line provided in the fuselage superstructure close to frame No.24.

CAUTION: Never use devices other than standard for building up pressure in the wing tank compartments to avoid damaging the fuel system.

In case of necessity, discharge the fuel only from the wing tank compartments through the fuel draining plugs in each compartment using a special discharge wrench. As a result, some 500 lit. of fuel will be drained from the 1st tank group, provided the entire fuel system has been filled up to capacity.

Drain fuel from the drop tank with the aid of a refuelling truck. The fuel is pumped over through the hose with a special end-piece. The hose is lowered in the tank through the filler neck in the front part of the drop tank.

When the fuel has been drained, close, lockwire, and plug the discharge cock. Close the tank filler necks.

Oil Servicing

The engine bearings are lubricated and cooled with oil, grade MK-8, St. Std (ГОСТ) 6457-53.

Fill the oil tank installed in the engine with oil using the oil servicing truck.

To service the oil tank with oil:

1. Open the hatch located on the fuselage left side below the wing (Fig.11).
2. Screw out the plug provided with a dipstick, wipe the dipstick with cotton waist and measure the level of oil in the tank.
3. Open the filler neck of the oil tank and fill it with oil to the level of 12±0.5 lit.
4. After filling close and lockwire the filler cap together with the dipstick and close the hatch.

CAUTION: 1. It is not allowed to pour excessive oil in the engine oil system to prevent smoke and vapours from getting into the cockpit.

2. Measure the level of oil in the oil tank with the help of the dipstick not earlier than 10 - 15 min. after the engine has been stopped.

Oil Draining

Oil from the engine oil system is drained through the drain cocks, installed on the fuel-and-oil unit (on its left lower part) rear of frame No.22, and on the engine, close to frame No. 25(on the unit right lower part). To drain oil open the tank filler neck.

Filling Hydraulic System with АМГ-10 Fluid

The aircraft hydraulic system is filled with АМГ-10 fluid, St. Std (ГОСТ) 6794-53.

The main and booster hydraulic systems should be serviced from a special oil servicing truck or, if it is not available, with the help of a funnel provided with a gauze oil strainer No.40 (1600 meshes per sq.cm.)

Replenish oil in the system in the following sequence:

1. Bring the pressure in the hydraulic systems to zero by moving the con- stick forward and backward, with the air brakes, flaps and adjustable cone cted.

2. Open the hatch providing access to the filler caps of the hydraulic wipe the filler necks and screw out the plugs (Fig. 12).

3. Check the oil level in the hydraulic tank with the dipstick and reple- the tank, if necessary. The oil level should be kept within the notches on ipstick (with the pressure in the systems being equal to zero).

4. Tightly close and lockwire the filler caps of the hydraulic tank and the fuselage hatch.

To fill up the aircraft main and booster hydraulic systems, use the follow- rocedure:

1. Jack up the aircraft, check the hydraulic accumulators and charge them nitrogen, if necessary.

2. Fill the hydraulic tank to capacity (both systems).

3. Connect the aircraft to the ground power supply source.

4. Switch on the accumulator and circuit breakers of the L.G., flaps, air s, cone,and aileron boosters.

5. Set the landing gear control lever to the EXTEND (ВЫПУСК) position, ss the LANDING(ПОСАДКА) button on the flap control panel.

6. Connect the ground hydraulic pumps (with the hydraulic tank pressuriza- system) to the main and booster hydraulic systems and set up a pressure of 210 kg/sq.cm. in both systems.

CAUTION: When testing either of the hydraulic systems switch on the hydrau- lic tank pressure supply from the ground hydraulic unit.

7. Replenish oil in the oil tank; release and retract the landing gear, brakes, flaps, anti-surge shutters, cone,and engine nozzle flaps 8 or 10 s; move the control stick all the way forward, backward, to the right and he left.

Leave the landing gear extended, retracting only the air brakes, flaps,and .

8. Disconnect the ground hydraulic pumps and reduce the pressure in the sys- to zero by moving the control stick as indicated above.

9. Switch on the PUMPING UNIT (НАСОСНАЯ СТАНЦИЯ) circuit breaker and, with control stick stationary, set up a pressure equal to 180 - 195 kg/sq.cm. in hydraulic booster system by operating the pumping unit; this will switch off pumping station.

Switch off the pumping station circuit breaker and bring the pressure in system to zero as described above.

10. Check the oil level in the hydraulic tank with the help of dipsticks; the level should be the same as when the landing gear is released and the air es, flaps, anti-surge shutters,and cone are retracted.

If the level of oil in the hydraulic tank is above permissible, drain ex- ive oil through the delivery valves 75 for which purpose open the filler caps he hydraulic tank.

CAUTION: After checking the hydraulic system of a jacked up aircraft, pla- ce the landing gear control lever from the EXTEND (ВЫПУСК) to the NEUTRAL (НЕЙТРАЛЬНО) position only after the limit clamp has been lo- wered, which will make it impossible for the pilot to move the lever beyond the neutral position.

Draining AMГ-10 Fluid

The fluid is drained as follows:

1. Place the aircraft on jacks.

2. Connect the aircraft to the ground power supply source.

3. Switch on the circuit breakers of the landing gear, flaps, air brakes, and aileron boosters.

4. Connect the ground hydraulic unit to the main hydraulic system and build up a pressure of 180 - 210 kg/sq.cm.

5. Retract the landing gear and extend the air brakes and flaps.

6. Switch off the pump and bring the pressure in the main hydraulic system to zero by moving the control stick.

7. Disconnect the delivery hose of the ground hydraulic pump from the pipe union of the aircraft feed valve and place it in the container intended for the drained-off fluid.

8. Extend the landing gear by operating the emergency pneumatic system; to this end slowly open the valve.

9. Release air from the landing gear cylinders by disconnecting the pipes between the cylinder and the hydraulic lock installed in the discharge line.

10. Open the filler caps of the hydraulic tank.

11. Switch on the ground pump and discharge AMГ-10 fluid from the hydraulic tank of the main system.

12. Retract the flaps manually, which will force out AMГ-10 fluid from the cylinders into the hydraulic tank; switch on the ground pump and drain the fluid again.

13. Connect the suction hose of the ground pump to the pipe union of the booster system and switch on the pump, after which drain AMГ-10 fluid from the booster system.

Air Charging

1. Prior to charging the aircraft systems with air check to see that the landing gear emergency release control valve 76 in the cockpit is closed. Remove the plug from the aircraft charging pipe connection.

2. Connect the ground air supply bottle to the aircraft charging pipe in the right-hand wheel well, having previously blown the hose through with air (Fig. 13).

3. Open the valve of the air system, the valve for filling emergency air bottles, and the valve of the ground air supply bottle.

4. When the pressure in the main air system and in the emergency air bottles reaches the required value of 110 - 130 kg/sq.cm. close the main air system valve and the emergency system valve.

Check the pressure against the two-pointer pressure gauge located on the right panel in the cockpit.

5. Close the valve of the ground air supply bottle.

6. Loosen the nut fastening the delivery hose to the ground air supply bottle by 1 or 2 turns and release the air from the hose.

7. Disconnect the delivery hose from the aircraft pipe union and plug the pipe union.

Filling Alcohol

The tank of the de-icing system is filled up with rectified alcohol, St. Std (ГОСТ) 5962-51, through the filler neck located in front of the nose upper compartment. The tank should contain alcohol not in excess of 4.3 lit. (Fig.14).

The filling over, tightly close the filler cap, lock and seal it.

Servicing Oxygen Supply System

The oxygen supply system bottles should be filled with medical oxygen only. The system is serviced with oxygen as follows:

1. Open the access hatch for the aircraft charging pipe union and unscrew the pipe union plug. Access to the pipe union is gained through the well of the L.G. port strut.

2. Connect the pipe running from the bottles of the ground oxygen-servicing station to the charging pipe union of the aircraft air system.

3. Make sure that the KB-2MC valve in the cockpit is closed.

4. Open the valve of the ground oxygen-servicing station and fill the aircraft oxygen bottles with oxygen.

With a 15°C ambient air temperature fill the aircraft bottles with oxygen to obtain a 150 kg/sq.cm. pressure. At other ambient air temperatures fill the aircraft oxygen bottles in conformity with the Table below.

Table

Pressure of Oxygen in Aircraft Bottles Versus Ambient Air Temperature

Temperature, °C	Oxygen pressure in aircraft bottles, kg/sq.cm.	Temperature, °C	Oxygen pressure in aircraft bottles, kg/sq.cm.
+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. After the aircraft oxygen bottles have been filled up, close the valve of the ground oxygen-servicing station and disconnect the pipe from the aircraft pipe union.

6. Check pressure in the system against the ИК-18 oxygen-flow indicator, having opened the KB-2MC oxygen valve in the cockpit.

7. Screw the plug on the aircraft charging pipe union.

Filling Engine Oxygen Supply System with Oxygen

The engine oxygen supply system should be filled with medical gaseous oxygen to build up a pressure of 150 kg/sq.cm. To fill the system with oxygen:

1. Connect the hose of the oxygen container to the aircraft charging pipe union, located in the well of the main L.G. left strut.

2. Open the valve of the oxygen container and fill the system checking the pressure against the high-pressure gauge. The high-pressure gauge is mounted

in the well for the left strut of the main landing gear next to the aircraft charging pipe union.

The KB-2MC oxygen valve in the engine oxygen supply system should be closed.

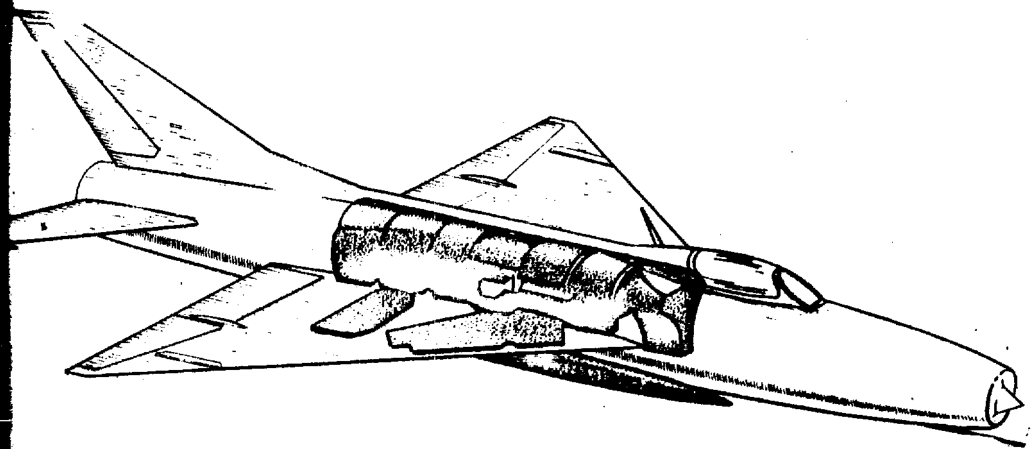
3. The filling completed, close the valve of the ground oxygen container, disconnect the pipeline of the ground oxygen container and plug the aircraft charging pipe union.

Note: When servicing the engine oxygen supply system with oxygen, make use of the Table "Pressure of Oxygen in Aircraft Bottles Versus Ambient Air Temperature".

Part Two

AIRCRAFT MAINTENANCE

Declassified in Part - Sanitized Copy Approved for Release 2012/04/13 : CIA-RDP78-03066R000100300001-6



Chapter I

FUEL SYSTEM

1. General

The aircraft fuel system (Fig.15) ensures the engine operation at all possible conditions of flight and provides for both ground and mid-air engine starting.

Total amount of the expendable fuel is:

2470 lit. without drop tank;

2950 lit. with drop tank suspended.

The fuel system comprises:

(a) seven bag tanks installed in the front portion of the fuselage, between frames Nos 11 and 28; the amount of expendable fuel for each of the bag tanks is:

235 lit. for fuel tank No.1;

660 lit. for fuel tank No.2;

60 lit. for fuel tank No.2a;

265 lit. for fuel tank No.3 (upper and bottom section);

200 lit. for fuel tank No.4;

240 lit. for fuel tank No.5 (right and left sections);

240 lit. for fuel tank No.6 (right and left sections);

(b) four tight-riveted compartments with metal casing located in the aircraft starboard and port wings. Capacity:

175 lit. for each of the front compartments (one in the starboard and the other in the port wing);

110 lit. for each of the rear compartments (one in the starboard, the other in the port wing);

(c) one drop tank suspended from the pylon on the fuselage bottom with a 480-lit. fuel capacity;

(d) fuel pumps installed in tanks Nos 1, 3, and 4 for pumping fuel in the service tank and in the engine;

(e) vent pipeline and tank pressurisation pipeline fed with the air from the engine compressor. Pressurisation is intended to force the fuel from the wing fuel compartments and from the drop tank as well as to ensure steady operation of the pumps at high altitudes;

(f) control pipeline provided with special float and vent valves designed for automatic control of fuel consumption, i.e. these valves provide for consumption of fuel from the tanks in a definite sequence to ensure the required C.G. location in flight;

(g) control system ensuring proper consumption of fuel and operation of pumps;

(h) gasoline air-pressure system for starting the engine and oxygen supply system which provides for starting the engine at high altitudes.

The aircraft fuel system (Fig.15) is designed as follows:

1. As to the sequence of fuel consumption the tanks are divided into three groups.

(a) The 1st group includes: tank No.1 and the upper portion of tank No.2 down to the tube connecting tank No.1 with tank No.2.

Consumption of fuel contained in the tanks of the 1st group is accomplished with the help of pump 422 A installed in tank No.1; this pump forces the fuel in tank No.3 (which is a service tank) through flow restrictor 32 with a 17 mm diameter and through special valve 30 installed on tank No.3.

Fuel from the wing fuel compartments is also consumed through the 1st tank group.

The fuel, forced from the wing fuel compartments along the pipeline, passes through special valve 30 installed on tank No.2 and further on in tank No.1 passing through the connection tube between the tanks.

Fuel from the wing fuel compartments is forced out with the help of the air fed from the engine compressor; the air is fed in the wing rear fuel compartments through the pressure pipeline.

(b) The 2nd group tanks include : the lower portion of tank No.2, tank No.2a, and tank No.3 (which is a service tank), the latter consisting of the upper and lower sections.

Fuel flows from tanks Nos 2 and 2a in tank No.3 (which is a service tank) by gravity.

(c) The 3rd group of tanks includes tanks Nos 4, 5, and 6.

Fuel is pumped over from the 3rd group tanks with the aid of pump 495 A2 installed in tank No.4. The fuel contained in tanks Nos 5 and 6 flows in tank No.4 through the pipeline by gravity. Pump 495 A2 forces the fuel from tank No.4 through the pipeline to the lower section of tank No.3. While passing through the pipeline the fuel flows through flow restrictor 37 with a 25-mm orifice and through special valve 36.

Tank No.4 is connected with the lower section of tank No.3 by an additional pipeline of a greater diameter to provide for the fuel flow from the 3rd group tanks in case pump 495 A2 or the special valve fails. This will ensure the fuel gravity-flow at engine ratings not exceeding the normal one.

To prevent fuel flow from the service tank to the 3rd group tanks, the pipelines connecting these tanks are provided with return valves 20.

(d) One drop tank (which may be jettisoned in flight) is suspended from the pylon on the fuselage bottom.

Fuel flow from the drop tank is ensured by the air pressure, the air being lied from the engine compressor. The fuel under pressure is forced in No.2 through special valve 30 (which is provided for fuel flowing from wing fuel compartments) and further on it flows by gravity through the ection tube to tank No.1 wherefrom it is forced into the service tank.

2. The sequence of fuel consumption from the tanks makes it possible to tain the aircraft centre-of-gravity position in flight.

The sequence of fuel consumption is automatically controlled by float es 17 installed in tanks Nos 1 and 3; these valves operate depending on level of fuel in the tanks.

Float valve 17 installed in tank No.1 controls (opens) special valve 30 tank No.2 and closes vent valve 13; both valves serve to ensure consumption fuel from the drop tank and wing fuel compartments in the specified sequence.

Pumps 495 A2 installed in tanks Nos 3 and 4 build up control fuel pressure. one of the pumps fails, control pressure is set up by the remaining pump which purpose each of the control pressure lines is interlocked by means return valve 29 or 34. If booster pump 495 A2 of the service tank fails, re-ble operation of the engine may be ensured up to a definite altitude at engine ratings other than augmented in conformity with the Engine ntenance Instructions.

To bleed the control pressure from the pipeline when disconnecting pumps A2 after the flight, return valve 29 in the pump line of tank No.4 is vided with a 0.8-mm throttle orifice.

Float valve 17 installed in tank No.3 controls (opens) special valves 30 36 which provide for fuel flow from the first and third group tanks in the tablished sequence.

Presented below will be information on the system operation when the fuel being consumed from the tanks and when the tanks are being filled up.

3. To ensure the established sequence of fuel consumption from the drop nk a special valve is installed on tank No.2 in the fuel consumption line; ntrol (opening) of this valve is performed by a float valve installed on nk No.1. Closing of the special valve is accomplished by means of a spring.

The special valve is being opened due to pressure exerted by the fuel the diaphragm. To set up the fuel pressure the special valve is connected the control pipeline with the delivery lines of pumps 495 A2 and float valve tank No.1.

For proper operation of the diaphragm throttle valve 31 is installed at e special valve inlet where the control pressure is fed to the special valve. e throttle valve has an orifice with a 0.7-mm diameter and is provided with gauze to protect it from clogging.

The discharge pipe union of the special valve is connected by the pipeline rough filter 16 with pipe union 2Б of the float valve on tank No.1. Filter 16 revents the orifices in the float valve from clogging.

The orifice in the float valve is opened when the float is lifted up s floating) and is closed when the float is lowered below the pre-set level.

Control pressure in the special valve (i.e. pressure exerted on the iaphragm) is set up with pumps 495 A2 operating and the orifice in pipe union of the float valve being closed (the float is lowered). In this case the pecial valve is open. When the fuel level in tank No.1 rises, the float rises too and opens the orifice in the pipe union of the float valve, which causes a drop in the control pressure exerted on the special valve diaphragm. This results in the closing of the special valve by the spring, which ceases the fuel flow from the drop tank until the next lowering of the fuel level in tank No.1.

To prevent the special valve orifice and float valve orifice from clogging, filter 35 is installed in the line in addition to the above mentioned protective gauses and filters.

4. The sequence of fuel consumption from the wing fuel compartments is maintained with the help of vent valve 13 which is controlled (closed) by the float valve on tank No.1.

The vent valve is opened by the spring.

Vent valve 13 is closed when the fuel acts on the diaphragm, for which purpose the control pressure chamber of the vent valve is connected via a pipeline with the delivery lines of pumps 495 A2 on tanks Nos 3 and 4 and with pipe connection 1B of the float valve on tank No.1.

Control pressure in the vent valve chamber is being built up by pumps 495 A2 operating with the port of pipe connection 1B of the float valve closed (the float lowered). In this case the vent valve is closed and the air pressure system builds up excessive pressure in the wing fuel compartments (as compared with the pressure in the fuselage fuel tanks) up to 0.17 - 0.2 kg/sq.cm., which causes fuel flow from the wing fuel compartments.

The excessive pressure of 0.17 - 0.2 kg/sq.cm. is maintained by safety valves 12.

With the rise in the level of fuel in tank No.1 (i.e. when the quantity of fuel supplied to the tank exceeds the quantity of fuel flowing out of it) the valve float rises and opens the port in pipe connection 1B of the float valve; as a result, the control pressure exerted on the diaphragm of the vent valve drops, the valve opens and the air pressure is relieved from the wing fuel compartments in the main vent line.

Thus, the fuel flow from the wing fuel compartments discontinues until the next lowering of the fuel level in tank No.1.

The second vent valve 11 of the wing front fuel compartments is closed during the entire flight and opens only after both pumps 495 A2 have been switched off. Vent valve 11 serves to discharge the air from the wing front fuel compartments during filling, when pumps 495 A2 are disengaged.

As special valve 30 controls both the fuel flow from the wing fuel compartments and from the drop tank, return valve 20 has been installed in the pipeline (through which the fuel flows from the drop tank) to prevent the fuel flow back to the drop tank.

To avoid the fuel flowing from the starboard wing fuel compartments to the port wing fuel compartments and vice versa as well as from the drop tank to the wing fuel compartments, a tee-piece provided with return valves 57 is installed in the fuel consumption line for the fuel flowing from the wing compartments.

To prevent flow of fuel from tank No.2 (through the filling pipeline for the wing compartments) to the wing fuel compartments in case of transverse acceleration when in flight, filling pipes 56 are provided with inertia-type valves 58.

To prevent the fuel in the wing fuel compartments from flowing through filling pipeline to tank No.2 (which will break the sequence of fuel conption) the filling pipeline is provided with return valves installed where filling pipeline is connected to the wing front fuel compartments.

5. Proper sequence of fuel flow from the 1st and 3rd group tanks to tank. 3 is ensured by special valves 30 and 36 installed in the consumption eline ahead of tank No. 3 inlet, the valves being controlled (opened) by at valve 17 mounted on tank No.3.

The operating principle of special valves for the 1st and 3rd group tanks similar to that used for the special valve which controls the fuel flow from drop tank and which is installed on tank No.2

6. Fuel is poured into the tanks through the filler necks on tanks Nos 2 1 4.

The filler neck of tank No.2 serves to service tank No.2 and (through the eline) tank No.1, tank No.2 a and tank No.3. The same filler neck is used r filling the wing fuel compartments through filling pipes 56.

Through the filler neck of tank No.4 fuel is poured into tanks Nos 4, 5, 1 6. During filling the tanks with fuel the air is released in the following y:

(a) from the fuselage tanks - through the vent pipeline and filler necks;

(b) from the wing front fuel compartments - through vent valve 11, fuselage nks vent line and filler neck;

(c) from the wing rear fuel compartments - through vent valve 13, fuselage nks vent line and filler neck.

When refuelling, vent valves 11 and 13 are open as there is no control essure.

Filling of the drop tank is performed through the filler neck.

7. Fuel from the fuselage tanks is discharged through cock 40 located on e pipeline supplying fuel to the engine. When discharging fuel, the pumps the 1st, 2nd, and 3rd group tanks should be switched on.

Fuel from the wing fuel compartments is discharged through discharge plugs 54 each compartment by means of the fuel discharge cock (a ground device).

It is possible to discharge fuel from the wing fuel compartments by air essure which forces the fuel to tank No.2. While doing this, excessive pressure the wing fuel compartments should not exceed 0.3 kg/sq.cm., which is made ssible owing to the E6-9820-00 device.

Fuel from the drop tank is discharged by pumping it with the help of the uck refueller through the hose (ground device), the latter being lowered into e tank through filler neck 50 in the tank front section.

8. To discharge fuel sediment from the fuel system, cocks 27 are installed the lower points of the pipeline and pumps. Installed on the drop tank front d rear sections are drain plugs 52 and 54 for discharging the fuel sediment.

9. As the fuel is consumed in flight, the air is delivered in the tanks rough the vent pipeline; the air intake pipe is directed towards the rushing air stream, which prevents rarefaction in the tanks (which might ve occurred during steep high-altitude diving with the engine throttled down).

10. To ensure normal operation of the fuel system pumps at high altitudes d proper consumption of fuel from the drop tank and wing fuel compartments, e vent line, the drop tank, and wing rear fuel compartments are pressurized.

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The air for building up pressure is supplied from the pipe union located aft of the compressor last stage; through return valve 34 it is fed to:

(a) The fuselage tanks through the throttle valve with a 3-mm orifice in the vent pipeline arranged in the fuselage tail portion.

To prevent bleeding of the air pressure through vent line air-inlet pipe union 49, return valve 48 with a 3-mm orifice is installed in the vent pipeline.

The vent pipeline (in the fuselage starboard tail portion) is provided with two spring-loaded safety valves 46 through which excessive air is released to maintain the required air pressure (of 0.21 - 0.23 kg/sq.cm.).

(b) To the drop tank through the 2-mm orifice and through the pipeline to the pipe union on the tank.

The required air pressure (of 0.81-0.83 kg/sq.cm.) is obtained due to two safety valves 42 through which excessive pressure is released into the atmosphere.

To prevent pressure bleeding from the drop tank air pressure line and to prevent the fuel from getting into the air pressure line from the drop tank, return valve 34 is installed in the pipeline next to the 2-mm orifice and safety valves.

The air pressure pipeline (in the tank pylon) is provided with vacuum valve 51 which opens when a 0.03 kg/sq.cm. rarefaction is created in the drop tank (which occurs in diving with the engine lowspeed operation).

(c) To the wing fuel compartments through the pipeline with a return valve which cuts off the wing fuel compartments air pressure line from the rest of the consumers and through the 2.1 mm orifice to the pipe unions on the wing rear fuel compartments.

To maintain the required pressure value of 0.17 - 0.20 kg/sq.cm. two safety valves (a valve box) is installed in the line.

Excessive air is bled through these valves to the fuselage tanks vent pipeline.

To provide for the specified sequence of fuel consumption (See Item 4), the air pressure forcing fuel from the wing compartments is applied from the moment of closing vent valve 13.

Before the vent valve is closed, the air can freely escape through the open valve to the vent pipeline of the fuselage tanks.

11. The drop tank is suspended from the detachable pylon under the fuselage by means of the БД3-56Е bomb rack and eye-bolt 6 (Fig.20).

The drop tank is provided with two stops 4 and 8 (front and rear) for its attachment to the pylon. The tank is lifted close to the pylon by eye-bolt 6 passing through the drop tank.

The drop tank is jettisoned by pressing a button in the cockpit. As a result, the rack lever moves and engages firing mechanism 25 whose push rod 8 is set against the stop (Fig.20).

To create the required initial force special washer 6 made of the АМГАМ-Л1.8 alloy is installed on the push rod; the washer is sheared when the firing mechanism operates. As a result, piston 4 with push rod 8 together with the drop tank break off from the pylon. Each drop tank is provided with a firing mechanism piston, a push rod, a special washer, a stop, and an eye-bolt.

The drop tank is divided into two sealed sections (the front one and the rear one). It is filled with fuel through filler neck 11 (Fig.20) on the rear section. The front section of the tank is filled through the pipe union provided with return valve 10 installed on the sealed partition. The valve is designed to prevent fuel flow from the front section to the rear one.

When filling the drop tank with fuel, the air escapes from the front ...on of the tank through the hole in the partition. The hole is connected ... the filler neck by pipe 12. Closing of the filler cap will involve closing ...e hole of the tube through which the air is released from the tank front ...ion (when the section is being filled with fuel). Thus, the atmospheric air ...llowed to flow to the front section only after it has passed through the ... section.

Fuel from the drop tank is forced out by means of the air from the engine ...ressor with an excessive pressure of 0.81 - 0.83 kg/sq.cm. The fuel flows ... the drop tank to tank No.2 through the special valve. Fuel from the tank ... section is the first to be consumed; then the front section contents is ...ied. This is made possible due to intake pipe union 3 installed on the tank ...t portion, the union end being lowered down to the tank bottom, while air ...sure pipe union 7 is connected with the tank rear section via the sealed ...ition.

When the tank is being suspended, these pipe unions become connected ... means of the sealed telescopic joint) with the respective pipes on the ...n, the pipes in their turn being connected with the fuel pipeline in the ...lage.

As the drop tank is suspended under the fuselage close to the third air ...e, the pylon is provided with limit switch 29 which cuts out the control ...cuit of the third air brake hydraulic control valve (with the tank suspended). ...s prevents the extension of the air brake.

12. Control of fuel consumption is accomplished by:

(a) fuel flowmeter PTC-16A installed in the pipeline running from the ...ks to the engine; the flowmeter indicator located in the cockpit shows the ...ntity of fuel remaining in the tanks;

(b) pressure warning units installed rear of the pumps for the 1st, 2nd, 3rd group tanks and in the drop tank pressure line; the pressure warning ...ts indicate that the fuel has been consumed from the tanks by the lights ...ing on in the cockpit; they also indicate switching-off (or failure) of the ...ps and drop of pressure in the drop tank pressure line.

The warning light for the 1st group tanks should come on when the fuel ...aining in the 1st group tanks according to the PTC-16A fuel flowmeter is ...al to 1350 ± 150 lit. and in the tanks of the 3rd group - 650 ± 100 lit.;

(c) emergency fuel warning unit installed in tank No.3; the unit indicates ...t only 500 $^{+100}_{-50}$ lit. of fuel has been left in the tanks by the flashing ...scription in the T-6 light panel.

13. Filtering of fuel in the fuel system is accomplished:

(a) during filling the system with fuel - by the filters of the refueller ...uck and in the filler necks which prevent foreign particles from getting into ...e tanks;

(b) during consumption of fuel - by the filters of fuel high and low ...essure installed in the engine fuel line as well as by the gauze installed on ...e drop tank inlet pipe and in the tee-piece of the wing fuel compartments ...nsumption pipeline.

14. To ensure normal operation of the engine in flight with negative ...celerations tank No.3 (its lower section) has been provided with a negative ...celeration valve which makes it possible to fly with negative accelerations ... any engine rating, except for augmented, for 15 sec. and 5 sec. at augmented ...ting.

15. For cutting-off the fuel flow to the engine in case of fire or engine stopping in case of failure of engine control use should be made of the shut-off valve installed in the pipeline at the engine inlet; the shut-off valve has electro-pneumatic remote control exercised from the cockpit. This valve can be shut off manually when the engine is removed and some fuel is left in the tanks. The valve remote control should be used only when it is necessary to close the valve. When in flight, it is impossible to open the valve, as the valve remote control on the aircraft is switched off.

16. The fuel system (starting) (Fig.16) with a 4.5-lit. tank installed in tank No.4 provides for 8 - 10 ground and mid-air startings of the engine. The tank is serviced through the filler neck on the tank, while discharge of fuel is ensured through discharge cock 10. When starting the engine, fuel is fed to the engine by the ПНР-10-9М electric pump.

To ensure reliable engine starting at high altitudes the tank is pressurized with air, the air coming from the engine at a pressure of 0.4 kg/sq.cm., through the special receiver-tank equipped with a filter and a return valve.

A special oxygen supply system for feeding the engine starting units is employed to improve the ignition of the starting fuel.

Sequence of fuel consumption

The specified sequence of fuel consumption from the tanks is ensured automatically. Before starting the engine the pilot should only switch on all fuel system pumps. Consumption (as illustrated in Fig.17) is accomplished in the following sequence:

(a) With drop tank suspended

I - Fuel from tanks Nos 1, 2, 3, 4, 5, and 6 is consumed down to the level when the float of the float valve in tank No.3 lowers and closes pipe union 3a; as a result, the control pressure will open special valve 10 for the 1st group tanks(Figs 17 and 18). The fuel is driven by pump 7.

II - Fuel from tanks Nos 1 and 2 flowing through open special valve 10 and driven by pump 6 is consumed down to the level when the float of the float valve in tank No.1 lowers and closes pipe union 2Б; as a result, the control pressure will open special valve 9 in the drop tank fuel consumption line.

III - Fuel from the rear section of the drop tank is consumed due to the pressure built up in the pressure line.

IV - Fuel from the front section of the drop tank is consumed due to the pressure built up in the line.

The fuel from the drop tank flows through special valve 9 to tank No.2, from tank No.2 to tank No.1 through the connecting pipe and further, forced by pump 6 through special valve 10 to service tank No. .

V - After the fuel from the drop tank has been consumed, the fuel from tanks Nos 1 and 2 is being consumed down to the level when the float of the valve of tank No.1 lowers to close pipe union 1B; as a result, the vent valve (Fig.19) will be closed due to the control pressure thus initiating pressurization of the wing fuel compartments.

VI - Fuel from the wing rear fuel compartments is consumed due to the pressure built up in the pressure line.

VII - Fuel from the wing front fuel compartments is forced out by pressure built up in the line.

VIII - Fuel from tank No.1 (forced by pump 6 through special valve 10) is consumed completely and from tank No.2 down to the level of the tube connecting tanks Nos 1 and 2.

IX - Fuel from tank No.3 forced by pump 7 is consumed down to the level when the float of the valve of tank No. 3 lowers and the hole of pipe union 2B closes; as a result, the control pressure will open special valve 11 and pump 8 will force the fuel from tanks Nos 4, 5, and 6.

The last to be consumed is the fuel remaining in tank No.2 and the fuel from tank No.2a (completely); in the latter case the fuel flows by gravity to tank No.3 and further, forced by pump 7, from tank No.3 to the engine.

The above sequence of fuel consumption is valid only for normal fuel consumption rate (the engine rating being below augmented) in level flight.

Maximum rate of fuel consumption for the tanks of different groups is equal to:

≈11,500 lit/hr	for drop tank;
≈5000 lit/hr	for wing fuel compartments;
≈10,000 lit/hr	for the 1st group tanks;
≈14,000 lit/hr	for the 3rd group tanks;

as for the 2nd group tanks the rate of fuel consumption is equal to the rate at which the fuel is consumed by the engine at every engine rating.

If the rate of engine fuel consumption is less than the rate of fuel consumption from the corresponding group tanks, then the fuel from the tanks of the group in question will flow to service tank No.3 in portions, i.e. the respective special valve (vent valve) will be opened and closed for a time period enough to provide for equal rates of fuel consumption from the tanks of the group in question and from the service tank to the engine.

In case the rate of fuel consumption by the engine exceeds the rate of fuel consumption from the appropriate group tanks, the lacking fuel will be supplied from the group of tanks next in sequence

Before the fuel starts flowing from the drop tank, 50 lit. of fuel are consumed from the fuselage tanks.

(b) Without drop tank

The sequence of fuel consumption in this case is the same as with the drop tank suspended, except that at first more fuel is consumed from tanks Nos 1 and 2 (down to the level when the float of the valve of tank No.2 lowers and the 1B pipe union closes), after which the fuel is supplied from the wing fuel compartments. Further sequence of consumption is the same as in case when the drop tank is suspended.

2. DROP TANK MAINTENANCE

(See Fig.20)

Installation of drop tank on aircraft

1. Before installing the drop tank on the aircraft make sure that the pylon has been properly installed on the fuselage in accordance with the respective Instructions; check to see that the drop tank is serviceable and furnished with all necessary parts. To this end:

(a) remove the plug from the fuel supply pipe connection and from the air-pressure pipe union; make sure that they are clean;

(b) examine the attachment of the drop tank front and rear stops; make certain that they are properly secured by the nuts on the tank bottom; check the attachment for absence of axial play;

(c) make sure that the stop of the firing mechanism push rod is screwed home in the seat on the tank;

(d) open the filler cap on the drop tank rear section and check to see that the tank is clean, after which close the filler cap;

(e) screw out the drain plug from the drop tank front section and make sure that the filter gauze is free of dirt, after which screw the plug in and lock it.

Make sure that the filler plug on the drop tank rear section is properly locked;

(f) remove the eye-bolt from the drop tank to examine it for serviceability;

(g) open the filler cap on the drop tank front section, remove the assembled firing mechanism push rod (with the piston, washer and clamp nut) for its installation on the pylon and make sure that it is not soiled.

2. Remove the protective fairing from the bottom of the pylon and check the БД8-56Е rack for proper operation.

To this end:

(a) unload the firing mechanism, if it has been loaded, put the locking plunger in position, cock the spring mechanism and connect its fork to the locking plunger safety pin. Do not install the ground lock pin;

CAUTION: It is strictly forbidden to check the rack for proper operation with the firing mechanism loaded.

(b) connect the ground storage battery to the aircraft;

(c) switch on the AUGMENTATION circuit breaker on the left-hand vertical panel;

(d) turn on the STORAGE BATTERY: AIRCRAFT, GROUND switch and the TANK JETTISON circuit breaker;

(e) cock the carrying hook of the rack and bring the eye-bolt close onto it, for which purpose press the eye-bolt against the lock stop and insert the lug of the eye-bolt in the span of the carrying hook;

(f) by observing through the two holes in the left side of the pylon and through the hatch in its right side inscribed JETTISON make sure that the carrying hook is reliably closed;

(g) depress the TANK JETTISON button on the upper left panel of the instrument board and make certain that the carrying hook of the rack has opened, the eye-bolt has dropped and the spring mechanism has operated to remove the safety pin from the firing mechanism locking plunger which has resulted in the release of the locking plunger striker.

After checking the operation of the carrier, cock the spring mechanism and the carrying hook of the rack.

3. Check operation of the interlock system for the 3rd air brake, for which purpose:

(a) connect the ground hydraulic pump to the main hydraulic system and pressurise it;

(b) switch on the AIR BRAKES and DROP TANK WARNING LIGHT, ROCKET MISSILE, AUTOMATIC ROCKET LAUNCHER circuit breakers on the starboard side of the cockpit;

(c) press the limit switch on the pylon; this will flash up the TANK SUS-
NDED warning light on the central panel of the instrument board in the cock-
t;

(d) the technician (in the cockpit) should set the slide located on the
gine control lever to the position corresponding to the release of air brakes
ich will cause release of two side air brakes. The third air brake will re-
in retracted;

(e) release the limit switch on the pylon, which will extinguish the TANK
SPENDED warning light and release the third air brake.

4. Retract the air brakes, switch off the ground pump, the AUGMENTATION
rcuit breaker, the STORAGE BATTERY: AIRCRAFT, GROUND switch and all
circuit breakers that have been switched on for checking; disconnect the
und power source from the aircraft.

5. Unscrew the union nut from the cylinder of the firing mechanism push
d installed on the pylon and remove the plug (if any); insert in the cylinder
the firing mechanism push rod the piston with the push rod assembled with the
ecial duralumin washer(screwed home on the piston by the clamp nut) after
ich secure them with the union nut (Fig.21). Make sure that the plug has been
moved from the pylon fuel pipeline, after which start installing the drop tank.

CAUTION: Do not install the special duralumin tube on the firing mechanism push rod, if the drop tank is suspended to accomplish test jettison of the tank when on the ground (with the firing mechanism unloaded).

6. Install the eye-bolt in the drop tank without securing it by the nuts.
lace the tank under the pylon and suspend it from the carrying hook of the car-
ier, having pulled the eye-bolt from the seat of the tank.

Remove the bolt from the stop of the firing mechanism push rod.

7. Lift the drop tank; move the front and rear stops, the pipe unions of
he pipelines and the stop of the firing mechanism push rod into the correspond-
ng places on the pylon.

Fit the steel washer onto the threaded part of the eye-bolt (from below),
crew on the nut, tighten it by means of the СД-7804-500 socket wrench and lock
t by a safety nut (Fig.22).

Make certain that the lug of the eye-bolt on the carrying hook is properly
ligned.

CAUTION: 1. When tightening the nut by means of the socket wrench, it is forbidden to use additional tools of the kind of an extension arm.

2. It is not allowed to install eye-bolts with a stripped thread, as well as rusty, burred, scored, and oily or soiled washers and nuts.

8. Connect the firing mechanism push rod with the stop on the tank, for
hich purpose align the hole in the push rod with the hole in the stop by turn-
ng the stop with the wrench and then insert the bolt in the hole.

9. Check the drop tank for reliable attachment by rocking it when holding
its nose. Check to see that there is some space between the drop tank and the
pylon edges. No contact between them is allowed.

10. Depress the button and perform the check jettison of the drop tank without actuating the firing mechanism. While doing this, hold the drop tank with the hands by its ends. It is also allowed to jettison the drop tank by mechanically opening the carrying hook of the rack.

In this case make sure that the firing mechanism contains no cartridge, after which open the JETTISON hatch located right of the pylon and press the

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tooth of the electromagnet axle sector. This will result in jettisoning the tank with simultaneous operating of the spring mechanism.

11. Suspend the drop tank from the pylon in the order indicated above. To this end install a special duralumin washer on the firing mechanism push rod, charge the firing mechanism with the ПК-3М-1 cartridge and insert a ground safety lock pin with a red thumbpiece.

Removal of drop tank

If it is necessary to remove the drop tank from the aircraft, proceed as follows:

1. Pump the fuel from the tank by means of the refuelling truck.
2. Discharge the firing mechanism.
3. Remove the bolt from the push rod of the firing mechanism.
4. Open the carrying hook mechanically or by pressing the respective button in the cockpit.
5. Remove the drop tank.

CAUTION: 1. It is advisable to carry out a check jettison of the drop tank when a new drop tank is installed on the aircraft or the pylon is replaced by a new one, as well as in cases when the drop tank is installed on the aircraft after it had been removed from the aircraft for a period of more than 30 days.

2. The drop tank removed from the aircraft should be provided with the plugs which should be installed on all pipe unions to prevent their soiling. In case of prolonged storage the drop tank should be slushed. The drop tanks should be stored at specially provided places to protect them from moisture getting inside.

3. Checking and maintenance of the pylon mechanism should be carried out in conformity with Book II of the present Instructions.

It is allowed to put into service an aircraft with the pylon installed but without the drop tank suspension. In this case the lower portion of the pylon should be furnished with a protective fairing which will prevent the pipe union and the БДЗ-56Е rack from getting fouled.

Operations to be performed after jettisoning drop tank

After the drop tank has been jettisoned in flight, proceed as follows:

1. Open the hatch on the pylon and remove the firing mechanism; disassemble and clean it; clean and inspect all parts of the push rod mechanism.
2. Inspect the pylon visually to make sure that it is intact.
3. Inspect and check the БДЗ-56Е rack for proper operation.
4. Check the pylon for reliable attachment to the fuselage.
5. After inspection and cleaning of the pylon, rack and parts of the firing mechanism, install the new drop tank in compliance with the respective instructions (contained in the present Section) or install the protective fairing, if the aircraft is to be operated without a drop tank.

3. CHECKING FUEL SYSTEM FOR SERVICEABILITY (during pre-flight preparation)

Check the fuel system with the tanks filled up and the ground power source connected to the aircraft. To check the fuel system:

1. Switch on the AUGMENTATION circuit breaker on the left-hand side of the ...pit.

CAUTION: To prevent the flaps of the afterburner nozzle moving from the AUGMENTED to MAXIMUM RATING position and prior to cutting-in the STORAGE BATTERY: AIRCRAFT, GROUND switch, switch on the circuit breaker bearing the AUGMENTATION inscription. Switch off the latter only after switching off the STORAGE BATTERY: AIRCRAFT, GROUND switch. The flaps can move to the MAXIMUM RATING position only when the hydraulic system is pressurized.

If the nozzle flaps have moved to the MAXIMUM RATING position, the engine ...fail to be started autonomously. Therefore, to start the engine the ground ...r source should be resorted to.

2. Turn on the STORAGE BATTERY: AIRCRAFT, GROUND switch on the right-hand ... of the cockpit.

3. Switch on the circuit breakers located on the left-hand side of the ...pit and bearing the following inscriptions:

(a) DISTANT-READING ELECTRIC PRESSURE GAUGE OF HYDRAULIC SYSTEM (ЭДМ), DROP ...SERVICE TANK WARNING SYSTEM; as a result, the SERVICE TANK and the DROP TANK ...UMPTION inscriptions will flash up, the latter being located on the T-6 light ...l of the instrument board;

(b) PUMP No.1; this will cut in and extinguish the PUMP No.1 light on the ...t-hand side of the instrument board;

(c) PUMP No.3; this will bring about coming on and going out the PUMP No.3 ...ht on the right-hand side of the instrument board;

(d) PUMP No.2; this will extinguish the SERVICE TANK inscription on the T-6 ...ht panel;

(e) if the drop tank is suspended, switch on the DROP TANK WARNING LIGHT, ...KET MISSILE, AUTOMATIC ROCKET LAUNCHER circuit breaker; this will result in ...ing on of the TANK SUSPENDED warning light on the lower panel of the in...ument board.

After checking switch off all the circuit breakers (that have been switched ... and the storage battery in the reverse sequence.

After starting the engine with the drop tank suspended and filled up (when ... pressure is being built up), the DROP TANK CONSUMPTION warning light on the ...er panel of the instrument board should go out.

4. FUEL SYSTEM MAINTENANCE AND CHECKING ITS SEALING

To ensure proper operation of the fuel system:

1. See to it that the fuel system connections and units are sealed up.

2. Eliminate leakage by tightening the union nuts and hose clamps only if ... nuts and clamps are loose.

It is not allowed to eliminate leaks from under the cover of the special ...ve by tightening the cover. In this case it is necessary to replace the faul... valve.

3. If a leak is discovered with the nuts and hose clamps being properly ...htened, find the cause by disconnecting the joint. Check the parts for sound ...dition; repair them or replace, if required. See to it that the thread of the ...e unions is not nicked or stripped, the pipes are free of dents and cracks, ... flexible hoses are not damaged.

4. Keep the vent pipes in the fuselage clean. See that no ice is present ... the ends of the vent pipes and in the recess accommodating the safety valves ...g.23).

5. Do not overflow the tanks when filling the system with fuel. Tighten the cap of the filler neck manually, and close the hatch panel.

6. If the filler neck cap or the joint under the rubber gasket are leaky replace the gasket (the latter being available in the set of spare parts).

7. In winter thoroughly examine the fuel for it may contain water, which might get into fuel as a result of the fuel filter icing.

8. In case the pump vent pipe is leaky, replace the pump.

9. When replacing the ПНР-10-9М pump in the fuel system, check the fuel pressure in the pipeline in conformity with the Instructions on engine operat

<u>Checking fuel system for proper sealing</u>

(when performing scheduled maintenance)

When checking the fuel system for proper sealing make use of the Е6-9820 special ground device; the checking is carried out with the fuel tanks filled to capacity and with excessive air pressure (of 0.3 kg/sq.cm.) in the system. The checking sequence is as follows:

1. Remove the drop tank and the pylon. It is allowed to check the fuel sys tem sealing with the pylon installed.

2. Fill the fuel tanks with kerosene to capacity and close tightly the c of the filler neck of tank No.2. Install the special pipe union of the Е6-982 ground device in the filler neck of tank No.4 to connect the device.

3. Close the shut-off valve of the fuel system through the bottom hatch (located on the fuselage port side, between frames Nos 20-22), having previous removed the locking wire from the valve lever.

4. Install special plugs (supplied with the ground device) on all pipe unions and holes connecting the fuel system with the atmosphere and with othe aircraft systems, i.e. :

(a) plug the drop tank fuel pipeline;

(b) plug the drop tank pressurization pipeline;

(c) plug the pipe union of the hydraulic system and gasoline tank pressu rization line, having disconnected from it the pipeline (next to the safety-valve box for the drop tank);

(d) plug the air intake pipe union running from the engine compressor hav ing disconnected from it the pipe connected with the return valve;

(e) plug up the impact pressure pipe;

(f) plug the vent pipe located next to frame No.29;

(g) install two plugs on the pipe unions of the safety valves located on the fuselage tail portion and protected with the screen (Fig.23); prior to in stalling the plugs remove the safety valves;

(h) install a rubber plug on the pipe running from the safety-valve box for the drop tank pressurization system further through the fuselage skin on the left side in front of the hatch for filling oil in the engine.

The diagram showing connection of the Е6-9820-00 device and indicating pl es for installation of plugs is displayed inside the device cover.

5. Using the ground device build up a 0.3 kg/sq.cm. pressure in the fuel system, close the valve of the device and wait for 15 minutes.

See to it that no drop in the air pressure and no kerosene leakage occur in the system.

6. Restore the system, open the shut-off valve and lockwire it. With the engine control lever at the CUT-OFF limit, switch on all pumps of the fuel sys tem for 5 or 10 minutes. See that fuel does not leak in the pipelines and in the vent line.

<u>Checking gasoline system and</u>
<u>hydraulic tank pressure</u>
<u>line for Proper sealing</u>

(when performing scheduled maintenance operations)

Check the gasoline system for proper sealing with the gasoline tank fil-d up to capacity. The hydraulic tank pressure line should be checked simulta-ously. The checking is accomplished by means of the device provided with a ducer for inflating the pneumatics of the landing gear wheels in the follow-g sequence:

1. Fill the tank with fuel and install a special cap with the pressure uge on the filler neck.

2. Check the level of the AMГ-10 fluid in the sections of the hydraulic nk for main and booster systems.

Close tightly the filler neck of the section for the main hydraulic system th the cap; install a special cap provided with a pressure gauge on the filler ck of the section for the booster system.

3. Through the access hatch used for filling oil in the engine, disconnect e pressure pipe running to the gasoline tank and to the hydraulic tank from e tee-piece located next to the safety-valve box. Connect to the pipe the hose th the adapter(Е6-9919-00) together with the device for inflating the L.G. eumatics.

4. Remove the plugs with the 1-mm orifices (sleeves with 1-mm orifices) ff the sumps for trapping sediment in the hydraulic and gasoline systems, the umps being located in the wells of the main landing gear wheels ahead of the ressure units. Replace the plugs with blind plugs.

5. Connect the ground compressed air bottle to the device, open the valve n the bottle with the reducer valve closed and set up a 10 kg/sq.cm. pressure by lowly opening the valve of the reducer.

6. Make certain that the gasoline tank pressure gauge indicates a $.4^{+0.05}$ kg/sq.cm. pressure, the hydraulic tank pressure gauge indicates from .6 to 2.55 kg/sq.cm.; then close the valve of the reducer and disconnect the de-vice from the pressurization pipe. For 15 min. maintain the above pressure in the system.

A drop in the pressure (indicated by the pressure gauges) as well as gaso-line or AMГ-10 fluid leakage are impermissible.

The checking over, replace what has been removed off the system. When only the gasoline system is checked for sealing, perform only those steps under Items 2 and 4 which refer to the gasoline and hydraulic systems, respectively; besides, disconnect and plug the pipe running to the hydraulic system sump.

<u>Checking fuel system and hydraulic</u>
<u>tanks for additional air pressure</u>

(while performing scheduled maintenance)

Check the system for additional air pressure in the following sequence:

1. Fill the fuel tanks to capacity, check the level of fluid in the hyd-raulic tanks.

2. Install special caps furnished with pressure gauges in place of the caps of the filler neck of tank No.4, drop tank, gasoline tank and hydraulic tank of the booster system.

3. To measure the additional pressure in the wing fuel tanks install the pressure gauge on the tee-piece in the wing tanks air-pressure line, having previously removed the plug.

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The tee-piece is arranged in the superstructure over tank No.5.

4. Start the engine and bring the engine speed to 70 - 80% of the low-pr sure rotor speed. While operating the engine at this rating, the drop tank fu low-level warning light should go out upon expiration of some time necessary filling the tanks with the air.

5. Determine the additional pressure by the pressure gauges.

The pressure should be within the following values:

0.21 to 0.23 kg/sq.cm. — in the fuselage tanks;
0.81 to 0.83 kg/sq.cm. — in the drop tank;
1.6 to 2.55 kg/sq.cm. — in the hydraulic tank;
$0.4^{+0.05}$ kg/sq.cm. — in the gasoline tank.

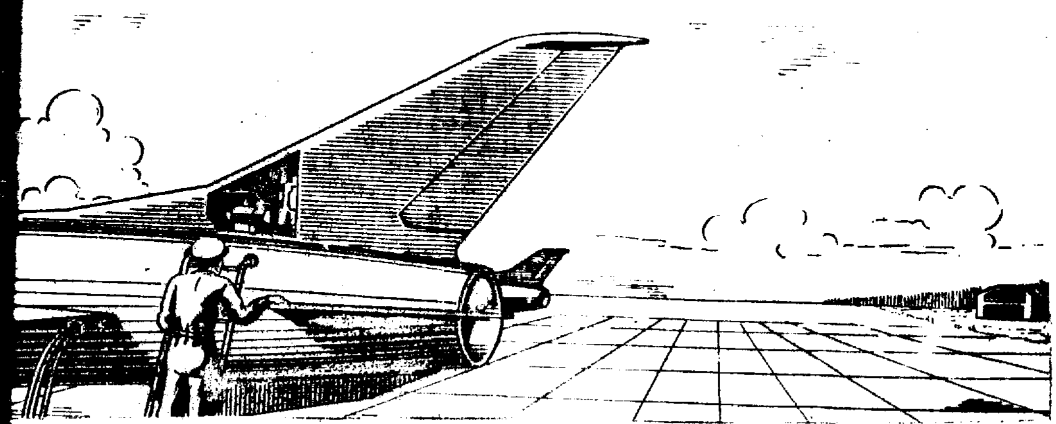
Air pressure in the wing fuel compartments and in the fuselage tanks shou be equal up to the moment when the fuel is completely consumed from the drop t and 50 or 100 lit. of fuel is emptied from the fuselage tanks. From this mome on the air pressure in the wing compartments should increase and fluctuate ex ceeding the air pressure in the fuselage tanks by 0.12-0.17 kg/sq.cm. However, should never exceed the pressure in the fuselage tanks by more than 0.2 kg/sq.c

To avoid excessive consumption of fuel, i.e. consumption in quantities ex ceeding the amount in the drop tank plus 50 or 100 lit., when checking air pre sure in the wing fuel compartments do not suspend the drop tank.

6. Make certain that the air pressure valves are within the permissible li mits, reduce the engine r.p.m. to the low throttle value and wait for 1 min.; make sure that the air pressure in the fuselage tanks (in the filler neck of ta No.4) does not drop below 0.17 kg/sq.cm.

7. Should the air pressure in the tanks be lower than that indicated under Items 5 and 6, locate the air leak in the system and remedy the fault.

8. 15 min. after the engine has been stopped, check the air pressure in the gasoline and hydraulic tanks without removing the filler caps. The air pressure should be within the permissible limits.



Chapter II

AIRCRAFT HYDRAULIC SYSTEM MAINTENANCE

1. General

The aircraft hydraulic system consists of two separate systems: the main and booster systems (Fig.24).

The main hydraulic system is designed to actuate the aircraft landing gear, flaps, air brakes, to control the engine nozzle flaps, anti-surge shutters, air intake cone, automatic braking of the wheels while retracting the landing gear, and to actuate one chamber of the stabilizer booster. It also serves as a stand-by system for the БУ-45А aileron control boosters in case the booster hydraulic system fails.

The booster hydraulic system is intended to actuate the aileron boosters and one chamber of the stabilizer booster. Serving as sources of hydraulic energy for the main and booster systems are the НП-34-2Т variable displacement pumps with operating pressure range of from 180 to 210 kg/sq.cm. The pumps are installed in each of the systems and operate in combination with the hydraulic accumulators.

The operating pressure in the hydraulic system being 180 kg/sq.cm. and maximum speed of the pump n_{max} of 4000 r.p.m., the pump capacity is maximum and is at least 31 lit/min. (by the end of the guaranteed service life).

With a 210 kg/sq.cm. operating pressure in the system the pump capacity (irrespective of the pump r.p.m.) is minimum, being spent to compensate for the internal leaks in the system and to cool down the pump through the return line of the outer circulation line.

With the operating pressure in the hydraulic system of 175 kg/sq.cm. and the pump r.p.m. approaching the autorotating engine r.p.m. at landing, the pump capacity is at least 2.5 lit./min. The pump capacity is pre-set automatically depending on the pressure in the hydraulic system by means of the pressure regulator incorporated in the pump.

The hydraulic accumulators installed in the main and booster systems operate in conjunction with the pumps and are intended to ensure the system acceleration, i.e. replenishment of hydraulic energy used up instantaneously in the system, for the pumps are lagging in adjusting their capacity for that required to compensate for the energy consumption in the system. This lag is accounted for by the inertia of the pump capacity regulation system.

The hydraulic accumulators supply energy to the БУ-51МС stabilizer booster when landing with the autorotating or dead engine. In this case the energy is supplied by the accumulators and the НП-27Т emergency pump unit.

In addition, the hydraulic accumulators serve for damping the pressure fluctuations.

Each of the systems is provided with two hydraulic accumulators, one of them being of a spherical-diaphragm type, the other, cylindrical-piston (Figs 25 and 2 The gas chambers of the accumulators are filled with nitrogen. To preserve the energy of the hydraulic accumulators in case of the НП-34-2Т pump failure in the booster system, the spherical accumulator is separated from the pump by a return valve; the cylindrical hydraulic accumulator is separated by a return valve from the whole system (except for the БУ-51МС booster).

For the same reason all hydraulic energy consumers in the main system, except for the boosters and nozzle flap control systems, are also separated from the hydraulic accumulators by a return valve. Thus, increased energy consumption and pressure drop in the main system when operating the air brakes, flaps, cone and other consumers will not affect the boosters operation. Besides, the energy of the hydraulic accumulators, with the booster system inoperative, will be used only for the boosters actuation.

The hydraulic system is provided with a common hydraulic tank which is divided by a sealed partition into two compartments, one for the main hydraulic system the other for the booster one (Fig.27). To ensure proper operation of the hydraulic system at high altitudes and to prevent pump cavitation, excessive pressure of 1.6 to 2.55 kg/sq.cm. is set up in the pump suction line. The air used for pressurizing the hydraulic tanks is taken from the engine compressor and supplied to a unit consisting of a 1.3-lit. container, a return valve and an air filter. The 8 - 12 kg/sq.cm. pressure, built up by the compressor when the engine is being raced at maximum r.p.m. on the ground, is further maintained during the entire flight in the pressurization unit irrespective of the flying altitude and engine rating. This pressure compensates for the air leaks in the pressurization system which may occur due to poor tightness of the system. From the pressurization unit the air passes through the PB-1.5 reducing valve and then it is fed to the hydraulic tank air compartments under a 1.6 - 2.55 kg/sq.cm. pressure. Installed next to the PB-1.5 reducing valve are two return valves which prevent the АМГ-10 fluid from getting in the reducing valve and pressurization system. Also installed in the pressurization system is a safety valve which prevents the hydraulic tank from damage during sharp pressure changes in case of the landing gear emergency release. Each compartment of the hydraulic tank is provided with a filler neck furnished with a measuring stick and valves which ensure operation of the pumps at negative accelerations. Provided for inspection, cleaning and washing the inner compartments of the hydraulic tank are access hatches which are designed as bases of the drain and overflow pipe unions.

Both compartments of the tank are connected by a pipe to prevent overflow in case the fluid flows from one system into the other through the slide valve control mechanisms of the aileron boosters.

Overflow of the operating fluid (through the slide valve control mechanisms of the aileron boosters) is most intensive with one system being pressurized and the other under no pressure as well as at the moment when the boosters are being switched over from one system to the other. This may be the case when one of the systems is operated by a ground hydraulic pump (on the ground) or when one of the pumps fails (in flight).

To prevent pressure increase in the systems in case of the pump output governor failure, the main and booster systems are provided with the ГА-186М safety valves (Fig.28). When the pressure comes to exceed 210 kg/sq.cm. and reaches 240^{+5} kg/sq.cm., the ГА-186М valve opens slightly and brings the pressure back to not over 260 kg/sq.cm.

The booster hydraulic system provides energy for the aircraft control system. To increase reliability of the aircraft control system the main hydraulic system serves as a stand-by system for the aileron boosters and for one chamber of the stabilizer booster.

When landing with an autorotating or dead engine, the stabilizer booster is from the НП-27Т pump unit and from the hydraulic accumulators.

With both systems serviceable, the aileron boosters are actuated from the ...ter system, while the pressurized main system is ready to be used upon actua-...n of the БУ-45А booster slide valve control mechanisms.

When the pressure in the booster system drops to half the pressure in the ...n system, the aileron boosters are automatically switched over to operation ...m the main hydraulic system.

This change-over is accomplished by the slide valve control mechanisms ...the БУ-45А booster heads. If the pressure in the booster system exceeds half ... pressure in the main system, the aileron boosters get automatically discon-...ted from the main system and switch over for operation from the booster system.

If the БУ-45А boosters get disconnected or the pressure drops in both systems ...ultaneously, the aileron control should be exercised manually. While the pres-...e is dropping (the pressure difference between the delivery and discharge cycle ... the booster being equal to 5 ± 1 kg/sq.cm.), the cross-feed valves of the ...uating cylinder and locking mechanism of the booster distributing slide ...ve operate in the boosters. Operation of these mechanisms makes the ...osters rigid and eliminates play induced by the slide valves, while cross-...eding of the actuating cylinder chambers ensures aileron manual control ...th minimum efforts.

The БУ-51МС two-chamber booster of the stabilizer is actuated from both hyd-...ulic systems: the main and booster ones. In case the pressure drops in the boost-... or main hydraulic system, the БУ-51МС booster will continue operating with its ...e chamber actuated from the main or booster hydraulic system depending on which ...stem is operative.

In these cases one chamber's efficiency of the БУ-51МС booster is sufficient ...r stabilizer control when the flight comes to an end (i.e. before landing) and ...hen landing the aircraft.

Return valves are fitted in the delivery lines of the booster and main ...ydraulic systems (in the booster body) to prevent adverse movement of the ...У-51МС booster rod due to the aerodynamic forces with simultaneous pres-...ure drop in both hydraulic systems.

The НП-27Т emergency pump unit installed in the booster system automatically ...perates when the pressure in the booster system drops. Automatic engagement and ...isengagement of the pump unit is performed by means of the ГА-135/32 pressure ...elay. When the pressure in the system drops to 165^{+10}_{-5} kg/sq.cm., the pump unit ...tarts operating; with the increase in pressure built up by the НП-34-2Т pump ...r by the НП-27Т pump unit) up to 195 kg/sq.cm. the pump unit gets disengaged. In ...his case the pressure difference at the engagement and disengagement moments ...hould be at least 12 kg/sq.cm.

Manual engagement and disengagement of the pump unit when performing ground checks or disengagement in flight, with the НП-34-2Т pump of the booster system inoperative, should be effected with the help of the PUMP UNIT (НАСОСНАЯ СТАНЦИЯ) circuit breaker fitted on the right-hand panel.

The НП-27Т pump unit ensures control of the stabilizer under the following emergency landing conditions:

1. In case the engine fails in flight and cannot be started with the engine autorotation r.p.m., the НП-34-2Т pumps will ensure operation of the aircraft control system till the aircraft landing. In this case decrease in the aircraft speed when landing and reduction in the engine autorotation r.p.m., as well as increase in the control stick travel when landing, will cause pressure reduction in the hydraulic systems. It is possible that the НП-27Т pump unit gets engaged 15 or 20 sec. before the aircraft wheels touch-down.

2. In case of engine jamming in flight or abnormal autorotation r.p.m. (less than 15% of the high-pressure rotor r.p.m.) the capacity of the НП-34-2Т pumps becomes insufficient for keeping the hydraulic system operative or is brought to zero. So the pressure in the main system will drop to zero while in the booster system it will be dropping until the pump unit is engaged.

Emergency landings with a cut-off engine referred to in Items 2 and 3 can be effected only with a sound booster system, i.e. under normal pressure (of at least 140 kg/sq.cm.) conditions.

In these cases the БУ-45А aileron boosters must be switched off to decrease consumption of the working fluid. When landing with a jammed engine with the НП-27Т pump unit switched on for the entire period of landing approach and landing, electric energy is saved by automatic disconnection from the aircraft mains of powerful consumers and other consumers ennumerated in the Pilot's Instructions.

Under normal operating conditions the aileron boosters and stabilizer boosters are always switched on. If necessary, the БУ-45А aileron boosters can be disconnected from the systems by the ГА-190Б control valves. One of them disconnects the boosters from the booster system, the other - from the main system. Both valves are controlled by one selector switch in the cockpit. The БУ-51МС stabilizer booster is not disconnected from the systems.

When checking operation of the boosters from the booster and main systems independently, disconnect one chamber of the БУ-51МС stabilizer booster from the booster system using the ГА-190Б valve (Fig.29) specially provided for the purpose. The other chamber of the booster is not disconnected from the main system. When checking operation of the БУ-45А aileron boosters disconnect them from the booster system with the ГА-190Б valve. During checks both valves will be off, with the button on the right-hand panel kept depressed.

Pressure in the hydraulic systems is checked by the electric distant reading pressure gauge whose two-pointer indicator is installed in the cockpit, the pressure transmitters being fitted in the systems. In addition to the electric distant reading pressure gauges both systems are provided with two yellow warning lights with the BOOSTER SYSTEM, NO PRESSURE (НЕТ ДАВЛЕНИЯ В БУСТЕРНОЙ СИСТЕМЕ) and MAIN SYSTEM, NO PRESSURE (НЕТ ДАВЛЕНИЯ В ОСНОВНОЙ СИСТЕМЕ) inscriptions.

The warning lights flash up when the pressure in the systems drops to 165^{+10}_{-5} kg/sq.cm. The lights are switched on by the ГА-135/32 pressure relay. The warning light system in the booster system is connected to the ГА-135/32 relay which engages and disengages the НП-27Т pump unit.

The warning lights in the main hydraulic system are controlled by another ГА-135/32 pressure relay. The warning lights are extinguished when the pressure in the systems increases up to 195 kg/sq.cm.

When performing ground checks, remember that while decreasing pressure in the hydraulic systems by operating the aileron boosters, pressure drop warning lights in the systems will flash up at a pressure less than 165^{+10}_{-5} kg/sq.cm. as indicated by the cockpit pressure gauge.

It is accounted for by the fact that the ГА-135/32 pressure relays are installed in the fuselage tail portion and separated by return valves from that part of the system in which the aileron boosters and pressure gauge transmitters are located. Hence, the pressure drop in the system lines, where the ГА-135/32 relays are installed, will be slow and, consequently, the lights will flash up later. With the systems pressure decreased by operating the stabilizer booster, the warning lights will flash up at a pressure of 165^{+10}_{-5} kg/sq.cm.

It should be remembered that the return valve installed in the main system next to the spherical hydraulic accumulator not only separates from this accumulaor all the consumers (except for the boosters and engine nozzle flap control ystem) but also separates the cockpit pressure gauge from all the consumers.

This accounts for the fact that after the engine has been stopped or the round pump has been switched off, the cockpit pressure gauge cannot check pressure in the landing gear, air brakes, flaps, cone, and anti-surge shutter systems. In his case relieve pressure in the main system with the help of the БУ-51МС booster.

The main hydraulic system units are actuated by means of solenoid-operated ontrol valves provided with electrical remote control.

The landing gear is actuated by the ГА-142/1 three-position control valve (Fig.30).

With the valve in the OFF position its distributing slide valve is neutral. With zero or low pressure at the valve inlet, the spring-actuated distributing slide valve also assumes the neutral position irrespective of whether the electric magnets are energized or not. With the slide valve in the neutral position, the pressure line is blocked while both operating lines of the landing gear communicate with the system return line.

When the ГА-142/1 valve is on, one of its two electric magnets will be energized. In this case the distributing slide valve (being in the extreme position) will connect one operating line of the landing gear with the delivery line and the other with the drain line.

Two buttons installed on the valve body are intended for manual control of the valve. The buttons can be used when testing the landing gear on the ground without connecting the ground power source to the aircraft mains.

Installed in the return line ahead of the ГА-142/1 landing gear valve is a return valve protecting the landing gear retraction and extension lines (with the landing gear valve neutral) from pressures set up due to operation of the air brakes, flaps, and other units.

The hydraulic system for the air intake cone control consists of a three-position actuating cylinder, two hydraulic locks, two ГА-185 control valves and a return valve.

The cone is kept retracted or released by the fluid pressure. When the pressure in the main hydraulic system drops, the cone is held in any position by the working fluid enclosed in the cylinder chambers. The fluid is locked by hydraulic locks.

When the system is under pressure, the hydraulic locks are always open and the cylinder chamber communicates with the delivery and return lines through the hydraulic valves. A pressure drop in the system down to 35 kg/sq.cm. closes the hydraulic locks. A pressure increase in the hydraulic system up to 70 kg/sq.cm. will result in the opening of the hydraulic locks.

A return valve installed ahead of the ГА-185 valves in the delivery line prevents the cone from adverse movement due to external forces in case of pressure drop in the system before the hydraulic locks are closed. When the pressure in the system drops, the valve closes and thus prevents the liquid from flowing out of the cylinder extension chambers in case some external force is applied to the cone.

The ГА-185 valves are of a two-position type. Each of them is furnished with two magnets, one being always energized. Hence, the slide valve is always in one of the extreme positions which ensures communication of one of the cylinder chambers with the delivery line, the other with the drain line (Fig.31).

If the aircraft mains is energized and the main hydraulic system is under pressure, one of the electric magnets in the ГА-185 valve of the cone 1st position and in the ГА-185 valve controlling the cone 2nd position will be energized and the slide valves will be so positioned as to let the liquid under pressure into both chambers of the cylinder for the cone retraction. The other two chambers of the cylinder will be connected with the return line. The valve electric magnets can be energized for a long time.

The lines for retraction and release of the cone to the 2nd position are fitted with flow restrictors.

Upon reaching the airspeed of M>1.5 the MP1.5 transmitter will operate and energize the winding of the actuating relay. This relay will operate, pick up current from the RETRACTION (УБОРКА) electric magnet for the ГА-185 1st position valve and energize the EXTENSION (ВЫПУСК) electric magnet of the ГА-185 valve.

The cone will be released to the 1st position and will be kept in this position by the fluid pressure. After the flying speed decreases to M less than 1.5, the MP1.5 transmitter will pick up current from the actuating relay winding, the relay will disconnect and de-energize the electric magnet of the ГА-185 valve for cone release; simultaneously, it will energize the electric magnet of the valve for cone retraction. The cone will be retracted and held in position due to the fluid pressure.

Similar to the above described is the operation of the cone 2nd position ГА-185 control valve upon the aircraft acceleration and operation of the MP1.9 transmitter.

The engine jet nozzle flaps are controlled by means of three actuating cylinders, one ГА-164M three-position hydro-electric valve (Fig.32) and an electric system for nozzle control.

Each actuating hydraulic cylinder is provided with two pipe unions (I and II) for delivery of the working fluid. When pressure is fed to pipe union I, pipe union II will be communicating with the return line, the rod will move to the right, and the flaps will open. When pressure is fed to pipe union II, pipe union will be communicating with the return line, the rod will move to the left and the flaps will close.

To avoid misalignment of the flap ring, the movements of the rods of all three actuating cylinders are synchronized by specially provided valves.

The synchronizing valves in the return line maintain constant consumption of the working fluid from each cylinder so that the pistons should move synchronously and with equal speed. The influence of the jet stream on the speed of the cylinder rods movement is compensated for by additional restrictors that relieve the pressure of the working fluid in the flap release cylinder chambers. Electric pulses are fed to the ГА-164M valve depending on the position of the engine control lever.

With the engine control lever remaining within the sector of from CUT-OFF (СТОП) to the position corresponding to 66% of the high-pressure rotor r.p.m., the nozzle flaps are fully open. When the engine control lever is within the sector from the 66% of high-pressure rotor r.p.m. to the MINIMUM AUGMENTATION (МИНИМАЛЬНЫЙ ФОРСАЖ) position, the flaps are slightly closed.

In the sector from the MINIMUM AUGMENTATION to FULL AUGMENTATION (ПОЛНЫЙ ФОРСАЖ) control lever positions the nozzle is controlled by the electric follow-up system with current feed-back. A feed-back potentiometer is installed on one of the nozzle flap control cylinders. When picking up an electric pulse, the ГА-164M valve is set neutral. In this position the distribution valves close the lines running to the cylinder chambers. As a result, the cylinder chambers are locked by the ГА-164M valve hydraulic locks. The expansion of the enclosed working fluid is relieved by thermal valves incorporated in the ГА-164M valve.

In order to reduce the high temperature of the working fluid in the afterburner zone, the pipelines running to the nozzle flap cylinders are laid in a special casing and cooled by the air stream. The pipelines between frame No.30 and the tail cone joint are designed as a flexible loop which compensates for thermal expansion of the afterburner.

The aircraft is provided with float-type flaps. For TAKE-OFF (ВЗЛЕТ) and LANDING (ПОСАДКА) positions the flaps are extended to an equal angle, the angle being adjusted by impact pressure forces.

The design peculiarity of the aircraft hydraulic system is that hydraulic sure is fed to the RETRACTION (УБОРКА) chambers of the cylinders continuously, when retracting and releasing the flaps, without involving the ГА-185 valve. extending the flaps, hydraulic pressure is fed to the EXTENSION (ВЫПУСК) ber through the ГА-185 valve.

The flaps get extended due to the difference between the piston working areas the EXTENSION and RETRACTION position, the former exceeding the latter by the ue of the piston rod section area.

Control of the air brakes is exercised by two valves. The side air brakes controlled by the ГА-140 valve while the bottom air brake is controlled by the 184 valve. When the air brakes are being extended, both valves are energised. ing retraction the valves are de-energized and their distribution slide valves set by the springs to the retracting position. The air brakes are kept releas- or retracted by the hydraulic pressure. In case the electric power supply fails h the air brakes in the released position, they will be retracted hydraulically. case of pressure drop in the hydraulic system the air brakes will be retracted the impact pressure forces.

To keep the air brakes from retraction under no pressure conditions in the stem and to compensate for thermal expansion of the fluid in the retraction linder, a return valve coupled with a thermal valve is installed in the pressure ne ahead of the solenoid-operated valves. The thermal valve is adjusted to open an excessive pressure of 25 kg/sq.cm. relative to the pressure in the feed line. ring installation of a drop tank the ГА-184 solenoid-operated valve for the bot- m air brake should be switched off by depressing the switch button.

To ensure safety when carrying out maintenance work in the wells of the side r brakes, the hydraulic lines for release and retraction of the air brakes are ovided with a manually controlled cross-feed cock. When performing maintenance rk in the wells of the air brakes, the cross-feed cock should be open and the ock rod should be locked with a safety pin. Before flight it is necessary to lose the cock.

Anti-surge blow-off shutters installed on the air intake duct operate in light automatically. The shutters open at M = 1.5 and higher in response to the lectric signal of the M-relay, when the КВ-9А limit switch operates upon stabiliz- r deflection through an angle of from -20° to -28° as well as when the engine con- rol lever is set within the engine ratings from MAXIMUM (МАКСИМАЛ) to IDLE SPEED (МАЛЫЙ ГАЗ). The shutters can also be controlled manually for which urpose a switch is fitted in the cockpit. The shutter control system includes a ydraulic system consisting of the ГА-184 solenoid-operated valve (Fig.33), throt- le valves and actuating cylinders. The solenoid-operated valve opens in response o an electric signal sent to its terminals, thereby allowing the fluid under pres- ure to flow to the actuating cylinders for the shutter opening. When the electric ignal is taken off the valve, the shutters get closed. The shutters are held open r closed by fluid pressure. Time necessary for the shutters opening and closing s controlled by the throttle valve installed in the return line.

A number of filters installed in the hydraulic system protect the units from logging.

The filters in the booster system are installed in the following points:

(a) ФГ11-100-2 filter - at the НП-34-2Т booster pump outlet;

(b) 11ГФ-4-1 filter - at the БУ-51МС booster inlet;

(c) screen filter - in the tank return line;

(d) screen filter - in the tank filler neck.

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

(a) ФГ-11-100-2 filter - in the main return line at the tank inlet;

(b) 11Г94-1 filter - in the pump return line;
(c) ФГ-11-100-2 filter - at the НП-34-2Т pump outlet;
(d) 11Г94-1 filter - at the БУ-51МС booster inlet;
(e) screen filter - in the tank filler neck.

Each of the 11Г94-1 and ФГ-11-100-2 filters consists of a number of fine coarse filters mounted as one unit in a case.

The fine filter traps solids of at least 10 or 12 microns while the coarse filter - greater than 80 microns.

Clogging of the fine filter element with simultaneous increase in the difference between the filter inlet and outlet pressures will cause opening of the by-pass valve which will let the working fluid through the coarse filter only. The opening pressure of the by-pass valve is equal to 7 kg/sq.cm.

The following throttles are installed in the main hydraulic system to reduce pressure in its return line during operation of the hydraulic units:

No.	Location	Orifice diameter, mm
1	Pipe union 2 EXTENSION in ГА-142/1 landing gear control valve	
2	Landing gear nose strut retraction line, pipe union of tee-piece connected with actuating cylinder	3
3	Pipe union RETRACTION of ГА-140 air brake control valve	2.5
4	Pipe union EXTENSION (ВЫПУСК) of ГА-140 air brake control valve	1.8
5	Pipe union RETRACTION of bottom air brake ГА-184 control valve	1.8
6	Pipe union EXTENSION of bottom air brake ГА-184 control valve	1.5
7	Pipe union EXTENSION of ГА-185 flap control valve	1.5
8	Flap extension line, pipe union of tee-piece connected with ГА-185 control valve	1.0
		1.0

2. Specifications for Hydraulic Systems

1. Working fluid . . . . AМГ-10 St.Std (ГОСТ) 6794-53
2. Capacity of tank and hydraulic systems . . . . 36 lit.
3. Capacity of hydraulic tank for main system (main and booster sections contain 6.5 lit. each) . . . . 10.5 lit.
4. Capacity of booster system tank . . . . 8.0 lit.
5. Maximum operating pressure for pump output of 0 lit /min. . . . . 210^{+5}_{-15} kg/sq.cm.
6. Pump operating pressure range within which pump output changes from maximum to zero . . . . from 180 kg/sq.cm. to 215 kg/sq.cm.
7. Pump output at 180 kg/sq.cm. pressure (at the end of the guaranteed service life period)
   - for 4000 r.p.m. at least 31 lit /min.
   - for 500 r.p.m. (pressure equalling 175 kg/sq.cm.) . . . . at least 2.5 lit /min.

Safety valve is adjusted for opening pressure of . . . 240^{+5} kg/sq.cm.

Nitrogen pressure in hydraulic accumulator gas chamber with system under no-pressure conditions . . . 50^{+5} kg/sq.cm.

Fluid quantity in spherical hydraulic accumulator with 210 kg/sq.cm. pressure in system . . . . 1.15 lit.

Fluid quantity in cylindrical accumulator with 210 kg/sq.cm. pressure in the system . . . . 0.83 lit.

. Pressure in hydraulic tank pressurization system (in hydraulic tank) . . . . 1.6 - 2.55 kg/sq.cm.

, Safety valve of hydraulic tank pressurization system is adjusted for opening pressure of . . . . $2.8^{\pm}0.2$ kg/sq.cm.

. Thermal valves of hydraulic locks for landing gear nose and main struts are adjusted for opening pressure of . . . . 275^{+15}_{-5} kg/sq.cm.

. Thermal valve of air brake cylinders is adjusted for differential pressure of . . . . 25^{+5} kg/sq.cm.

5. НП-27Т pump unit output at 210 kg/sq.cm. pressure, $90^{\circ}C$ temperature of working fluid and 20 V voltage (by the end of guaranteed service life period) . . . at least 0.9 lit/min.

7. ГА-135/32 pressure relay for main and booster system pressure drop warning (and for НП-27Т pump unit switching on) is calibrated for:

(a) switching-on pressure drop warning light and engaging pump unit at pressure of . . . 165^{+10}_{-5} kg/sq.cm.

(b) switching-out pressure drop warning light and pump unit at pressure . . . . not in excess of 195 kg/sq.cm.

3. Instructions on Hydraulic System Maintenance

General

1. When servicing the aircraft hydraulic system bear in mind that the system udes units featuring sliding pairs with small clearances (e.g. pumps, boosters,). To ensure faultless operations of these units it is necessary to keep the ing fluid clean.

Faultless operation of each unit provides for reliable operation of the entire aulic system. This makes it obligatory for the maintenance personnel to strictbserve the Maintenance Instructions set forth in the present Section.

2. Replacement of units, disconnection of hydraulic system pipelines and aulic system maintenance should be performed indoors or under conditions which re protection of the exposed places of the system from sand, dust and moisture. These conditions imply covering the working site with canvas or sheltering it rwise.

It is strictly forbidden to perform the above work near the sites where engines being tested.

3. When removing units from the aircraft, disconnecting pipelines or performscheduled maintenance operations, use clean tools and appliances.

4. Make use of pans, funnels, cellophane and vinyl chloride aprons so as not spill working fluid on the aircraft units, communicating lines and airframe hin the area of dismantling.

5. Wipe open pipe unions and the inside of units with clean cloth soaked in pure gasoline and wrung out.

CAUTION: It is strictly forbidden to use cotton, waste, cloth and other fl... materials for wiping.

Hydraulic system maintenance when replacing hydraulic system units

1. Before removing a unit thoroughly wipe the ends of pipes connected to the ... to be removed and the unit itself as well as the neighbouring parts.

2. Remove the attachment fittings of the unit and pipes and wipe them, after which disconnect the pipes and remove the unit.

3. If the unit is not to be replaced right after its removal, fit clean plugs in the pipe ends and pipe unions. The unit to be installed in place of the old one should be depreocessed and washed in conformity with the respective Instructions.

When installing a new unit, see to it that the system is not fouled.

4. After a new unit has been installed, the entire area adjoining to it should be pressure-checked for sealing and wiped clean to remove all traces of the working fluid.

5. Whether it is necessary or not to drain the working fluid from the system before removing a unit depends on the unit location in the system as well as on the number of pipes running to the unit which are to be removed together with the unit, etc. If the piping of the unit to be removed is provided with a shut-off valve or return valves, do not drain the working fluid.

If removal of a unit will cause considerable spilling of working fluid, it is recommended that the fluid be first drained from the entire hydraulic system or from that part of the system in which the unit is located.

6. After replacing the unit scavange the system to evacuate the air, after which add up working fluid in the system.

Hydraulic system maintenance when disassembling the aircraft

1. Before disassembling the aircraft thoroughly wipe the joints of hydraulic pipes to be disjointed.

2. After disassembly insert clean plugs in the open ends of the connectors and pipes.

3. Before joining thoroughly wipe all connectors and adjacent areas.

4. Install special plugs on split valves, type "Argus".

Maintenance operations when filling and re-filling the hydraulic system with fluid

1. The working fluid for the aircraft hydraulic system should be stored in a special sealed container.

2. Fill the service car reservoir with working fluid from the special contain... indoors or under conditions which ensure protection of fluid from impurities.

3. Before opening the filler necks of the service car reservoir and special container for filling, thoroughly clean the filler necks from dust and dirt.

4. Before opening the tank of the aircraft hydraulic system thoroughly wipe the filler neck and cap and wash the tip of the filling hose in pure gasoline.

5. When filling, open the hydraulic tank for a period sufficient to fill the tank. After closing the tank, wipe the neck and plug to remove the spilled fluid.

Hydraulic system scheduled maintenance

1. When replacing fine filters in the pressure and return lines:

(a) thoroughly wipe the filter and connect to it the pipe ends;

(b) screw out the fuel filter with a sediment bowl, remove the fine filter, pour out the sediment and wash the filter body in gasoline.

Wash the coarse filter in gasoline, install a new fine filter element, screw in the filter body and wipe it thoroughly;

Note: If the filtering element cannot be replaced at once, cover the coarse filter with cellophane or install the filter body in place for the time being, without inserting the fine filter element;

(c) in case of a straight-flow filter remove the whole filter. Close the open ends of the disconnected pipes with clean plugs. With the filter removed, wash the coarse filter element and replace the fine filter. After the filter has been installed in the system, wipe it thoroughly.

2. When washing the screen filter of the booster system return line:

(a) before removal thoroughly wipe the filter body and pipe ends connected to it;

(b) remove the filter and insert clean plugs in the open ends of the pipes;

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

(d) assemble the filter, install it in the system and wipe thoroughly the adjacent area.

3. When inspecting and washing screen filters installed in the БУ-45А and БУ-51МС boosters:

(a) before removing the screen filter wipe thoroughly the booster body which incorporates the filter;

(b) remove and wash the screen filter; when washing the filter, its seat in the booster should be plugged or covered with cellophane;

(c) after the filter washing and installation is over, wipe thoroughly the booster body.

Maintenance operations when connecting ground pump

1. Before connecting the ground pump to the aircraft wash the aircraft pipe unions and hose tips in pure gasoline.

2. After disconnecting the ground pump from the aircraft, wipe thoroughly the aircraft pipe unions and tips of the hoses, after which plug them.

4. Checking Operation of НП-27Т Pump Unit

To check the operation of the pump unit proceed as follows:

1. Connect the ground power source to the aircraft and the ground hydraulic pump to the booster system pipe unions on the aircraft port side.

2. Switch on the circuit breakers with inscriptions BOOSTER SYSTEM OFF, HYDRAULIC SYSTEM WARNING LIGHT (ОТКЛЮЧ. БУ СИСТЕМЫ, СИГН. ГИДР.) on the right-hand panel and ЭДМ pressure gauge of hydraulic system inscribed HYDRAULIC SYSTEM DISTANT-READING ELECTRIC PRESSURE GAUGE, DROP AND SERVICE TANK WARNING LIGHT (ЭДМ ГИДРАВЛИЧ., СИГН. ПОДВ. РАСХ. БАКОВ) on the left-hand panel.

3. Turn on the STORAGE BATTERY: AIRCRAFT, GROUND (АККУМУЛЯТ. БОРТОВОЙ АЭРОДРОМН.) switch on the right-hand panel; as a result, BOOSTER (БУСТЕРНАЯ)

and MAIN (ОСНОВНАЯ) warning lights flash up on the instrument panel.

4. Switch on the ground hydraulic pump and set up operating pressure the booster hydraulic system. The pressure should be checked against the pressure gauge in the cockpit. When a pressure of 195 kg/sq.cm. has been built the BOOSTER (БУСТЕРНАЯ) warning light goes out, while the MAIN (ОСНОВНАЯ) warning light continues burning.

5. Switch on the PUMP. UNIT (НАСОСНАЯ СТАНЦИЯ) circuit breaker on the right-hand panel.

6. Switch off the ground hydraulic pump and by slowly moving the control stick back and forth (to bleed the pressure in the system) check to see that the pump gets switched on at the proper moment.

A pressure drop in the system down to 165 $^{+10}_{-5}$ kg/sq.cm. will result in flashing up of the BOOSTER (БУСТЕРНАЯ) warning light and automatic switching on of the pump unit.

Switching-on of the pump unit will be checked audibly (by listening to electric motor and pump operation).

7. Cut out the AILERON BOOSTER (БУСТЕР ЭЛЕРОНОВ) switch on the left panel.

8. By operating the control stick bleed the pressure in the system down to 100 kg/sq.cm., after which stop moving the control stick and switch on the pump unit. Check the pressure increase, built up by the pump unit.

With the control stick stationary and aileron boosters switched off, see that the time required to increase the pressure in the system from 130 kg/sq.cm. to 170 kg/sq.cm. does not exceed 7 seconds. Should the period exceed 7 sec. this will indicate that the system or its units are poorly sealed or that the НП-27Т booster pump station output has dropped.

9. The pump unit should become engaged upon gaining a pressure of 195 kg/sq.cm. Check the difference between pressures at the moment of the pump unit engagement and disengagement. This difference should be equal to at least 12 kg/sq.cm. Determine the moment of the pump unit disengagement by listening to the electric motor operation. The noise from the pump unit operation ceases and the pressure (as read off the pressure gauge in the cockpit) no longer increases.

After checking according to Items 7 and 8 switch on the aileron boosters and cut out all circuit breakers and switches.

Note: When performing ground checks of the pump unit, see that the unit motor total operating time should not exceed 3 min., as it is detrimental to the motor. After every operation have a 5-min. interval to cool the motor.

CAUTION: To ensure the НП-27Т pump unit normal engagement and disengagement and proper operation of the pressure drop warning units in the hydraulic systems in case of replacing the ГА-135/32 hydraulic relays in the main or booster systems, check the calibration of the relays according to their Certificates. See that the relay is switched on at 165$^{+10}_{-5}$ kg/sq.cm. and is switched off at 195 kg/sq.cm. The difference between the switching-on and switching-off pressures should be at least 12 kg/sq.cm. For the data refer to the relay Certificates.

5. Checking НП-34-2Т Pumps Output

(during pre-flight preparation

with the engine running)

1. Check nitrogen pressure as read off the pressure gauges in the cylin

hydraulic accumulators of the main and booster hydraulic systems. The ure should be 50^{+5} kg/sq.cm. with both hydraulic systems under no-ure conditions.

2. Check to see that the air brakes are tightly pressed. When checking umps, deflection of the air brakes is not allowed. To eliminate deflec- open the cross-feed valve and press the air brakes to the fuselage by after which close the cross-feed valve.

3. Switch off the БУ-45А aileron boosters to prevent the working fluid leaking through the boosters when checking the pumps. Cut out the boosters erating the AILERON BOOSTER switch.

4. Start the engine. As the engine gains speed, check the pressure increase th hydraulic systems by the pressure gauge. By the moment the high-pres- rotor gains 25% r.p.m., pressure in both systems as read off the pressure should rise from zero to 210^{+5}_{-10} kg/sq.cm. The control stick in this case ld be stationary.

5. While testing the engine after racing it at maximum engine r.p.m., set engine to 50% of high-pressure rotor r.p.m. Switch on the aileron boosters. the engine steady, the r.p.m. equal to 50% of high-pressure rotor r.p.m., the control stick all the way back and forth diagonally at the maximum d possible.

When moving the control stick, see that the pressure in the booster em indicated by the pressure gauge should not drop below 180 kg/sq.cm.

The НП-34-2Т booster system pump and the booster system are considered iceable provided the pressure, when checked, will be found equal to the e value.

6. With the engine running at the same r.p.m., check the НП-34-2Т pump he main hydraulic system. To this end, press the BOOSTER SYSTEM OFF button he right-hand panel and, holding it pressed, move the control stick in same manner as it was indicated under Item 5. While doing so, see that pressure in the main system should not drop below 180 kg/sq.cm.

If the pressure is as indicated, the НП-34-2Т booster pump for the main ulic system and the main system itself are considered sound.

CAUTION: It is forbidden to clear the aircraft for flight in case any of the requirements set forth under Items 4, 5, and 6 have not been observed.

6. Determining Causes of Hydraulic Pump Abnormal Operation

If checks will prove that the hydraulic pump characteristics do not conform those stipulated in Section 5 of the present Instructions, find the cause abnormal operation.

A drop in the pump output may be the result of the following circum-nces:

(a) failure of hydraulic pumps;

(b) poor sealing of the hydraulic tank pressurizing system or insufficient essure in the system;

(c) poor sealing inside the hydraulic system;

(d) poor external sealing of the hydraulic system.

To find the fault in the hydraulic system that caused a drop in the pump tput, the following procedure should be used:

1. With the engine running check the pressurization of the hydraulic tank.

If the pressure is below 1.6 kg/sq.cm., check the system for sealing as is dicated in Section "Checking Hydraulic Tank Pressurization System for Sealing" d restore the sealing, if required.

If the pressurization value is less than specified, with the pressurization system in good repair, replace the system reducing valve, check the return valves and other units.

Check the pressurization of the hydraulic tank and operation of the hydraulic pumps.

If the pressurization value has come to be within 1.6 to 2.55 kg/sq.cm (i.e. normal value) and the characteristics of the pumps meet the requirements set forth in the Instructions, the hydraulic system and pumps are considered to be sound.

2. Check the hydraulic systems for external sealing (See Section "Checking Airtightness of Hydraulic System"). Eliminate external leakage of the hydraulic system, if found, and check the hydraulic pumps for proper operation. With the hydraulic system sealing restored and the pumps operating properly, the hydraulic system is considered sound.

3. Check the hydraulic systems for internal leaks (See Section "Checking Airtightness of Hydraulic System"). When the internal leaks of the hydraulic system are discovered, locate and replace the defective unit.

The internal leaks eliminated, once more check the pumps for proper operation. With the pumps operating properly, the whole hydraulic system is considered sound.

4. If the pumps output is below rated with the hydraulic tank pressurized as specified and the hydraulic system properly sealed, replace the pumps which are sure to be defective. After replacing the pumps check them for proper operation. If their operational characteristics conform to the specified values the hydraulic systems are considered sound.

7. Checking Airtightness of Hydraulic System

The hydraulic system should be checked for airtightness in the following cases:

(a) when performing scheduled maintenance;

(b) in case of improper operation of the pumps during pre-flight preparation;

(c) when replacing the units or pipelines in the hydraulic system and when dismantling or assembling separate sections of the system. Checking the hydraulic system for sealing includes checks for inner and external leaks. Described below is the checking procedure.

Checking pipelines and units of hydraulic system for external leaks

The main and booster hydraulic systems should be checked separately.

Before checking:

1. Open access holes on the fuselage, wings and fin to inspect the units and pipelines of the hydraulic system.

2. Check to see that nitrogen pressure in the gas chambers of the hydraulic accumulators in both hydraulic systems is 50^{+5} kg/sq.cm. Charge the hydraulic accumulators, if necessary.

3. Close the fuel shut-off valve by hand to prevent the fuel from getting in the engine when moving the engine control lever. After checking the hydraulic system for sealing and setting the engine control lever to the STOP position, open the fuel shut-off valve by hand and lock it in this position.

Check the booster hydraulic system for external leaks in the following sequence:

1. Connect the ground power source to the aircraft and the ground hydraulic pump to the pipe unions of the booster system. Cut in the circuit breakers and switches necessary for the hydraulic system operation.

2. Set up a pressure of 210 kg/sq.cm. in the hydraulic system by operating the ground hydraulic pump. Check the pressure by the cockpit pressure gauge. Switch on the aileron boosters and place the control stick in the neutral position.

3. With the pump in operation keep the system under pressure during 10 or 15 min. Through the open hatches visually check the condition of the units and connections of the system in its pressure and return lines throughout the pump-to-boosters length. Leaky connections and gaskets shall not be tolerated.

4. Cut in the PUMP.UNIT switch, disconnect the aileron boosters and the ground power source.

5. By moving the control stick forward and backward, bleed pressure in the booster hydraulic system down to 165^{+10}_{-5} kg/sq.cm. This pressure will actuate the НП-27Т pump unit. Discontinue the control stick movement. The pressure in the system should increase, and the pump unit should get disengaged at a pressure of 195 kg/sq.cm.

Operating the pump station for not more than 3 min. (total operating time) check the units and connections of the pump unit system for external leaks. Leaks in connections and units shall not be tolerated. Disengage the pump unit and bleed the pressure to zero by moving the control stick.

Check the main hydraulic system for external leaks in the following way:

1. Lift the aircraft on jacks.

2. Connect the ground power source to the main hydraulic system and build up in the system a pressure of 210 kg/sq.cm. as read off the cockpit pressure gauge scale.

3. Inspect through the open hatches the connections of the pipelines and units for external leaks at the following sections of the main hydraulic system:

(a) landing gear retraction and extension system in three positions of the control valve: NEUTRAL, RETRACTION, EXTENSION;

(b) flap control system in two positions of the control valve: RETRACTED and LANDING;

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

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

(e) retractable cone system in two extreme positions: RETRACTED and EXTENDED;

(f) engine nozzle flap system at the maximum rating and in augmentation positions;

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

<u>Note</u>: Extension and retraction of the cone as well as opening and closing of the anti-surge shutters should be carried out manually. After checking set their switches to AUTOMATIC and lock them.

In each position of the control valve keep the hydraulic system under pressure for 10 min. minimum.

By external inspection check the PUMP - CONTROL VALVES, CONTROL VALVES - CYLINDERS and PUMP - BOOSTERS lines in the pressure and return systems.

Leaks in the pipeline and unit connections are not allowed.

Checking hydraulic system for inner leaks

Check the main and booster hydraulic systems for inner leaks separately. Determine the system sealing by the time necessary to obtain a pressure drop in the system in question, the ground hydraulic pump being disconnected.

Before checking both hydraulic systems for inner leaks perform the following operations:

(a) check the fluid level in both compartments of the hydraulic tank. Top up the tank with the AMГ-10 fluid, if required;

(b) check nitrogen pressure in the gas chambers of hydraulic accumulators in both systems. It should amount to 50^{+5} kg/sq.cm. Charge the hydraulic accumulators with nitrogen, if required;

(c) remove the return valve installed ahead of the spherical hydraulic accumulator in the pressure line of the main hydraulic system;

(d) in place of the removed return valve install a special auxiliary straight pipe union No. 74-7801-1050 available in the tool set (one for each four sets). The inner diameter of the straight pipe union corresponds to that of the pipeline at the section being checked;

(e) hoist the aircraft on jacks. Below is given the procedure used for checking the main and booster hydraulic systems for inner leakage.

Main hydraulic system

1. Connect the ground power source and ground hydraulic pump to the pipe unions of the main hydraulic system. Engage the ground hydraulic pump and set up a pressure of 210 kg/sq.cm. in the system.

2. In order to warm up working fluid and units of the system and to evacuate air from the system, operate the hydraulic system units in the following sequence: perform 10 or 12 retractions and extensions of the landing gear, flaps, air brakes, cone, anti-surge shutters and engine nozzle flaps. Move the control stick 20 - 30 times forward and backward at the maximum speed possible.

3. With the system under operating pressure, set the control valves in the system to the following positions:

(a) aileron booster control valve to OFF;
(b) cone control valve to RETRACTED;
(c) landing gear control valve to NEUTRAL;
(d) flap control valve to the RETRACTED position;
(e) anti-surge shutter control valve to CLOSED;
(f) air brake control valve to the RETRACTED position;
(g) make sure that the air brake cross-feed valve is closed;
(h) see that the engine nozzle flap control valve is neutral, engine control lever is set within the MINIMUM AUGMENTATION and FULL AUGMENTATION positions.

4. Keep the system under pressure during 1 or 2 min. Switch off the ground hydraulic pump and, holding the control stick stationary, check the time of the pressure drop in the system by the cockpit pressure gauge. The time required for the pressure drop from 180 to 150 kg/sq.cm. should be at least 10 sec.

5. Determine the time of pressure drop in the system with the control valves set to other possible positions (See Item 3), with the aileron boosters control valves disengaged. The time required for the pressure drop from 180 to 150 kg/sq.cm., with the control valves in any position possible, should be at least 10 sec.

6. Switch on the ground hydraulic pump and set the control valves to the positions indicated under tem 3, the hydraulic system being under operating

ressure. Switch on the aileron boosters and move the control stick 20 or 30 imes all the way to the right and to the left at the maximum speed possible. his done, stop the control stick in the neutral position.

7. With the system under operating pressure switch off the ground hydraulic pump and, keeping the control stick stationary, check the time of pressure rop in the system from 180 to 150 kg/sq.cm., the aileron boosters remaining ngaged. The time of pressure drop should be at least 5 sec. Bleed the pressure n the hydraulic system by moving the control stick.

8. Should checks prove that the main hydraulic system is properly sealed, estore the system to an operating condition, i.e. remove auxiliary straight pipe union No. 74-7801-1050 installed for the checking period only and replace it by the return valve which should be installed in the pressure line ahead of the spherical hydraulic accumulator.

Install the return valve in such a way that the pointer located on its body should settle in the direction of fluid flow in the pipeline, i.e. towards the spherical hydraulic accumulator.

The valve installed, check under pressure its connections with the pipelines for leaks.

If any leaks, involving repair, have been discovered in the main hydraulic system during checking, replace the straight pipe union by the return valve only after repairing the system.

Booster hydraulic system

1. Connect the ground hydraulic pump to the booster system and build up operating pressure in the system. In this case the pressure in the main hydraulic system should be equal to zero.

2. Engage the aileron boosters and move the control stick forward – backward and right-left at the maximum possible speed during 2 or 3 min.

3. Stop moving the control stick and place it neutral.

With the system under operating pressure, switch off the ground hydraulic pump and check the time of pressure drop from 180 to 150 kg/sq.cm.; the time should be at least 5 sec.

4. Switch on the ground hydraulic pump, build up operating pressure in the system, cut off the aileron boosters, and check to see that the time of pressure drop in the system from 180 to 150 kg/sq.cm. (with the control stick stationary and the aileron boosters disengaged) is at least 35 sec.

Bleed the pressure in the hydraulic system by moving the control stick.

Notes: 1. Switch over all solenoid-operated valves from one position to the other only when the hydraulic system is under operating pressure to prevent the sliding valves of the control valves from assuming inoperative positions.

2. If the time of pressure drop in the system is other than specified, it is necessary to find the cause and eliminate it.

3. The time of pressure drop in the hydraulic system during checking for inner leaks is given proceeding from the leakage rate at the end of the guaranteed service life of the units.

8. Instructions on Finding Causes of Hydraulic System Inner Leaks

If during checking for inner leaks the time of pressure drop in the booster or main hydraulic system happens to be less than specified, find the defective unit and replace it. Given below are the instructions on finding such units, for the booster and main hydraulic systems separately.

Booster System

1. If during checking the booster hydraulic system for inner leaks (as set forth in the previous Section) the pressure drop time appears to be within the specified limits with the aileron boosters disengaged and below the specified period with the aileron boosters engaged, this is indicative of poor sealing of the БУ-45А boosters. Replace one by one the boosters to locate the defective u and replace it.

2. Check the hydraulic system fuselage portion for inner leaks. To this en

(a) make sure that the PUMP UNIT circuit breaker is off. Set up operating pressure in the booster system by the ground hydraulic pump;

(b) pump the booster hydraulic system through, with the aileron boosters engaged, by moving the control stick forward and backward, to the left and righ at the maximum speed possible during 2 or 3 min.;

(c) stop the stick and switch off the ground hydraulic pump with the syste being under operating pressure. By moving the control stick to the right and to the left (i.e. operating aileron boosters) bleed the pressure in the fuselage front section of the booster system to zero. Check the pressure by the cockpit pressure gauge. Stop the control stick;

(d) simultaneously with operations under Item (c) check the time during whi the pressure in the fuselage tail section hydraulic system drops from 180 to 150 kg/sq.cm.; see that it is at least 15 sec. Check the pressure by the pressur gauge of the cylindrical hydraulic accumulator in the booster hydraulic system;

(e) if the pressure in this section of the system drops quicker than it is specified, disconnect the БУ-51МС stabilizer booster from the booster hydraulic system, for which purpose depress and keep in this position the BOOSTER SYSTEM O button in the cockpit and check the time of pressure drop from 180 to 150 kg/sq. see that it is at least 4 min. Release the button. If the time of pressure drop actually 4 min. (the check is carried out as specified in Item (e) while the requirement indicated under Point 4 of the previous Section "Booster System" is not fulfilled), this will indicate excessive inner leaks of the stabilizer booster. This being the case, replace the БУ-51МС booster;

(f) if the time of pressure drop in the fuselage tail portion hydraulic sys appears to be less than 4 min., it is necessary to find the defective unit by su cessive replacement of the following units: the ГА-190Б valve for switching off stabilizer booster, cylindrical hydraulic accumulator and return valve. The faul unit found, replace it.

Note: Poor sealing of the return valve cannot be the cause of inner leakage of the booster system. Replace the defective valve, if any, and contin checking the system for faults.

3. Check the booster system in the fuselage front section for inner leaks. To this end:

(a) disconnect the split valve in the pressure line between the fuselage front and rear sections;

CAUTION: When disconnecting the delivery line split valve it is forbidden to disconnect the split valve in the return line not to damage the booster system cylindrical accumulator when operating the stabilizer booster from the main hydraulic system.

(b) set up operating pressure in the hydraulic system. With the aileron boosters on, pump the system through by moving the control stick to the right and to the left during 1 min. Place the control stick neutral and disengage the aileron boosters. The system pressure being 210 kg/sq.cm., switch off the ground hydraulic pump and check the time of pressure drop in the hydraulic system from 180 to 150 kg/sq.cm. by the cockpit pressure gauge. The pressure drop time should be equal to at least 2.5 min.;

(c) the time of pressure drop appearing less than 2.5 min., find the defective unit by replacing successively: the valve for disconnection of the aileron boosters, the ГА-186М safety valve, the pump safety valves and the ground pump line safety valves. The defective unit found, replace it.

4. If the time of pressure drop in the booster hydraulic system parts located in the fuselage front and rear portions is found within the specified limits when checking them separately, but the booster hydraulic system as a whole is found defective, this may be due to (in exceptional cases) inner leaks of two return valves of the pump unit. One of the pump unit return valves is installed in the body of the return twin valve in the cylindrical hydraulic accumulator, the other return valve - in the pump unit pressure line. Replace the return valves.

Note: When the booster hydraulic system is pressurized, rotation of the disc fitted on the pump unit shaft observed through the holes in the body of the НП-27Т pump unit will be indicative of leakage of the pump unit return valves. In this case replace the valves.

5. After performing all checking and repairing operations required, connect the pressure line split valve between the fuselage front and rear sections and check the entire hydraulic system for inner leaks.

Main Hydraulic System

Prepare the main hydraulic system to check it for inner leaks, i.e. replace the return valve ahead of the spherical hydraulic accumulator by straight pipe union No.74-7801-1050, jack up the aircraft, connect the power source and ground hydraulic pump. For checking use the following procedure:

1. Check the hydraulic system in the fuselage rear section for inner leaks, for which purpose:

(a) build up operating pressure in the hydraulic system by the ground hydraulic pump and pump the system through by moving the control stick 20 or 30 times forward and backward at the maximum speed possible;

(b) with the control stick stationary and the pressure in the system being 210 kg/sq.cm., switch off the ground hydraulic pump and by operating the air brakes bleed the pressure in the fuselage front section hydraulic system down to zero as read off the cockpit pressure gauge scale;

(c) simultaneously with performing operations under Item (b) check the time of pressure drop in the fuselage rear section hydraulic system from 180 to 150 kg/sq.cm., the control stick remaining stationary. The pressure drop time should be at least 15 sec. Check the pressure drop by reading the indications of the pressure gauge of the cylindrical hydraulic accumulator.

Should the pressure drop take less time than is specified, it will be indicative of leaks in the БУ-51МС stabilizer booster, return valve or cylindrical hydraulic accumulator.

In this case check the amount of inner leaks through the БУ-51МС booster. To this end:

(a) bleed pressure in the fuselage rear section hydraulic system to zero by moving the control stick forward and backward;

(b) bleed the pressure in the hydraulic tank pressurization line;

(c) disconnect the hydraulic system drain pipe from the БУ-51МС booster and plug it, leaving the booster drain pipe union open;

(d) build up operating pressure in the hydraulic system and place a measuring tank under the drain pipe union;

(e) with the control stick stationary, check to see that the rate of fluid leakage through the booster does not exceed 250^{+50} cu.cm/min. If the leakage exceeds this value, replace the booster.

With the booster serviceable replace the parts that have been removed an
locate the defective unit by successively replacing the rest of the units in
system, i.e. replacing the return valve and cylindrical hydraulic accumulator,
The defective unit should be replaced with a sound one.

<u>Note</u>: Poor sealing of the return valve cannot cause inner leakage of the hydraulic system. The leaky valve should be replaced, while the sys should be further checked for the actual defect.

2. Check the fuselage front section hydraulic system for inner leaks, for which purpose:

(a) disconnect the split valve in the pressure line of the main hydraulic system between the fuselage front and rear sections;

CAUTION: It is forbidden in this case to disconnect the split valve in the return line to avoid pressure damage to the cylindrical accumulator w operating the boosters from the booster system.

(b) switch on the ground hydraulic pump and pump the hydraulic system thr with the aileron boosters engaged, by moving the control stick to the right and the left 20 or 30 times at the maximum speed possible;

(c) with the pressure in the system being 210 kg/sq.cm. switch off the grou hydraulic pump and check the time of pressure drop in the hydraulic system by t cockpit pressure gauge. The time of pressure drop from 180 to 150 kg/sq.cm., wi the control stick stationary, should be equal to at least 35 sec.

3. If the time of pressure drop in the fuselage front and rear sections of the hydraulic system, when checking them separately, is within the specified li poor sealing of the entire hydraulic system may be attributable to the inner le in the engine nozzle flap units.

If this is the case, connect the split valve in the pressure line between fuselage front and rear sections, disconnect from the ГA-164M valve the pipes su plying fluid to the engine nozzle cylinders and plug them. Check again the enti main hydraulic system for inner leaks as outlined in the preceding Section. If the system inner leaks persist, replace the control valve actuating the engine nozzle flaps. With the engine nozzle flap control valve properly sealed, find t defective cylinder by successively replacing the nozzle cylinders; replace the faulty cylinder with a new one.

4. If the time of pressure drop in the hydraulic system laid in the fusela front section is found to be less than 35 sec. (when checking the hydraulic sys for inner leaks), do not connect the split valve in the pressure line between t fuselage front and rear sections and perform the following:

A. By successively disconnecting the pressure pipelines from the solenoid-operated valves, locate the portion of the hydraulic system with inner leaks. Di connect the pipeline portion arranged ahead of the valve.

Disconnect the hydraulic system sections in the following sequence:

(a) cone control valves;

(b) anti-surge shutter control valve;

(c) landing gear control valve;

(d) flap control valve;

(e) two control valves for air brakes.

The following is the procedure used for locating sections of the system hav poor sealing:

(a) disconnect and plug the pressure line supplying fluid to the valve;

(b) check the fuselage front section hydraulic system for inner leaks as se forth above.

If during checking there has been noted an abrupt increase in the time red to obtain a pressure drop in the system upon disconnection of the system on with a valve, this will be indicative of inner leaks in this section of hydraulic system.

Note: Slight increase by 1 or 2 seconds in the time required to obtain a pressure drop during checks may be caused by inaccurate measuring and should not be considered as proof of poor sealing of the tested sectior.

The defective section of the hydraulic system found, it is necessary by successreplacing of units within this section to locate the defective unit and re- it. Then the hydraulic system should be checked for inner leaks again.

B. If the check of the hydraulic system according to Item (a) has proved all the tested sections and units are properly sealed, locate the defective by successively replacing the safety and return valves and replace it.

5. After eliminating inner leaks in the system, pump it through operating all system units. This done, remove and inspect all filters.

Notes: 1. In the course of operation the hydraulic system may become leaky after replacement of a unit.

In this case it might not be due to the new unit; the inner leaks of the new unit being insignificant as compared with those of the unit removed; the inner leaks of the new unit are likely to be within the permissible limits.

If that is the case, make sure that the newly installed unit is serviceable, after which find the defective unit in the hydraulic system in compliance with the Instructions set forth above.

2. To avoid clogging of the hydraulic system all checking operations should be performed in conformity with the requirements stated in Section "Hydraulic System Maintenance".

3. After checking of the hydraulic system for sealing is over, replace straight pipe union No.74-7801-1050 ahead of the spherical hydraulic accumulator in the pressure line by the return valve as indicated in Section 7 of the present Instructions.

9. Hydraulic System Maintenance after Emergency Extension of Landing Gear

After the landing gear emergency extension system has been used, perform the owing operations:

1. Close and lock the emergency control valve.
2. Release air from the landing gear emergency extension system, having disconed the pipes supplying the AMГ-10 hydraulic fluid for extension of the landing main and nose wheel struts within the sections from the hydraulic locks to the nders and the pipes supplying the AMГ-10 fluid for landing gear door emergency ing. After releasing the air connect the pipes and lock the connections.
3. Connect the ground hydraulic pump and operate the landing gear 10 or imes extending and retracting it to evacuate air from the hydraulic system make sure that the connections are properly sealed.
4. After the trouble that necessitated application of the emergency system been eliminated make certain that the landing gear up-locks are sound.

IT IS FORBIDDEN:

(a) to retract the landing gear after using the landing gear emergency extensystem without previously releasing air from the cylinders;

(b) to open the emergency control valve, if not required, and leave it unlocked.

10. Hydraulic System Washing

General

1. When washing the aircraft main and booster hydraulic systems use shou be made of a special set of filters which go to make up the group set (the ФГ-1 11ГФ-4 filters and screen filter for booster system). Besides, it is necessar to replace the throttle valves and dampers in the systems for extension of lan ing gear nose strut, anti-surge shutters, air brakes and flaps with special straight pipe connections.

2. The ground equipment used when washing and testing the aircraft hydra system, i.e. ground hydraulic pumps, pump hoses and filling means (funnels, bu kets and other containers) should be washed with the АМГ-10 fluid so as to protect the АМГ-10 fluid for the hydraulic system from impurities.

3. When operating the aircraft in adverse conditions from dusty airfields the aircraft hydraulic system is subject to excessive fouling. This necessit washing the hydraulic system more frequently than set forth in the regulating Instructions, the washing schedule being established by the Unit Engineer.

Hydraulic System Washing Procedure

1. Drain the АМГ-10 working fluid from both hydraulic systems as set forth Section "Draining Working Fluid from Hydraulic System".

2. Prepare the engine nozzle flap control system for ground testing with t engine inoperative as outlined in Section "Power Plant Control". Jack up the ai craft.

3. Remove the filters of both hydraulic systems along with the gauze filte in the return line of the booster hydraulic system.

4. In place of the removed filters install identical filters available in the special filter set intended for hydraulic system washing.

<u>Note</u>: Before installing washing filters in the hydraulic system plug their safety valves.

5. Remove, check and wash in pure gasoline the screen valves at the БУ-51М and БУ-45А booster inlets.

6. Replace the filters.

7. Wash the coarse filters, the filter bodies, throttle valves and dampers in pure gasoline, after which dry them up.

8. When performing maintenance work, remove the hydraulic tank from the ai craft and thoroughly wash both its chambers in pure gasoline 3 - 4 times all th time shaking and turning the tank. Wash the tank until the gasoline, poured out from it, will be pure and without any traces of dirt or the АМГ-10 fluid.

Dry up the hydraulic tank and install it on the aircraft.

9. Fill the АМГ-10 working fluid in both sections of the hydraulic tank.

10. Connect the ground hydraulic pump with the tank pressurization system t the main hydraulic system (fuselage starboard side).

11. Connect the ground power source, cut in the STORAGE BATTERY, AIRCRAFT, GROUND in the cockpit and all circuit breakers and switches which ensure operation of the aircraft control systems, take-off and landing mechanisms, air intak cone and anti-surge shutters.

12. Build up operating pressure in the main hydraulic system, switch on aileron boosters and pump the hydraulic system during 5 - 6 min. by moving the control stick forward - backward and right - left at the maximum speed possible. While doing so, see that the АРУ-3В automatic unit remains in the LOW SPEED position.

13. Pump the AMГ-10 fluid through other units of the main hydraulic system, or which purpose retract and extend 10 or 12 times the landing gear, flaps, air rakes, air intake cone, anti-surge shutters and engine nozzle flaps. Switch off he ground hydraulic pump and decrease pressure.

14. Connect the ground hydraulic pump to the aircraft booster hydraulic sys-em (fuselage port side).

15. Set up operating pressure in the booster hydraulic system, switch on ileron boosters and pump the hydraulic system through during 5 - 6 min. as indi-ated under Item 12.

16. With the system under operating pressure, disengage the aileron boosters nd ground hydraulic pump, after which switch on the pump unit by operating the UMP UNIT switch. When bleeding pressure in the system by moving the control stick orward and backward, the pump unit will become engaged.

Continue moving the control stick which will keep the pump unit engaged for ot over 3 min. Switch off the pump unit.

17. Reduce pressure in the hydraulic system to zero by moving the control tick.

18. Drain the AMГ-10 fluid from both hydraulic systems as indicated in Section Draining AMГ-10 Fluid from Hydraulic System".

19. Remove all washing filters, take them to pieces and check for fouling.

CAUTION: 1. If the ground hydraulic pump filters are found to be clogged with dirt, sand or other impurities, wash the filtering elements in gasoline and dry them up.

2. If dirt is found on the washing filters, wash the system once more.

3. Fine filtering elements of the washing filters which go to make up a special set should be checked for serviceability to make sure that their further use is possible. Checking should be repeated after each washing of the hydraulic system. When checking use the procedure described below.

20. Check the screen filters installed at the БУ-51МС and БУ-45А booster in-lets for cleanness and wash them in pure gasoline.

21. After both systems have been washed, replace all aircraft filters with new fine filtering elements, having previously washed and dried them up. Check all connections for external leaks and lock them.

CAUTION: After the hydraulic system has been washed, install new fine filter-ing elements in the operating filters.

22. Fill both hydraulic systems with fresh AMГ-10 fluid as set forth in Section "Filling Hydraulic System with AMГ-10 Fluid".

23. Enter in the aircraft Service Log all data concerning hydraulic system washing and testing.

Checking Washing Filters with Fine Filtering Elements for Possibility of Further Use

Subjected to this check are only washing filters available from the special set for aircraft hydraulic system washing. The aircraft operating filters are not subject to this kind of checking.

The following procedure is used for checking washing filters:

1. Take the filter to pieces and inspect the fine filtering elements.

2. The fine filtering elements should meet the following requirements:

(a) no paper tears should be found inside the crimp and on the outer edges, the paper should not be scorched or the plastic heads crushed; the glued joints should not be cracked or broken;

(b) with separate crimps being shrunk, the tops of adjacent crimps should b not more than 4 mm apart; there should be no twisting and warping of crimps;

(c) the filtering element should be inserted in the seats of the filter body and sleeve without application of force to avoid its twisting during filter as- sembly;

(d) wash the fine filtering elements in pure АМГ-10 fluid.

3. Wash the coarse filtering elements in gasoline and inspect them.

4. If the filtering elements conform to the requirements set forth above, assemble the filters and check the difference between the АМГ-10 working fluid pressures at the filter inlet and outlet. The fine filtering element is considere fit for further use, if the pressure difference does not exceed 6 kg/sq.cm., the fluid flow through the filter being at least 31 lit/min. and the fluid temperatu being from +20° to +50°C.

If the pressure difference exceeds 6 kg/sq.cm., replace the fine filtering element by a new one. Checking filters for pressure drop should be performed on a hydraulic installation with pressure gauges whose indications are accurate to within 0.5 kg/sq.cm.

11. Instructions on Charging Hydraulic Accumulators and Checking Their Pressure

Gas chambers of the cylindrical and spherical hydraulic accumulators in the booster and main hydraulic systems should be charged with nitrogen up to a pres- sure of 50^{+5} kg/sq.cm., with the pressure in the hydraulic systems bled.

The following is the procedure used for charging spherical hydraulic accumul tors:

1. Bleed the pressure in the hydraulic systems.

2. Remove the plug from the charging pipe union of the hydraulic accumulator and connect appliance 72-7804-250A with the pressure gauge to the pipe union, hav- ing previously screwed the rod of the appliance full way out.

3. Connect the hose of the ground nitrogen bottle to the appliance pipe union

4. Open the valve of the ground nitrogen bottle.

5. Open the closing valve of the hydraulic accumulator charging pipe union by screwing in the rod of the appliance, after which fill the gas chamber of the hydraulic accumulator with nitrogen until obtaining a pressure of 50^{+5} kg/sq.cm.

6. Close the valve of the ground nitrogen bottle, disconnect the hose, remove the appliance and plug the charging pipe union of the hydraulic accumulator.

Check nitrogen pressure in the spherical hydraulic accumulators with the help of the pressure gauge in the charging appliance. While doing so, see that the ap- pliance pipe union for connecting the ground bottle hose is plugged.

The following procedure is used for charging cylindrical hydraulic accumula- tors:

1. Bleed the pressure in the hydraulic systems to zero.

2. Remove the plug from the hydraulic accumulator charging pipe union and connect appliance 72-78[illegible]-250A to it.

3. Connect the hose of the ground nitrogen bottle to the appliance and open the bottle valve.

4. Open the closing valve of the hydraulic accumulator charging pipe union with simultaneous smooth movement of the control stick forward and backward, slightly displacing the control stick to displace the БУ-51МС booster slide valve. This will cause the АМГ-10 fluid flow from the return line chamber of the hydraulic accumula- tor when filling nitrogen to the gas chamber.

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5. When nitrogen pressure in the hydraulic accumulator has reached $^{+5}$ kg/sq.cm., close the valve of the ground nitrogen bottle and, moving the con- ol stick, make sure that the pressure in the hydraulic accumulator remains con- ant. If the pressure in this case slightly drops, open the bottle valve again d refill the hydraulic accumulator as required.

This done, filling is considered accomplished.

6. Remove the charging appliance and plug the charging pipe union of the ydraulic accumulator.

Check the pressure in the cylindrical hydraulic accumulators against the pres- ure gauges installed immediately at the accumulators.

12. Instructions on Checking Cylindrical Hydraulic Accumulators for Proper Sealing

In case of checking the cylindrical accumulators for air-tightness separately rom the aircraft hydraulic system feed operating pressure to the pressure pipe nion (see inscriptions on the union body). See that the return pipe unions of he hydraulic accumulator are open.

CAUTION: With the return pipe unions of the hydraulic accumulator plugged, the pressure supplied to the pressure chamber of the hydraulic accumulator will cause a pressure increase in the return line chamber that may damage the hydraulic accumulator.

The return line chamber of the cylindrical accumulator should be checked for proper sealing by building up a pressure of 8 ± 2 kg/sq.cm. at a temperature of $25^{\circ}C \pm 5^{\circ}$, the time of checking being 3 min.

For possible changes in the parameters of hydraulic accumulators to be checked see respective Certificates.

When performing $100^{\pm 10}$hour scheduled maintenance, as well as when filling the systems with fresh AMΓ-10 fluid, check the cylindrical accumulators for inner leaks using the following procedure:

1. Remove the accumulators from the aircraft, having previously reduced nitrogen pressure to zero.
2. With the pipe union of the hydraulic accumulator nitrogen chamber open, install the hydraulic accumulator with its pipe union down and drain the AMΓ-10 fluid from the nitrogen chamber into a measuring container. Using the same procedure drain the AMΓ-10 fluid from the hydraulic accumulator chamber communicating with the atmosphere.
3. If the amount of the AMΓ-10 fluid drained from the accumulator nitrogen or air chamber exceeds 100 cu.cm., this is indicative of poor sealing of the piston packing cups. In this case replace the hydraulic accumulator.
4. Install the hydraulic accumulators on the aircraft and charge them up with nitrogen.

13. Instructions on Draining Sediment from Sump of Hydraulic Tank Pressurizing System

The sediment sump is installed in the hydraulic tank pressurization line ahead of the pressurization unit.

The sump is located in the well of the port landing gear wheel.

When performing scheduled maintenance, check the sump drain opening and clean it from foreign matter and ice, that have accumulated there.

14. Instructions on Use of УПГ-250 Ground Hydraulic Installation

Ground checking and testing of the aircraft hydraulic system is effected by means of the УПГ-250 hydraulic installation. To check or test the main or booster hydraulic system separately use should be made of one of the УПГ-250 hydraulic installation pumps.

When checking the main and booster hydraulic systems together, employ both pumps connecting one to the booster system pipe unions, the other, to the main system pipe unions.

The aircraft hydraulic tank pressurization is accomplished by the air system of the УПГ-250 hydraulic installation. The output of the hydraulic pumps of the УПГ-250 installation is constant and depends on the driving motor r.p.m.

After connecting the УПГ-250 installation to the aircraft, pressure in the aircraft hydraulic system should be regulated by means of the ГА-198 control valve of the installation. Regulate pressure by turning the adjusting screw.

Regulate the pre-set pressure in the aircraft hydraulic system with the units of the aircraft hydraulic system brought to a standstill.

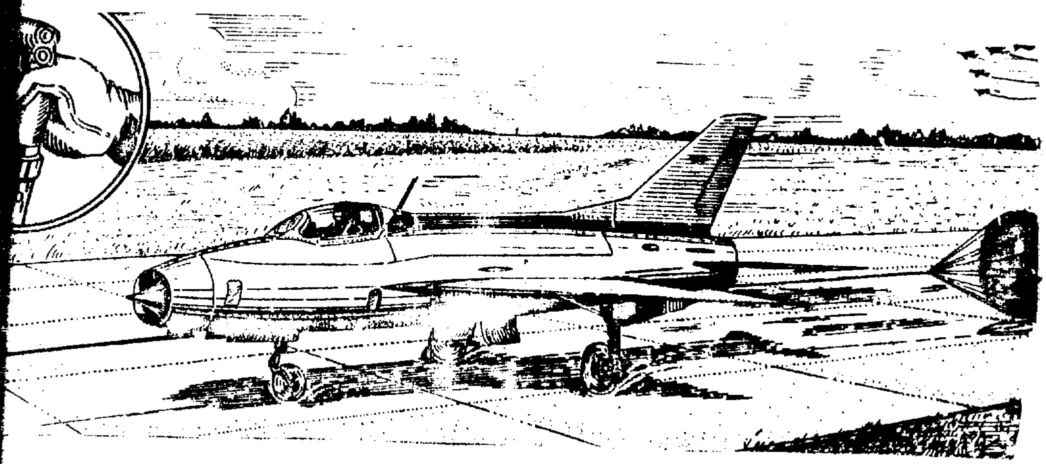
It is forbidden to check the aircraft hydraulic system with the aid of the УПГ-250 hydraulic installation, if the pump capacity is less than 27 - 30 lit/min (engine r.p.m. less than 1500), because of pressure pulsations in the system and vibration of the units.

For aircraft hydraulic system ground testing use may be made of the ЭГУ electrically-operated hydraulic installation provided with the НП-34 pumps.

15. Instructions on Operation of БУ-45А and БУ-51МС Boosters

In the course of operation of the БУ-45А and БУ-51МС boosters, leakage of the АМГ-10 fluid is allowed within the following limits:

Booster	Permissible rate of leakage of АМГ-10 fluid	Notes
БУ-51МС	3 cu.cm.per hour during operation	When at parking site, external leakage up to 2 cu.cm.per 24 hours is allowed
БУ-45А	4 cu.cm.per hour during operation	



Chapter III

AIR SYSTEM

1. General

The aircraft air system (See Fig.34) comprises two independent systems: the main and emergency one.

The main air system serves to ensure:

(a) braking of landing gear wheels;

(b) actuating of fuel system shut-off valve (which is disconnected for the time being);

(c) canopy lifting, pressurization and emergency jettison; opening of canopy timing lock;

(d) control of shutters for drag parachute release and drop;

(e) control of canopy de-icer system;

(f) control of pneumatic valve for cooling fuselage front pressurized compartment;

(g) cannon charging.

The emergency air system serves to ensure:

(a) landing gear emergency extension;

(b) main landing gear wheel emergency braking.

The air system is filled with air from the ground air bottles through the common pipe union in the right-hand main landing gear well.

When the automatic wheel braking cylinder is actuated during retraction of the landing gear, pressure aft of the ПУ-7 valve should amount to at least 3 - 4 kg/sq.cm. Pressure should be regulated by turning the screw on the cylinder.

[redacted]

Air System Basic Specifications

No.	Actuated system	Number of bottles	Bottle capacity, lit.	Total capacity of system bottles, lit.	Pressure in actuated system, kg/sq.cm.	Notes
1	Main system	2	2	4	110 - 130	Round bottles in port wing
2	Main system	2	2.2	4.4	110 - 130	Bottles in landing gear struts
3	Emergency system	2	1.3	2.6	110 - 130	Round bottles in starboard wing
4	Canopy emergency tossing	1	2	2	110 - 130	-
5	Cannon charging, canopy lifting, control of shutters for drag parachute release and drop, pressurized compartment cooling; operation of fuel shut-off valve	-	-	-	50	-
6	Brake system of main landing gear wheels KT-82M aft of УП-24/I pressure amplifiers	-	-	-	16 ± 0.5	-
7	Emergency braking of main landing gear wheels KT-82M	-	-	-	16^{+4}_{-1}	-
8	Brake system of nose wheel KT-38 and main landing gear wheels KT-82M ahead of УП-24/I pressure amplifiers	-	-	-	10.5 ± 0.5	-
9	Canopy de-icer	-	-	-	3	
10	Canopy pressurization system	-	-	-	[illegible]	

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Landing Gear Brake System

The landing gear brake system(Fig.35) provides for manual and automatic braking of the main and nose strut wheels.

The nose wheel brake can be disconnected from the main landing gear wheel brake system by operating the nose wheel brake control valve.

The pilot applies the nose wheel brake to shorten the aircraft roll after landing and switches it off while taxiing.

Automatic brake release system provided on the aircraft prevents the aircraft from skidding during application of brakes. If one of the main wheels begins skidding,the automatic brake release system gets engaged, which releases the skidding wheel and simultaneously the nose wheel. When the nose wheel starts skidding, the automatic brake release system releases the nose wheel alone, the main wheels remaining braked.

The air is supplied to the nose wheel brake from the high-pressure line in which pressure amounts to 110 - 130 kg/sq.cm. The air passes through the PB-50M reducer and the ПУ-7 reducing valve which bring the pressure down to 10.5 ± 0.5 kg/sq.cm. The pressure is further transmitted from the ПУ-7 valve through the УП-33/1 closing valve and УП-33/1 solenoid-operated valve to the nose wheel brake.

Installed in the line supplying air to the main wheel brakes and located aft of the ПУ-8 differential are two УП-24/1 pressure amplifiers arranged in the fuselage wells of the main wheels.

The pressure amplifiers provide for accelerated braking and releasing of the wheels, at the same time ensuring reduction of the air pressure,fed to the brakes, to 16 ± 0.5 kg/sq.cm.

The air which is fed from the ПУ-7 reducing valve through the ПУ-8 differential unit to the pressure amplifier is the control air, for it opens the pressure amplifier. The air pressure supplied to it from the air system (50 kg/sq.cm.) is reduced to 16 ± 0.5 kg/sq.cm. and fed, through the УП-53/1 solenoid-operated valves, to the KT-82M wheel brakes of a disc type.

Application of Main Brake System

Apply and release the automatic brake system with the help of the AUTOMATIC WHEEL BRAKE circuit breaker located on the left-hand panel in the cockpit.

In case of automatic braking while rolling after landing, the brake control lever on the aircraft control stick may be applied full way in. However, with the automatic wheel braking system on, for air saving purposes, it is recommended to brake the wheel by smoothly pressing the brake control lever so that by the end of aircraft roll the brake control lever is pressed full way in.

Note: It should be remembered that during automatic wheel braking air consumption is considerably increased.

With the automatic wheel brake system off, braking should be exercised from the manual wheel brake system.

During aircraft roll it is possible to change over from the manual wheel braking to the automatic braking and vice versa.

Change over from the manual to automatic braking by switching on the AUTOMATIC WHEEL BRAKE (АВТОМАТ ТОРМОЖЕНИЯ КОЛЕС) circuit breaker, all the time keeping the brake control lever engaged.

To change over from automatic to manual braking it is necessary first to release the brake control lever and then to switch off the AUTOMATIC

WHEEL BRAKE (АВТОМАТ ТОРМОЖЕНИЯ КОЛЕС) circuit breaker. This will cause switching over to the manual braking.

CAUTION: It is forbidden to apply brakes while running the engine at maximum speed r.p.m. without chocking the aircraft wheels. While running the engine under augmentation conditions secure the aircraft in place by special mooring cables attaching them to the main landing gear struts.

Application of Nose Wheel Brake System

To connect the nose wheel brake system place the handle of the УП-33/1 control valve to the NOSE WHEEL BRAKE ON (ТОРМОЖЕНИЕ НОСОВОГО КОЛЕСА ВКЛЮЧЕНО) position. The УП-33/1 control valve handle is located in the upper left corner of the instrument panel. To switch off the nose wheel brake, place the control valve handle to the OFF (ВЫКЛЮЧЕНО) position.

Brake the nose wheel from the L.G. brake control lever on the aircraft control stick. Braking of the nose wheel takes place simultaneously with braking of the main wheels. Braking can be controlled either manually or automatically.

Emergency Braking of Main Landing Gear Wheels

In case of damaged brake system wire cabling, failure of the ПУ-7 and П[illegible] valves, failure of the УП-24/1 pressure amplifiers, absence of air pressure in the main air system bottles or any other emergency situation, use should be made of the emergency brake system.

CAUTION: Aircraft drifting away from the runway, yawing and jerks during roll indicate that the main brake system is defective. In this case switch off automatic braking and change over to manual braking. Emergency braking should be resorted to only in case of failure of automatic and manual brake systems. It should be remembered that the pressure supplied to the brakes from the emergency system is not regulated, i.e. is not reduced, being equal to 16 ± 4 kg/sq.cm. As a result, instantaneous switching on of the emergency system will result in an instantaneous braking.

For emergency wheel braking open the emergency brake control valve located on the cockpit left-hand side at the instrument panel. To open the emergency brake control valve pull the valve control handle smoothly backward, having removed its wirelocking. As a result, the air under a 110 - 130 kg/sq.cm. pressure from the bottles of the landing gear emergency air system through reducer No.682500 (reducing pressure to 16^{+4}_{-1} kg/sq.cm.) will be let to emergency valve No.563600M and further through the emergency line to the brakes of the KT-82M wheels of the main landing gear struts.

To release wheel brakes it is necessary to close the emergency brake valve by placing the control stick in the initial position. Emergency braking is accomplished by feeding smooth pulses of pressure to the wheel brakes (i.e. by opening and closing the valve). The landing gear nose wheel is not provided with an emergency braking system.

Operation of Fuel Shut-Off Valve

Closing of the shut-off valve in flight is exercised by the actuating ylinder. The air supplied to the actuating cylinder passes via electro-neumatic valve No. 695000M from the air system under 50 kg/sq.cm. pressure.

Switching-on of the electro-pneumatic valve actuates the cylind . which loses the shut-off valve. The aircraft fuel shut-off valve is disconnected or the time being.

Canopy Lifting, Pressurizing and Emergency Tossing

Opening Canopy Timing Lock

Canopy lifting is exercised by the air from the main air system whose ressure is reduced to 50 kg/sq.cm. by the PB-50M reducer. The air passes hrough the canopy control valve to the canopy actuating cylinders hich lift the canopy, with its locks open .

For canopy pressurization, the air under a pressure of 50 kg/sq.cm. s forced through the PB-1.5 reducer, safety and return valves and further hrough the canopy control valve to the canopy pressurization hose.

The canopy emergency tossing is effected by the air under a pressure of 10 - 130 kg/sq.cm. supplied from the special reserve bottle having a 2-lit. apacity. The air supplied to this bottle passes from the main air system (under a pressure equal to 110 - 130 kg/sq.cm.) through the pipeline and via he return valve. A special pipe union is provided in the canopy toss bottle or measuring pressure. When performing canopy emergency tossing, the air from he canopy reserve bottle is forced through the diaphragm valve to the canopy ctuating cylinders, which results in canopy tossing. The canopy timing lock s opened by the air supplied under a pressure of 110 - 130 kg/sq.cm. from he special reserve bottle to the actuating cylinder for canopy timing lock pening.

Control of Shutters for Drag Parachute Release and Drop

The air from the main air system passes through the PB-50M reducer and eturn valve to the bottle for releasing and dropping the drag parachute. This ottle supplies air through electro-pneumatic valves No. 695000M to the cylinder or opening drag parachute release shutters and to the cylinder for drag parachute dropping (disengagement). The electro-pneumatic valves actuate the ylinders for drag parachute release or dropping.

Operation of Canopy De-Icer System

The air is supplied to the canopy de-icer system from the main air system nder a pressure of 50 kg/sq.cm., having previously passed through electro-pneumatic valve No. 695000M and the PB-3 reducer, to the alcohol tank.

From the alcohol tank the air forces alcohol into the sprayer and on anopy glass.

Control of Pneumatic Valve for Cooling

Fuselage Front Pressurized Compartment

(where РСИУ-5Г radio set is installed)

The air from the main air system is supplied under a pressure of 50 kg/sq.cm. through the ЭК-69 electro-pneumatic valve to the special pneumatic valve. When the flying speed comes to exceed M=1.5, the air will automatically open the above valve and cool the fuselage pressurized compartment with the РСИУ-5Г radio set installed there.

Cannon Charging

Cannon charging is effected by the air from the main air system. The air forced by pressure of 50 kg/sq.cm. passes from the РВ-50М reducer through the return valve to the 1.8-lit. bottle for cannon charging. Operation of the ЭК-48 electro-pneumatic valve brings the air further to the cannon charging cylinder.

Landing Gear Emergency Extension

Emergency extension of the landing gear is effected due to the action of the air from the emergency air system bottles compressed to 110 - 130 kg/sq.cm.

The air from the emergency air system is supplied through landing gear emergency control valve 652200/A (which should be opened) and through the hydraulic lock to the actuating cylinder for nose wheel strut extension, through the cylinders for emergency opening of locks to the landing gear door actuating cylinders and through the hydraulic locks to the cylinders for extending the landing gear main struts.

2. Checking Landing Gear Emergency

Extension System

(during ground tests)

For emergency extension of landing gear:

1. Hoist the aircraft on jacks installed under the aircraft wings and nose.

2. Connect the ground hydraulic pump to the main hydraulic system and retract the landing gear.

3. Watching the pressure gauge, make sure that the air pressure in the emergency system is at least 110 kg/sq.cm. and bring the pressure in the hydraulic system to zero.

4. See that the landing gear extension and retraction control lever is placed in the neutral position.

5. Open the landing gear emergency control valve on the cockpit right-hand panel.

6. Make certain that the landing gear locks have opened, i.e. check to see that the red warning lights have gone and the indicating pin has come out at the nose strut.

7. Close the landing gear emergency control valve, having made sure that the green warning lights are burning and the indicating pin is brought full way out, which means that the landing gear has been extended.

8. Release air from the landing gear retraction cylinders by disconnecting the pipe between the cylinder and hydraulic lock.

3. Checking Landing Gear Wheel Brake System

A. Checking Operation of Landing Gear Brake System

Check the brake system during pre-flight preparation.

Watching the 2M-150 two-pointer pressure gauge make sure that the main air system is charged with air under a pressure of 110 - 130 kg/sq.cm.

Then proceed to check:

1. The pressure in the brake system. When pressing the control lever to the fullest extent, the pressure in the brake system should be equal to 10.5 ± 0.5 kg/sq.cm., as read off the MB-12 two-pointer pressure gauge in the cockpit.

2. The nose wheel braking and unbreaking. This kind of check should be carried out with the nose wheel brake applied (by operation of the УП-33/1 control valve) and the brake lever pressed to the fullest extent to obtain a pressure of 10.5 ± 0.5 kg/sq.cm.

3. The readings of the MB-12 pressure gauge. See that with the brake lever pressed to the fullest extent the gauge indicates a pressure of 10.5 ± 0.5 kg/sq.cm. The difference between the right and left pointer indications is allowed to be within 0.5 kg/sq.cm.

4. Braking and unbraking of the main wheels (each separately) while pressing the brake lever and applying pedals.

5. The operation of the ПУ-7 valve. To this end press and release the brake lever, with the pedals in the neutral position. If deflection of the pedals is accompanied by noise caused by the air leaking through the ПУ-8 valve, this will indicate that the ПУ-7 valve does not ensure complete releasing of the system. This may be accounted for by jammed cable or sticky ПУ-7 valve.

B. Checking Pressure in KT-82M Wheel Brakes

This kind of check should be performed during scheduled maintenance, every 50 flying hours. To check the pressure in the KT-82M wheel brakes as well as the operating conditions of the УП-24/I pressure amplifier and emergency valve 563600 use the following procedure:

Disconnect the pipe (hose) at the KT-82M wheel and connect the MB-30 or MB-60 pressure gauge to this pipe, after which:

(a) press the brake lever on the control stick to obtain a pressure of 16 ± 0.5 kg/sq.cm.;

(b) open the emergency brake control valve; see that the pressure gauge reads 16^{+4}_{-1} kg/sq.cm.

Check the right and left wheels in turn. The checking over, connect the hose where required, and seal it.

3. Checking Operation of Automatic Brake System

The automatic brake system should be checked every 50 flying hours.

To check the automatic brake system for proper operation:

1. Jack up the aircraft.

2. Disconnect the plug connector of the УА-23 automatic brake transmitter (installed on the left or right КТ-82М main wheel).

3. Connect the ground power source and switch on the automatic wheel brake circuit breaker.

4. Switch on the УП-53/I control valve to brake the КТ-38 nose wheel.

5. Press the brake lever and build up a pressure of at least 4 - 5 kg/sq.cm. in the brake system.

6. Close the terminals of the УА-23 transmitter connector on the right or left КТ-82М main wheel. Opening of the terminals actuates two УП-53/I valves of the main wheel being checked and of the nose wheel. After the air is released through the УП-53/I valves, the wheels should become released.

Opening of the terminals will cause braking of both wheels.

Note: Check the left and right wheels in turn. Proper operation of the brake system should be determined by the noise produced by the air passing through the УП-53/I valve.

7. Connect the plug connector of the УП-23 transmitter of the main wheel under checks and disconnect the plug connector of the УА-24 transmitter of the nose wheel.

8. Press the brake lever on the control stick to close the terminals of the plug connector of nose wheel transmitter УА-24. This will actuate the УП-53/I valve of the nose wheel, which will result in releasing the nose wheel brake (leaving the main wheels braked).

Opening of the terminals will brake the nose wheel.

9. Connect the plug connector of the УА-24 transmitter.

10. Check all the three wheels for synchronous braking and releasing. The braking time should be equal to ? sec.

11. Remove the jacks from under the aircraft.

4. Adjusting Brake System

If required, adjust the brake system using the following procedure:

1. Turn the arm pressing the stem of the ПУ-7 valve to build up a pressure of 10.5 ± 0.5 kg/sq.cm. in the brake system.

With the arm in this position, turn out the adjusting screw on the arm until it rests against the body of the ПУ-7 valve.

Lock the adjusting screw with a locknut.

2. Turn out the adjusting screw of the automatic wheel brake cylinder (which becomes engaged when retracting the landing gear) and lock it in such a position as to ensure a 0.5 - 1.0 mm clearance between the adjusting screw and the ПУ-7 valve control arm.

3. Check the landing gear wheels for automatic braking during their retraction. With the landing gear control lever in the RETRACTED (УБРАНО) position pressure in the brakes should amount to 3 - 4 kg/sq.cm. After setting the landing gear control lever to the neutral position pressure in the brakes should drop to zero within not more than 1 min.

5. Checking Air System for Airtightness

This kind of check should be performed every 50 flying hours. Check the air system step by step using the following procedure.

A. Checking for airtightness air system portion from main air bottles to consumers

Charge the main air system with air to build up a pressure of 110 - 130 kg/sq.cm. Close all valves. Bleeding of the air from the system should not exceed 5 kg/sq.cm. during 2 hours.

Check pressure against the 2M-150 pressure gauge for the main system.

B. Checking brake system for airtightness

With the main system pressure being 110 - 130 kg/sq.cm., valves closed and nose wheel brake switched on, press the brake lever to obtain a 10.5 ± 0.5 kg/sq.cm. pressure in the brake system (pressure should be checked by means of the MB-12 two-pointer pressure gauge). While doing this, the ПУ-8 valve should be in one of the extreme positions (both extreme positions should be checked).

A pressure drop by 2.5 kg/sq.cm. during 30 min. is allowed (for each position of the ПУ-8 valve). Check the pressure against the 2M-150 pressure gauge for the main system.

C. Checking the landing gear emergency air system for airtightness

Fill the landing gear emergency system bottles to obtain a pressure of 110 - 130 kg/sq.cm. Close the valves for releasing air from, and filling of, the emergency system. See that the air pressure in the system portion from the emergency bottles to the valves is steady for 2 hours (no pressure drop within this time period is allowed).

Check pressure against the 2M-150 pressure gauge for the emergency system.

D. Checking the emergency brake system for airtightness

Charge with air the bottles of the landing gear emergency air system to build up a pressure of 110 - 130 kg/sq.cm. Close all valves of the emergency system.

Open the valve for emergency braking and keep the system under such conditions for 30 min.

The pressure drop in the system during 30 min. should not exceed 3 kg/sq.cm. Check the pressure against the 2M-150 pressure gauge for the emergency system.

CAUTION: It is forbidden to clear the aircraft for flight with the air pressure in the landing gear emergency and main systems being less than 110 kg/sq.cm.

6. Checking Operation of Pneumatic Valve for Cooling System of Fuselage Front Pressurized Compartment

(where РСИУ-5Г radio set is installed)

This kind of check should be performed every 50 flying hours.

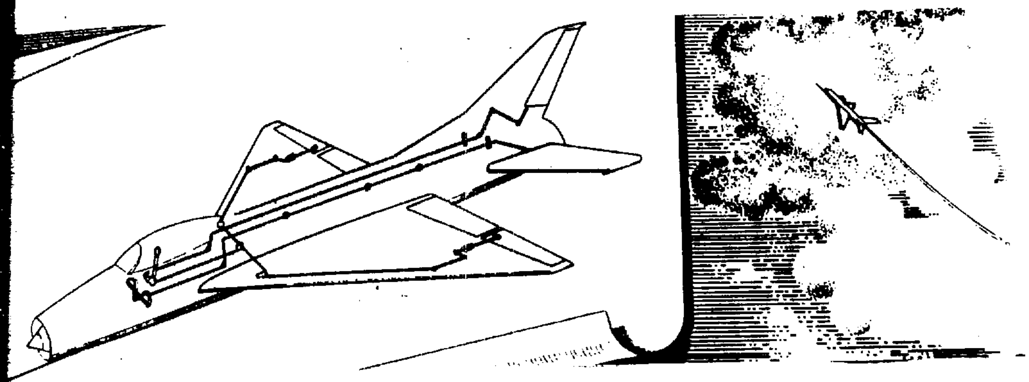
For checking use the following procedure:

1. Connect the ground power source to the aircraft.

2. Check operation (closing) of the pneumatic valve for the cooling system of the fuselage front compartment, having previously switched on the CONE, ENGINE CONTROL LEVER INTERLOCK (КОНУС, БЛОКИР. РУД) circuit breaker on the right-hand panel in the cockpit. To this end obtain the required speed using the Pitot-static tube (with M=1.5) to operate the MP-1.5 relay.

3. A serviceable ЭК-69 electro-pneumatic valve testifies that the whole system is serviceable.

4. Check the cooling system of the fuselage front pressurized compartment for airtightness. See that no air leaks during 3 min. with the system under 50 kg/sq.cm. pressure.



Chapter IV

AIRCRAFT CONTROL SYSTEM

The aircraft control system (Fig.36) includes: stabilizer control, aileron control, rudder control and air brake control systems.

1. Stabilizer Control System

General

Stabilizer control is exercised through the system of rods, bell cranks and the БУ-51 МС two-chamber booster, the latter being installed in an irreversible circuit.

When deflecting the aircraft control stick, efforts to the control stick are applied through the spring feel mechanism.

Removal of efforts from the control stick is exercised through the use of the "trimming effect" mechanism which is controlled by operating the butto on the control stick.

To relieve the pilot of the necessity of exercising "pushing" or "pulli efforts on the control stick the button should be pressed forward or backwa respectively. This will engage the "trimming effect" electric mechanism whi changes the tension of the springs in the spring feel mechanism. As a resul the efforts on the control stick will be removed.

The БУ-51МС two-chamber booster is supplied with working fluid from two hydraulic systems simultaneously - the booster and main systems. Each of the hydraulic systems supplies fluid to the respective chamber of the БУ-51МС booster independently. Both systems provide also for the return of the fluid from the chamber.

In case of failure of one of the hydraulic systems, the БУ-51МС booster will continue functioning as one of its chambers remains operative (the one connected with the serviceable hydraulic system).

The НП-27Т emergency booster pump unit, incorporated in the booster hydraulic system, maintains required pressure in the booster hydraulic system to ensure the aircraft landing, should the НП-34-2Т hydraulic pump fail to operate or should the aircraft engine fail in flight.

The pump unit is switched on automatically as soon as the pressure in the booster hydraulic system drops below 165 $^{+10}_{-5}$ kg/sq.cm.

When pressure in the booster hydraulic system rises up to 195 kg/sq.cm., the pump unit is automatically switched off, with the hydraulic pump being operative.

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With no pressure in both hydraulic systems, control of the stabilizer becomes impossible as it requires excessive efforts on the control stick.

The АРУ-3В variable-ratio boost control unit makes it possible to build up such responsing efforts on the control stick that are naturally involved in flying. This is accomplished with an allowance for the aircraft airspeed and flying altitude.

The АРУ-3В variable-ratio boost control unit incorporated in the stabilizer control system has the following specifications (Fig.38):

1. At altitudes up to 5000 m. the efforts to be applied to the control stick depend solely on the flying speed.

In this case indicated airspeeds below 450 km/hr and those over 1010 km/hr require constant values of the control stick-to-spring feel mechanism and control stick-to-stabilizer ratios which correspond to minimum or maximum efforts on the control stick and to minimum or maximum stabilizer deflection angles.

IMPORTANT: The specified regulation range according to indicated airspeed involves rated values.
The allowances are included in the Certificates for each АРУ-3В variable-ratio boost control unit.

2. When flying at altitudes from 5000 to 10,000 m., the АРУ-3В automatic unit operates as a function of both impact pressure and flying altitude. The error correction value introduced according to the flying altitude allows for changes pertaining to the aircraft control depending on flying airspeed and altitude.

Increase in the flying altitude results in decreasing the automatic unit operational range according to impact pressure.

The control stick is then less loaded and the stabilizer is deflected through a greater angle.

3. The АРУ-3В automatic unit gets switched off at altitudes over 10,000 m., irrespective of flying speed, and at indicated airspeed below 450 km/hr irrespective of flying altitude. Under these conditions the control stick-to-spring feel mechanism and control stick-to-stabilizer transmission ratios correspond to minimum loading of the control stick and to maximum deflection angles of the stabilizer.

4. The operation of the АРУ automatic unit is controlled by means of the indicator installed on the left-hand side of the instrument panel and by the signal light on the STABILIZER FOR LANDING (СТАБИЛИЗ. НА ПОСАДКЕ) light panel (Fig.39).

The АРУ automatic unit indicator is furnished with two scales, one of them showing operation of the АРУ automatic unit depending on the varying flying speed, the other showing its operation depending on the altitude changes.

Marked clockwise on the outer scale are the airspeed values and counter-clockwise on the inner scale - the altitude values.

When flying at airspeeds of 450 km/hr and less (at any altitude), at altitudes of 10 km. and higher (at any airspeed) and in landing, the rod of the АРУ automatic unit should be set to the larger arm. This will be indicated by the STABILIZER FOR LANDING (СТАБИЛИЗАТОР НА ПОСАДКЕ) signal light burning.

5. The АРУ-3В automatic unit operates autonomously by taking up dynamic and static pressures from the Pitot-static tube.

The АРУ automatic unit carries out the preset regulation program not smoothly but in separate intermittent cycles.

The number of operations should be selected so that the pilot feels them in flight but slightly, the relays being loaded to minimum.

6. If the АРУ-3В automatic unit fails in flight, the pilot can exercise control of the АРУ-3В mechanism manually, by means of the switch in the cockpit.

7. The stabilizer control system includes the following electrical circuits (Fig.40):

(a) The circuit for automatic control of the АРУ-3В unit mechanism from the control unit. This circuit should be switched on during the entire flight.

(b) Circuit for manual control of the АРУ-3В unit mechanism. This circuit should be energized in case of the АРУ-3В unit failure.

(c) Circuit for control of the "trimming effect" mechanism. This kind of control is exercised by pressing the button on the control stick. The circuit is switched on during the entire flight.

(d) With the stabilizer nose portion deflected down through an angle of 20° and more the КВ-9А microswitch closes the circuit controlling the anti-surge shutters (See Chapter "Power Plant Control").

Checking stabilizer control system

Described in this section are the following steps:

A. Simplified checking of the АРУ-3В automatic unit for proper functioning under no pressure conditions in the hydraulic system during pre-flight preparation.

B. Checking of the "trimming effect" mechanism for proper operation during pre-flight and preliminary aircraft preparation.

C. Checking of the АРУ-3В automatic unit (with the hydraulic systems under pressure) when performing scheduled maintenance operations every 3 months.

A. Simplified checking of the АРУ-3В automatic unit for proper functioning (under conditions of no pressure in the hydraulic systems during pre-flight preparation)

Check the АРУ-3В automatic unit for proper operation under no hydraulic pressure conditions.

In this case the aircraft control stick should be close to the neutral position and free from manual efforts because under this kind of checking it is the control stick which will move while the stabilizer nose portion will remain stationary (no deflection will take place). The operation on checking the АРУ-3В unit should be carried out in parallel with preliminary checks of the instrument equipment of diaphragm type in the following sequence:

1. Connect the ground power source to the aircraft.

2. Cut in the STORAGE BATTERY: AIRCRAFT, GROUND (АККУМУЛ. БОРТОВОЙ АЭРОДРОМНЫЙ) switch on the right-hand panel.

3. Make sure that the АРУ AUTOMATIC CONTROL (АВТОМАТ. УПР. АРУ) circuit breaker is on. This is indicated by the burning of the STABILIZER FOR LANDING (СТАБИЛИЗ. НА ПОСАДКЕ) signal light and by deflection of the pointer of the АРУ automatic unit indicator to the scale extreme left limit.

4. Make certain that the АРУ-3В automatic unit mode of operation selector switch is set to AUTOMATIC (АВТОМАТ) and locked there.

5. Connect the КПУ-3 unit to the total pressure hole in the Pitot-static tube.

6. Build up excessive pressure in the total pressure line of the Pitot-static tube and while gradually increasing it during 40 - 60 sec. watch the readings of the airspeed scale of the АРУ automatic unit indicator (outer marking). The readings should comply with the indications of the КПУ-3 unit and the airspeed indicator in the cockpit within the indicated airspeed range, i.e. from 450 to 1010 km/hr. When the pressure has reached the value corresponding to the airspeed of some 450 km/hr, the STABILIZER FOR LANDING (СТАБИЛИЗ. НА ПОСАДКЕ) signal light should go out and the pointer of the АРУ automatic unit indicator should start moving clockwise.

Further increase of the indicated airspeed up to 1010 km/hr will cause slight deflection of the control stick backward due to smaller arm setting of the АРУ-3В automatic unit arm.

7. Smoothly reduce the pressure in the total pressure line of the Pitot-static tube. As a result, the indicator pointer and control stick begin returning to the initial position (i.e. the pointer will be deflecting to the left, while the control stick will be moving forward).

When reducing pressure corresponding to a 450 km/hr airspeed, the STABILIZER FOR LANDING (СТАБИЛИЗ. НА ПОСАДКЕ) signal light should flash on.

The checking over, disconnect the КПУ-3 unit.

CAUTION: If the АРУ-3В automatic unit is checked with the ambient air temperature below -30°C, run the engine and warm the cockpit prior to checking. When checking, it is not allowed to exceed the maximum permissible speed indicated in the Certificate of the АРУ-3В unit.

B. Checking "trimming effect" mechanism for proper operation during pre-flight and preliminary aircraft preparation

This kind of checking should be performed with the engine running or the ground pump connected to the aircraft. For checking use the following procedure:

1. Connect the TRIMMING EFFECT circuit breaker on the right-hand panel and the CHECKING LIGHTS, LIGHT PANEL, FUEL REMAINDER AND TRIMMING EFFECT SIGNALIZATION (КОНТРОЛЬ ЛАМП, ТАБЛО, ОСТ.ГОРЮЧ. И СИГН.ТРИМ.ЭФФ.) circuit breaker. This will result in TRIM. EFFECT NEUTRAL (ТРИМ. ЭФФЕКТ НЕЙТР.) signal light flashing up.

2. Press the button on the aircraft control stick first forward and then backward; pressing the button will cause deflection of the released control stick forward or backward, respectively (the direction of the stick and button movement should coincide).

3. Pressing the TRIMMING EFFECT (ТРИММЕРНЫЙ ЭФФЕКТ) button should xtinguish the TRIMMING EFFECT NEUTRAL (ТРИМ. ЭФФЕКТ НЕЙТР.) signal light.

4. After checking set the "trimming effect" mechanism neutral; check he neutral position of the mechanism by flashing of the TRIMMING EFFECT NEUTRAL (ТРИМ. ЭФФЕКТ НЕЙТР.) signal light.

Determine the neutral position of the "trimming effect" mechanism with the button pressed in one direction only - moving the button from the forward position to the backward one.

C. Checking АРУ-3В unit (with one hydraulic system under pressure) when performing 3 month scheduled maintenance operations

The АРУ-3В automatic unit should be checked for proper operation in the following sequence:

(a) check the mechanism automatic control depending on airspeed and altitude;

(b) check the mechanism manual control.

Checking АРУ-3В unit automatic control relative to airspeed and altitude

Check the АРУ-3В mechanism operation depending on airspeed, with due allowance for altitude correction with one of the hydraulic systems under pressure. To check the АРУ-3В unit for proper functioning, use the following procedure:

1. Connect the ground hydraulic pump to the aircraft and build up operational pressure in it.
2. Connect the ground power source to the aircraft.
3. Make sure that the АРУ AUTOMATIC CONTROL (АВТОМ. УПР. АРУ) circuit breaker is on and the АРУ unit mode of operation selector switch is set to the AUTOMATIC (АВТОМАТ) position.
4. Connect one КПУ-3 unit to the Pitot-static tube total pressure hole, the other to the control unit of the АРУ automatic unit installed in the cockpit. Before connecting the КПУ-3 unit to measure the static pressure, remove the seal and disconnect the split pipe union located next to the control unit of the АРУ unit and then connect the КПУ-3 unit hose to the hose of the МРД-126 transmitter (Fig.41) by means of adapter 72-7702-170 available in the instrum technician's tool kit (set 1:4).
5. Make sure that the selector switch on the port panel for the Pitot-s tube and the ТП-156 Pitot tube total pressure line is set to the OPERATION (position.
6. Switch on the storage battery; this will result in flashing up of the STABILIZER FOR LANDING (СТАБИЛИЗ. НА ПОСАД.) light.
7. Set up excessive pressure in the total pressure line and, by gradually increasing it, bring the pressure to a value corresponding to the indicated ai speed of 1010 km/hr.

Under such conditions the rod of the АРУ-3В automatic unit will assume the GREAT SPEED (БОЛЬШАЯ СКОРОСТЬ) position; the signal light STABILIZER FOR LANDING (СТАБИЛИЗ. НА ПОСАДКЕ) will go out at indicated speed exceeding 450 km/hr. Create a rarefaction in the static line, increase it gradually to obtain a rarefaction corresponding to a 10,000-m altitude. At a 10,000-m altitude the rod of the АРУ automatic unit will change over to SLOW SPEED position. When decreasing the rarefaction to a value corresponding to a 5000-m altitude the rod of the automatic unit should change over to the GREAT SPEED position. This being the case, make sure that the АРУ automatic unit readings are correct (by checking them against the altitude scale).

After checking disconnect the КПУ-3 units, remove adapter 72-7702-170, connect the split pipe union, check the system for airtightness and seal the pipe union connection.

CAUTION: It should be remembered that the APY automatic unit is calibrated under standard atmospheric conditions; therefore, the altitude scale of the APY automatic unit indicator readings may differ from those of the aircraft altimeter.

Checking manual control of APY-3B automatic unit

This kind of check should be performed in the following sequence:

1. Unlock the selector switch of the APY automatic unit on the left-side panel and set it from the AUTOMATIC to MANUAL position.

2. With the hydraulic unit and power source connected, cut in the MANUAL CONTROL circuit breaker and the STORAGE BATTERY: AIRCRAFT, GROUND switch.

3. Set the "trimming effect" mechanism to the neutral position.

4. Change over the selector switch of the APY automatic unit from the neutral position to the GREAT SPEED position until the APY automatic unit operates, i.e. until the rod of the automatic mechanism changes over from the larger arm to the smaller arm; this will extinguish the STABILIZER FOR LANDING signal light and the pointer of the APY automatic mechanism will assume the extreme right position.

CAUTION: Changing-over the APY automatic unit manually should be effected in short impulses.

5. By deflecting the aircraft control stick full way forward and backward, make sure that the control stick is "heavily" loaded.

6. Change over the selector switch of the APY automatic unit from the neutral position to the LOW SPEED position until the automatic unit operates, i.e. until the rod of the APY automatic mechanism changes over from operation on the smaller arm to operation on the larger arm; as a result, the STABILIZER FOR LANDING signal light will flash up and the pointer of the APY automatic unit indicator will move to the extreme left-hand position.

7. By deflecting the control stick full way forward and backward make certain that the control stick is "slightly" loaded.

8. The checking over, set the mode of operation selector switch of the APY automatic unit from the MANUAL to the AUTOMATIC position and lock it with a 0.25-mm brass wire.

Adjustment of stabilizer control system

The stabilizer control system should be adjusted in case of disturbed setting of the stabilizer control system in the course of the aircraft operation (e.g. repair of the aircraft controls) as well as after replacing of the stabilizer, APY automatic unit mechanism, БУ-51MC booster or spring feel mechanism.

CAUTION: After replacing the stabilizer, level the aircraft before proceeding to adjust the stabilizer control system.

Adjustment of stabilizer control system includes the following steps:

1. Adjustment of the stabilizer angles of deflection and control stick travel.

2. Adjustment of the stabilizer "drift" when changing over the APY automatic unit from the LOW SPEED to the GREAT SPEED position.

3. Adjustment of the TRIMMING EFFECT mechanism neutral position.

4. Finishing of the TRIMMING EFFECT mechanism adjustment after flying for trimming the aircraft.

Adjustment of the stabilizer control system should be performed with the ground hydraulic pump connected to one of the hydraulic systems and the ground power source connected to the aircraft mains. Adjustment should be carried out in conformity with the levelling diagram which contains data pertaining to the stabilizer left-side part.

Adjustment of stabilizer angles of deflection and control stick travel

For adjustment of stabilizer angles of deflection use the following procedure (Fig. 42):

1. Make sure that the APY AUTOMATIC CONTROL and APY MANUAL CONTROL circuit breakers are on.

2. Make sure that the rod of the APY automatic unit is in the LOW SPEED position; check it by the flashing of the STABILIZER FOR LANDING light and by the pointer of the APY unit indicator which should rest against the left-side stop.

3. By deflecting the control stick forward and backward make certain that the control stick stops come in contact with the adjusting screws and all hinged connections, bell cranks and units of the control system have proper clearances.

4. By pulling the control stick backward from the extreme front position set the stabilizer to the zero position, i.e. match points 54 and 55 (See the levelling diagram).

With points 54 and 55 of the stabilizer left part aligned, the allowance for their misalignment on the right-hand part should not exceed ± 2 mm.

IMPORTANT: If necessary, adjust the stabilizer left-hand and right-hand par misalignment by operating rod 6 (Fig.43).

With the stabilizer in this position set the control stick at a distance $K=250^{+10}_{-7}$ mm from the instrument panel to point T marked on the upper handle 605 mm away from the axle of rotation.

When adjusting the stabilizer angles of deflection and control stick tr (for instance, in case of replacing the stabilizer, fuselage rear part or in c of the stabilizer control system), it is allowed to perform the adjustment by screwing in and out the tips of the rods arranged in the fuselage superstructu re at frame 12 or 28.

While doing so, do not screw out the rod tip beyond the check hole in the sleeve.

After adjustment of the rods (with the APY automatic unit set to the larger arm) deflect the control stick full way forward and then backward to make sure that the control stick reaches as far as the stops and all hinged connections of the bell cranks and units have proper clearances.

Besides, make sure that the cotter pin in the tip of the stabilizer control rod does not rest against the sealed lead-out bushing located next to frame 12.

The adjustment accomplished, lock the tips of the rods by nuts.

5. Deflect the control stick forward and then backward to the extreme positions and check the stabilizer deflection angles, with the APY automatic unit being set to the larger and then smaller arms, for compliance with the Levelling diagram.

Measure the angles of stabilizer deflection (in degrees) by means of the protractor installed with its scale normal to the stabilizer rotation axis.

Adjustment of stabilizer "drift"

Check the stabilizer "drift" during changing over the rod of the APY auto-matic unit from the LOW SPEED to GREAT SPEED position in the sequence which fol-lows:

1. Build up operational pressure in the hydraulic system.

2. Set the "trimming effect" mechanism neutral; check the neutral position by the signal light flashing up.

3. By moving the control stick backward from the extreme front position set the left-hand portion of the stabilizer to the zero position, i.e. align the notch on the fillet with the corresponding notch on the stabilizer.

Stop the control stick in this position.

4. Change over the rod of the APY automatic unit from the LOW SPEED position to the GREAT SPEED position; this will cause the pointer of the APY automatic unit indicator to move to the extreme right-hand position and the stabilizer nose end go down (as a result, point 55 will be lower than point 54). Measure the distance between points 54 and 55 which should be equal to $Д_{drift}$=10-19 mm (for trimming purposes).

If it occurs during the measurement that the stabilizer "drift" is beyond the permissible limits, once more adjust the stabilizer.

CAUTION: It should be remembered that improperly adjusted "drift" considerably affects the longitudinal trimming of the aircraft.

To increase the stabilizer "drift", turn the APY automatic unit mechanism clockwise (as viewed from the aircraft left side), to decrease the stabilizer "drift", turn the APY automatic unit counter-clockwise (Fig.43).

Adjust the stabilizer "drift" in the following sequence:

(a) Change over the rod of the APY automatic unit mechanism from the GREAT SPEED to the LOW SPEED position; this will result in the flashing up of the STABILIZER FOR LANDING signal light, moving of the pointer of the APY automatic unit indicator to the left stop and its resting there.

(b) Bleed pressure in the hydraulic system to zero so as to get rid of the negative allowance in the connections.

(c) Disconnect rods 1 and 3 (or 4) (Fig.43).

(d) Change the APY automatic unit mechanism tilting, i.e. turn it clockwise or counter-clockwise depending on displacement value of point 55 relative to point 54.

(e) Adjust the length of the above-mentioned rods; while doing so, check the length of the adjustable tips entering the sleeves of the rods by reference to the check holes. If it occurs during adjustment of the rod tips that one of the tips does not go as far as the check hole in the sleeve, adjust the rods at the expense of the tips whose threaded length is greater.

(f) Connect the rods and tighten the lock nuts of the tips.

(g) Build up operating pressure in the hydraulic system and check again the stabilizer "drift" in the sequence stated above.

CAUTION: Check the stabilizer for "drift" with the control stick fixed in position.

Adjustment of "trimming effect" mechanism neutral position

When adjusting the "trimming effect" mechanism, see that the neutral position of the "trimming effect" mechanism corresponds to the assigned trimming position of the stabilizer as determined by the pre-set deflection value of the stabilizer nose portion upward. This value is designated as $Д_{mean}$.

Before the first flight for longitudinal trimming value $Д_{mean}$ is set to be $10^{\pm}2$ mm; this means that the stabilizer nose portion is raised, i.e. point 55 is above point 54, the distance between them being $10^{\pm}2$ mm.

After the first flight for longitudinal trimming value $Д_{mean}$ is not pre-assigned, being changed depending on the data obtained during the aircraft flights for trimming.

For adjusting the "trimming effect" mechanism neutral position use the following procedure:

1. Connect to the aircraft the ground power source.
2. Connect the ground hydraulic pump to the pipe unions of the booster hydraulic system and build up operating pressure in the system to ensure operation of the stabilizer booster.
3. Make sure that the rod of the APY automatic unit is in the LOW SPEED position.
4. Switch on the AUGMENTATION circuit breaker on the left-hand panel and the STORAGE BATTERY: AIRCRAFT, GROUND selector switch on the right-hand panel. This sequence of switching provides for keeping the shutters fully open during engine start.
5. Switch on the CHECKING LIGHTS, LIGHT PANEL, FUEL REMAINDER AND TRIMMING EFFECT SIGNALIZATION and TRIMMING EFFECT circuit breakers on the right-hand panel.
6. Set the "trimming effect" mechanism neutral by reference to the TRIMMING EFFECT NEUTRAL signal light which should come on when the button on the control stick is moved from the front to the rear position.
7. Determine the value of the stabilizer deflection ($Д_{mean}$) corresponding to the trimming position.

To this end:

(a) Deflect the control stick full way backward, then slowly release it for the neutral position at a speed of not over 100 mm per 10 sec. holding it slightly to allow the control stick stop due to friction forces in the system.

(b) Measure distance $Д_1$ between points 54 and 55 on the stabilizer left-side portion.

(c) Deflect the control stick full way forward and slowly release it to the neutral position.

(d) Measure distance $Д_2$ between the same points.

(e) Determine the mean value of the two measurements, which should be equal to:

$$Д_{mean} = \frac{Д_1 + Д_2}{2} .$$

When calculating the mean value of the above two measurements, $Д_2$ should be taken with a "plus" (the control stick being deflected from the forward position) for point 55 setting stationary over point 54 and with a "minus" for point 55 found below point 54.

(f) Repeat the measurements twice and find the mean value.

Should the obtained value of $Д_{mean}$ be other than $10^{\pm}2$ mm, bring it to the above value by adjusting the control system.

When performing the adjustment, remember the following:

If value $Д_{mean}$ (found as instructed under Item 7) appears to be more than $10^{\pm}2$ mm, decrease it by lowering the stabilizer nose portion. To this end unlock the nut on the rod of the spring feel mechanism and screw out the rod from the APY-3B unit tail piece.

If value $Д_{mean}$, found according to Item 7, appears to be less than $10^{\pm}2$ mm, increase it by screwing the rod of the spring feel mechanism on the APY-3B unit tail piece, thereby lifting the stabilizer nose portion.

8. Check value $Д_{mean}$ in the sequence presented under Item 7.

If it occurs that value $Д_{mean}$ is other than assigned for the first longi-tudinal trimming flight, obtain the required valve by adjustment.

When the required value of $Д_{mean}$ has been obtained, lock the spring feel mechanism rod-to-APY-3B unit tail piece connection with a nut and seal it. While doing this, see that the length of the free end of the piece tail is not over 15 mm (Fig.43).

After adjusting the "trimming effect" mechanism neutral position the air-craft is considered ready for the first flight with the purpose of longitudinal trimming.

Final adjustment of aircraft longitudinal control after flying for trimming

1. If the pilot made use of the button which controls the "trimming effect" mechanism to trim the aircraft longitudinally at IAS=750±100 km/hr, he should use this button in flight any more after having trimmed the aircraft.

After landing find the new value of $Д_{mean}$ at which the aircraft was actu-ally trimmed in flight.

To finally adjust the "trimming effect" mechanism use the following pro-cedure:

(a) Leaving the "trimming effect" mechanism as it has been set by the pilot when in flight, find the value of $Д_{mean}$ using the method described in Section "Adjustment of Trimming Effect Mechanism Neutral Position", Item 7.

(b) Operating the button on the control stick set the "trimming effect" mechanism to the neutral position by reference to the TRIMMING EFFECT NEUTRAL warning light which should flash up.

The moment when the light flashes up should be determined while pressing the button backward, having previously reset the "trimming effect" mechanism by pulling the button forward.

Using the button for "trimming effect" control will change the value of $Д_{mean}$ found as indicated in Item (a).

(c) Determine $Д_{mean}$ obtained after the "trimming effect" mechanism has been placed neutral; this will be indicated by flashing up of the TRIMMING EFFECT NEUTRAL light.

(d) Compare the values of $Д_{mean}$, obtained according to Item (c), and $Д_{mean}$ obtained according to Item (a).

If the value of $Д_{mean}$ according to Item (c) appears to be less than the value of $Д_{mean}$ according to Item (a), increase the former to make it equal to $Д_{mean}$ obtained during trimming the aircraft in flight. For this purpose screw the rod of the spring feel mechanism on the tail piece of the APY-3B automatic unit, thereby raising the stabilizer nose portion.

If the value of $Д_{mean}$ calculated according to Item (c) exceeds the value of $Д_{mean}$ according to Item (a), decrease the former by screwing the rod of the spring feel mechanism from the APY-3B automatic unit tail piece. This will force the stabilizer nose portion down.

IMPORTANT: When performing the adjustment remember that a 1-mm increase or decrease in the value of $Д_{mean}$ will accordingly increase or decrease the trimming speed by approximately 10 km/hr.

(e) Having adjusted the spring feel mechanism rod according to Item (d), check the value of $Д_{mean}$ to see that it corresponds to the value of $Д_{mean}$ ob-tained according to Item (a), the latter being the value at which the aircraft has been trimmed.

This value of $Д_{mean}$ should be recorded in the Aircraft trimming chart.

2. If the aircraft is properly trimmed in flight at IAS = 750±100 km/hr, but in accelerating the aircraft to 1000-1050 km/hr "pulling" efforts on the control stick will exceed 4 kg, increase the stabilizer "drift" as it was pointed out above in Section "Adjustment of Stabilizer Drift".

IMPORTANT: When performing adjustment, remember that a 1-mm increase in the stabilizer "drift" will decrease "pulling" efforts by 3-4 kg.

The new value of the stabilizer "drift" should be recorded in the Aircraft Trimming Chart.

CAUTION: When adjusting the aircraft longitudinal control, it is strictly forbidden to bend the stabilizer trailing edge, for the latter is not used to trim the aircraft longitudinally.

2. Aileron Control System

General

The aileron control system comprises the following units (Fig.44):

1. Two БУ-45А boosters installed in the aileron control system each ensuring aileron deflection in one direction only.

Hydraulic power can be supplied to the booster either from the booster or from the main hydraulic system. If a pressure drop in the booster hydraulic system reduces the pressure to half the value of pressure in the main system, the booster hydraulic power supply is automatically switched over from the booster to the main hydraulic system. If the pressure in the booster hydraulic system increases to a value, exceeding half the pressure in the main system, the booster supply is automatically switched over from the main to the booster hydraulic system.

Switching over from one hydraulic system to the other is accomplished by means of special valves built in БУ-45А booster heads.

With one of the hydraulic systems under operating pressure, aerodynamic forces acting on the aileron are taken up by the boosters, while under no pressure conditions in the systems, the boosters operate as rods and therefore the aerodynamic forces acting on the ailerons should be overcome by the pilot.

2. The spring feel mechanism incorporated in the aileron control system transmits aileron pressure to the control stick, with the boosters being switched on.

3. Two non-linear transmission mechanisms of a leverage type which transmit forces from the control stick to the ailerons are installed in the wings ahead of the ailerons.

The above mechanisms serve to ensure:

(a) normal lateral stability of the aircraft at high indicated airspeeds when the ailerons become too responsive and the lateral control excessively sensitive;

(b) small angles of aileron deflection (up to ⅓ of aileron full deflection angle) following increased deflection of the control stick;

(c) easy control of the ailerons with the БУ-45А boosters switched out.

Checking aileron control system

The general procedure for checking of the aileron control system is the following:

1. Check the aileron control system with the boosters switched off. For this purpose:

(a) turn off the AILERON BOOSTERS switch on the left panel;

(b) deflecting the control stick to the extreme right-hand and left-hand positions, make sure that the control stick moves smoothly, control stick is acted upon by the spring-feel mechanism and booster cylinder friction; make sure that the control stick and ailerons can be deflected through all the way of their travel.

2. Check aileron control with connected boosters, with either the engine running or with the ground hydraulic pump and ground power source connected proceeding in the following sequence:

(a) build up operating pressure in the booster hydraulic system and turn on the STORAGE BATTERY: AIRCRAFT, GROUND switch on the right-hand panel;

(b) turn on the AILERON BOOSTERS switch on the left-hand panel;

(c) deflecting the control stick to the extreme right-hand and left-hand positions make sure that it moves smoothly without jerks and jamming; see that the forces due to the spring feel mechanism are felt while deflecting the control stick.

The released control stick should return to neutral position. Check the play in the aileron control system by abrupt application of force to the aileron trailing edge. No knocking shall be tolerated in the connections with the boosters switched on.

Final adjustment of aircraft lateral control after trimming flight

If the aircraft has not been trimmed up completely during the lateral trimming flight with the aileron boosters switched on and off according to the Instructions given in Section "In-Flight Check of Aircraft Trimming", before the next trimming flight, do the following:

1. After Flight for Aircraft Trimming with the Aileron Boosters Off

To finally adjust the aircraft lateral control bend the tab of the port-side aileron up or down by not more than ± 4 mm.

To eliminate port-side bank with the boosters switched off, the tab of the port-side aileron should be bent up, whereas to eliminate starboard-side bank the tab should be bent down.

The direction and amount of tab bending depend on the nature and degree of lateral instability revealed during flight for trimming. They are adjusted in the subsequent flights to completely trim the aircraft.

After the direction and value of bending have been selected make the following inscription on the tab (in red paint):

Tab trimmed position

up . . . . mm

down . . . . mm

Bending of the port aileron tab should correspond to that recorded in the aircraft Trimming Chart.

2. After Flight for Trimming with the Aileron Boosters On

If lateral trimming has not been achieved in flight, it should be accomplished after the trimming flight, on the ground. To this end set the control stick neutral, and adjust the amount and sign of the port and starboard aileron misalignment within ±1° (total misalignment of ailerons relative to points 38 - 38a is allowed to be within 0 to 16 mm).

Aileron misalignment is corrected by adjusting the ends of the rods next to the ailerons.

After adjustment check aileron misalignment by reference to the Levelling Chart, then finally check the aircraft trimming in flight.

To eliminate port banking with the aileron boosters on, lower the port aileron and raise the starboard one through equal angles with the help of the rod ends.

3. Rudder Control System

General

Rudder control is exercised through the pedals and the system of rigid links connected with the rudder (Fig.45). The pilot perceives the aerodynamic forces acting on the rudder through the pedals.

Installed in the rudder control system is a pedal-to-rudder non-direct transmission mechanism to reduce the efforts on the pedals at high flying speeds (Fig.46).

The non-linear transmission mechanism comprises a rocker arm, gear, toothed segment and a universal joint incorporated in a common case. The mechanism is installed in the tail fin.

Checking Rudder Control System

In the course of operation the rudder control system should be checked for smooth functioning to make sure that the rocker arms and rods are not jammed and no play occurs in the hinges. If the hinges in the rudder control system do not knock when pushing the rudder trailing edge, this is a proof that the hinges are free of play. Knocking in the hinges shall not be tolerated.

See that the rudder tab is always set within the trimming position limits, avoid damaging it when covering and uncovering the fuselage tail portion.

While performing the 100-hour scheduled maintenance remove the pedals from the aircraft and inspect the locks, attaching the straps to the pedals. Make sure that the clamps and cotter pins are intact and that each lock can be easily opened with one hand (the locks are to be opened to release the pilot's feet when bailing out).

Final Adjustment of Aircraft Directional Control - after Trimming Flight

If in trimming flight the ball of the ЭУП-56 turn-and-bank indicator has deflected through a length exceeding the ball diameter, correct directional stability on the ground after the flight. This should be achieved by bending the rear edge of the rudder tab through some ± 2 mm.

To eliminate the aircraft turning when flying at subsonic speeds, bend the lower portion of the tab, when flying at supersonic speeds, bend its upper portion. For elimination of starboard turning bend the tab to the right whereas to eliminate port turning, bend it to the left.

CAUTION: To trim the aircraft directionally at the aircraft manufacturing plant use the gas equalizing flap riveted to the jet nozzle. When trimming the aircraft in the using arms do not bend or cut the gas equalizing flap with the purpose of trimming the aircraft directionally.

4. Air Brake Control System

General

To increase the drag under various flight conditions, three air brakes are provided on the aircraft fuselage. With the drop tank suspended, the bottom air brake is interlocked and cannot be released.

The air brakes are controlled by solenoid-operated valves (Fig.47). The air brakes on the fuselage sides are controlled by the ГА-140 solenoid-operated valve, while the fuselage bottom air brake is operated by means of the ГА-184 valve.

The side air brakes can be deflected through 25°, and the bottom air brake through 40°. When extended or retracted, the air brakes are held in position due to the working fluid pressure supplied from the main hydraulic system. The air brakes can be controlled either by means of the button on the control stick or by moving the slide on the engine control lever.

The button provided on the control stick is used for short-time application of the air brakes, while the slide on the engine control lever is employed for continuous application of the air brakes (e.g. when diving).

Checking Air Brake Control System

The procedure used for checking the air brake control system is as follows:

1. Connect the ground power source to the aircraft.
2. Connect the ground hydraulic pump to the main hydraulic system and set up operating pressure in the system.
3. Switch on the AIR BRAKES (ТОРМ. ЩИТКИ) and LANDING GEAR, NAVIGATION LIGHT SIGNALIZATION SYSTEM (СИГН. ШАССИ, АНО) circuit breakers and accumulator switch.
4. Extend the air brakes by operating the button on the control stick. When the air brakes start extending, the AIR BRAKES EXTENDED (ЩИТКИ ВЫПУЩЕНЫ) light inscription should flash up on the ППС-2 panel.

Extend and retract the air brakes three times to make sure that all three air brakes operate synchronously and their mechanisms function properly.

CAUTION: It is forbidden to extend and retract the air brakes when the fuselage bottom engine hatches are open to prevent the air brakes from damage.

5. Check the air brakes for proper extension and retraction by operating the slide on the engine control lever.

Move the slide backward to extend the air brakes and forward to retract them.

Note: To check the bottom air brake-to-drop tank interlock system refer to Chapter "Fuel System".

Instructions on Operations in Wells of Air Brakes

To avoid accidents while performing maintenance operations in the air brake wells observe the following sequence in operations.

In Case of Maintenance Operations Carried Out in the Side Air Brake Wells:

1. Make sure that no pressure exists in the main hydraulic system.
2. Open the pressure unloading valve in the well of the right-hand wheel by pulling the valve lever backward. Fix the lever in this position with a safety pin.
3. Extend manually both side air brakes.

CAUTION: When maintenance operations are to be carried out in the air brake wells, it is forbidden to extend the air brakes using the main hydraulic system under operating pressure.

The above operations finished, start working in the side air brake wells, then close the side air brakes manually and remove the safety pin from the unloading valve lever. Removal of the safety pin will close the unloading valve, i.e. the valve will be lowered under the action of the spring.

In Case of Maintenance Operations in the Bottom Air Brake Well:

Before proceeding to maintenance operations in the well of the bottom air brake bleed pressure in the main hydraulic system to slacken the bolt that connects the bottom air brake with the rod of the hydraulic cylinder, after which remove the bolt.

CAUTION: Secure the disconnected air brake to keep it away from the fuselage to avoid damaging the fuselage bottom skin and the air brake skin. This calls for only partial lowering of the air brake.

Start working in the well of the bottom air brake only after fulfilling the above operations. The work finished, connect the bottom air brake to the hydraulic cylinder rod.

5. In-Flight Check of Aircraft Trimming

Check the aircraft for trimming in the following cases:

(a) after assembly of the aircraft which has been delivered disassembled to the unit from the Manufacturing plant;

(b) after replacement or repair of the control system units, such as stabilizer, aileron, rudder, flap;

(c) after replacement of the spring feel mechanism, actuating mechanism of the АРУ-3В automatic boost control unit, "trimming effect" mechanism (МП-100М), booster БУ-45А or БУ-51МС;

(d) in case of abnormal behaviour of the aircraft in flight.

Prior to a flight for trimming the pilot must look through the Aircraft Trimming Chart which is appended to the aircraft Service Log and together with the technician adjust the aircraft parameters in conformity with the data recorded in the Trimming Chart.

In a trimming flight the pilot should check:

(a) the aircraft longitudinal trimming;

(b) the aircraft lateral trimming with the aileron boosters on and off;

(c) the aircraft directional trimming.

CAUTION: Before a trimming flight remove ammunition and the drop tank from the aircraft.

Checking Aircraft Longitudinal Trimming

1. After take-off and while climbing to 3000 m. at engine maximum rating (with landing gear, flaps and air brakes retracted) use the "trimming effect" mechanism for trimming the aircraft longitudinally at an indicated airspeed (IAS) equal to 750 ± 100 km/hr.

2. After the aircraft has been properly trimmed within the indicated airspeed limits, check the efforts on the control stick changing during the aircraft acceleration up to IAS = 1000 - 1050 km/hr at altitudes up to 4000 m. In this case "pulling" efforts up to 3 - 4 kg are allowed on the control stick (Fig.48).

3. If the "trimming effect" mechanism has not been used for trimming the aircraft at IAS = 750 ± 100 km/hr and the flashing of the TRIMMING EFFECT NEUTRAL (ТРИМ. СТАБ. НЕЙТР.) signal light indicated that the trimming speed has been achieved, with the control stick "pulling" efforts not exceeding 4 kg while accelerating the aircraft up to indicated airspeed of 1000 - 1050 km/hr, the aircraft trimming may be considered accomplished. In this case post-flight adjustment of the longitudinal control is superfluous.

4. If the "trimming effect" mechanism was used for trimming the aircraft longitudinally at indicated airspeed of 750 ± 100 km/hr, do not use the "trimming effect" mechanism until landing after the aircraft was trimmed. After landing adjust the "trimming effect" mechanism so that its position should correspond to the stabilizer trimming position obtained by the pilot proceeding as instructed in Section "Final Adjustment of Aircraft Longitudinal Control after Trimming Flight".

5. If the aircraft has been properly trimmed in flight at IAS = 750 ± 100 km/hr, but its further acceleration up to IAS = 1000 - 1050 km/hr causes "pulling" efforts on the control stick exceeding the permissible value (4 kg), stop further trimming and land the aircraft. After landing increase the stabilizer "drift".

CAUTION: 1. When performing longitudinal trimming, remember that "pushing" efforts on the control stick are not specified.

2. The procedure used for adjustment of the stabilizer "drift" is set forth in Section "Adjustment of Stabilizer Control System".

Checking Aircraft Lateral Trimming with Aileron Boosters On

6. When trimming the aircraft longitudinally, check lateral trimming of the aircraft in flight with the aileron boosters on, at airspeeds IAS = 1000-1050 km/hr and altitudes up to 4000 m.

7. Start performing lateral trimming of the aircraft with the aileron boosters off, when the control stick deflection required for counteracting the aircraft banking is not more than 1/4 of its full travel (in this position the control stick deflects the ailerons through 2 - 3°).

IMPORTANT: In case of incomplete aircraft directional trimming the ball displacement in the turn-and-bank indicator is allowed to be ± 1 diameter (of the ball).

8. If the control stick deflection required for counteracting the aircraft banking exceeds 1/4 of control stick full travel, then after landing adjust the aileron neutral position misalignment.

9. After misalignment in the neutral position of both ailerons has been corrected, finally check in flight the aircraft lateral trimming with the aileron boosters switched on.

Checking Aircraft Lateral Trimming with Aileron Boosters Switched Off

10. Switch off the aileron boosters upon reaching the altitude of 4000 m. and IAS = 600 km/hr. Then accelerate the aircraft to 1000^{-50} km/hr while descending to altitude of 2500 - 2000 m. and at this altitude check lateral trimming of the aircraft, then decelerate the aircraft to IAS = 750 km/hr and switch on the aileron boosters.

When starting acceleration, efforts on the control stick required to counteract the aircraft banking should be minimum. However, as the aircraft accelerates, the efforts can increase and change their sign (Fig.49).

When accelerating the aircraft to IAS = 1050 km/hr, maximum efforts on the control stick required to counteract the aircraft banking should not exceed 15 kg.

11. If the efforts on the control stick exceed 15 kg, record the following parameters: indicated airspeed, flying altitude, direction of banking, rough value of efforts on the control stick and control stick travel required for elimination of banking. Then decelerate the aircraft to IAS = 750 km/hr and switch on the aileron boosters.

12. After landing adjust the tab bending on the port wing aileron and check the position of the trailing edges of the ailerons and flaps to make sure that they are intact.

13. If aileron tab bending has been adjusted after the trimming flight, then the flight which will follow should envolve checking of the aircraft lateral trimming with the boosters switched off.

Checking Aircraft Directional Trimming

14. Trim the aircraft directionally under conditions of maximum permissible Mach number and indicated airspeed (IAS). When flying at IAS exceeding 1000 km/hr and Mach number exceeding 0.92 (M > 0.92), smooth deflection of the ЭУП-56 turn-and-bank indicator ball is allowed by the amount equal to ± 1 diameter of the ball (under conditions of straight flight, with the pedals released and no G-forces experienced).

In this case the pilot should check abrupt aircraft turns and counteract the aircraft banking by application of the pedals.

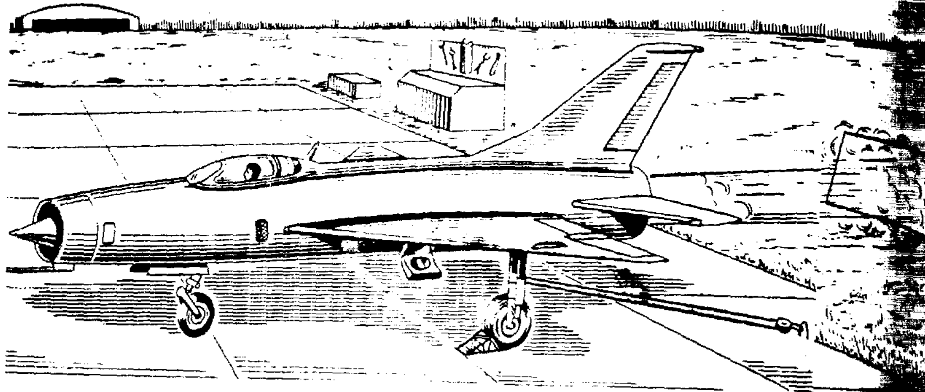
15. Should the aircraft prove to be poorly trimmed under any of the flight conditions, the pilot must note the following parameters characterizing this flight condition: indicated airspeed or Mach number, flying altitude, direction and amount of the ЭУП-56 ball deflection with the pedals released and approximate amount of efforts to be applied to the pedals for counteracting the aircraft turning.

This done, land the aircraft.

16. After landing check to see that the jet nozzle flaps are symmetrical under all engine ratings. If otherwise, the aircraft may become directionally unstable. Asymmetrical position of the flaps may result from improper adjustment of rollers fastening the afterburner or from deformation of the jet nozzle flaps, particularly in the region of the drag parachute location.

17. Should the jet nozzle flaps prove to be symmetrical throughout the entire range of engine ratings, adjust the rudder tab.

18. After adjustment of the aircraft directional stability finally check the directional trimming.



Chapter V

POWER PLANT CONTROL

(Fig.50)

The aircraft is powered with the PIIФ-30C engine with variable thrust under augmented rating. The aircraft is provided with a system for autonomous engine start from the 15CЦС-45 aircraft storage battery.

Normal operation of the power plant is ensured by:

(a) the engine rating control system;

(b) the system controlling the air intake cone, anti-surge shutters and engine control lever interlock according to Mach number;

(c) the system for control of the engine jet nozzle flaps;

(d) the system for control of the additional air intake shutters to supply additional air to the engine compressor during take-off.

1. Engine Rating Control System

General

The engine is controlled by means of the engine control lever through the control unit which consists of the HP-21Ф pump which controls the fuel flow and by the engine rating control panel ПУРТ-IФ interconnected by a rod.

The engine control lever can be fixed by stops in the following positions: CUT-OFF, IDLE SPEED, NORMAL RATING, MAXIMUM RATING, MINIMUM AUGMENTATION and FULL AUGMENTATION.

All stops with the exception of the CUT-OFF are adjustable.

To move the engine control lever to the required position press one of the two buttons which fix the lever in position on the throttle control.

One button serves to fix the engine control lever in the CUT-OFF and IDLE SPEED positions, the other is used for fixing it in the MAXIMUM RATING, MINIMUM AUGMENTATION and FULL AUGMENTATION positions.

The engine control lever position corresponding to the NORMAL SPEED rating is fixed by a ball retainer provided on the bracket of the control lever sector.

For stiffening the travel of the engine control lever and fixing the latter in any position a special handle is used which should be turned up and clockwise.

Provided in the end portion of the engine control lever is a button for operating on the radioset transmitter and a slide for extension and retraction of the air brakes.

Installed on the engine control lever handle is a drum whose turning es the diameter of the reticle. Turning of the drum is possible only after ing a specially provided stop button on the handle.

Checking Engine Rating Control System

When checking the engine control system make sure that:

(a) the movement of the engine control lever is smooth;

(b) no play is present in the engine control system;

(c) the engine control lever is distinctly(reliably)fixed at the sector s.

To check the engine control lever for smooth movement throughout the sector, y release the engine control lever by turning the tightening handle counter- kwise. Move the engine control lever between the CUT-OFF and FULL AUGMENTATION tions and make sure that the lever moves in both directions smoothly and out sticking. When moving the engine control lever, the clearance between the ng elements (rods, rocker arms) and fuselage members should be at least 5 mm.

To check the engine control system for play, first hold the lever on the 21Ф pump and then by smoothly moving the engine control stick in the cockpit sure that the engine control system is free from play.

When checking the engine control lever for distinct and reliable fixing by IDLE SPEED and NORMAL RATING stops, follow the notches on the body of the 21Ф pump. With the engine control lever at the MAXIMUM RATING and MINIMUM MENTATION stops, follow the degrees read off the engine rating control el (ПУРТ-1Ф).

Check proper fixing of the engine control lever at all stops of the sector oughout all engine ratings both with the engine control lever being moved othly and abruptly.

For checking use the following procedure:

1. Set the engine control lever at the CUT-OFF stop; the lever of the HP-21Ф p should get fixed at the stop, while the engine control lever should be 2 mm short of the stop.

Make sure that the button on the sector holds the engine control lever (for s purpose try to move it forward); while doing this, the lever of the HP-21Ф p should remain at the stop.

2. Move the engine control lever to the IDLE SPEED stop by pressing the tton on the sector. Then release the button and make certain that the engine ntrol lever is fixed by the button retainer when moved backward and freely avels forward when moved.

When placing the engine control lever at the IDLE SPEED position, the -21Ф lever should remain between the first and third notches.

Check reliability of the HP-21Ф pump lever setting at the IDLE SPEED stop ring abrupt moving of the engine control lever from the MAXIMUM RATING stop; e lever of the HP-21Ф pump should stop at least 1.5 mm short of the first tch.

3. Move the engine control lever to the NORMAL RATING position. When in this sition, the engine control lever should be fixed by the ball retainer provided the sector, while the HP-21Ф pump lever should remain at the fifth notch.

During the engine control lever forward and backward movement the lever should ave the ball retainer following additional efforts applied to the handle of the gine control lever (this effort being of the order of 1 or 1.5 kg).

4. Change over the engine control lever to the MAXIMUM RATING position. hen trying to move the engine control lever forward, see that the lever is lock- d by the button which should rest against the MAXIMUM RATING stop.

When the engine control lever has been ~~set~~ on the MAXIMUM RATING stop, the lever should remain within 65 to 70° range of the ПУРТ-1Ф engine rating control panel limb.

5. By pressing the button on the engine control lever change over the latter to the MINIMUM AUGMENTATION position, after which release the button. When trying to move the engine control lever backward, see that it is locked by the button which rests against the MINIMUM AUGMENTATION stop. When setting the engine control lever to the MINIMUM AUGMENTATION stop, the lever according to the ПУРТ-1Ф engine rating control panel should remain within 75 to 77° limits. When moving the engine control lever from the MINIMUM AUGMENTATION stop forward, the lever should travel freely. To move the engine control lever backward from the MINIMUM AUGMENTATION stop, press the button on the engine control lever after which move it backward.

6. Change over the engine control lever to the FULL AUGMENTATION position; this will fix the lever on the ПУРТ-1Ф engine rating control panel in position, while the engine control lever will be held by the FULL AUGMENTATION stop.

See that a clearance of 1 - 2 mm is observed between the button in the lowered position and the FULL AUGMENTATION stop on the sector.

Make sure that the button locks the engine control lever when trying to move the latter backward. When the engine control lever is locked, try to move it backward and forward. In this case the lever on the ПУРТ-1Ф engine rating control panel should remain on its stop.

To move the engine control lever backward from the FULL AUGMENTATION stop, first press the button on the lever and then pull the lever.

During operation of the engine control lever in the engine ratings from the MINIMUM AUGMENTATION to FULL AUGMENTATION stops, the button on the lever should be released.

2. System for Control of Air Intake Cone, Anti-Surge Shutters and Engine Control Lever Interlock according to Mach Number

General

(Fig.52)

To reduce losses in the engine air intake when flying at supersonic speeds, a retractable cone is provided in the fuselage nose portion. The cone ensures engine maximum thrust and reduces the aircraft drag at great Mach numbers.

In flight the cone assumes the following positions:

1. retracted;
2. 1st extended position at $M = 1.5$;
3. 2nd extended position at $M = 1.9$.

When in flight, the cone is automatically extended depending on the Mach number. At M below 1.5 the cone is in the retracted position.

In aircraft acceleration up to $M \geqslant 1.5$ the cone is being automatically extended to the 1st position, while during acceleration up to $M \geqslant 1.9$ the cone is extended to the 2nd position.

Both extended positions of the cone are checked by means of one signal light CONE EXTENDED which flashes up on the T-4 light panel following extension of the cone from the retracted position.

A serviceable cone automatic control system operates without the pilot's interference, whereas in case the automatic control system fails, the cone can be controlled manually from the cockpit. To change over to manual control of the cone the mode of operation selector switch should be set from the AUTOMATIC to the MANUAL position.

The cone control system comprises: two Mach transmitters MP-1.5T and MP-1.9T, two ГА-185 solenoid-operated valves, one three-position hydraulic cylinder and two hydraulic locks. For the cone solenoid-operated system functioning see Chapter "Aircraft Hydraulic System Maintenance".

To prevent surging in the air intake at great flying speeds, automatically controlled anti-surge shutters are provided in the front portion of the air inlet ducts on both fuselage sides (Fig.53).

The anti-surge shutters open automatically only at flying speeds corresponding to M>1.5 following the afterburner switching-off or stabilizer deflection down through 20° and more.

The anti-surge shutter interlock system operation depending on afterburner operation is controlled by the afterburner electric circuit incorporated in the КАФ-13Д (series 3) afterburner control box, while its operation depending on stabilizer deflection is controlled by the KB-9A microswitch.

In both cases the electric signal is transmitted to the ГА-184 valve which opens and directs working fluid to the hydraulic cylinders to open the shutters. If the automatic system fails, it is possible to control the operation of the anti-surge shutters manually.

To change over to manual control set the switch from the AUTOMATIC to the CLOSED or OPEN position.

To prevent surging in the air intake due to abrupt moving of the engine control lever backward at great flying speeds (M>1.5), an automatic stop is provided on the engine control lever sector to prevent the engine control lever from being moved backward from the MAXIMUM to the CUT-OFF position (Fig. 51).

With M<1.5 the automatic switch is countersunk, and does not hamper the engine control lever backward movement. The automatic stop does not prevent the control lever from moving forward at any value of Mach number. The switch is actuated by a signal transmitted from the MP-1.5 relay which controls the extension of the air intake cone in the 1st position (Fig.53).

If the control lever automatic interlock system (functioning depending on Mach number value) fails, it is possible to disconnect it mechanically by pressing the red button provided on the sector bracket.

Checking control systems of air intake cone, anti-surge shutters and engine control lever interlock according to Mach number (Fig.54)

The checking should be performed in two steps:

(a) checking of automatic control system;

(b) checking of manual control system.

(a) Checking of automatic control system

1. Make sure that all circuit breakers and switches in the cockpit are off.
2. Connect the ground power source to the aircraft mains.
3. Connect the ground hydraulic pump to the main hydraulic system pipe unions and build up a pressure of 180 - 210 kg/sq.cm. in the system.
4. Set the ENGINE PROCESSING switch to the K (PROCESSING) position in the engine processing box which is installed next to frame No.16 at the right-hand lower fuselage portion.
5. Set the Г3 and БФО limit switches in the КАФ-13Д (series 3) afterburner control box to the OFF position by turning the M screw. This will prevent the limit switches from interlock.
6. Switch on the AUGMENTATION circuit breaker on the left-hand panel.

7. Turn on the STORAGE BATTERY: AIRCRAFT, GROUND switch on the right-hand panel.

8. Switch on the following circuit breakers located on the right-hand pa[illegible] CONE, ENGINE CONTROL LEVER INTERLOCK, CHECKING LIGHTS, LIGHT PANEL, FUEL REMAIN-ING AND TRIMMING EFFECT SIGNALIZATION and BOOSTER SYSTEM OFF, HYDRAULIC SYSTEM SIGNALIZATION.

9. Make sure that the cone and anti-surge shutter mode-of-operation sele[illegible] switches on the left panel are in the AUTOMATIC position.

10. Create a rarefaction in the static and total pressure lines of the Pitot-static tube using two КПУ-3 units. First create a rarefaction corresponding to a 7500-m. altitude in the Pitot-static tube static line, and then by gradually increasing the pressure in the total pressure line set up a pressure correspond-ing to M=1.5. Upon gaining this pressure in the Pitot-static tube line the fol-lowing automatic operations will take place:

(a) The cone will move from the retracted position to the 1st extended po-sition. The beginning of the cone movement will be indicated by flashing of the CONE EXTENDED signalization light on the T-4 light panel.

(b) The system for anti-surge shutter interlock actuated by afterburner switching-off and stabilizer deflection will get switched on. The engine contr[illegible] lever being at the moment in the CUT-OFF position and the afterburner being off, the ГА-184 solenoid-operated valve for anti-surge shutter control will get swit[illegible]ed on, which will result in the anti-surge shutter opening.

(c) The system for engine control lever interlock according to Mach number will get switched on.

11. To check the operation of the anti-surge shutters interlock system, pro-ceed as follows:

(a) Check the operation of the anti-surge shutters interlock system actuated by afterburner switching-off, for which purpose:

- change over the engine control lever from the CUT-OFF to the MAXIMUM RATING position. With the engine control lever within this range, the anti-surge shutters should be in the open position;

- change over the engine control lever from the MAXIMUM RATING to the MINI-MUM AUGMENTATION position. As a result, the afterburner will become switched on, the AUGMENTATION signal light on the T-6 light panel will start burning and the anti-surge shutters will get closed.

With the engine control lever travelling from the MINIMUM AUGMENTATION to the FULL AUGMENTATION positions, the anti-surge shutters should be closed;

- change over the engine control lever from the MINIMUM AUGMENTATION to MAXIMUM RATING position. The afterburner will get switched off, the AUGMENTATIO[illegible] light will go out and the anti-surge shutters will open.

(b) Check operation of the shutter interlock system according to stabiliz[illegible] deflection, for which purpose:

- set the engine control lever at the MINIMUM AUGMENTATION stop, which will cause switching-on of the afterburner and closing of the anti-surge shutters;

- pull the aircraft control stick backward until the stabilizer nose port[illegible] lowers through -20^{o}. The anti-surge shutters will get opened;

- deflect the control stick forward to place it neutral. As soon as the stabilizer nose upward deflection angle becomes less than -20^{o}, the anti-surge shutters will get closed;

- change over the engine control lever from the MINIMUM AUGMENTATION to MAXIMUM RATING stop. The afterburner will get switched off, the AUGMENTATION light will go out and the anti-surge shutters will get opened.

12. To check the operation of the system for the engine control lever interlock depending on Mach number use the following procedure:

(a) Move the engine control lever backward from the MAXIMUM RATING stop to the stop providing the engine control lever interlock according to Mach number. In this case the automatic stop should prevent backward movement of the engine control lever. The clearance between the button on the engine control lever and the MAXIMUM RATING stop on the sector should amount to 0.5 - 1.0 mm.

CAUTION: The above clearance is possible due to the adjustment of the MAXIMUM RATING stop.

(b) Gradually relieve pressure in the Pitot-static tube total pressure line down to Mach number below 1.5; this will disconnect the system for engine control lever interlock according to Mach number. As a result, the automatic stop will no longer hinder the engine control lever movement along the sector from the MAXIMUM RATING to the CUT-OFF position.

(c) Place the engine control lever at the MAXIMUM RATING stop and gradually build up a pressure in the Pitot-static tube total pressure line corresponding to Mach number amounting to 1.5. When this value of Mach number has been gained, the system for engine control lever interlock according to Mach number will operate as a result of which the automatic stop will prevent the engine control backward movement (Fig.51).

(d) Press the button for emergency disengagement of the automatic stop depending on Mach number, after which make sure that the engine control lever moves freely forward and backward in the range MAXIMUM RATING - CUT-OFF position.

(e) Bring the button for emergency disengagement of the automatic stop depending on Mach number to the initial position and lock it with a 0.25-mm wire, type Л-62.

13. Check operation of the air intake cone in the following sequence:

(a) Gradually increase the pressure in the Pitot-static tube total pressure line up to $M \geqslant 1.9$; as a result, the cone will extend from the 1st extended position to the 2nd one.

(b) Reduce pressure in the Pitot-static tube system down to that corresponding to Mach number of 1.7 to 1.6. The cone retraction to the 1st extended position should take place at $M < 1.9$ with an allowance for the M-relay and Mach number indicator errors.

(c) Reduce pressure in the Pitot-static tube line to correspond to Mach number below 1.5; the cone will be retracted to the initial retracted position, the CONE EXTENDED indicating light will go out, the system for the anti-surge shutter interlock depending on afterburner operation and stabilizer deflection will be switched off, the system for the engine control lever interlock depending on Mach number will get disengaged and the anti-surge shutters will close. After reducing the pressure in the Pitot-static tube system to that corresponding to Mach number below 1.5, forward and backward deflection of the control stick and shifting of the engine control lever from the MINIMUM AUGMENTATION to IDLE SPEED stop will not open the anti-surge shutters and the stop for engine control lever interlock depending on Mach number will not hinder the movement of the engine control lever along the sector.

IMPORTANT: 1. When checking the cone extension according to Mach number, take into account the errors of the M-relay and of Mach number indicator recorded in the respective Certificates.

2. When measuring the length of cone travel proceed from the following data: the distance between the cone top and the air intake edge with the cone retracted is 320 mm, with the cone in the 1st extended position - 450 mm, and with the cone in the 2nd extended position - 490 mm. The above sizes can be found in the aircraft levelling diagram.

14. All operations mentioned in the present Section accomplished, bring the engine control lever into the CUT-OFF position and the M screw on the КАФ-13Д afterburner control unit to the initial position.

(b) Checking manual control system of air intake cone and anti-surge Shutters

1. Perform all operations under Items 6, 7 and 8 of the previous Section.
2. Change over the mode of operation selector switch bearing the inscription CONE on the left-hand panel from the AUTOMATIC to MANUAL position and the anti-surge shutter control switch inscribed AIR BY-PASS SHUTTERS set from the AUTOMATIC to CLOSED position.
3. Set the selector switch for cone manual control to the 1.5 position, which will result in:
(a) the cone extending to the 1st position;
(b) flashing up of the CONE EXTENDED light on the T-4 light panel.
4. Set the selector switch for cone manual control to the 1.9 position, which will shift the cone to the 2nd extended position.
5. Place the selector switch for cone manual control from the 1.9 position to the 1.5 position; the cone will retract from the 2nd extended position to the 1st position.
6. Set the selector switch for cone manual control to the RETRACTION position. The cone will get completely retracted to the initial position and the CONE EXTENDED indicating light will go out.
7. Check the anti-surge shutters manual control system, for which purpose:
(a) Place the AIR BY-PASS SHUTTERS selector switch from the CLOSED to the OPEN position. The shutters should open synchronously.
(b) Place the AIR BY-PASS SHUTTERS selector switch from the OPEN to the CLOSED position.
The shutters should get closed synchronously.
8. The check over, set the mode of operation selector switches for the cone and anti-surge shutters to the AUTOMATIC position and lock them in this position with a 0.25-mm brass wire.
9. Cut out all circuit breakers and selector switches which have been cut in for checking; disconnect the ground power source and ground hydraulic pump.
10. Change over the ENGINE PROCESSING selector switch from the K position to the OPERATION position.

3. Engine Jet Nozzle Flap Control System

General

Control of the engine jet nozzle flaps is accomplished by means of three hydraulic actuating cylinders, one three-position ГА-164М solenoid-operated valve and nozzle control electric circuit. The sequence of operation of the solenoid-operated jet nozzle flap control system is presented in Chapter "Aircraft Hydraulic System Maintenance".

The jet nozzle flap control system provides for:

(a) complete opening of the flaps in the course of engine starting, thereby improving the conditions for starting due to decrease in the back pressure which hinders the free escape of gases from the afterburner chamber;

(b) smooth changes of the jet nozzle diameter in the process of adjustment of the engine thrust under conditions of thrust augmentation.

Presented below is the operating cycle of the jet nozzle flap system.

Prior to engine starting and later on during the entire starting procedure until the engine speed reaches $66^{+2}_{-1}\%$ according to the high-pressure rotor the flaps are open, the outer jet nozzle area diameter being equal to 675^{-10} mm (Fig.55).

With the high-pressure rotor r.p.m. increasing over $66^{+2}_{-1}\%$, the flaps will converge, the diameter of the throat being 530 mm and remaining within these limits up to the moment when the engine control lever is set at the MAXIMUM RATING stop. Setting the engine control lever to the MINIMUM AUGMENTATION position will open the flaps increasing the throat diameter to 610 mm, which will switch on the adjustable afterburner. When moving the engine control lever from the MINIMUM AUGMENTATION to the FULL AUGMENTATION stop, the flaps will smoothly open and when finally the engine control lever rests against the FULL AUGMENTATION stop, the flaps will be fully opened, the nozzle throat diameter coming to 675^{-10} mm.

When the engine control lever moves backward, the flaps operate in the reverse sequence. In this case, however , the flaps will diverge changing the 530-mm dia. of the throat for the 675^{-10}-mm diameter somewhat later, when the high-pressure rotor r.p.m. will be equal to $60^{+1}_{-2}\%$ of the rated value (instead of $66^{+2}_{-1}\%$). This difference in r.p.m. at the moment of flaps divergence and convergence when assuming the 675^{-10}-mm dia. is provided to prevent multiple opening and closing of the jet nozzle flaps when flying at engine speeds close to the high-pressure rotor r.p.m. equal to $66^{+2}_{-1}\%$.

In the event of failure of the automatic follow-up system the jet nozzle flaps are controlled by the emergency system. To change over to operation from the emergency shutter control system, turn on the NOZZLE EMERGENCY CONTROL switch on the left-hand panel; this will disconnect the automatic follow-up system for flap control, after which thrust adjustment under the augmented conditions becomes impossible.

In this case, with the engine running, the flaps can assume the following positions:

(a) the engine control lever being moved within the range between the CUT-OFF stop and the position corresponding to $66^{+2}_{-1}\%$ of high-pressure rotor r.p.m., the flaps are opened to a dia. of 675^{-10} mm;

(b) when moving the engine control lever forward from the $66^{+2}_{-1}\%$ of high-pressure rotor r.p.m. position, the converging nozzle flaps leave a 530-mm throat. The flaps will remain converged to this extent up to the moment when the engine control lever is set to a position close to the FULL AUGMENTATION stop (corresponding to 100° according to the ПУРТ-1Ф panel limb). With the engine control lever in this position, the full augmentation rating will be reached and the nozzle flaps will fully diverge increasing the throat diameter to 675^{-10} mm.

Checking operation of jet nozzle flaps with cut-off engine

As it is impossible to simulate the operation of the БУ-4Б unit with a cut-off engine, a full-scope checking of the nozzle flaps under these conditions cannot be performed. Presented below is the description of a simplified method for checking the flap control follow-up system when the engine augmented rating is being adjusted.

To check the diameter of the flaps at the MAXIMUM rating (the diameter should be equal to 530 mm) switch on the AUGMENTATION circuit breaker.

Changes in the throat dia. under 66^{+2}_{-1} % and 60^{+1}_{-2} % high-pressure rotor r.p.m. can be checked only on a running engine.

To check the operation of the nozzle flaps use the following procedure:

1. Make sure that all circuit breakers and switches in the cockpit are off.
2. Change over the ENGINE PROCESSING selector switch on the processing box from the OPERATION to the PROCESSING position.
3. Cut out the electric interlock of limit switches Г3 and В4О in the КАФ-13Д afterburner control unit by setting the И screw to the OFF position.
4. Connect the ground power source (27 V ± 10%) to the aircraft.
5. Connect the ground hydraulic pump to the main hydraulic system pipe unions and build up an operating pressure of 180 - 210 kg/sq.cm.
6. Switch on the AUGMENTATION circuit breaker on the left-hand panel, after which turn on the STORAGE BATTERY: AIRCRAFT, GROUND switch on the right-hand panel.

CAUTION: The above sequence of switching-on ensures a fully open position of the flaps during the entire engine start.

7. With the engine control lever moving along the sector from the CUT-OFF stop to the MAXIMUM stop, the nozzle flaps will be fully opened, the jet nozzle throat being 675^{-10}mm in diameter which corresponds to the engine full augmentation rating.
8. Bring the engine control lever to the CUT-OFF position and switch off the AUGMENTATION circuit breaker. The nozzle flaps which have been fully open will converge decreasing the nozzle throat diameter to 530 mm.
9. Move the engine control lever from the CUT-OFF stop to the MAXIMUM stop. With the engine control lever within this range, the nozzle flaps will remain closed forming a 530-mm nozzle diameter.
10. With the engine control lever at the MAXIMUM stop, switch on the AUGMENTATION circuit breaker; this will fully open the shutters to a dia. of 675^{-10}mm.
11. Set the engine control lever at the MINIMUM AUGMENTATION stop; this will close the flaps to a dia. of 610 mm which will be indicated by the flashing up of the AUGMENTATION light on the T-6 light panel.
12. When moving the engine control lever from the MINIMUM AUGMENTATION stop, the nozzle flaps will smoothly open; setting the engine control lever at the FULL AUGMENTATION stop will force their complete opening to a diameter of 675^{-10}mm.
13. Move the engine control lever from the FULL AUGMENTATION to the MINIMUM AUGMENTATION stop; the nozzle flaps will be smoothly closing with the displacement of the control lever. When the engine control lever movement discontinues, the flaps will stop closing accordingly. Setting the engine control lever at the MINIMUM AUGMENTATION stop will close the flaps so that the nozzle diameter will be brought to 610 mm.
14. Place the engine control lever at the MAXIMUM stop; this will fully open the nozzle flaps to a 675^{-10}mm nozzle diameter and extinguish the AUGMENTATION indicating light on the T-6 light panel.

Placing the engine control lever at the CUT-OFF stop will not change the position of the nozzle flaps; they will remain fully open.

Leave the engine control lever in the CUT-OFF position.

15. After checking the nozzle flaps operation within the scope set forth in the present Section switch off the STORAGE BATTERY: AIRCRAFT, GROUND on the right-hand panel, after which switch off the AUGMENTATION circuit breaker, set

e processing switch to the OPERATION position, shift over the И screw on the Ф-13Д afterburner control unit to the initial position and disconnect the ound power source and ground hydraulic pump from the aircraft.

CAUTION: 1. Remember that each time the engine is stopped the AUGMENTATION circuit breaker should be switched off only after cutting out the STORAGE BATTERY: AIRCRAFT, GROUND switch. This is indispensable in order that the nozzle flaps should be kept open after checking their operation. Before starting the engine use the reverse procedure: switch on the AUGMENTATION circuit breaker and then the storage battery.

2. Given in the present Section are the rated sizes of the nozzle flap diameters. When checking the operation of the nozzle flaps refer to the sizes recorded in the engine Service Log.

Checking system for emergency nozzle flap control with engine running

It is impossible to check the emergency nozzle flap control system with the ngine at standstill. Hence, this system should be checked with the engine running during testing of the engine augmented rating.

The following procedure is used for checking the flap emergency control ystem:

1. After testing the engine under the augmented rating turn on the NOZZLE MERGENCY CONTROL switch on the left-hand panel.

2. Move the engine control lever from the FULL AUGMENTATION stop backward. s soon as the engine control lever leaves the FULL AUGMENTATION stop and assumes the position corresponding to 100° as counted by the ПУРТ-1Ф panel limb, he afterburner will be switched off, the nozzle flaps will close to a size orresponding to the MAXIMUM rating and the AUGMENTATION light will go out on he T-6 light panel.

CAUTION: Watch the changes in the nozzle throat diameter at a safe distance from the aircraft.

3. Move smoothly the engine control lever to the IDLE SPEED stop. When moving the engine control lever at engine r.p.m. equal to 60^{+1}_{-2} % of high-pressure otor r.p.m., the nozzle flaps will open from the size corresponding to the MAXIMUM RATING to a diameter characteristic of the FULL AUGMENTATION rating.

4. Change over the engine control lever to the MAXIMUM RATING position and again switch on the augmentation rating by moving the engine control lever forward. After setting the engine control lever at the MINIMUM AUGMENTATION stop the adjustable augmented rating will not get switched. Further movement of the engine control lever will switch on the full augmentation rating before the engine control lever is set at the FULL AUGMENTATION stop; the nozzle flaps will be fully opened and the AUGMENTATION light will flash up on the T-6 light panel.

This position of the engine control lever should correspond to the 100±1° position of the lever on the ПУРТ-1Ф panel.

5. Place the engine control lever at the FULL AUGMENTATION position, after which:

(a) cut off the NOZZLE EMERGENCY CONTROL switch;

(b) switch off the augmentation by changing over the engine control lever to the MAXIMUM RATING stop;

(c) cut off the engine.

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4. Shutters for Additional Intake of Air to Engine Compressor (during take-off)

General

The shutters for additional intake of air to engine compressor installed on the fuselage right side and left side between frames Nos 9 and 10 serve the purpose of increasing engine thrust during take-off.

The shutters operate on the principle employing the difference between the pressures in the air intake and in the ambient air. They open inside the suction ducts. The shutters have no control mechanisms.

During engine operation on the ground at different engine ratings, the impact pressure being small (while taking-off) or even equal to zero (in case of engine test), the rarefaction created inside the suction ducts pushes the shutters open and gives access to additional air which flows to the engine compressor. When in flight, with increased impact pressure a pressure develops inside the suction ducts exceeding the ambient pressure, which results in the shutter closing.

Additional air intake shutter maintenance

To keep the additional air intake shutters in proper operational condition perform the following maintenance work:

(a) Check to see that the shutters fit tightly to the fuselage walls. When slightly pressed by hand they should freely and smoothly open inside the suction duct. During engine starting and operation at different ratings the shutters should always remain open.

CAUTION: Remember that on the ground foreign matter can be sucked inside a running engine through the shutters, which may result in the engine failure.

(b) To prevent foreign particles from getting in the engine through the shutters do the following:

- before starting the engine clean the parking site of dirt and ice;
- install protective screens on the air intake shutters prior to engine ground testing; before installing the screens check the suction ducts for presence of foreign particles;
- see that the shutter holes are plugged at the parking site or during aircraft towing;
- remove the protective screens from the shutter holes only before taxiing and prior to a flight.

(c) It is forbidden to remain close to the shutter holes not protected with screens during engine operation at all ratings except for IDLE SPEED.

5. Maintenance of Retractable Cone Mechanism

When performing scheduled maintenance work every 3 months, inspect all frictional parts of the retractable cone for sound condition (Fig.56).

To inspect the cone mechanism extend the cone manually to the 1.9 position and bleed pressure in the main hydraulic system to zero, after which remove the detachable portion of the cone and do the following:

1. Turn out the self-locking screws which fasten the cone to its cylindrical portion and remove the detachable portion of the cone.

2. Unlock and screw out the nut which has been screwed in the axle along which moves the cone guide bush.

3. Unlock and screw out the nut and drive out the attachment bolt from the rod of the cone actuating hydraulic cylinder.

4. Remove the sliding portion of the retractable cone together with the guide bush.

The cone sliding portion removed, do the following:

(a) Wash and inspect the friction areas of the axle and the cone guide bush. Scores, dents and scratches on the friction areas are not allowed.

(b) Clean the cone stationary portion from dirt.

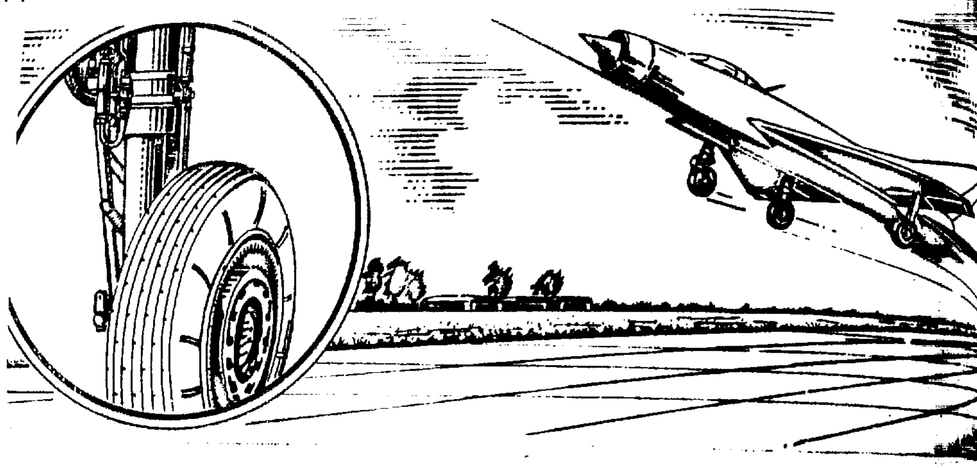
(c) Make sure that no oil leaks from the hydraulic cylinder actueting the cone.

(d) Check the position of the limit switch inside the cone stationary portion and make sure that it functions properly.

Pressing the limit switch should result in the flashing up of the CONE EXTENDED indicating light in the cockpit, while releasing the limit switch should extinguish the light.

(e) Pack the grooves of the cone guide bush with ЦИАТИМ-201 lubricant and assemble the cone mechanism in the sequence reverse to that of dismantling. Before installation of the cone retractable portion back on the aircraft inspect it thoroughly. After installing make sure that the self-locking screws are reliably tightened.

(f) Build up operating pressure in the main hydraulic system and check the cone for proper operation.



Chapter VI

TAKE-OFF AND LANDING MECHANISMS

1. General

Take-off and landing mechanisms ensure the aircraft taking-off from and landing on concrete runways as well as soil airfields.

Take-off and landing mechanisms include: the landing gear, flaps and drag parachute.

Landing Gear

The aircraft is equipped with a tricycle landing gear retractable in flight.

The landing gear main struts (Figs 57 and 58) are provided with KT-82M wheels, 600x200B, and equipped with pneumatic brakes of a disc type. The main struts are attached one to the starboard wing, the other to the port wing.

In flight, the main struts are retracted in the wing, while the wheels, after being automatically turned relative to the struts, are retracted in the fuselage.

The landing gear nose strut (Figs 57 and 59) has one KT-38 wheel, 500x180A, and is provided with two pneumatic brakes of a chamber type. The nose strut is attached to the fuselage nose portion on frame No.6.

The nose strut and wheel are retracted forward into the fuselage.

When extended, the main struts are held in position by side cylinder-struts provided with mechanical and hydraulic locks, while the nose strut is held by a mechanical and a hydraulic lock.

When retracted, all the three struts are held by mechanical locks (Figs 60 and 61).

The landing gear retraction and extension is accomplished by operating the hydraulic system, while emergency extension is gained through the use of the emergency air system. If required, the nose strut can be extended separately by operating the autonomous nose strut release emergency system (to this end use a special handle provided to actuate cables for opening the up-lock). In this case the nose wheel leaves its well in the fuselage under its own weight and due to the airstream.

All the three struts incorporate shock absorbers of hydro-nitrogen type with braking accomplished in the process of direct and reverse stroke. The upper chambers of the main struts are used as bottles for the main air system. The landing gear nose strut (Fig.59) is provided with:

(a) castor mechanism which returns the nose wheel to its neutral position. This mechanism is incorporated in the strut. While taxiing, with the shock absorber compressed, the castor mechanism gets disengaged and the wheel can turn.

During take-off, when the load is removed from the shock absorber, the castor mechanism gets engaged and locks the wheel in the neutral position;

(b) non-linear drive to the damper. On one hand this drive provides for great angular travel of the damper guide in case of wheel small-angle deflections (within $\pm$ 15°) from the neutral position, thereby preventing the "shimmy" effect within this deflection range. On the other hand, it provides for small angular travel of the damper guide in case of wheel great deflection angles (within $\pm$50°). This considerably facilitates the aircraft taxiing as in this case no work is spent on damping;

(c) shimmy damper whose purpose is to prevent non-damped oscillations (shimmy effect) of the nose strut wheel during aircraft take-off run and landing roll (Fig.76).

The shimmy damper is provided with a compensating chamber which replenishes the working chambers of the shimmy damper with the АМГ-10 fluid in the event of fluid leaks and compensates for thermal expansions.

To check the shimmy damper for filling with the АМГ-10 fluid refer to the notches on the rod. Normal filling of the shimmy damper with the АМГ-10 fluid at a temperature t = +20 $\pm$ 10°C will be known by alignment of the white notch on the rod with the surface of the compensating chamber upper cover.

The red notch on the rod corresponds to a low level of the АМГ-10 fluid.

Normal operation of the shimmy damper is allowed provided the red notch on the rod is visible.

The landing gear main strut (Fig.62) is equipped with:

(a) mechanism for turning main landing gear wheel semi-axle;

(b) actuating cylinder for main landing gear strut retraction and extension provided with landing gear down-lock of a mechanical type (Fig.63).

Landing Gear Main Specifications

No.	Name	Main struts	Nose strut
1	Type of shock absorber	Hydraulic-nitrogen	Hydraulic-nitrogen
2	Working fluid in shock absorbers	АМГ-10 St. Std. 6794-53	St. Std. 6794-5
3	Shock absorber full travel	280^{+2}_{-3} mm	90^{+2}_{-1} mm
4	Size and type of wheels	600x200B КТ-82М	500x180A КТ-38
5	Initial nitrogen pressure in shock absorber:		
	(a) at normal take-off weight	30 $\pm$ 1 kg/sq.cm.	34 $\pm$ 1 kg/sq.cm.
	(b) at maximum take-off weight	30 $\pm$ 1 kg/sq.cm.	34 $\pm$ 1 kg/sq.cm.
6	Pressure in wheel tires:		
	(a) at normal take-off weight	$8^{+0.5}$ kg/sq.cm.	$6^{+0.5}$ kg/sq.cm.
	(b) at maximum take-off weight	$10^{+0.5}$ kg/sq.cm.	$6^{+0.5}$ kg/sq.cm.
7	Deflection of wheel tires:		
	(a) at normal take-off weight	40 mm	25 mm
	(b) at maximum take-off weight	45 mm	30 mm

Notes: 1. Parking compression of shock absorbers is illustrated in Figs and 65.

2. Operation of aircraft at temperatures above +30°C causes pressure increase in the landing gear wheel tires. In view of this, aircraft operation under such conditions calls for checking pressure in the tires and reducing it, if required, to the values pointed out in Item 7 of the above Table.

Flaps

Flaps are intended for decrease of the aircraft take-off run and landing airspeed.

The flaps can be set in two positions: retracted and extended. They are controlled by solenoid-operated values (Figs 66 and 67). When retracted, the flaps are held both by ball-type locks in the hydraulic cylinders and working fluid pressure; when extended, they are held in position by hydraulic fluid pressure only.

With the increase in airspeed and impact pressure the extended flaps will force the fluid out of the "extension" chambers of the actuating cylinders, thus reducing the angle of flap deflection.

Retraction of the flaps should begin at IAS = 340 km/hr. The force acting on the flaps due to the impact pressure under conditions of such airspeed is not sufficient to overcome the forces exerted by the hydraulic cylinders. Therefore, in addition to the pressure fed from the ГА-185 valve, constant pressure from the hydraulic system is supplied to the retraction pipe unions of the cylinders.

This ensures flap retraction beginning at IAS = 340 km/hr and higher.

Thus, the ГА-185 valve supplies fluid for flap extension only and by-passes it to the return line during retraction of the flaps. The valve retraction pipe union of the pressure line is plugged.

Flaps extension is achieved due to the difference between the cylinder piston areas in the extension and retraction chambers, i.e. owing to the greater area of the piston in the cylinder extension chamber.

Installed in the cockpit, on the left-hand horizontal panel is an M3-1 two-button flap control mechanism.

The buttons of the mechanism are intended to set the flaps to the RETRACTED or EXTENDED positions. The flaps are extended and retracted by pressing the appropriate button.

The M3-1 mechanism is not provided with a signal light, the position of the flaps being checked by reference to the indicating light on the ППС-2 panel in the cockpit.

Drag Parachute

The ПТ-6152-59 drag parachute is used to reduce the aircraft landing run. The drag parachute should be packed in a cover and placed in a container by a parachute rigger who should consult Instructions No.2010-59. Packing should be done on a special table. Then the container with the parachute and its cable should be installed in the drag parachute bay and the bay shutters should be closed.

The shutters are locked and wirelocked with M2-Kl wire.

The drag parachute cable is stowed in the clamps of the fuselage ventral fin and in the groove in the fuselage tail part.

One end of the cable is attached by means of a fork to the parachute thimble, the other end to the connecting link which, in its turn, is attached by a shackle to the parachute catch-lock fitted in the aircraft tail portion (Figs 78 and 81).

When using the ПТ-6152-59 drag parachute remember the following:

1. Normal airspeed for releasing the drag parachute is considered to be 250 - 280 km/hr.

2. Maximum airspeed for the drag parachute release is 300 km/hr.

3. After releasing the drag parachute at airspeeds exceeding 300 km/hr replace the drag parachute, cable and connecting link.

4. The number of the ПТ-6152-59 drag parachute applications depends on the aircraft airspeed at the moment of release; it is presented in the following Table:

Airspeed	Number of chute applications	Notes
300 km/hr	1	Maximum permissible airspeed
290 km/hr	2	One-time permissible airspeed
280 km/hr	10	Maximum operational airspeed
250 - 260 km/hr	20	Mean operational airspeed

The parachute rigger should take the drag parachute away from the runway right after the aircraft landing and taxiing to the parking site, pack the parachute in the bag, bring it to specially provided premises and get it ready for the next flight according to Instructions No. 2010-59 on Operation of the ПТ-6152-59 Parachute.

2. Landing Gear Retraction and Extension

(Fig.68)

The following procedure is used for ground checks of the landing gear for proper retraction and extension:

1. Jack up the aircraft so that the wheels should break contact with the ground.

2. Connect the ground power source to the aircraft.

3. Connect the ground hydraulic pump to the aircraft.

4. Build up operating pressure in the main hydraulic system.

5. Place the landing gear control lever first to the EXTENDED and then to the RETRACTED positions. 10 - 15 sec. after the landing gear red warning lights flash up change over the lever to the neutral position and secure it with a latch.

6. Set the landing gear control lever to the EXTENDED position. 10 - 1.5 sec. after the flashing up of the green warning lights place the landing gear control lever neutral and secure it with a latch.

Extension of the landing gear nose strut can be checked by the extension of the indicating pin.

Note: See that while landing the aircraft its landing gear control lever is set in the EXTENDED position. Leave the control lever in this position until taxiing the aircraft to the parking site, after which set it neutral and secure with a latch.

7. Remove the jacks from under the aircraft so that the wheels should touch the ground.

CAUTION: Disconnect the ground hydraulic pump from the aircraft only upon expiration of 1 min. since the moment the landing gear control lever has been set to the EXTENDED position and the green warning light has flashed up. Having disconnected the ground hydraulic pump, switch over the landing gear control lever to the neutral position and lower the aircraft from the jacks to the ground. Under these conditions the strut will be locked in the EXTENDED position.

3. Checking Landing Gear for Condition

When inspecting the landing gear check the following:

1. Inspect the weld seams on the struts and landing gear units thoroughly through the magnifying glass. Particular attention should be paid to the seam ends and to the areas where the welded metal merges with the base metal. Before inspection clean the seams from dirt and dust and wash them with gasoline. If cracks are found, remove the defective strut or unit and send it for repair.

2. Total end and side play of the wheel fitted on the axle, when a force of 15 kg is applied to it, should be: not over 8 mm both in longitudinal and lateral directions in case of the main struts; not over 5 mm both in longitudinal and lateral directions for the nose strut.

3. With the landing gear main and nose struts extended, the main strut wheel door play should not exceed 12 mm when a 2- or 3-kg force is applied. The play is measured in the direction of the wheel door turning at its end. In case the wheel doors are rigidly fixed to the strut, no play is allowed at all.

Play in the nose strut doors, as measured at the door ends in the direction of the door rotation, should not exceed 7 mm (upon application of a 2- or 3-kg force to the door end).

4. With the landing gear retracted (the landing gear control lever in the neutral position) the surface of the wheel doors should be flush with the wing and fuselage bottom surfaces. Play between the wheel doors and recesses in the wing and fuselage should correspond to the values indicated in Fig.69.

<u>Note</u>: In operation, decrease in the play along the rear edges of the wing-attached doors is allowed down to 3 mm. This may be the result of worn hinges or residual deformation of the struts. Play below 3 mm indicates that excessive residual deformation is present in the landing gear struts due to rough landings at great landing speeds. Replace struts whose play is less than 3 mm. It is forbidden to file down the wheel doors rear edge or recess edge to increase the play.

5. Pressure in the wheel tires should be measured with the aircraft on the ground, while the pressure in the shock absorbers is checked with the aircraft jacked up.

6. Check the tire for slip relative to the rim by reference to the red marks on the tires and rims. Misalignment of these marks involves checking the inner tube and charging nipple for sound condition.

7. Axial play in the hinges is allowed within the permissible tolerance range provided the hinges rotate freely and without jamming.

4. Filling and Refilling Landing Gear Shock Absorbers

General

Place jacks under the aircraft nose and wings and hoist the aircraft so that the wheels break contact with the ground.

Connect the filling device to the strut filling pipe union.

Reduce nitrogen pressure in the shock absorbers to zero. Keep the struts motionless for 2 or 2.5 hours till the AMГ-10 fluid settles down.

A. Nose Strut

1. Screw out the filling valve and plug from the drain hole of the nose strut shock absorber (Fig.70). Using a gun fill the shock absorber through the holes in the strut with 100 cu.cm. of the AMГ-10 fluid (total capacity of the shock absorber when filled with the AMГ-10 fluid is 650 cu.cm.).

2. Smoothly lower the aircraft nose with the help of the jack until the nose strut shock absorber is fully compressed. With the shock absorber fully compressed, set the strut in the vertical position by adjusting the jack. As a result, the superfluous AMГ-10 fluid will be drained from the shock absorber through the opening in the filling valve.

Keeping the shock absorber compressed during 20 min. will result in complete draining of the excessive AMГ-10 fluid. If the AMГ-10 fluid will not run out, add some more fluid into the shock absorber and drain superfluous fluid in the sequence presented above.

3. Screw in the filling valve and plug of the drain hole, lift the aircraft nose so that the wheel breakes contact with the ground and charge the shock absorber with nitrogen to a pressure of 34 ± 1 kg/sq.cm. with the help of the special device.

B. Main Struts

1. Screw out the filling valve of the main strut shock absorbers (Fig.71) and fill each shock absorber with 100 cu.cm. of the AMГ-10 fluid by means of a gun (total capacity of the shock absorber is 2400 cu.cm. of the AMГ-10 fluid).

2. Adjust the jacks placed under the aircraft wings to lower the aircraft so as to fully compress the main strut shock absorbers. By adjusting the jacks set the struts vertically with the shock absorbers fully compressed. In this case the excess AMГ-10 fluid will run out of the shock absorbers through the openings in the filling valve.

Keep the shock absorbers compressed during 20 min. to completely drain the superfluous AMГ-10 fluid. If the fluid does not run out, add some more of it to the shock absorber, after which drain excess fluid in the sequence presented above.

3. Screw in the filling valve, hoist the aircraft on wing jacks to raise the wheels from the ground and charge the shock absorbers with nitrogen up to a pressure of 30 ± 1 kg/sq.cm. using a special device.

4. Lower the aircraft so that the wheels should touch the ground.

Notes: 1. When filling the shock absorbers in well heated premises in winter, remember, that a decrease in the ambient air temperature will cause a pressure decrease in the shock absorbers. In this case increase the filling pressure by 4 kg/sq.cm. per every 10°C of difference between the ambient temperature and indoor temperature.

2. To replace the fluid in the shock absorbers remove the struts from the aircraft.

5. Maintenance of Landing Gear Wheels

Operation of landing gear wheels requires the following maintenance.

1. Remove the main wheel tires worn on one side and after turning them through 180° about the vertical axis place them again on the wheels. Operation of landing gear wheel tires is allowed until their protectors are worn down to the cord.

2. Wheel brakes should be inspected every 3 months of the aircraft operation. When inspecting the brakes of the KT-82M wheels, proceed as follows:

(a) The following surfaces of the brake disc bimetal sectors are allowed to have any number of small cracks and scores (not more than 0.5 mm deep) within the iron layer only.

(b) Open cracks running throughout the entire sector length and penetrating through the iron layer down to the steel frame are not allowed. Should even a single crack of such a kind be found, replace the defective sector by a new one.

(c) Metal-and-ceramic discs, the pressure disc and ceramic-plated body and are allowed to have any number of cracks in their metal-and-ceramic layers.

(d) Cracks running through the metal-and-ceramic layer down to the frame shall not be tolerated.

(e) Warping of the bimetal and metal-and-ceramic discs which will not induce any wheel braking with the brake released is allowed.

(f) Intermediate and pressure discs and the bearing flange are allowed to have their metal-and-ceramic plating crumbled along the entire length of the sector edges up to 12 mm in width.

(g) Permissible wear of metal-and-ceramic discs should not exceed 6 mm and the bimetal ones as far as the rivets.

(h) Should total wear of bimetal and metal-and-ceramic discs amount to a value which will cause the pressure disc pistons move out of the cylinder by more than 25 mm (Fig.72), replace the discs that are badly worn.

(i) Wheels in which the pressure disc moves through 25 mm or more, when actuated by cylinder pressure, should be replaced.

3. Every three months of aircraft operation replace lubricant in the landing gear wheels. Lubricate roller bearings with lubricant, grade HK-50.

6. Removal of Landing Gear Wheels

Main Landing Gear Wheels

Jack up the aircraft.

To remove the wheels use the following procedure:

1. Disconnect the hose of the brake air system from the wheel.
2. Remove the ЎA-23/2M transmitter from the wheel, having previously disconnected the electric wiring.
3. Remove the spring ring (No.12 in Fig.72) from the groove in the wheel drum and take off the wheel cover (No.6 in Fig.72).
4. Unlock and screw out the nut on the wheel axle and remove the protective flange.
5. Remove the wheel from the axle; remove the outer roller bearing, wheel drum, inner roller bearing and gland.
6. Screw out the nuts and remove bolts fastening the brake to the flange of the wheel axle.
7. Remove the wheel brake from the axle.

Note: Do not remove the brake when replacing the tires.

8. Wheels are installed in the reverse order. When installing wheels use lubricant, grade HK-50, for roller bearings.

CAUTION: During wheel installation tighten up the nut on the axle, slowly rotating the wheel until further rotation becomes difficult. Then screw out the nut by 1/8 of a turn and lockwire it. It is forbidden to tighten the nut applying great effort.

Landing Gear Nose Strut Wheel (Fig.73)

1. Disconnect the brake control air line from the pipe unions of both wheel brakes.
2. Disconnect the electric wiring without removing the ЎA-24 transmitter.
3. Unlock and unscrew the nut on the wheel axle.

4. Using a special puller remove the wheel axle from the fork for the strut and wheel.

5. Remove the wheel from the strut fork.

6. The wheel is mounted on the strut in the reverse order; use lubricant, grade HK-50 (for roller bearings); tighten up the wheel nut as far as it will go.

Note: When replacing the wheel, remove the brakes from it. Screw out the nuts and remove the bolts fastening the brakes to the brake flanges. Remove the flanges and mount them on the new brake. Install the brakes on the wheel.

7. Checking Operation of Mechanism for Turning Landing Gear Main Strut Wheel

A. General

The landing gear main struts are provided with mechanisms for turning the wheel semi-axles and with mechanic locks for fixing the struts in the extended and retracted positions (i.e. up-locks and down-locks).

During landing gear retraction or extension the angle between the longitudinal axes of the actuating cylinder and the strut changes, which causes turning of both the cylinder and the brace strut bolt about the axle of the brace strut bolt. Turning of the brace strut bolt during landing gear retraction and extension actuates the mechanism for turning the main landing gear wheel semi-axles (Fig.74).

All rods of the wheel turning mechanism except for the upper one are non-adjustable. The mechanical lock is adjusted by changing the length of the upper adjustable rod (Fig.75).

In the course of landing gear maintenance see that the upper adjustable rod is locked and the marks on it are aligned (Fig.75, detail A). When carrying out the 50-hour scheduled maintenance, inspect and lubricate with ЦИАТИМ-201 lubricant all hinges of the mechanism, and check the clearance between the stop on the strut rod and the head of the semi-axle bolt (Fig.75, view along B-B).

B. Checking Mechanical Lock
(in ground checking)

Check the mechanical lock in the following sequence:

(a) Jack up the aircraft nose and wings to separate the wheels from the ground.

(b) Operate the landing gear extending and retracting it two or three times.

(c) With the strut fully extended, check the mechanical lock for proper closing using rod gauge Ø3-0.05. The rod gauge should freely enter the check hole in the mechanical lock opened to the fullest extent and go as far as 22 mm (Fig.75, view along Б-Б). If the check holes on the links of the mechanical lock are not aligned, the rod gauge would not sink into the holes to a required depth (of at least 22 mm). In this case adjust the lock, for which purpose unlock and unscrew the locknuts of upper adjustable rod 2 (Fig.75), remove locking blocks 12 (two pieces) and adjust the mechanical lock by screwing adjusting bush 5 in and out to the check holes as shown in Fig.75, view Б-Б.

During one complete turn of the adjusting bush the rod length changes by 0.5 mm. Screwing the rod in reduces the rod length (right-hand thread), and vice versa.

(d) With the mechanical lock completely closed, check the clearance between the strut rod and the head of the semi-axle stop bolt. Permissible clearance is 0.03 - 0.25 mm.

The clearance being over 0.25 mm, replace the stop bolt with a new one, file down the head of the bolt to obtain a 0.03 - 0.1 mm clearance and a bolt-to-head contact area of at least 75%. The filing over, thoroughly remove the cuttings and coat the filed area with ЦИАТИМ-201 lubricant (Fig.75, view along B-B).

Note: 1. It is allowed to disconnect the brake hose from the wheel and the electric wiring from the УА-23/2М transmitters to make clearance measuring more convenient and facilitate filing the bolt head.

2. The mechanical lock should be checked for proper closing only after jacking up the aircraft to break the wheel contact with the ground and then operating the landing gear three times. With the shock absorber compressed on a parked aircraft clearance in the lock of the wheel semi-axle along Д-Д (Fig.75, detail Г) should not be checked as it does not affect the lock operation. In this case checking of the lock for proper closing with the help of the rod gauge is superfluous.

(e) Lower the aircraft to the ground.

C. Checking Main Strut Actuating Cylinders for Proper Locking

(When performing 50-hour scheduled maintenance)

After checking the mechanism for turning the main strut wheel it is necessary to check it for proper operation during landing gear extension and retraction. Check the landing gear emergency extension by compressed air (See Chapter "Aircraft Air System") to make sure that the main landing gear actuating cylinders are properly secured by their mechanical locks.

For this purpose bleed from the cylinders the air pressure which developed there after emergency extension of the landing gear, and apply a 50-kg force to each wheel to retract it.

Improper operation of the hydraulic cylinder mechanical lock will be indicated by deflection of the strut in the direction of retraction. In this case the hydraulic cylinder should be replaced.

8. Checking Operation of Landing Gear Nose Strut Shimmy Damper

A. General

The nose strut shimmy damper has a compensation chamber which is intended for replenishing of the operating chambers with fluid and serves as a temperature compensator when the fluid volume changes due to the shimmy damper heating or cooling (Fig.76).

The compensation chamber consists of a cylinder and a piston with a rod.

The rod projects to the outside and has two marks: a mark painted white, and a red one. When the shimmy damper is normally filled with the АМГ-10 fluid, the ambient air temperature being equal to +20° ± 10°C, the white check mark should be aligned with the surface of the upper cover (Fig.76).

Changes in temperature up to +55°C may result in the white check mark appearing 2 - 3 mm above the cover surface level, the shimmy damper being filled to a proper level. As a result of negative temperatures and fluid leaks in the shimmy damper the white mark will be found at a level with the compensator upper cover or below it.

Normal operation of the shimmy damper is allowed provided the red check rk is visible.

Note: The check lines mentioned should be marked 18.5 mm (in case of the white mark) and 10 mm (in case of the red mark) off the top of the plug.

B. Shimmy Damper Maintenance

Care of a shimmy damper includes: inspecting the damper for external leaks f the AMГ-10 fluid, replenishing the compensating chamber with fluid in due ime, replacing fluid and cleaning the holes in the compensator body.

1. Refilling Shimmy Damper with AMГ-10 Fluid

Refill the shimmy damper as follows:

(a) in summer: outdoors, provided the ambient temperature is +20 ± 10°C;

(b) in winter: indoors, with the ambient temperature of +20 ± 10°C, having reviously kept the shimmy damper under this temperature conditions for at east 3 hours.

Refill the damper in the following sequence:

(a) Place the shimmy damper in the operating position (with the orizontal).

(b) Unscrew the filler plug from the compensator rod and screw in adapter o.65641/233 available in the set (1:4).

(c) Connect the special filler appliance to the shimmy damper and pump the MГ-10 fluid into the compensation chamber until the rod will be pulled out 24 mm off the upper cover plane.

(d) Disconnect the filler appliance and unscrew adapter No.65641/233.

(e) Press the ball of the return valve (Fig.76) with a duralumin rod to bleed excess fluid and align the white check mark with the upper cover plane.

(f) Screw the plug home and lock it with the KOK-0.8 wire.

Note: If the first lot of shimmy dampers bears no check marks, remember the following data:

(a) With the chamber filled to normal capacity and the temperature being 20 ± 10°C, the rod is moved out at a distance of 18.5 mm from the top of the filler plug to the cover of the chamber.

(b) Minimum permissible length by which the rod may project is 10 mm as measured from the top of the plug to the cover.

2. Replacing AMГ-10 Fluid in Shimmy Damper

The AMГ-10 fluid in the shimmy damper should be replaced indoors, with the ambient temperature of +20 ± 10°C.

Proceed as follows:

(a) Screw out the filler plug from the rod, press the ball of the return valve with a duralumin stick, bleed the fluid completely and move the compensator rod fully down. Unscrew compensator 3 from body 2 (Fig.76).

(b) Unscrew filler plugs 1 and thoroughly drain fluid from the shimmy damper.

(c) Wash the inside of the working chambers and central chamber of the shimmy damper with fresh AMГ-10 fluid; wash also the compensation chamber of the removed compensator. Pour out the washing fluid completely.

(d) Place the shimmy damper horizontally with its non-linear transmission unit down. Fill fresh AMГ-10 fluid into the working chambers through the filler holes so that the fluid level is as high as the upper edge of the lug for filler neck and into the central chamber of the shimmy so that the fluid level is high as the upper edge of the body. See that the fluid temperature is +20 ± 10°C.

(e) Make sure that packing ring 11 on the compensator body is in good condition; replace the ring, if required. Screw the compensator in the shimmy damper body by smooth turns avoiding damage to the packing ring.

(f) Unscrew the plug from the rod of the compensator, screw the adapter in the rod and connect to it the device for filling the AMΓ-10 fluid.

(g) Use a gun to feed the AMΓ-10 fluid until it starts running over, free of air bubbles, out of the filling holes in the working chambers.

(h) Screw the filler plugs in the filler holes of the working chambers and turn the pump handle 3 or 4 times from one extreme position to the other. Stop the handle in the neutral position and screw the plugs from the filling holes of the chambers again.

(i) Pump the shimmy damper through, filling the chambers with AMΓ-10 fluid until the fluid starts running out of the filling holes of the working chambers after which discontinue the pumping.

(j) Screw the plugs in the holes of the working chambers, lockwire and seal them.

(k) Refill the compensator in conformity with Item 1.

Note: When refilling, see that no air bubbles appear during bleeding the fluid through the return valve in the compensation chamber. If bubbles are noticed during the bleeding, repeat refilling several times during which procedure each time press the compensator rod fully down.

After the running fluid appears free of air bubbles, refill the compensator in conformity with Item 1, Section B.

9. Checking Autonomous Extension of Landing Gear Nose Strut

(ground check)

Place jacks under the aircraft wings and nose to break the wheel contact with the ground.

2. Connect the ground hydraulic pump to the aircraft and retract the landing gear. Set the landing gear control valve neutral.

3. Open the nose strut up-lock by operating the autonomous extension handle located in the lower portion of the cockpit instrument panel. The nose strut should extend under its own weight. By pressing the strut manually set it in the locked position, after which set the up-lock in the closed position. Check the strut position by reference to the indicating light and the L.G. position indicator. Check to see that the retaining pipe union has entered the down-lock as far as 6 mm.

After checking the nose strut for autonomous extension, return the handle back to its position and lock it with the KOK-0.5 wire.

4. 3 or 4 times extend and retract the landing gear applying hydraulic pressure.

5. Lower the aircraft to the ground.

10. Adjustment of Main Strut Position Indicating System (to be performed in case of strut and landing gear lock replacement and every 50 flying hours)

A. Landing Gear Main Strut Down Position

Adjustment of landing gear main strut down position indicating system must ensure switching-on of the green indicating lights at the moment of the strut full extension, i.e. when it has travelled 0.5 - 1.6 mm short of its stop.

The following is the procedure used to adjust the landing gear main strut down position indicating system:

1. Hoist the aircraft on jacks placed under its wings and nose to break the wheels contact with the ground.

2. Connect the ground power source and ground hydraulic pump to the aircraft.

3. Lock the hydraulic cylinders of the main struts, for which purpose move the landing gear control handle to the RETRACTION position and turn (using hydraulic power) the main struts to place them at a 45 - 50° angle.

This done, change over the landing gear control handle to the EXTENSION position and after the main struts have been fully extended hold the handle in this position for 1 or 2 min., then place it neutral.

4. Press the wheel in the direction of its retraction and try to retract the strut by pushing it manually. If the strut resists, the mechanical lock may be considered closed.

5. Having made sure that the mechanical lock of the L.G. hydraulic cylinder is closed, adjust the limit switch in the following sequence:

(a) Turn the adjusting screw of the MBШ-2T mechanism limit switch into the rod of the pressing device as far as the stop (Fig.77).

(b) Apply a force of 50 kg to the wheel axle in the direction of the strut extension and, while holding it in this position, screw out the adjusting screw until the green indicating light flashes up on the ППС-2 panel in the cockpit. When doing this, do not shift the rod of the limit switch axially (Fig.77). The green light on, screw out the adjusting screw by 0.5 - 1.5 turns.

Applying a 50-kg force to the wheel axle towards the landing gear extension and retraction, i.e. taking up the play in the strut, make certain that the green indicating light on the ППС-2 panel in the cockpit is burning.

(c) Depress the rod of the switch to the stop and check to see that the rod travels freely at least 4 mm (Fig.77).

(d) Lock the adjusting screw.

6. Having adjusted the microswitches, perform 3 or 4 landing gear extensions and retractions and check the L.G. position indicating system for stable operation.

7. If the indicating system operation is not stable, unlock the adjusting screw, slacken it by 0.5 turn, lock again and proceed as set forth under Item 6.

Note: 1. The above Istructions are valid for aircraft from series number 1701.
2. In aircraft beginning with series number 1701 no adjustment is necessary.

B. Main Landing Strut Retracted Position

With the aircraft jacked up and main landing gear lowered, check adjustment of the МВШ-2Т retracted position limit switch using the following procedure:

1. Make sure that the mechanical up-lock for main struts is open and the [illegible] of the hydraulic cylinder is depressed.

2. Check to see that the clearance between the rod of the МВШ-2Т switch (for the main strut up position) and the lever of the lock is 0.2 - 0.5 mm (Fig.77).

3. Close the up-lock by hand.

4. Check to see that the rod of the МВШ-2Т limit switch travels freely at least 4 mm (Fig.77).

5. Displacement of the rod axle (of the МВШ-2Т limit switch) from the centre of the up-lock lever seat should be not over 2 mm.

6. See that the adjusting bolt is locked (Fig.77).

7. 3 or 4 times retract the landing gear to make sure that the indicating system functions properly (the red indicating light on the ППО-2 panel is on) with the main struts retracted and landing gear control handle in the NEUTRAL position.

8. Lower the aircraft from the jacks to the ground.

9. Disconnect the ground power source and hydraulic pump from the aircraft.

11. Extension and Retraction of Flaps

Extend and retract the flaps with the main hydraulic system under operating pressure and ground storage battery connected to the aircraft (or with the aircraft storage battery switched on when the engine is running). To extend and retract flaps use the following procedure:

1. Switch on the STORAGE BATTERY: AIRCRAFT, GROUND.

2. Switch on the LANDING GEAR, FLAPS and LANDING GEAR WARNING SYSTEM, NAVIGATION LIGHTS circuit-breakers on the cockpit right-hand side.

3. Connect the ground power source to the aircraft mains and hydraulic pump to the pipe union of the main hydraulic system.

4. Press the EXTENDED button on the M3-1 flap control panel, which will actuate the ГА-185 solenoid-operated valve. As a result, the flaps will start extending. Full extension of the flaps will cause burning of the FLAPS EXTENDED light on the ППС-2 panel in the cockpit.

If the landing gear is not extended in this case, the EXTEND LANDING GEAR light will flash up on the ППС-2 panel.

5. Press the RETRACTED button, which actuates the ГА-185 flap control valve. The flaps will get retracted.

Note: When a button is depressed on the M3-1 flap control panel, it remains depressed until the other button is depressed, in which case the first button returns to its initial position.

12. Checking Flaps for Proper Condition

When inspecting the flaps for defects do the following:

1. Make a thorough inspection of the flap tabs. See that no bends, cracks, damaged coating or other defects are present.

2. Check the outer skin of the flaps for dents, nicks, bends; check the riveted seams for condition.

3. Perform check extension and retraction of the flaps and compare maximum deflection (extension) of the flaps with the data contained in the Levelling Chart (Chapter XI). Make sure that the flap actuating cylinder and the ГА-185 solenoid-operated valve which actuate the flaps for normal extension and retraction function properly.

4. Check the flaps for synchronous operation. One of the flaps may be fully extended or retracted while the other has only started extending or retracting. In this case asynchronous operation of the flaps is allowed provided the force applied to the flap lagging behind (i.e. to the flap trailing edge) to retract or extend it is not over 5 kg (the force should be applied to the flap after disconnecting the flap control rod).

Notes: 1. Check the flaps for synchronous operation, with the aircraft in use, in the following cases: asynchronous operation of the flaps with one of the flaps lagging by one full travel behind the other, or when the pilot complains of poor lateral stability of the aircraft.

2. After extension of the flaps prior to flight the aircraft technician should make certain that both flaps have been fully extended.

5. Check proper operation of the flap position indicating system during retraction and extension of the flaps by pressing the corresponding button on the M3-1 flap control panel in the cockpit and watching the relative indicating lights flash up on the ППС-2 panel in the cockpit.

13. Drag Parachute Release and Drop

The drag parachute is released and dropped by the pilot, with the air system under a 30 kg/sq.cm. pressure. For this purpose use the following procedure:

1. Switch on the storage battery and the DRAG PARACHUTE circuit breaker on the cockpit right-hand side.

2. Press the PARACHUTE RELEASE button on the instrument panel, which actuates the electro-pneumatic valve. This valve will supply air to the cylinder which opens the drag parachute shutters to release the parachute from the container.

3. Press the PARACHUTE DROP button on the cockpit left-side panel to drop the drag parachute. This will actuate the second electro-pneumatic valve which will supply air to the cylinder for opening the lock holding the drag chute cable. The lock will open and release the cable.

Note: Each time a drag chute container is installed on the aircraft, check the shutters for proper opening by pressing the PARACHUTE RELEASE button. When doing this, hold the left-side shutter with the right shoulder. If the shutters have a tendency for opening (i.e. they offer resistance), the shutter opening system may be considered sound. The checking over, close the shutters and lock the retainer with the M2-K1 wire.

14. Attachment of Drag Parachute to Aircraft

(Fig.78)

After landing in which use has been made of the drag parachute, disconnect the cable from the lock (if the parachute has not been dropped during the aircraft roll), clean the parachute compartment from dust, dirt, snow or moisture and inspect the shutters, compartment and locks for damage. Then place a new parachute in the compartment.

The parachute which has been used should be packed in conformity with the Instructions on Packing and Maintenance of ПТ-6152-59 Parachute.

To hold the drag parachute in the container when placing it in the parachute compartment, four flaps made of special cloth are provided on the container to cover the drag parachute.

The side flaps (one upper and one lower) have loops which should be secured with a cable with a red flag after the parachute has been packed in the container (Fig.79).

To install the drag parachute on the aircraft use the following procedure:

1. Arrange the cable in the container removed from the aircraft in such a manner as to form a loose "eight", one end of the cable coming out to the outside in the container rear right-hand corner (as viewed from the aircraft rear).

Then put the packed parachute on top of the cable (the parachute should be packed according to Instructions No.2010-59). See that the open end of the parachute pack faces the aircraft tail.

Smooth out the parachute in the container and spread it uniformly all over the container. Place the pilot chute on the rear flap of the drag parachute container in its upper left-hand corner (Fig.78).

2. Close the parachute and cable with the flaps.

The front flap is the first to be closed, then follows the rear flap and finally the right-hand and left-hand flaps (upper and lower). Next lock the flaps with the cable provided with a red flag and close the fifth (protective) flap.

3. Install the container with the drag parachute in the aircraft fuselage compartment (Figs 79 and 80). To this end:

(a) Make sure that the doors are open and locked by the spring mechanism and the rod of the pneumatic cylinder for parachute door opening is drawn in (Fig.80).

<u>Notes</u>: 1. Parachute door opening is performed by turning the hexahedral piece of the lock on the outer door (the mark on the lock should move to the OPEN position) or by pressing the PARACHUTE RELEASE button in the cockpit.

2. When opening the drag parachute doors, hold them with the hands. Be careful not to hurt the hands when the doors open abruptly, actuated by a spring.

(b) Move the container right-hand lower part in the fuselage compartment in such a way as to insert the container pins in the corresponding holes provided in the fuselage (Fig.79).

(c) Move the container left-hand upper part in the fuselage compartment, pull the lock cable and open the locks. Having made certain that the pins on the left side of the container are inserted in the locks on the fuselage, let the cable go.

(d) Make sure that the container is locked and closed by the fifth (protective) flap.

CAUTION: When placing the parachute container in the fuselage compartment:

1. Be careful not to pull out the locking cable of the parachute and not to tear off the ties.

2. See that the fifth flap of the container is not jammed bet en the container rear edge and the doors.

4. Close the parachute compartment doors, first the right-hand lower door and then the left-hand (upper) door. While holding the doors with the hands, pull out the locking cable of the parachute (Figs 79 and 80).

5. Lock the doors, for which purpose close the doors tightly by turning the axle of the lock on the left-hand door with a wrench (i.e. by turning with a wrench the hexahedral socket); hold the doors tight and close the front lock having pressed the stop of the lock; then turn up the axle of the lock with the wrench, again (Fig.80).

6. Make sure that the marks on the axles of the locks have been aligned with the marks on the fuselage skin, after which lock the hexahedral piece on the fuselage with the M2-K1 wire (Fig.80).

7. If the catch-lock (Fig.81) of the drag parachute cable is closed, open it by pressing the PARACHUTE DROP button in the cockpit or by means of the socket wrench (manually).

8. Put the ring of the shackle of the connecting link cable on the hook of the lock and close the lock (Fig.78).

9. Place the cable and connecting link of the parachute in the clamps on the bottom fin and in the channel provided in the fuselage tail part. The clamps ensure proper attachment of the cable throughout its entire length. The cord should not slip out of the clamps (Fig.78). Remove the drag parachute and its container from the aircraft in the reverse order.

15. Checking Operation of Drag Parachute System

When performing scheduled maintenance every 50 flying hours, check the parachute operating system in the following sequence:

1. Place a canvas piece on the ground under the fuselage drag parachute compartment to avoid parachute fouling when it is dropped from the container.

2. Make sure that the doors of the parachute compartment are closed and the lock is wired.

3. See that the air system is under a 50 kg/sq.cm. pressure (which is a normal operating pressure).

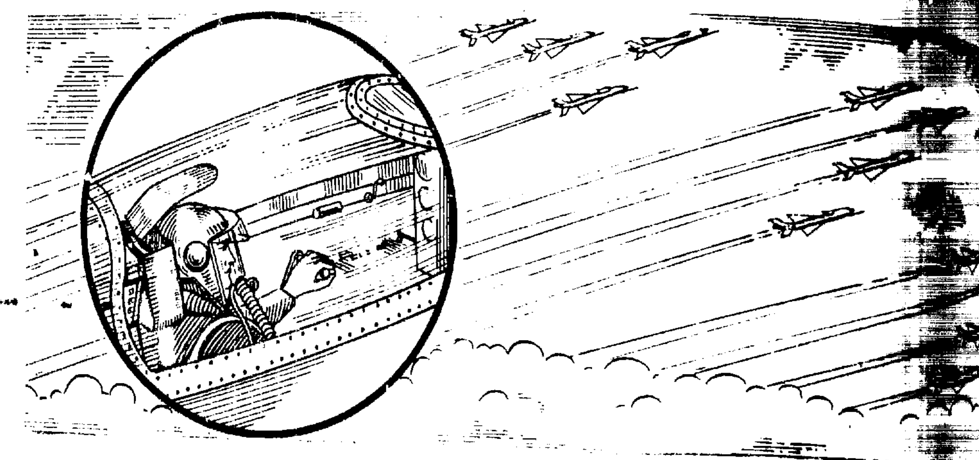
4. Press the PARACHUTE RELEASE button. This will break the locking wire, which results in the opening of the doors. The drag parachute drops under its own weight from the container housed in the parachute compartment. The shutters should remain open.

5. Apply a 5-to 15-kg force to the parachute cable and press the PARACHUTE DROP button. The lock should open.

Operations pointed out in Items 4 and 5 should be repeated with the air system being under a 30 kg/sq.cm. pressure (which is a minimum operating pressure).

The check over, restore the system to its initial position.

6. Check to see that the outer doors of the drag parachute container fit closely to the fuselage skin, which will ensure tightness of the drag parachute fuselage compartment.



Chapter VII

PRESSURIZED COCKPIT

1. General

The aircraft pressurized cockpit is of a ventilation type and is provided with an automatic remote-control supply system.

Free ventilation of the cockpit is provided for altitudes from 0 to 2000 m. Beginning from 2000 m. the pressure difference develops in the cockpit which gradually increases with altitude and reaches 220 ± 10 mm Hg(0.3 kg/sq.cm.) at 9000-12,000 m., this amount of pressure difference remaining constant up to the aircraft ceiling.

Pressure in the cockpit is regulated by means of the АРД-57В pressure regulator.

Valve ПК calibrated for a 0.35 kg/sq.cm. pressure protects the cockpit from excessive pressures. The УВПД-20 cockpit altitude and pressure differential gauge shows the difference between the cockpit and atmospheric pressure, and indicates the cockpit "altitude".

The cockpit is supplied with the air from the engine compressor (Fig.82).

The air from the compressor is fed to solenoid-operated air distribution valve 14 (unit 525) and then through the "hot" or "cold" line to cockpit supply valve 8. When directed through the "cold" line, the air passes through air cooler 13 and, after cooling, through turbine cooler 12 to return valve 11; when passed through the "hot" line, the hot air is supplied to the return valve, without passing through the cooling units.

At the cockpit entrance both lines merge to form one line. So the mixed air is directed to the cockpit supply valve. From this valve the air is fed to canopy blow-off manifold 4 and pilot's feet blow-off manifold 5. Installed in the pipeline running from the cockpit supply valve to the manifolds for canopy glass and pilot's feet blow-off is valve 10 which restricts air supply to the manifolds. This restricting valve automatically controls the pressure of the air which is supplied to the blow-off manifolds.

When pressure under which the air is suplied to the blow-off manifolds exceeds 0.12 kg/sq.cm. the restricting valve by-passes a certain amount of of the air from the supply line to the cockpit.

From the same line air is branched off to the ТРТВК-45М automatic temperature controller for blowing-off the controller spiral.

While blowing-off the spiral of the temperature controller the air simultaneously ejects the cockpit air bringing its temperature to the mean cockpit air temperature. Electrical remote control of the cockpit supply system is accomplished through the use of four-position selector switch 6 bearing the COCKPIT HEATER inscription.

The selector switch has four positions:
HOT, COLD, AUTOMATIC and NEUTRAL.

With the switch in the NEUTRAL position, the control of the cockpit supply system is switched off.

When the switch is set to the HOT position, only hot air is being directed to the cockpit from the engine compressor. When the switch is set to the COLD position, only cold air is being supplied by the air distributing unit to the cockpit (through the air cooler and turbine cooler).

The switch being placed to the AUTOMATIC position, air distribution is controlled by the TPTBK-45M (9) automatic temperature controller which maintains the pre-assigned air temperature in the cockpit.

The required temperature should be set on the scale of the automatic temperature controller by turning its head.

The temperature controller can be set for any temperature from +16°C to to +26°C (as read off the scale).

CAUTION: The controller should be set for the required temperature by the technician when on the ground. It is recommended that the temperature controller should be set to a +16°C temperature.

When the air temperature in the cockpit deviates from the required value, the temperature controller switches on one of the windings of the air distributing valve reversible electric mechanism. The latter turns the flaps in the air distributing valve and directs the air to the cockpit through the "hot" and "cold" lines.

After the cockpit air has reached the pre-assigned temperature, the automatic temperature controller will break the electric circuit, as a result of which the air distributing valve will remain in the position which ensures a required hot-to-cold air ratio for the mixed air supplied to the cockpit.

CAUTION: To ensure efficient operation of the "cold" line, a "hot" line vent pipe is provided in the air distributing valve. After passing through the "hot" line flap the "hot" air is directed to the atmosphere through the vent pipe.

2. Location of Instruments and Units which Go to Make Up System for Cockpit Heating, Ventilation and Pressurization

The air cooler is installed between frames Nos 21 and 22. The purpose of the air cooler is to cool the air before it is supplied to the turbo-cooler. When passing through the air cooler, the hot air transfers about 80% of heat.

The air distribution solenoid-operated valve (unit 525) is located on frame No.22.

The electric valve is an actuating mechanism incorporated in the system for cockpit temperature automatic remote control. It is designed for distributing the air which is fed to the cockpit through the "hot" or "cold" line or through both lines at a time. The air distribution electric valve is automatically controlled by the TPTBK-45M temperature controller.

The turbo-cooler (unit 477) is located between frames Nos 14 and 15 in the right-hand bottom corner. The turbo-cooler is designed to cool the air supplied to the pressurized cockpit from the air cooler.

The cockpit supply valve is installed in the cockpit on frame No.11.

The cockpit supply valve has a flap which can be set to one of the following positions: OPEN and CLOSED.

The valve is remotely controlled through the cabling system. It is operated by the control handle installed on the right-hand panel in the cockpit (Fig.83).

If smoke, fuel or oil vapours get in the cockpit, disconnect the cockpit pressurization system from the engine by placing the supply valve control handle to the CLOSED position.

When the aircraft is on the ground with the engine inoperative, the cockpit supply valve should be always closed.

Open the valve before starting the engine. Starting and operation of the engine with the cockpit supply valve in the closed position is not recommended.

CAUTION: In summer, the ambient air temperature being 2° or 6°C below the temperature set at the scale of the temperature controller, it is advisable before starting the engine that the solenoid-operated air distribution valve should be set to the COLD position so as to preclude supplying hot air to the cockpit at the first moment.

The АРД-57В air pressure regulator is installed on the cockpit canopy-carrying panel in its right-hand section, between frames Nos 10 and 11 (Fig.84).

The purpose of the air pressure regulator is to automatically maintain constant air pressure in the cockpit as has been preset by regulating the air consumption in the cockpit.

The air pressure regulator consists of two units: regulator (transmitter) and valve 520 Б (actuating mechanism). Valve 520 Б is located on frame No.6 in the cockpit.

The regulator is provided with a valve whose handle can set the regulator to one of the three positions: ON, OFF and CHECK. In operation the regulator CHECK position is not used.

When the handle is placed in the ON position, the regulator becomes switched on for normal operation in flight. In this position the handle should be locked. The handle being placed in the OFF position, the regulator will close the air passage from the cockpit through valve 520Б. With the handle in this position, the cockpit may be checked for tightness when on the ground.

The ПК safety valve is located on frame No. 6 in the cockpit.

The safety valve is designed to protect the cockpit from damage when the pressure in the cockpit exceeds the permissible limits. The excessive pressure in the cockpit being of the order of 240^{-5} mm Hg, the valve gets opened and bleeds excessive air from the cockpit.

The УВПД-20 cockpit altitude and pressure differential gauge is installed on the instrument panel (in its lower section).

The УВПД-20 gauge is intended for measuring the cockpit "altitude" and difference between the pressure inside the cockpit and atmospheric pressure, the instrument altitude readings being from 0 to 20,000 m. and pressure difference from - 0.04 to + 0.6 kg/sq.cm.

The ТРТВК-45М air temperature controller (Fig.85) is installed in the cockpit, rear of the pilot's seat, at frame No.11, on the left side.

The temperature controller is designed to automatically maintain the air temperature in the cockpit within the required limits (distributing valve 525 being the actuating mechanism).

Using the limb, the air temperature in the cockpit can be set within the range of from +16 to +26°C. Normal setting of the limb is at +16°C mark.

The four-position selector switch bearing the COCKPIT HEATING inscription is installed on the right-hand panel in the cockpit.

The four-position selector switch is intended for control of the distribution valve.

The return valve (unit 738И) is located between frames Nos 12 and 13, at the bottom.

The return valve lets the air in one direction only, i.e. from the engine to the cockpit. In case of engine failure or any damage to the pipeline supplying air to the cockpit, this valve closes, thereby preventing leakage of air from the cockpit. The arrow mark on the valve body shows the direction of air flow.

The restricting valve which regulates the air supply to the manifold is intended to automatically maintain constant pressure of the air which is directed to the manifold for blowing off the canopy and pilot's feet.

It is installed on the cockpit left side, under the floor, next to frame No.7.

The pipe union for ground cockpit ventilation is intended for forced ventilation of the cockpit when the aircraft is on the ground with the engine inoperative in case the pilot has to stay in the cockpit for a long time.

3. Cockpit Ground Check for Tightness

The cockpit is checked for tightness with the aid of a Ж6-9820-00 special device in the following sequence:

1. Set the valve of the АРД-57В pressure regulator to the OFF position (which is the position for ground checking of the cockpit).
2. Close the cockpit supply valve.
3. Connect the hoses of the ground device to the pipe unions located in the nose strut well on the plug for the cockpit ground ventilation branch pipe. Connect the ground air bottle to the ground device.
4. Close the canopy and seal it from the outside.

CAUTION! When using the ground device for cockpit checking see that nobody is present in the cockpit.

5. Open the valve of the ground bottle and, while slowly opening the valve of the ground device, fill the cockpit with air. Watch indications of the pressure gauge mounted on the device. See that the rate of pressure increase does not exceed 0.1 kg/sq.cm. per minute.
6. Having brought the pressure to 0.35 kg/sq.cm., stop supplying air to the cockpit, close the valve of the device and the valve of the air bottle.

Check the time required to obtain a pressure drop in the cockpit from 0.3 to 0.1 kg/sq.cm.

7. The cockpit is considered airtight, if the time of pressure drop from 0.3 to 0.1 kg/sq.cm. is at least 90 sec. If this period is less than 90 sec., locate the leaks and eliminate them.

CAUTION! One of the probable causes of the cockpit poor sealing may be dried grease in hermetic lead-outs of the engine or aircraft control rods. If that is the case, lubricate the rods as prescribed in Chapter "Aircraft Maintenance", Section "Control System".

8. Disconnect the hoses of the ground device and set the valve of the АРД-57В pressure regulator to the ON position. Lock it in this position and plug the pipe unions.

4. Checking Operation of System for Automatic Air Temperature Control

Solenoid-operated air distribution valve (unit 525)

Using the ground power source, check operation of the electric air distribution valve in the following sequence:

(a) Turn on the STORAGE BATTERY: AIRCRAFT, GROUND switch and the COCKPIT HEATING circuit breaker, both located on the right-hand panel.

(b) Set the four-position selector switch of the cockpit supply system to the COLD position and, watching through the left-hand bottom hatch between frames Nos 20 and 22 the movement of the air distribution valve levers, make sure that it is intact. After the distribution valve has been set to the extreme position, the electric mechanism should become switched off, which is checked by ear.

(c) Set the selector switch to the HOT position and watch the movement of the levers up to the moment of the air distribution valve switching-off to make sure that the air distribution valve functions properly. The time during which the air distribution valve gets switched over should total 30 sec.

CAUTION: If setting the switch to the COLD position will not result in the switching-on of the electric mechanism (which may be the case if the distribution valve has already been set to this position), set it first to the HOT position and then to the COLD position.

Switch off the STORAGE BATTERY: AIRCRAFT, GROUND switch and the COCKPIT HEATING circuit breaker which are both switched on for the check period.

ТРТВК-45М cockpit air temperature controller
(to be checked in case of system failure)

Using a ground power source check operation of the cockpit air temperature controller in the following sequence:

(a) Turn on the STORAGE BATTERY: AIRCRAFT, GROUND switch and the COCKPIT HEATING circuit breaker, both located on the right-hand panel.

(b) Open the cockpit supply valve.

(c) With the ambient temperature below +16°C, switch over the supply system to the "cold" line, after which set the four-position selector switch to the AUTOMATIC position.

The air temperature controller being intact, the system will be switched over to "hot" air supply.

(d) With the ambient air temperature being over +16°C, switch over the system to the "hot" air supply, after which set the selector switch to the AUTOMATIC position.

Proper switching-over of the system to the "cold" air supply will indicate normal operation of the air temperature controller.

(e) Turn off the STORAGE BATTERY: AIRCRAFT, GROUND switch and COCKPIT HEATING circuit breaker, that were switched on for the check.

CAUTION: Remember that at a temperature of +16° ±4°C the contact of the temperature controller may be in the neutral position and, hence, the temperature controller may fail to get switched over under these conitions. In this case it is advisable to blow off the controller with warm or cold ir from the ground source.

(f) Place the cockpit supply valve to the CLOSED position.

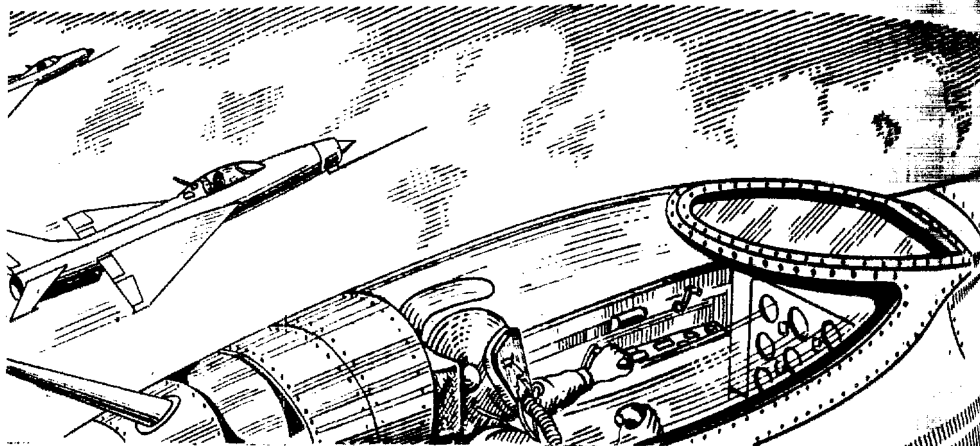
Turbo-cooler (unit 477)

(a) During preliminary preparation check the turbo-cooler for proper funcioning turning its rotor by the fan blade. To gain access to the fan blade pen the bottom hatch between frames Nos 14 and 16.

Easy rotation of the rotor is a proof that the turbo-cooler condition is satisfactory.

(b) Check the turbo-cooler for proper operation with the engine running. To his end switch the system to the cold air supply and see that the temperature f the air flowing from the manifold for blowing off the canopy is 5 or 15° below the ambient air temperature (under average humidity conditions). If it occurs that the air temperature is not below the ambient air temperature (after the "cold" line has been switched on), check the shaft of the turbo-cooler for free otation. If the temperature of the "cold" line air does not drop to a noticeable xtent, with the turbo-cooler intact, this is indicative of excessive air overflow rom the "hot" line to the "cold" one via the flaps of unit 525.

(c) Every 50 hours of operation refill the OKB-I22-I4 oil to the turbo-cooler. Fill 55 gr of oil through one of the holes provided for the purpose.



Chapter VIII

COCKPIT CANOPY

1. General

The cockpit canopy is designed to protect the pilot from the impact air pressure in flight. It provides good visibility from the cockpit and ensures the necessary cockpit pressurization.

The canopy has the following constructional characteristics:

1. The canopy can be opened and closed for the pilot to enter and leave the cockpit, i.e. it turns about the canopy-to-fuselage front attachment unit. In flight the canopy can be jettisoned by operating the canopy emergency control system or it can be detached from the fuselage together with the pilot's seat in case of bailing out.

2. The canopy glass panels are made of various kinds of glass:

(a) most of the canopy (except for the front glass panel) is made of heat-resistant organic glass, grade CT-1, 10 mm thick;

(b) the front glass panel is made of silicate triplex, 14.5 mm thick.

Placed under the canopy is transparent armoured glass, 65 mm thick, on both sides of which are installed glass flaps which protect the pilot from the onrushing airstream in case of canopy emergency jettison.

3. The canopy is provided with two systems which control the canopy locks: service and emergency.

The service canopy control system provides canopy lifting and lowering, its pressurization and attachment to the fuselage.

The emergency canopy control system provides autonomous (independent of the seat) emergency jettison of the canopy, detachment of the canopy from the fuselage during ejection with canopy protection as well as separation of the canopy from the seat after ejection.

Therefore, the locks by which the canopy is attached to the fuselage and the catch-locks connecting the canopy to the seat during ejection are joined to the control rods. The layout and operating principle of the locks will be presented further.

Located on the fuselage inside the canopy-carrying panel are six locks 3 (Fig.86) controlled through the rod system by lever 7 on the left-hand side of the cockpit (service control system)

The canopy frame is furnished with six emergency side locks 3 (Fig.87) (corresponding to the six locks on the fuselage) which are opened in case of canopy emergency jettison.

Slip-out loops 20 in these locks (elements common for both service and emergency systems) enter the slots provided in the fuselage locks when the canopy is lowered. When lever 7 (Fig.86) is deflected forward, the slip-out loops become locked by pins 21 (Fig.87), thereby accomplishing canopy-to-fuselage attachment.

Deflection of lever 7 rearward (Fig.86) will drive the pins out of the loops, thus releasing the canopy.

Locks 3 for canopy emergency jettison (Fig.87) are interconnected inside the canopy frame through the rods and bell cranks actuated by the pressure of gas generated after operation of firing gun 6 which is actuated by deflecting handle 2 for canopy emergency jettison, the handle being located on the cockpit right-hand side (canopy emergency control system).

Operation of the canopy emergency control system will open locks 3; the latter will release loops 20. The loops will slip out of locks 3 and remain on pins 21 in the slots of the canopy-carrying panel. This breaks canopy-to-fuselage attachment.

When lifted, the canopy turns about the front bracket attached to the fuselage, to which the canopy is connected by two locks (a left-side and a right-side lock) installed on hinged joint 26 of the canopy. These locks (hinges) are usually closed, and open only when the canopy emergency jettison system operates, being actuated simultaneously with side locks 3.

Bolt 22 gets released, thus disconnecting the canopy from the fuselage.

4. Opening (lifting) and closing (lowering) of the canopy is accomplished through its turning about the front hinged joint by 45°.

Opening of the canopy is accomplished by two actuating cylinders 7 (on the right and left side) whose rods are connected to the canopy by special pins via C-shaped hooks and canopy locks. The cylinders in their turn are connected to the fuselage by hinges.

The upper ends of hooks 25 are set in the slots of double-arm bell cranks 24 of the canopy emergency jettison system (the system being in the closed position), which will connect pins 23 to the canopy.

Operation of the canopy emergency jettison system will turn double-arm bell cranks 24 and release the C-shaped hooks which will release the pins of the canopy actuating cylinder rods. To open the canopy, air under 50 kg/sq.cm. pressure is supplied to the actuating cylinders from the aircraft air system.
The canopy closes under its own weight. In this case the air is bled from the cylinders into the atmosphere.

5. Canopy closing and opening is accomplished by operating valve 22 installed on the cockpit left-hand side. The valve passes the air to the actuating cylinders to open the canopy and bleeds the air into the atmosphere to close it.

The valve is actuated by the handle connected through a hinge joint with the axle on which is fitted the toothed sector. The sector teeth mesh with the teeth of the wheel which is fixed on the valve axle. Provided on the valve control handle is a lever connected by rods with all six fuselage locks 3 which close the loops of the canopy side locks.

When in the CANOPY CLOSED position (i.e. in the front position), the spring-actuated valve handle enters the slot in the panel, thereby becoming locked; with the handle in this position, pins 21 (Fig.87) enter loops 20 of the canopy side locks and lock the canopy, the valve supplying air to the actuating cylinders and the relief valve intended to bleed air from the cylinders being closed.

Before moving the valve control handle for canopy opening first deflect the handle away from the cockpit side wall, then move it out of the panel recess and by deflecting it rearward open the canopy.

A 60° handle travel will cause the pins to come out of the loops of the canopy side locks, and with a 15° handle travel the air from the air system will get to the actuating cylinders through the valve.

Air delivery to the canopy actuating cylinders begins after the handle has been moved through 3 or 6° from the position in which the pins are completely brought out from the loops of the side locks. This will eliminate the possibility of air accumulation in the cylinders and of abrupt opening of the canopy after the pins have come out of the loops.

When moving the valve handle forward to close the canopy, the handle will be locked in the vertical position (after it has passed through 45°); the air in this case is bled from the cylinder into the atmosphere through the valve.

After the canopy has been completely lowered, the loops of the locks have entered the slots of the canopy-carrying panel and the rear left-side loop of the lock has depressed spring-type retainer 5 (Fig.86) of the closing pin, the valve handle can move further to the CANOPY CLOSED position. As a result the closing pins will enter the loops of the canopy side locks and the valve handle will enter the panel recess and will be locked there.

Locking of the handle in the intermediate position by retainer 5 (which supports the end-face of the rear left-side pin till it moves up to the stop of the loop of the rear left-hand lock) will prevent the aircraft from taking off with the side locks open.

It is possible to open and close the canopy from the outside, for which purpose the axle of the valve handle is brought through the packing box and outer skin to appear from the outside of the cockpit. Attached to the axle outer end is another handle which, when removed, is brought flush with the fuselage outer skin when the canopy is closed (Fig.88).

The canopy actuating valve can be operated both from the handle in the cockpit and by means of the outside handle.

For canopy smooth opening and closing the valve is provided with orifices (at the valve inlet and at the relief line) which ensure the canopy opening within 3 - 5 sec. and closing within 5 - 10 sec.

If it is necessary to open the canopy from the outside when no pressure exists in the aircraft air system, use should be made of the handle which is provided on the fuselage left-hand side rear of the first external handle. Operation of this handle (also flush with the fuselage) will lift the canopy. In this case the canopy locks should be opened by the handle inscribed CANOPY OPENING (Fig.88).

6. Canopy-to-fuselage connection is sealed owing to a shaped rubber hose (canopy sealing) filled with air under a pressure of $2^{+0.55}_{-0.3}$ kg/sq.cm. supplied from the aircraft air system (Fig.86). The rubber pressurization hose placed in a groove runs along the canopy-supporting panel and along the edge of the sealing partition (rear of the pilot).

Filling the hose with air is accomplished through the same valve which actuates the canopy. For the purpose the valve is provided with a second chamber 23 independently connected with the air system through a separate line.

Engaging lever 15, whose operation will supply air or bleed it into the atmosphere, is fitted on the common axle with the canopy actuating handle and is connected with the valve axle through the gear wheel. The canopy pressurization hose should be filled with air when the canopy is closed. To fill the hose, move the engaging lever forward.

Bleed the air from the canopy pressurization hose before opening the canopy. For this purpose move the engaging lever rearward .

To save time and efforts, the canopy is opened and depressurized by a single rearward movement of the valve handle. When moved, the handle will travel together with the engaging lever.

For canopy pressurization from the outside, the valve axle is brought through the packing box to the outside flush with the fuselage skin. The outer end of the valve axle is provided with slot 17 (Fig.86) for the screw driver. The air for filling the canopy pressurization hose is fed from the aircraft air system through the PB-1.5 reducing valve (Fig.86, No.9), safety and return valves 10 and further through the valve to canopy pressurization hose 4.

7. In case of emergency the canopy can be jettisoned in flight, for which purpose (as it was stated above) the canopy and fuselage are furnished with the canopy emergency jettison system (emergency lock opening system) with forced canopy jettison by air pressure equal to 110 - 130 kg/sq.cm.

To actuate the canopy jettison system a handle for canopy autonomous jettison is installed on the cockpit right-hand side, the handle being fitted with a hinged lever. The canopy emergency jettison system operates in the following sequence:

When hinged lever 2 is thrown up (Fig.87) through a $\sim 45^{\circ}$ angle, the cable which connects the lever with cotter pin 10 of diaphragm valve 12 will extract this cotter pin, which will release striker 4 (Fig.89) and break diaphragm 3.

The air from emergency air bottle 11 (Fig.87) separated from the main air system by return valve 9 will get into canopy actuating cylinders 7, thereby preparing the canopy for jettisoning. Then the air will be supplied to cylinder 13 which actuates (opens) the time lock whose rod will shear rivet 19, drive out axle 18 and open lock 15.

When the hinged lever of the canopy emergency jettison system has been turned through 75°, its tooth will be disengaged, which allows the lever rearward movement.

After moving 20 - 30 mm rearward, the end of the handle lever set in the slot of the canopy trigger mechanism will move the plunger of the actuating mechanism. As the plunger is connected by a cable with the release lever of firing gun 6, the latter will be actuated (Fig.87).

The powder gas pressure from the firing gun will be supplied to two cylinders 5 whose rods, while moving, will open through the system of bell cranks and rods six canopy emergency locks 3 and two locks 1 of the front hinged joint.

Double-arm bell cranks 24 will release C-shaped hooks 25 which connect the canopy with the actuating cylinders, as a result of which the canopy will be tossed by the air pressure supplied to the cylinders from the emergency bottle.

Further rearward movement of the handle will cause switching-on of valve 16 (bleeding of gases from the TCM-2500-38 firing gun), i.e. the valve cotter pin will be pulled out (refer to Chapter IX).

<u>Note</u>: If one of the firing gun cylinders fails, the system can reliably operate actuated by the other cylinder. This is achieved due to the right-side and left-side locks of the canopy emergency jettison system being connected by a common axle which is fitted with the levers of the canopy front locks.

When closed , the canopy emergency jettison system is locked and sealed in the following hinged joints (Fig.91):

(a) hinged handle 1 is locked with the M1M-KO.5 wire;

(b) canopy firing gun release lever on autonomous jettison handle 1 is locked with the KO-KO.5 wire;

(c) cotter pin of the canopy firing mechanism 2 is locked with the M1M-KO.5 wire;

(d) rear control levers for the canopy emergency jettison system at the bell cranks of firing gun cylinders 4 are locked with the KO-KO.5 wire;

(e) cotter pin of diaphragm valve 6 is locked with the MIM-KO.5 wire.

The canopy locks are considered closed, if the above-mentioned wires are found in their appropriate places and C-shaped hooks 25 (Fig.87) of the actuating cylinder rods are properly set relative to the slots in double-arm bell cranks 24.

The canopy closed position is checked:

(a) by red marks on the hooks of the cylinder rods; the hooks should enter the slots in the double-arm bell cranks in such a manner that their painted surface should be completely hidden inside the slots in the bell cranks (Fig.92);

(b) by alignment of the holes in the left hook of the rod and in the double-arm bell crank, which is determined by inserting a ground lock pin in the holes of the bell crank and hook (Fig.93).

The ground lock pin is used not only for checking alignment, but also for locking the system in the closed position and preventing its shifting. It should be installed each time the canopy is opened and the ground lock pins are inserted in the rods of the canopy actuating cylinders.

8. Installed on the canopy are front and rear catch-locks which connect the canopy with the pilot's seat when ejecting under the protection of the canopy (See Chapter IX).

Front catch-locks 4 (Fig.87) are installed on the right-hand and left-hand fuselage sides. When ejecting, they engage the hinged supports on the seat sides.

Rear catch-locks 14 are installed also on the canopy right-hand and left-hand sides next to the side rear locks. During ejection they engage the seat trunnions.

To avoid lifting of the canopy front portion during ejection and ensure reliable canopy-to-seat connection, a time lock (Fig.90) is installed on the fuselage.

The time lock gets opened when the canopy has turned the lock through about 70°. Fitted on the front hinged joint are two rollers whose purpose is to ensure canopy movement on the armoured glass at the initial moment of seat ejection under protection of the canopy.

When ejecting with the canopy, the seat trunnions will enter the rear catch-locks (Fig.94) after the seat has travelled 20 mm upward. After the trunnions have been locked, rod 7 will open all emergency locks 3 and 1 (Fig.87), which will cause breaking of all canopy-to-fuselage connections except for the time lock (Fig.90).

The seat trunnions are closed by the catch-locks before the canopy rear locks get opened.

Further upward movement of the seat together with the canopy will turn the time lock which releases the canopy after turning through 70°. The released canopy rolls along the armoured glass on rollers 7 (Fig.95).

At the moment when the seat pan ejects from the cockpit, the spring-loaded collapsible supports will open and engage the front catch-locks of the canopy rolling on the armoured glass (Fig.87, No.4 and Fig.96).

The canopy is disengaged from the seat upon operation of firing gun mechanisms 215Φ which will turn the seat double-arm levers (See Chapter IX). These levers press triggers 6 (Fig.94) mounted on the rear catch-locks and through the rods open front catch-locks 4 (Fig.87) whose clamps drop out of the locks, thereby breaking the canopy-to-collapsible supports connection.

To ensure synchronous disconnection of the canopy from the seat as well as for duplication purposes if one of the firing gun mechanisms 215Φ fails, the front locks are interconnected with double cabling.

Actuated by the impact airstream and by firing gun mechanisms 215Φ which turn the canopy about the seat trunnions through the double-arm levers, the canopy becomes lifted and thus opens the cockpit.

Turning the canopy through some 110° engages guides 9 (Fig.94) on the rear catch-locks with the cams of the seat trunnions; the cams press back the trunnions and release the rear catch-locks, thereby completely breaking the canopy-to-seat connection.

9. To remove ice from the front glass panel when flying under ice formation conditions, an alcohol de-icer manifold is installed on the canopy. For maintenance of the de-icer and canopy glass see Section 4 of the present Chapter.

10. To ensure heating of the cockpit and canopy glass under conditions of ice formation or glass sweating, a blow-off manifold is provided on the canopy.

When the canopy is closed, the p[illegible] of the blow-off manifold is connected to the cockpit pressurization pipeline.

Presented below is the procedure for operation and maintenance of the canopy.

2. General Instructions on Canopy Maintenance

1. As the canopy control systems serve to ensure reliable operation of those aircraft elements which are used to save the pilot's life, maintenance of the canopy should be performed by personnel who have been thoroughly acquainted with the canopy operation and maintenance and have passed necessary examinations.

2. See that all units and parts of the emergency systems are in proper position, locked and sealed. Take into account that the lockwires and seals found at their proper places indicate that the canopy emergency jettison system is in the correct position; the seals and lockwire in no way hinder the rods and bell cranks shifting during seat ejection.

3. To avoid accidental shift of the canopy emergency jettison system rods towards canopy opening and to prevent moving the handle of the canopy autonomous jettison during aircraft ground maintenance, insert ground safety lock pins in the holes of the double-arm lever and the hook of the canopy actuating cylinder rod (on the left-hand side) as well as in the rod of the left-side cylinder and in the handle for canopy autonomous jettison (Fig.92).

Install safety pins immediately after the canopy has been opened and remove them before flight prior to closing the canopy.

4. To prevent the cotter pin from being accidentally pulled out of the diaphragm valve during maintenance operations in the vicinity of the instrument panel, insert a ground safety lock pin in the diaphragm valve and remove it right after the maintenance work is over.

5. To avoid accidental operation of the canopy emergency jettison firing mechanism during removal and installation of the canopy when performing maintenance operations the firing mechanism should be locked with a ground safety pin removed after the maintenance work is over.

6. To prevent the canopy glass from being adversely affected by the sunrays or damaged when at the parking site, the canopy must be protected with a soft cover.

3. Canopy Opening and Closing

Canopy opening (lifting) and closing (lowering) from the outside should be effected by operating the CANOPY OPENING handle mounted on the fuselage port side in a special housing, while to open or close the canopy from the cockpit use should be made of the CANOPY OPENING,CLOSING handle on the fuselage port side (Figs 88, 97, 98).

Prior to opening the canopy from the outside:

1. Press the button inscribed TO PRESS, which will move the handle from its housing provided in the fuselage.

2. Turn the handle from the horizontal position downward as far as it will go in the direction indicated by the arrow; this will cause canopy depressurization, the rods will come out of the loops of the side locks, and the canopy actuating cylinders will be filled with air.

3. After the canopy has been lifted, install ground safety pins in the hole of the left cylinder rod, in the holes of the double-arm bell crank and of the hook on the left side.

Close the canopy from the outside by moving the handle in the reverse direction, previously removing the ground safety pins.

To open the canopy from the cockpit use the following procedure (Fig.97):

1. Unlock the control valve handle by bringing it out of the panel recess.

2. Pull the handle to the extreme rear position without stopping it in the intermediate positions; this will cause canopy depressurization and opening in the same sequence as in the case of canopy opening from the outside.

3. After lifting the canopy insert the ground safety pins as indicated above.

To close the canopy from the cockpit use the following procedure (Fig.98):

1. Remove the ground safety pins from the rod of the canopy left-side cylinder and from the double-arm bell crank of the canopy emergency jettison system.

2. Push the control valve handle forward until it is in the STOP position (i.e. vertical position); as a result the air will be bled from the cylinders. Further movement of the handle will be prevented up to the moment of complete lowering of the canopy.

After the canopy has been fully lowered and the rear left-side loop has fully depressed retainer 5 (Fig.86) of the closing rod, further forward movement of the handle will become possible.

3. Push the handle to the extreme forward position. The rods will engage the loops of the canopy side locks, after which the handle will enter the panel recess and thereby will become locked.

4. Move the latch to the front position to pressurize the canopy.

CAUTION! 1. Take-off is allowed only with the handle locked in the extreme forward position, i.e. when it is in the panel recess.

2. To open the canopy, move the handle from the forward to the rear position without interruption.

4. Canopy Dismantling and Mounting

To dismantle the canopy perform the following operations:

1. Open the fuselage front upper access hatch.

2. Open the canopy, install ground safety pins in the rods of the cylinders and in the left-side joint of the double-arm bell crank for canopy emergency jettison system and make sure that the ground safety pins are inserted in the canopy autonomous jettison handle and into the seat mechanisms.

3. Install a ground safety lock in the canopy ejection gun.

4. Holding up the canopy with hands remove pins 23 (Fig.87) from the rods of the canopy actuating cylinders.

5. Climb into the cockpit and lower the canopy, having placed the canopy control handle in the vertical position (with the canopy locks open). Do not pressurize the canopy.

6. Disconnect the rubber hose of the de-icer manifold from the left-side

pipe. To avoid damaging the manifold, remove it from the canopy having turned out the fastening screws.

7. Unlock and unscrew the nuts and remove two bolts 22 of the canopy slide portion attachment (from the front locks of the hinged joint).

8. Slightly lift the canopy from the cockpit and move it somewhat backward to allow the time lock to open. Move the axle of the rollers out of the time lock and carefully remove the canopy from the aircraft.

9. To install the canopy on the aircraft, the reverse procedure should be used. Prior to installation make sure that the canopy emergency system is completely closed.

Before placing the canopy on the cockpit turn the time lock 70° upward, after which bring the axle of the rollers in the lock span and, while holding the hook of the lock, align the holes in the canopy front hinged locks with the holes in the fuselage bracket. Insert bolts 22 in the holes having previously coated them with ЦИАТИМ-201 lubricant.

The bolts should freely enter the locks yielding to hand effort. Hammering the bolts in is forbidden.

CAUTION: 1. It is allowed to put the canopy on the ground only after spreading a mat on the ground. It is good practice to place the canopy on the mat with its loops down. See that the closing hooks of the rear catch-locks do not rest against the support to prevent damaging the lockwires.

The canopy is allowed to be placed with its top down if the support repeats the shape of the canopy and is covered with rubber sheet.

2. Having removed the canopy from the aircraft, place the cover on it to prevent moisture and dirt from getting in the locks.

10. After installation of the canopy on the aircraft check to see that the emergency jettison system is completely closed, for which purpose:

(a) insert a ground safety pin in the left-side cylinder rod-to-canopy joint (i.e. make sure that the holes of the double-arm bell crank and of the hook of the rod are aligned);

(b) make certain that the red marks on the hooks are completely hidden in the slots of the double-arm bell crank forks;

(c) check the canopy emergency jettison system for presence of all lock wires and seals. Make certain that the red marks on the closing hooks of the rear catch-locks are aligned with the marks on the locks.

(d) check to see that when the canopy is closed, the upper end of the handle for canopy emergency jettison is set in the slot of the rod of the firing mechanism trigger. Be sure that the emergency handle on the fuselage is locked in the forward position and that the rod of the firing mechanism trigger on the canopy is in the extreme back position.

5. Checking Operation of Firing Mechanism, Diaphragm Valve of Canopy Emergency Jettison System and Relief Valve of TCM-2500-38 Firing Mechanism

This kind of check should be performed during scheduled maintenance simultaneously with performing seat maintenance operations with the help of the canopy autonomous jettison handle, the following procedure being used:

1. Open the canopy, set ground safety pins in the canopy actuating cylinder rods and in the joint of the left-side bell crank of the canopy emergency

jettison system and make certain that all ground pins are inserted in the ...
and canopy mechanisms.

2. Discharge the canopy firing gun, disconnect the pipeline from the fir-
ing gun pipe unions, plug the pipe unions, charge the firing gun with two ...
blank cartridges. Do not insert the ground safety pin.

3. Completely bleed the air pressure in the main air system and canopy
toss air bottle through the pipe union located in the nose strut well. Bleed
the air by means of special device 72-7804-250/A. Check the pressure against
the pressure gauges in the cockpit and on the device.

4. Fill the canopy toss air bottle with compressed air to a pressure of
50 - 60 kg/sq.cm. using the same device.

After the canopy toss air bottle has been filled, check pressure against
the main air system pressure gauge. Zero pressure will be indicative of return
valve 24 being properly sealed (Fig.86).

Steady pressure indications read off the pressure gauge of the device ...
indicative of a properly sealed return valve of the canopy toss system.

5. Take a seat in the cockpit, remove the ground safety pins from the
rods of the canopy actuating cylinders and the safety pin inserted in the ...
side double-arm bell crank of the canopy emergency jettison system and close
the canopy. Do not pressurize the canopy.

6. After romoving the ground safety pin from the handle for canopy emer-
gency jettison, turn the handle down to place it horizontally.

This will actuate the diaphragm valve through which the air coming from
the emergency bottle is supplied to the cylinders actuating the canopy and
to the cylinder of the time lock whose rod shears the aluminium rivet thus
driving out the axle of the lock hook.

7. Energetically pull the canopy emergency jettison handle to the extreme
rear position having broken the wire locking the actuating lever of the firing
mechanism.

Shifting the handle by 20 - 30 mm will hit the primer cap of the blank
cartridge in the firing mechanism.

Further movement of the handle will engage the relief valve for bleeding
the gases from the TCM-2500-38 firing mechanism, i.e. the cotter pin will be
pulled out of the valve.

After the cotter pin has been pulled out, there should remain at least ...
for the handle to travel.

8. Completely bleed pressure from the canopy toss system with the aid of
the 72-7804-250/A device.

CAUTION: Remove or open the canopy only after bleeding the pressure from
the canopy toss system.

9. Remove the canopy from the aircraft as prescribed in Section "Cano-
py Dismantling and Mounting". Make sure that the time lock is open, i.e. the
lock span can be opened readily.

10. Restore the canopy emergency jettison system, for which purpose:

(a) Disconnect the pipeline from the diaphragm valve and filter.

Screw the pipe unions out of the above valve and filter, make sure that
the diaphragm is broken, after which remove from the valve bush 2 (Fig.89)
with the broken diaphragm and remove the broken parts of the diaphragm from
the valve and filter.

(b) Bring the canopy emergency jettison handle to the initial position
and make certain that the cable running from the handle is placed in the
grooves of the rollers and is protected from dropping-out by covers.

(c) Cock striker 4 of the diaphragm valve by using special device 74-7804-300/A and insert cotter pin 5.

Seal the cotter pin as shown in Fig.91 and install a ground safety pin.

CAUTION: See that the cotter pin is correctly inserted between roller 7 and float washer 6 with its rib facing the float washer (Fig.89, view along arrow A).

Inobservance of this rule may cause spontaneous operation of the valve.

(d) Insert in the valve new bush 2 with diaphragm 3 so that the diaphragm should face the striker.

(e) Assemble the fragmentation filter and connect the pipeline to the diaphragm valve and filter, after which lock the union nuts with the KO-KO.8 wire.

(f) Remove the parts of the sheared rivet from the bush and axle of the front time lock, after which close the lock, insert the axle coated with ЦИАТИМ-201 lubricant in the lock, having shifted the cylinder rod, and rivet it with the bush in the old hole using aluminium rivet 3520A-2-6.

(g) The seat being removed from the aircraft, install the cotter pin in the relief valve of the TCM-2500-38 firing mechanism and lock it with the MIM-KO.5 wire. To perform this work proceed as set forth in Chapter IX, Section "Dismantling and Mounting of TCM-2500-38 Firing Mechanism".

(h) Discharge the canopy firing gun and make sure that the primer caps of the blank cartridges are hit.

(i) Remove the firing mechanism from the canopy, clean it, replace on the canopy, screw in the bolt and connect the firing system pipes.

(j) Check the firing gun operation from the actuating mechanism on the canopy starboard side.

Charge the firing gun with live cartridges ПВ-1 and lock the system joints only after checking operation of the emergency system locks (See Section 6).

CAUTION: 1. While performing the ground maintenance operations in the aircraft cockpit, see that the cable running to the cotter pin of the canopy toss system emergency valve is not loaded accidentally to avoid partial removal of the cotter pin which may cause spontaneous operation of the valve.

2. During ground maintenance operations see that the canopy is closed under conditions when the canopy emergency jettison handle is in the forward position and locked. Closing the canopy, with the handle deflected backward, may cause damage to the handle and actuating mechanism on the canopy.

6. Checking Operation of Canopy Emergency Lock Opening System

1. Place the canopy on the ground support and suspend a 5 - 10 kg weight from each loop of the locks (Fig. 99).

2. Unscrew the bolt mechanism from the firing gun and connect the device for checking the operation of the canopy locks to the firing gun. Connect the ground compressed air bottle with the reducer to obtain a pressure of 5 - 10 kg/sq.cm.

3. Having made certain that the canopy emergency system is in the closed position, open the bottle valve and supply air to the reducer under a 5 - 10 kg/sq.cm. pressure.

4. Under this pressure the emergency lock opening system will operate which will separate the loops of the locks from the canopy and open the front hinged locks.

CAUTION: 1. See that the loops of the locks are not damaged in dropping from the locks.

2. Each loop bears the same number as the corresponding lock to facilitate installation in the proper lock.

After checking cock the locks in the following order:

(a) Insert loop 1 (Fig.100) in the appropriate lock (according to the marking) turn lever 2 downwards and lower closing lever 3 by turning it with the help of a rod (marking tool or awl) which should be inserted in the hole provided in the lever; this will set the lock to the LOCK CLOSED position.

(b) With the lock closed, suspend a 3-kg weight from the lug of lever 3 or apply an equal force with the aid of the 72-7804-820 spring retainer.

(c) After all six side locks have been closed, close the front hinged lock, for which purpose deflect the upper end of larger catch 4 (Fig. 95) (i.e. decrease the span between the greater and smaller catches) and throw back closing lever 2 (Fig.95).

(d) Simultaneously turn double-arm levers 27 (Fig.87) forward and see to it that the C-shaped hooks of the cylinder rods enter the slots of double-arm bell cranks 24.

This turning will bring the rod-and-bell crank system forward, thereby locking the mechanisms of the emergency locks in the cocked position.

Note: When cocking the system be sure that the rear catch-locks are open (Fig.94), otherwise the system will fail to cock (i.e.it would not lock).

(e) Make certain that the loops of the side locks are fastened and do not slip out; see that the catches of the front hinged lock cannot be turned.

When no bolts for canopy suspension system are present in the catch span, the catches may have some play.

(f) Lock and seal all joints of the canopy emergency jettison system according to the scheme in Fig. 91.

(g) Install the canopy on the aircraft (See Section 4).

(h) See that the canopy emergency jettison system is completely closed by checking the alignment of the holes in the left-side hook of the rod and double-arm bell crank (to be checked by inserting a ground safety pin).

(i) Charge the firing mechanism of the canopy emergency jettison system with the ПВ-I live cartridges, install a ground safety pin in the firing mechanism and lock the larger nut and the firing mechanism lever (Fig.91).

(j) Remove the ground safety pin from the firing mechanism of the canopy emergency jettison system.

Notes: 1. It is forbidden to open the system without previously removing closing levers 3 from the side locks (Fig. 100) with the help of a 3-kg weight or the 72-7804-820 device. Inobservance of this requirement will lead to damage of the contact surfaces of closing lever 3 and retaining shaft on bell crank 4. This also may cause unbalance of the whole system.

2. To close the system, move the double-arm levers (Fig.87) forward, as it is outlined under Item 4. It is possible to close the system by operating double-arm bell cranks 24 which engage the hooks of the actuating cylinder rods. Closing the system by moving the levers on the rear locks is not allowed.

3. Check operation of the catch-lock system only in case of canopy or seat replacement and when the special plate is to be dismantled or canopy repaired (replacing of canopy locks, glass, etc.).

The procedure employed for dismantling and mounting the special plate is presented in Chapter IX, "Ejection Seat".

The check over, close the emergency lock system, lock and seal it at the rear levers (Fig. 91, Ref.4).

7. Canopy Anti-Corrosive Treatment

If the aircraft is not to be flown for more than 3 months, the canopy and its operation system should be prepared for storage.

Before the anti-corrosive treatment of the canopy perform the following:

1. Bleed air from the aircraft air system and canopy emergency air bottle.
2. Discharge the canopy firing gun.
3. Release the striker of the canopy firing gun.
4. Unscrew the pipeline from the diaphragm valve of the canopy toss system, remove the bush with the diaphragm and lower the valve striker (pull out the cotter pin). See that the bush is properly stored after being subjected to anti-corrosive treatment.

Procedure

1. Using mixed graphite grease and ЦИАТИМ-201 grease, coat the exposed areas of the cable wires both on the canopy and fuselage.
2. Coat liberally with ЦИАТИМ-201 grease the following parts and units:

(a) all joints in the canopy control and emergency jettison systems;

(b) emergency diaphragm valve;

(c) inner portion of the firing gun;

(d) emergency locks to prevent moisture from getting inside the locks installed in the canopy longitudinal profiles;

(e) handle for canopy outside opening (located on the fuselage outer side).

Anti-corrosive treatment of the canopy does not require its removal from the aircraft.

8. Canopy Glass Maintenance

Canopy glass panels, being made of organic glass, require thorough maintenance and care to keep the canopy in the operational condition.

Any kinds of damage to the organic glass surface (e.g. scratches, notches, "silvery" spots) reduce the glass transparency and hamper visibility (when looking through the glass), while cracks and dents reduce the glass strength.

To prevent the organic glass from damage, care should be taken to protect it from being adversely affected by moisture, sunrays, dust as well as by harmful solutions and vapours (acetone, benzol, alcohol, etc.).

The following instructions should be followed to keep organic glass in proper condition:

1. When the aircraft is parked, the glass parts should be covered to protect them from sunrays, dust, rain, snow and mechanical damage.

Before placing the cover on the canopy the former should be thoroughly cleaned from dirt and dust, especially on the side which comes in contact with the glass.

2. Before and after flight clean the glass from dirt and dust in the following way:

(a) Wipe the glass with a clean and soft cloth wetted in water and wrung out.

(b) Remove oil spots, if any, by wiping the glass with a dry and soft cloth thinly coated with ВИАМ-2 paste. After removing oil, clean the glass as instructed in Item (a).

If no ВИАМ-2 paste is available, wipe the glass with a soft cloth wetted in soapy water (a 3-5% solution) and wrung out.

(c) Wipe the glass with a soft cloth wetted in water and wrung out, after which wipe it with a dry cloth.

Note: When wiping the glass, it is forbidden to use woolen or silk cloth not to excite electric charges in the organic glass which, if electrified, attracts dust particles.

3. The following defects can be tolerated on the glass:

(a) separate hair lines;

(b) shallow scratches and notches 30-mm long, scattered over the glass surface.

4. The appearing hair lines or notches are allowed to be eliminated by polishing the glass with ВИАМ-2 paste.

Polish the glass using hygroscopic cotton wool slightly coated with paste first along the scratch and then across it, after which polish the glass in circular movements slightly pressing the surface and polishing each spot for a short time to avoid heating the surface by friction. The entire surface of the glass is allowed to be polished.

Elimination of scratches and notches with emery paper is forbidden.

Elimination of silvery spots with emery paper as well as by polishing, filing, grinding or heating the defective spot is prohibited.

5. When performing maintenance operations on the aircraft, protect from damage the parts made of glass by special casings and covers.

6. When performing operations on canopy sealing in repair shops, before tightening the bolts of the glass attachment fittings, make sure that the length of the distance bushes exceeds the glass thickness by not over 0.5-1.3 mm.

9. De-Icer System Maintenance

The de-icer system (Fig. 101) is intended for removing ice from the canopy front glass panel when flying under conditions of ice formation . Ice removal is accomplished by spraying ethyl alcohol over the canopy glass.

The de-icer system is actuated by pressing button 12 bearing the inscription GLASS DE-ICER (ПРОТИВООБЛЕДЕНИТЕЛЬ СТЕКЛА) on the left-hand side of the instrument panel. Prior to pressing the button, cut in the appropriate circuit breaker on the left-side panel. Pressing button 12 will close the circuit of valve 695000/M; as a result, the air will be supplied from the aircraft air system through the РВ-3 reducing valve to alcohol tank 1 (6.5 lit.) of the de-icer system.

The air pressure will force the alcohol out of the tank and direct it through return valve 5 to manifold 4 mounted on the canopy. The system is switched off when the button is released.

To use the alcohol in a most efficient way, duration of the system switching-on should be 2 or 3 sec.

If ice is not removed during one switching-on of the de-icer system, carry out several successive engagements of the system observing a short interval after each engagement.

The de-icer system allows to switch it on for 20 - 30 times, the duration of one operation being 2 - 3 sec.

To check the de-icer system for proper operation switch it on for a period of not over 1 - 2 sec. In this case the alcohol should flow out of all openings.

If otherwise, clean the manifold openings with a brass wire, 0.4-mm dia., the diameter of the opening being 0.5 mm. To this end remove the manifold from the canopy and the reflecting plate from the manifold.

In due time (as indicated in the list of maintenance operations) wash the de-icer tank with water after removing it from the aircraft, check the de-icer system for sealing and rate of liquid flow through the manifold.

Check the de-icer system for sealing, by applying a 3 kg/sq.cm. air pressure.

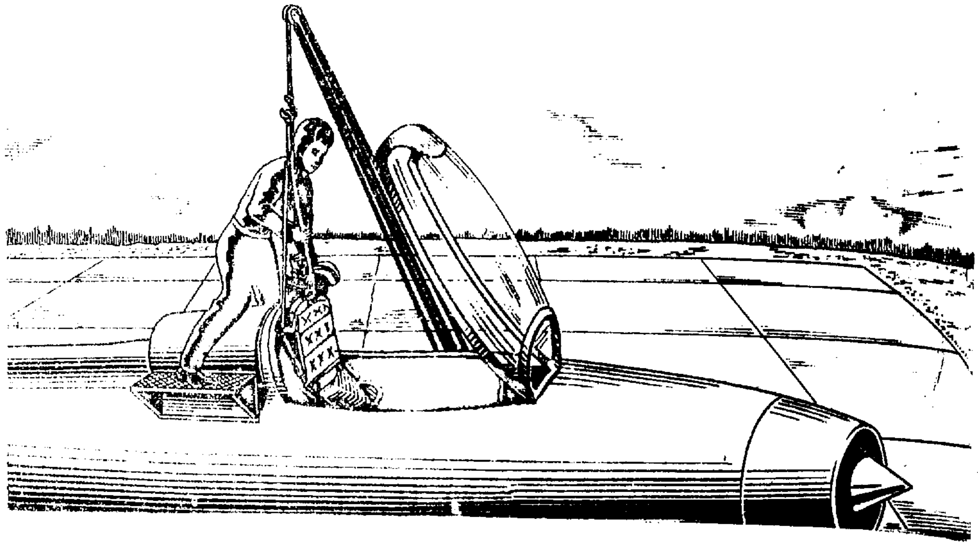
Checking should be made in the following order.

Disconnect the manifold together with the return valve from the system and plug the open end of the pipeline. Press the switch button to fill the system with air.

No air leaks through the connections of the pipelines are allowed. After checking the system for sealing connect the manifold with the return valve and the system.

Check the de-icer system for the rate of liquid flow through the manifold with the tank filled to capacity. For checking press the switch button and measure the time during which the liquid will flow through the manifold until the tank becomes empty. The time being equal to 5 min. , the system is considered sound. This kind of checking should be carried out with the tank filled with at least 6 lit. of water.

The checking over, wash the tank and the system with alcohol (1 lit.) by operating the system.



Chapter IX

EJECTION SEAT

1. General

The ejection seat, type CK (Figs 102, 103, 104), employed on the aircraft has the following characteristics:

(a) During ejection the canopy of the cockpit protects the pilot from the impact airstream, which makes it possible to bail out with safety at an airspeed of up to 1100 km/hr.

(b) The parachute harness is used to fix the pilot in the seat.

(c) The seat is provided with a restraint mechanism which makes it unnecessary for the pilot to assume a definite attitude in ejecting.

(d) Instead of foot steps the seat is provided with foot supports with the foot grips which automatically lock the pilot's feet in ejection.

(e) The parachute is installed on the removable rod to stabilize the seat in the airstream encountered after ejection.

(f) The seat height is adjusted on the ground and in flight which offers maximum conveniences for the pilot.

(g) The minimum safe altitude for ejection in level flight has been brought to as low as 110 m. due to reducing the time necessary to carry out operations preliminary to ejection.

(h) The increased weight of the ejection system due to the canopy and seat rails incorporated in the system has reduced the G-force which acts on the pilot at the initial moment of ejection (when the seat is caught in the airstream).

All the above said made it possible to ensure safe ejection at high flying speeds.

The ejection procedure is shown in Fig.105.

The above seat characteristics have been obtained due to the following systems and mechanisms introduced in the ejection seat, type CK.

1. The pilot is fastened to the seat (Fig.106) by the parachute harness straps, viz.: by the shoulder straps (shoulder restraint) and waist belt (waist restraint).

This type of parachute harness makes it possible for the pilot to be fastened to , and unfastened from, the parachute in the cockpit, the parachute remaining in the seat pan.

The shoulder restraint is operated by a telescopic cylinder with a spring, the cylinder being controlled by the pilot who operates the handle on the left armrest of the seat (Fig.107).

In case of ejection the shoulder restraint is actuated by the 215Ф firing mechanism, the generating gases being fed to the telescopic cylinder.

The 215Ф firing mechanism is actuated by the levers fitted on the seat armrests, the levers being also used for seat ejection. The shoulder restraint holds the pilot from moving forward throughout the entire range of pilot's positions from the extreme forward position, which the pilot assumes when working in the cockpit to the rearmost position characteristic in take-offs, landing and ejection.

The waist restraint is adjusted right after climbing in the cockpit and putting on the parachute harness by a handle with a ratchet fitted on the right-side armrest. To actuate the waist restraint move the handle back and forth (Fig.107, A).

To release the restraint the pilot should push the above handle to the extreme forward position and, while keeping it in this position, move the lower part of the body forward.

2. The supply lines running from the aircraft equipment to the pilot are connected through the OPK-2 common connector installed on the seat left armrest. The OPK-2 common connector ensures disconnection of all pipelines during ejection and changing-over of the pilot's oxygen supply to the parachute oxygen bottle.

The upper and lower blocks of the OPK-2 common connector become disconnected automatically when the seat moves upwards, this is effected through a cable connecting the OPK-2 common connector with the fuselage.

3. An electric mechanism with the МУ-100 АП motor and limit switches is provided for on the ejection seat to adjust the seat to the pilot's height on the ground and in flight. To switch on the МУ-100 АП electric motor press the switch button on the cockpit left-hand side.

Adjustment of the seat is possible due to travelling (maximum travel being 90 mm) of the seat pan relative to the rails, for which purpose the МУ-100 АП electric motor with a reduction unit and lifting screw is provided on the rails of the seat; the seat pan is furnished with a threaded bush and guides sliding along the rails.

To switch off the electric mechanism with the seat pan being in one of the extreme positions, the pan is connected (by a link) with the limit switches fitted on the seat rail. With the seat pan in the extreme upper position, the pilot's pressurized helmet should be clear of the canopy glass.

To obtain the clearance, the extreme upper position of the seat pan should be adjusted to fit the pilot's height by means of the upper rod of the limit-switch mechanism link. For a tall pilot the seat travel will be reduced.

In order to simplify the seat adjustment to the pilots height (the aircraft being flown by different pilots), the limit-switch mechanism is provided with four moving pointers, set according to each pilot's height.

To cut in the power supply to the МУ-100 АП motor from the aircraft electric power sources, the bracket carries a plug connector whose detachable portion has a cable connection (through a snaphook) with the clamp on the fuselage. This ensures separation of the plug connector in bailing out.

4. To switch on the system for ejecting the seat (Fig.108), i.e. the ТСМ-2500-38 firing mechanism, operate the levers on the seat right-side and left-side armrests, the levers being connected in their turn by rods and cables with the cotter pin of the ТСМ-2500-38 firing mechanism.

Switch on the seat ejection system by pressing together the upper and lower levers on one of the seat armrests, which will cause opening of the lock for the levers.

The firing system is switched on either by pressing the levers of one of the armrests or by pressing the levers of both armrests at a time.

Initial pressing of the seat firing system levers will switch on the 215П firing mechanism actuating the shoulder restraint which makes the pilot assume the extreme rear position and locks him in this position. Further pressing the levers will actuate the TCM-2500-38 firing mechanism which ejects the seat.

The levers are set to the initial position by springs and held in this position by special locks installed on the levers.

5. To stabilize the seat in the encountered airstream during ejection, a drogue parachute packed in a container is installed rear of the headrest (Fig.

The drogue parachute is pushed into the airstream by the 215П firing mechanism, the latter driving out the panel of the hatch provided in the canopy, which releases the telescopic rod of the firing mechanism, the parachute attached to the rod being thrown into the airstream.

The parachute creates a torque opposite to that generated by the TCM-2500-38 firing mechanism.

The 215П firing mechanism operates at the moment when the seat has travelled some 30 - 50 mm upward and the cable fastened to the fuselage has pulled out the cotter pin from the 215П firing mechanism. The cotter pin is studded to the cable, which ensures easy dismantling of the seat. The stud is connected to the seat frame with a cable.

The telescopic rod of the firing mechanism has a clamp, attached with the help of two studs to a parachute container terminating in cables with balls.

The studs are locked with the KO-KO.5 wire and sealed. The cables with balls are inserted in pipes attached to the seat. The ends of the pipes are compressed to fit the cable diameter so that when the firing mechanism rod is moved approximately 250 mm out, the balls should be caught in the pipes and thus pull out the studs from the openings of the container, releasing the parachute for opening.

Attached to the head of the telescopic rod for the 215П firing mechanism is a swivel connected to the thimble of the parachute shroud lines. The shroud lines running from the parachute container are stowed in the cover which, in its turn, is placed in the housing provided aft of the headrest and fastened by a snaphook.

6. The supports and feet catch-locks with a mechanism for their opening (Figs 110 and 111) serve to prevent leg spreading during ejection and to lock them in position.

Each foot support is provided with a pin on its inner side, the pin being set in a guide mounted on the cockpit floor. When adjusting the seat height, the pins of the feet supports move in the guides without leaving them. When ejecting, the pins of the supports project past the guides. As the seat leaves the cockpit, the supports turn, while the pilot's feet under inertia forces move towards the supports and press the levers of the foot catch locks. The latter, in their turning, are fixed by the ratchet sectors, leaving the feet caught tight between the catch locks and rubber pads of the supports.

7. To ensure for the pilot canopy protection in bailing out the seat is provided with supports to connect it with the canopy:

(a) Trunnions are installed to engage the rear catch locks. Being installed on the ends of the cross beam of the seat frame, the trunnions enter the catches of the canopy rear lock (after the seat has travelled 20 mm upward) and become locked there (Fig.104, Ref.3).

This being the case, the rods which connect the locks with the bell cranks actuate the canopy emergency opening system and open the locks connecting the canopy with the fuselage. In this case, however, the front hook of the time lock will not open, for its purpose is to hold the canopy nose portion while the rear portion of the canopy is being lifted.

Further upward movement of the seat together with the canopy will allow the canopy turning about the trunnions to protect the pilot.

The rollers fitted in the canopy front portion will roll on the transparent armour glass and the canopy will start covering the pilot.

(b) Collapsible supports are provided on both sides of the seat pan to engage the canopy front catch locks. These supports are always folded and locked by the sectors mounted on the same shaft (Fig 110 and 111).

The shaft is screwed in the left-side sector and in the support (Fig.125, Ref.20). When the seat has been lifted by approximately 530±10 mm, i.e. when the supports become level with the canopy-carrying panel, the cable fastened to the cockpit floor and to the bell crank on the shaft will turn the shaft with the sectors, thereby shearing the screw and releasing the collapsible supports.

Actuated by springs, the supports will be hinged and locked in this position by special spring retainers. The canopy drops on the supports, its front locks (Fig.112) striking against the rod stops, thereby shearing the locking screw. This results in the canopy being locked by the spring pins on the supports. Thus, the canopy becomes locked to the seat in four points.

8. Two 215Ф firing mechanisms mounted on the seat are intended for separation of the canopy from the seat after ejection, as well as for disconnection of the drogue parachute with its telescopic rod, for opening of the foot catch-locks and the pilot's shoulder and waist restraints. The rods of the firing mechanisms are connected with the brackets of the rails at the seat bottom portion, while the cylinders of the firing mechanisms are connected with the double-arm levers on the seat trunnions at the seat upper portion.

The locks of the firing mechanisms are of a double-primer cap type, which ensures operation of the firing mechanism despite failure of one of the caps.

The 215Ф firing mechanisms are switched on automatically by the АД-3 time mechanism which gets engaged 1.5 sec. after switching. The cord which ensures switching-on of the АД-3 automatic time mechanism should have a slack of 50 mm to allow the seat to travel the distance at which the АД-3 mechanism is engaged.

In case the АД-3 time mechanism fails during ejection, the canopy will be opened from the firing mechanism manually by pulling the grip for canopy emergency opening system located on the seat pan (after which the grip remains in the pilot's hand). The same should be done in case of emergency canopy opening on the ground.

In these cases the system operates in the following way:

A. <u>When actuated by the АД-3 time mechanism</u>

1. After the seat has travelled 50 mm upwards, the cord of the АД-3 time mechanism will pull out the cotter pin and upon elapsing of 1.5 sec. the spring of the time mechanism will pull the cable and turn intermediate cable 13 of cross shaft 10 (Fig.121.)

The intermediate lever will release the lock after the former has travelled 8 mm, while the lever which controls the 215Ф firing mechanisms will turn the shaft and force switching-on of the 215Ф firing mechanism through the rods (Fig.121).

2. The discharge gases actuate the cylinders of the firing mechanisms to turn the double-arm levers about the seat trunnions. This will bring about the following:

(a) The canopy front catch-lock control system will get engaged and will release the canopy.

(b) The 215П firing mechanism rod attachment split clamp lock control system will become engaged via the rods and bell cranks, the clamp ends will go apart and the rod together with the parachute will get detached from the seat.

Note: With the seat pan in the down position, the front catch-locks will open before the rod of the drogue parachute is detached. With the seat pan in the up position, the front catch-locks open after the parachute rod becomes detached.

(c) Operation of the 215Ф firing mechanism will turn the double-arm levers; as a result, the canopy will be turned about the seat trunnions. When the canopy has turned through about 110°, the cams of the trunnions will open the canopy rear catch-locks, which will detach the canopy from the seat.

(d) At the end of the 215Ф firing mechanism stroke the double-arm levers will press the levers of the upper cross shaft and, via the system of rods and bell cranks, open the locks of the foot straps, shoulder restraint and waist restraint, thereby, detaching the pilot from the seat.

The locks of the waist restraint will be the last to open the sequence ensuring proper separation of the pilot from the seat (Fig.113).

When actuated from the grip:

Pulling the grip out by approximately 65-70 mm (after which it remains in the pilot's hand) will let the roller turn to actuate the spring mechanism drive. The 215Ф firing mechanisms will become actuated. This will actuate the mechanism which detaches the canopy from the seat as well as the mechanism which separates the seat from the pilot.

9. In order to reduce the force to be applied to the grip for opening the locks, spring mechanism 4 (Fig.114) is mounted on the cross shaft right side.

The spring mechanism is engaged after the 215Ф firing mechanism operates from the АД-3 time mechanism or from the drive which switches on following the pull-out of the grip. This allows the spring mechanism to secure all fixing locks in the open position.

10. When the pilot is separated from the seat during ejection, the parachute cord for the КАП-3 parachute controller connected to the seat clamp will pull out the cotter pin of the КАП-3 parachute controller and the parachute becomes automatically opened.

11. To reduce the G-forces acting on the pilot during ejection with the canopy jettisoned before ejection (excessive G-forces being the result of the decreased weight of the ejection installation), a relief valve is provided in the ТСМ-2500-38 firing mechanism lower part to release the gases.

The cabling for control of the valve is connected to the canopy emergency jettison handle, which permits the valve to open and relieve gases during the canopy emergency jettison.

12. The seat is connected with the fuselage through the following split joints:

(a) Through special hooks which engage the upper trunnions of the ТСМ-2500-38 firing mechanism, the hooks being fitted on the seat headrest and taking the forces which act on the seat vertically. The TCM-2500 3Д firing mechanism, in its turn, is connected to the fuselage through the trunnions located on the outer tube in its middle portion and two rods attached to the armour plate.

To restrict turning of the firing mechanism during ejection (the angle of turn being not over 15^{0}), the firing mechanism is additionally connected by two bell cranks whose ends with oval openings are bolted to the firing mechanism while the other ends of the bell cranks are attached to the axles of the rollers on the armour plate.

(b) Through two pairs of rollers bracketed to the armour plate, the rollers being in contact with the seat rails. The rollers take the forces which act on the seat horizontally.

(c) Through the rail guides installed on the cockpit floor. The guides partially relieve the rollers of the forces acting on them and prevent vibration of the seat lower portion.

(d) Through plug connector of the МУ- 100 АП electric motor, the former being disconnected in ejection.

(e) Through joints and units which ensure operation of the mechanisms during ejection, namely:

- pins of the foot supports, the former entering the guides on the cockpit floor, which provide locking of the foot supports in a required position or release them in ejection;

- cable for the bell crank of the shaft which controls the collapsible supports for the canopy catch-locks, the cable having the guide pipe attached to the cockpit floor. The purpose of the cable is to ensure tipping of the supports in ejection;

- cable running from the ОРК-2 common connector and fastened to the clamp on the fuselage, the cable ensuring disconnection of the ОРК-2 common connector and switching over of the pilot's oxygen supply to the КП-27М parachute oxygen breathing apparatus;

- cable for the cotter pin of the 215П firing mechanism, the cable being attached to the cockpit rear wall and ensuring operation of the drogue parachute firing mechanism;

- the АП-3 cord attached to the fuselage, the purpose of the cord being to ensure operation of the 215П firing mechanisms.

13. The seat firing mechanism control systems are lockwired and sealed at the Manufacturing plant. It is forbidden to remove the seals off the mechanisms before starting the scheduled maintenance operations.

14. To avoid spontaneous operation of the seat mechanisms on the ground, two sets of ground safety lock pins are supplied with the aircraft, each set tied up with a caprone cord.

A. The cord with ground safety pins is designed for everyday maintenance of the aircraft (service cord). The safety pins of this kind are to be installed in the cockpit right after flight and removed before the next flight. The service cord carries the following safety pins fastened to it by snaphooks:

(a) safety lock pin marked Г (1 piece) to be installed in the TCM-2500-3Д firing mechanism;

(b) safety lock pin marked 4 (1 piece) to be installed in the 215П firing mechanism for the drogue parachute;

(c) protective casings marked 9 (2 pieces) to be installed on the seat armrests;

(d) safety lock pin marked 7 (2 pieces) to be installed on the ejection un levers on the seat armrests through the openings in the protective casings,

(e) safety lock pin marked 8 (1 piece) to be installed in the canopy autonomous jettison handle;

(f) safety lock pin marked 10 (1 piece) to be installed in the roller of the mechanism for actuating the 215Ф firing mechanism from the grip.

B. The cord carrying the ground safety pins to be used during the seat removal and installation. This cord which is called "mounting cord" is installed on the aircraft before dismantling the seat and is removed after installation of the seat on the aircraft.

This cord carries the following safety lock pins fastened to it by snap-hooks:

(a) safety lock pin marked 2 (2 pieces) to be installed in the 215P restraint firing mechanism (in the head of the 215P firing mechanism and in the lever);

(b) safety lock pin marked 3 (2 pieces) to be installed in the 215Ф firing mechanism;

(c) safety lock pin marked 4 (1 piece) to be installed in the 215П firing mechanism;

(d) safety lock pin marked 5 (2 pieces) to be installed in the collapsible supports for canopy front catch-locks;

(e) safety lock pin marked 6 (2 pieces) to be installed in the foot catch-locks only when the seat is being mounted on the aircraft, for locking the catches in the folded position;

(f) flexible pin (1 piece) to be installed in the TCM-2500-38 firing mechanism when charging and discharging the firing mechanism;

(g) safety lock pin marked 10 (1 piece) to be installed in the roller of the mechanism actuating the 215Ф firing mechanisms from the grip.

Note: Location of the ground safety pins on the seat is marked with the same number as the safety lock pins to be installed.

Attachment of Parachute Harness to Seat and Its Adjustment to Fit Pilot's Height

The parachute harness is attached to the seat (Fig.106) by means of:

(a) Shoulder link 3 with central shackle 7 which fastens the harness to the strap of the lock for shoulder restraint 12 on the seat, the shoulder link being fastened to the buckles of the shoulder straps. Shackle 7, in its turn, is fixed by shock-absorbing pipe union 8 to the seatback (Fig.106, Detail A).

(b) buckles of the waist restraint pulleys (on the right and left sides) through the leg straps of the parachute harness.

The above attachment fittings of the parachute harness, i.e. the caprone shoulder link with the central shackle, shock-absorbing cord and pulleys of the waist restraint, are parts of the seat supplied with each seat.

Operation of the seat, type CK, is allowed only if it is furnished with parachute harness made of caprone straps.

Safe flying when using the seats of CK type as well as safe bail-out depend, to a great extent, on proper adjustment of the parachute harness to fit the pilot's height, the harness being used also for fixing the pilot in the required position in the cockpit. The harness should be fitted as tightly as possible, the shoulder link being fitted snugly about the pilot's neck and shoulders.

When flying in winter clothes, the shoulder link should be either on top of the collar or under it, but it should necessarily fit the pilot's neck and shoulders.

General Instructions on Seat Maintenance

1. Maintenance operations on the seat should be carried out only by skilled personnel thoroughly acquainted with the seat design who have passed examinations on the subject.

2. The seat mechanisms which operate during ejection should be always lockwired and sealed.

3. Checking the systems which operate during ejection is allowed only when performing scheduled maintenance.

When carrying out scheduled maintenance of the firing mechanisms, measure the length of each mechanism before dismantling. During assembly the length of the firing mechanisms should not be changed, as it might adversely affect the seat units operation in ejection. Readjustment of the seat units is prohibited.

Remove and install the TCM-2500-38 and 215P firing mechanisms in conformity with the Instructions set forth in Section "Dismantling and Mounting of TCM-2500-38 and 215P Firing Mechanisms".

Taking to pieces and assembling the firing mechanisms should be carried out in accordance with the technical description and Instructions on operation of the 215P, П, Ф and TCM-2500-38 firing mechanisms issued by the Manufacturer

Note: Take to pieces and clean the 215П firing mechanism without removing it from the seat.

4. After performing maintenance operations lock and seal the systems. See that the locking wire meets the requirements outlined in the instructions.

When disassembling the 215П firing mechanism, the locking plates of the lock for the firing mechanism three-link yoke should be replaced by new ones taken from the set of spare parts (as repeated bending of their edges is not allowed).

5. When carrying out maintenance operations on the ejection seat, observe the following:

(a) If the aircraft is operated under an ambient temperature of from -50°C to +20°C, prepare the TCM-2500-38 firing mechanism for operation under winter conditions , i. e. replace the plug by the relief nozzle.

(b) If the aircraft is operated under ambient temperatures from +5° C to +50° C, bring the firing mechanism to the summer variant, i.e. remove the plug and in its stead install a relief nozzle (available from the set of spares and tools).

Install and remove plugs and nozzles in compliance with the TCM-2500-38 firing mechanism Operating Instructions.

(c) The TCM-2500-38 firing mechanism is supplied by the Manufacturer in its winter variant.

When preparing the firing mechanism for winter operation after it was used in summer and vice versa, make records in the aircraft Service Log.

6. Remove and install the seat with the TCM-2500-38 and 215П firing mechanisms discharged.

7. The 215P and 215Ф firing mechanisms should be discharged after the seat removal from the aircraft and charged before the seat is mounted back on the aircraft.

8. If the canopy or seat has been replaced on the aircraft or the cockpit has been repaired or modified so that it somehow affected the seat-to-canopy connection, perform "ground ejection", i.e. pull the seat with the canopy upward using a special device provided with a control panel. This testing should be performed by specialists thoroughly acquainted with the manufacturing process.

2. Removal and Installation of Seat

Before removing the seat from the aircraft, insert ground safety lock pins secured to the mounting cord in the seat mechanisms. Observe precautionary measures to prevent spontaneous operation of the mechanisms.

CAUTION: When installing ground safety pin 2 in the 215P firing mechanism or removing the safety pin from it, take care not to turn the lever as it will break the lever lockwiring.

To remove the seat from the aircraft, use the following procedure:

1. Open the canopy and insert ground safety pins in the rods of the canopy cylinders and in the double-arm bell crank of the canopy emergency jettison system. Install ground safety pins marked 1 in the TCM-2500-38 firing mechanism, pins marked 8 in the canopy emergency jettison handle, pins marked 2 in the lever of the 215P firing mechanism, pins marked 3 in the 215Ф firing mechanism and pins marked 4 in the 215П firing mechanism. Insert lock pins marked 10 in the roller of the mechanism which actuates the 215Ф firing mechanism and pins marked 5 in the collapsible supports for canopy front catch-locks.

2. To obtain access to the TCM-2500-38 firing mechanism, disconnect the drogue parachute with the container and the parachute swivel from the member of the 215П firing mechanism, having previously locked the parachute container at its end openings in the plates with wire and carefully put the container on the seat headrest. Do not remove the chute shroud lines with the cover from the housing. Disconnect the drogue parachute in accordance with the Instructions given in Section 5 of the present Chapter.

3. Discharge the TCM-2500-38 firing mechanism, having previously replaced the ground lock pin marked 1 by a flexible pin, the latter being fastened to the lock of the firing mechanism by the KO-KO.5 wire.

Discharge the 215П firing mechanisms in complience with the Instructions given in Section 4 of the present Chapter.

4. Disconnect the cord of the АД-3 time mechanism from the clamp on the fuselage.

5. Disconnect the cable from the bell crank of the shaft for control of the collapsible supports.

6. Disconnect the plug connector of the МУ-100АП motor wire cable.

7. Disconnect the lower block of the ОРК-2 common connector from the seat armrest.

8. Unscrew the thrust screws of the hooks, which lock the upper trunnions of the TCM-2500-38 firing mechanism in the seat beam suspension fittings.

9. Attach the cables for seat lifting to the seat trunnions and start removing the seat from the aircraft with a crane.

10. While slowly lifting the seat, move the pins of the foot supports from the guides on the cockpit floor, after which lift the seat higher and release the rails from the rollers on the fuselage.

Place the seat on a specially prepared site with its rails down or put on a special support.

Note: When removing the seat, move the engine control lever and canopy control handle forward and backward as required.

To install the seat in the cockpit, use the reverse procedure.

When installing the seat, remember the following:

1. Before mounting the seat in the cockpit, insert all safety lock pins of mounting cord in the seat.

2. To facilitate seat mounting, fix the foot supports by inserting the ground lock pins.

3. Slowly lower the seat in the cockpit until the upper trunnions of the firing mechanism rest against the seat hooks, after which screw in the bolts and lock them. In lowering the seat see that the pins of the foot support enter the guides on the cockpit floor and the foot catch-locks remain open.

Be sure that the lower ends of the rails have entered the guides on the cockpit floor.

When lowering the seat, move the engine control lever and canopy control handle forward and rearward as required.

4. After the seat replacement, connect all cables of the seat mechanisms as well as the cord of the АД-3 time mechanism to the fuselage, charge the TCM-2500-38 and 215П firing mechanisms, after which fasten the container with the drogue parachute.

CAUTION: 1. Prior to seat installation make sure that the calibrated nozzle opening of the 215P firing mechanism is not clogged with grease or dirt.

2. When connecting the cable with the cotter pin of the TCM-2500-38 firing mechanism install the anchor bolt with its head in the direction of flight to avoid the bolt head coming in contact with the clamp of the catch-locks for the firing mechanism trunnion.

3. Dismantling and Mounting of TCM-2500-38 and 215P Firing Mechanisms

A. Dismantling and Mounting of TCM-2500-38 Firing Mechanism

Dismantle and mount the firing mechanism during scheduled maintenance involving work on the seat and firing mechanism. In this case the seat should be removed from the aircraft before starting the work.

Prior to removal of the firing mechanism make sure that it has been discharged, after which begin its removal in the following sequence:

1. Disconnect the cable running from the canopy emergency jettison handle to the relief valve on the lower part of the firing mechanism (Figs 115 and 116), for which purpose:

(a) Remove the locking wire and seal from the valve pin.

(b) Remove two screws fastening the bracket to the firing mechanism without disconnecting the Bowden cable from the container.

(c) Pull out the pin from the relief valve and move the cable with the bracket away.

2. Unscrew bolt 2 (Fig.116) fastening bushing 4 and roller 3, after which remove the pin together with the roller (left-side or right-side).

3. Unlock and unscrew bolts 2 and 3 on the left and right sides of the attachment fitting for rod 1 and bell crank 4 (Fig.115). Remove the washers from the trunnions of the lower nut of the firing mechanism.

4. Remove the rod from the upper bracket and firing mechanism trunnion. Leave bell cranks 4 (Fig.115) fixed on the middle bracket.

5. Move the firing mechanism trunnion out of the hole of the second rod, after which remove the firing mechanism.

To install the firing mechanism on the aircraft, use the reverse procedure.

When installing the firing mechanism, remember the following:

(a) If the pin of the cable will fail to enter the corresponding holes in the relief valve of the firing mechanism, when connecting the pin to the valve, remove the washer from the valve, insert the screw driver in the 3-mm hole, then move or turn the valve piston so as to give way to the pin to be installed. This done, install the washer back on БФ-4 glue.

(b) After replacing the bracket with cable on the firing mechanism lock the attachment screws.

(c) The screws and bolts being turned in the firing mechanism trunnions and bell cranks, lock them with a plate.

(d) Deflect the lower portion of the firing mechanism full way forward to make sure that the pin will not be pulled out of the valve.

(e) Lock the valve pin with the M1K-0.5 wire and seal it.

Caution: If the firing mechanism has been mounted in its "summer" variant, make certain that the calibrated nozzle opening is not clogged with grease or dirt.

B. Dismantling and Mounting of Firing Mechanism 215P

1. Undo the screws fastening the protective plate to the firing mechanism yokes.

2. Turn out the screws fastening the pipe of cable 28 (Fig.107) of the firing mechanism to the upper cross beam.

3. Unscrew and remove lock 29 of the firing gun.

4. To maintain the preset position of the firing mechanism inner tube relative to the upper yoke, make check marks on them.

5. Turn out two screws fastening upper yoke 30 of the firing mechanism to the rail, and then carefully remove the tube with the spring and fire bar.

CAUTION: 1. When turning out the second screw factening the yoke of the firing mechanism, hold the upper tube to avoid abrupt spring release.

2. If the upper yoke is provided with adjusting gasket, see that it is properly installed when mounting the yoke.

6. Unscrew the lower cover with roller 31 from the outer tube of the firing mechanism.

7. Check to see that no grease is present in the relief hole. If necessary, unscrew the nozzle and wash it.

Notes: 1. Pre-installation cleaning, taking to pieces and checking procedure should be performed in conformity with the corresponding Instructions issued by the Manufacturing plant.

2. When mounting the upper yoke with the tube, see that the Bowden cable is not jammed and is intact.

8. Assemble the firing mechanism and mount it on the seat in the sequence reverse to that of dismantling.

9. Check the shoulder restraint mechanism for smooth operation and sticking by moving the handle on the seat.

4. Charging and Discharging Firing Mechanisms

The charging mechanisms are charged with double-primer cap cartridges:

(a) the TCM-2500-38 firing mechanism with the ПК-16 cartridge;

(b) the 215П, 215Ф and 215P firing mechanisms with the ПК-3М-1 cartridges.

The firing mechanisms should be discharged before transportation of the aircraft by train, before replacing cartridges and checking the primer caps for hitting.

The TCM-2500-38 and 215П firing mechanisms should be discharged and charged with the seat installed on the aircraft.

The 215П and 215Ф firing mechanisms should be charged and discharged with the seat removed from the aircraft.

To discharge the TCM-2500-38 firing mechanism, remove the drogue chute as indicated in Item 2, Section "Removal and Installation of Seat". To check the primer caps for hitting, special check cartridges are used which ensure the mechanisms cleanliness after checking.

Note: When no check cartridges are available, test discharging of the firing mechanism should be performed with a capped washer. After test firing clean and lubricate the bolts, inner tubes and chambers.

It is forbidden to test the firing mechanisms without having previously made sure that they are not charged with live explosive cartridges. Presented below is the procedure to be used for charging all firing mechanisms of the seat.

Charging TCM-2500-38 Firing Mechanism

The TCM-2500-38 firing mechanism is charged with the ПК-16 explosive cartridge in the following sequence:

1. After disconnecting the cable from the arming pin unscrew the lock nut of the firing mechanism bolt.
2. Unscrew the union nut of the bolt and remove the bolt.
3. Cock the firing mechanism, for which purpose press the striker to move it back with the Ø5-6 mm rod inserted in the hole of the bolt body, after which install the arming pin.
4. Insert the flexible ground safety pin in the firing mechanism bolt, having disconnected the pin from the service cord. Tie up the flexible pin to the lock with the KOK-0.5 wire.
5. Fit the explosive charge on the locking rod (while doing this, hold the lock upside down to depress the indicating pin (which indicates presence of an explosive cartridge in the mechanism) in the bolt face, after which turn the explosive cartridge about the locking rod clockwise and fit the flange of the cartridge in the grooves of the catches.
6. Insert the explosive cartridge with the bolt in the firing mechanism.
7. Screw the union nut home and tighten the lock nut with a special wrench.
8. After charging the firing mechanism remove the flexible pin from the firing mechanism bolt and insert in its stead, the ground safety lock pin marked 1.
9. Connect the lock pin with the fire control cable.

Discharge the firing mechanism in the reverse order, having previously inserted in the bolt the flexible safety pin by fastening it to the firing mechanism bolt with the KOK-0.5 wire.

Charging 215П Firing Mechanism

The 215П firing mechanism (Fig.117) is charged with the ПКЗ-М1 explosive cartridge.

Charging is accomplished as follows:

1. Disconnect cable 10 from the bolt pin.
2. Turn out lock screw 6.
3. Slightly pull out the inner tube of the firing mechanism to open the tetrahedral portion of the tube.
4. Unscrew bolt lock nut 3.
5. Remove ring 5 with drogue parachute container attachment fitting.
6. Unscrew union nut 7.
7. Remove bolt 9.

8. Press the striker through the hole in the bolt body face with a rod, 4 - 5 mm in dia., and install pin 2.

9. Lock the pin with ground safety lock pin 1 after disconnecting it from the service cord.

10. Fit on the ПК3-М1 explosive cartridge on the pin in the bolt body face, turn the explosive cartridge and fit the flange of the explosive cartridge under the bolt lugs.

11. Place the explosive cartridge with the bolt inside the firing mechanism tube.

12. Screw the nut home.

13. Fit in the inner tube.

14. Turn in the lock screw.

15. Install the ring with the attachment fitting for the drogue parachute.

16. Screw on the lock nut.

17. If the firing mechanism is charged with the seat in situ, the cable for the firing mechanism control system should be connected to the lock pin.

18. Connect the ground safety pin to the service cord.

To discharge the firing mechanism, use the reverse procedure, having previously set the ground safety lock pin in the mechanism.

Charging 215P Firing Mechanism

For charging the 215P firing mechanism use the ПК3-М1 explosive cartridge.

The following procedure is employed for charging:

1. Open and lock in this position the flaps on the seat back.

2. Disconnect the control rods from the lever on the firing mechanism bolt and remove the locking wire with the seat from the lever.

3. Turn out the screws of the attachment fitting for the swivel pin bracket locking the axle of the firing mechanism swivel pin in position.

4. Remove the lever from the firing mechanism swivel pin.

5. Unscrew the union nut and remove the bolt.

6. Screw the cock key in the striker.

7. Pull the key and cock the striker; turn the arming pin to direct the indicating pin along the axis of the firing mechanism (which corresponds to the closed position) and insert the safety lock pin after removing it from the service cord.

8. Fit the explosive cartridge on the pins of the bolt and insert the cartridge in the firing mechanism.

9. Fit the lever on the swivel pin and lock the pin axle in the bracket. Fasten the bracket with screws to the seat rail.

10. Screw home the union nut and lock it.

11. Connect the control rods to the lever and lockwire the lever to the bracket.

12. Connect the ground safety lock pin to the cord.

13. Close the flaps on the seat pan. To discharge the firing mechanism, use the reverse procedure, having previously installed the ground safety pin.

Charging 215Ф Firing Mechanism

The 215Ф firing mechanism is charged with the ПК3-М1 explosive cartridge in the following sequence:

1. Disconnect the rod from the release lever.

2. Remove release levers 16 (Fig.121) from the swivel pin of bolt 17.

3. Unscrew the union nut of the bolt.

4. Remove bolt 17.

5. Cock the striker with the help of the cock key and turn the arming pin to place it in position when the indicating pin of the arming pin is directed along the bolt axle (closed position).

6. Insert in the bolt the safety lock pin, having removed it from the service cord.

7. Fit the ПКЗ-М1 explosive cartridge on the bolt pins.

8. Install the explosive cartridge with the bolt in the chamber to fit the swivel pin in the locking fork of the yoke holding the chamber. When installing the bolt, see that the bolt marked П is installed in the right-side firing mechanism, while the one marked Л, in the left-hand firing mechanism.

9. Screw home the union nut and lock it.

10. Fit the release lever on the swivel pin of the bolt and fit a cotter pin on it.

11. Connect the control rod and lockwire it.

12. Connect the ground safety lock pin to the service cord.

For discharging of the firing mechanism use the reverse procedure, having previously installed the ground safety lock pin.

5. Adjusting the Seat to Fit Pilot's Height (Fig.118)

With the canopy closed, ensure a clearance of 50 mm between the pilot's head pressed against the headrest (the pilot wearing the ГШ-4М pressurized helmet) and the canopy glass irrespective of the pilot's height.

This requires adjustment of the seat according to the height the pilot flying the aircraft. The seat should be raised or lowered by readjustment of the МУ-100АП motor operation in the following sequence:

1. Lower the seat pan to the extreme down position.

2. Unlock the nut of the upper rod for the seat adjusting mechanism (Fig.119), for which purpose slacken the lock nut by screwing out the upper rod with a screw driver.

3. By screwing the upper rod out or in, set the rod bead against the arrow which corresponds to the pilot's height (when seated), then fix the rod with lock nut.

4. Lower and lift the seat pan by pressing the switch on the left-side panel and placing it to the DOWN and UP positions; make sure that the limit switches disconnect the МУ-100АП electric motor in the extreme positions of the seat pan.

The aircraft technician should remember that:

(a) the lower arrow bears the inscription UP TO 86 which corresponds to pilots' height up to 86 cm. (when seated);

(b) the first middle arrow is inscribed 87 - 91, which corresponds to pilots' height of from 87 to 91 cm.;

(c) the second middle arrow bears the inscription 92 - 93, which corresponds to pilots' height of 92 and 93 cm.

5. The upper arrow inscribed 94 corresponds to pilots' height of 94 cm.

Note : The pilot's height (when seated without flying clothes and the ГШ-4М pressurized helmet) can be found in the pilot's medical card.

For instance, the pilot's height (when seated) being 90 cm., the bead of the upper rod of the seat adjusting mechanism should be set against the arrow inscribed 87 - 91; the pilot's height being 94 cm., it should be set against the arrow marked 94, etc.

4. If the pilot's height is 94 cm., set the bead of the upper rod of the

seat adjusting mechanism against the button of the upper microswitch by screwing the rod out. In this case the seat pan will be brought to the extreme down position, which will make impossible in-flight adjustment of the seat.

The arrows on the mechanism for seat adjustment should be set as indicated in Fig.119.

6. Mounting Drogue Parachute on Seat

Mounted on the seat is the СПК-6381-59 drogue parachute set (Fig.120). The parachute with the container is double sealed.

Removal of the parachute for checking or replacement should be done only in case of scheduled maintenance performed in conformity with specially issued Instructions.

The parachute is installed in the section member of the 215П firing mechanism with the help of two plates mounted on the container. This section member together with the plates is secured with two pins. The thimble of the parachute shroud lines is connected to the swivel provided on the bolt of the firing mechanism.

To install the drogue parachute on the seat, use the following procedure:

1. Arrange the cover with the shroud lines in the right-side housing of the seat headrest, having previously fastened the snaphook of the cover to the lug in the housing.
2. Connect the thimble of the parachute shroud lines to the swivel of the 215П firing mechanism bolt.
3. Install the plates of the container in the section member of the 215П firing mechanism bolt and match the holes in the plates with the holes in the section member.
4. Secure the section member, container plates and ring of the strap sewn to the shroud line cover with two pins, having first placed the ring of the strap between the container plates on the right-hand side.
5. Lock the pins with the KOK-0.5 wire and seal them.
6. Remove the wire with seals from the extreme holes of the container.

CAUTION: It is forbidden to give permission for a flight if the container is sealed, as in this case the parachute will not be released from the container bailing out.

To remove the drogue parachute, follow the order, reverse to that of installation. Before removing the parachute container seal the container through the extreme holes in its plates.

7. Checking Seat Units for Proper Operation

All units of the seat are to be checked for proper operation only when performing scheduled maintenance operations on the aircraft. In this case no adjustment operations should be carried out on the seat, all the seat mechanisms being adjusted at the Manufacturing plant.

Check the serviceability of the mechanisms; check primer caps of all firing mechanisms for proper hitting.

Both checks should be performed at one time and in the specified sequence.

All the main checking operations on the seat units as well as the primer caps hitting should be performed with the seat removed from the aircraft. In this case the seat should be placed on a special support.

The firing mechanisms should be discharged. Described below is the procedure to be used when checking the seat units for proper operation to avoid accidents and to save labour.

(a) Checking Operation of Firing Mechanisms and Restraint Mechanism

When checking operation of the firing mechanisms, simultaneously check the primer caps of the TCM-2500-38 and 215P firing mechanisms for proper hitting.

The checking should be carried out in the following order:

1. Remove the TCM-2500-38 firing mechanism from the seat and suspend it from the seat, securing it to the seat with wire.

2. Charge the TCM-2500-38 and 215P firing mechanisms with test cartridges.

3. Connect the control lines to the bolts of the firing mechanisms and restore the lockwire removed from the lever of the firing mechanism during discharge.

4. By slowly pressing the release lever on one of the armrests actuate the 215P firing mechanism. When firing, make sure that the pin of the TCM-2500-38 firing mechanism has not moved at the moment when the 215P firing mechanism has operated.

5. By further slow pressing of the release lever fire the TCM-2500-38 mechanism. Make sure that the lever possesses additional free travel.

6. Discharge the TCM-2500-38 and 215P firing mechanisms and make certain that the primer caps of the test cartridges have been hit and have operated.

7. Replace the bolts of the firing mechanisms for operation, i.e. pull out the

8. Repeat checking the firing mechanisms for operation, i.e. pull out the pin of the lever on the second armrest. While doing this, do not check the primer caps for hitting.

Note : If at least one primer cap has not been hitted, eliminate the defect and repeat the check.

(b) Checking Primer Cap of 215Ф Firing Mechanisms for Hitting

To check the primer caps for hitting, charge the firing mechanisms with check cartridges and use the following procedure:

1. Cock the АД-3 time mechanism if it has not been cocked, for which purpose:

(a) Disconnect the cable of the АД-3 time mechanism from the lever of the seat cross shaft by removing the axle.

(b) Cock the АД-3 time mechanism pulling the cable full way out of the time mechanism with the ring provided with a hook (supplied with the АД-3 time mechanism).

(c) Fit a flexible pin in the АД-3 time mechanism.

(d) Connect the cable of the АД-3 time mechanism to the lever of the cross shaft by inserting the axle.

2. Open the seat flaps and remove the ground safety lock pin marked 10 from the roller of the drive mechanism for the system which provides opening of locks of the pilot's position fixing system (on aircraft where the left-side bell crank of the cross shaft is locked with a shear screw), after which turn out the screw.

3. Pull out the flexible pin from the АД-3 time mechanism, which will actuate the time mechanism (the cable will be drawn in). This will turn the seat cross shaft controlling through the rods the bolts of the 215Ф firing mechanisms; as a result, the firing mechanisms will operate.

See that the roller of the drive for the pilot's position lock opening system does not turn and break the roller lockwire.

4. Discharge the 215Ф firing mechanism and check the primer caps of the test cartridges for hitting and operation.

5. Cock the bolts of the 215Ф firing mechanisms and place them where they belong to.

6. Cock the АД-3 time mechanism as prescribed above and lock the flexible pin with a thick thread.

7. Turn the seat cross shaft controlling the bolts of the firing mechanisms to set it to the initial position and connect the rods with the bolts of the firing mechanisms.

Prior to connecting the rods check to see that the system has been locked, to this end press the rod in the direction for actuating the firing mechanisms. Be sure that no turning of the shaft occurs.

Note : If at least one of the primer caps has not been hitted, eliminate the defect and repeat the checks.

Checking the Cartridge of 215П Firing Mechanism (for Drogue Parachute) for Hitting

The 215П firing mechanism primer cap is checked for hitting with a test cartridge in the following sequence:

1. Connect the cable to the pin of the 215П firing mechanism bolt.

2. Remove the pin from the bolt of the 215П firing mechanism by pulling the cable.

3. Discharge the 215П firing mechanism and make certain that the primer caps of the test cartridge have been hitted and have operated.

4. Cock the bolt of the 215П firing mechanism, set it where it belongs to and connect the cable to it.

Note : If at least one primer cap has not been hitted, eliminate the trouble and repeat the checking.

Checking Opening of Locks for Pilot's Position Fixing System from Emergency Grip

Check opening of the locks for pilot's position fixing system (Fig.121), i.e. the locks for the shoulder and waist restraints and the foot catch-locks with the seat removed from the aircraft and installed on the support and with discharged firing mechanisms. For checking use the following procedure:

1. Arrange in the seat pan the parachute with the harness and connect the latter to the locks of the shoulder and waist restraints. Remove the ground safety pin marked 10 from the roller of the drive for opening the locks of the pilot's position fixing system.

2. Climb in the cockpit , put on the harness, fasten the main lock of the harness, adjust the waist and shoulder restraints and close the foot catch-locks.

3. Pull sharply the emergency lock opening grip provided on the seat pan. The grip should remain in the pilot's hands. This will cause:

(a) breaking of the lock wire on the grip and on the roller of the drive for the pilot's position fixing locks;

(b) operation of the 215Ф firing mechanism bolts;

(c) operation of the spring mechanism, which will turn the upper cross shaft and open the shoulder and waist restraint locks as well as foot catch-locks, the waist restraint locks being the last to open.

4. Remove the parachute with the harness from the seat pan.

5. Inspect the rod of the spring mechanism and apply the fresh ЦИАТИМ-201 lubricant.

After the locks have operated, reset the system to the initial position:

1. Fit the grip cable in the roller on the seat pan, for which purpose:

(a) remove the cover from the transmission roller on the seat pan;

(b) pass the grip cable with the fitting through the pipe in the roller body;

(c) bring the seat for the cable fitting in the roller to the body cable outlet;

(d) insert the cable fitting in the roller seat;

(e) secure the cover of the roller on the body.

2. Disconnect the rods from the release levers of the 215Φ firing mechanisms.

3. Cock the spring mechanism, for which purpose:

(a) through the hole in the upper nut of the spring mechanism insert and screw in a special device intended for cocking;

(b) pull the device up and compress the spring by drawing the rod inside. Lock the spring mechanism by inserting a pin in the device.

4. Cock the lock of the shoulder restraint, for which purpose (Fig.122):

(a) disconnect rod 26 connecting the lever of the upper cross shaft with the lever for opening the shoulder restraint lock from the lock opening lever by removing the pin;

(b) insert link strap 4 in the hole of the shoulder restraint lock and move it inside as far as it will go; the drum of the lock will be turning during this operation;

(c) press the tang of the catch with a roller by a screw driver inserted in the hole of the lock body and place the lug of the catch in the loop of the link strap, which will correspond to the "closed" position of the lock;

(d) keeping the catch with the roller in this position by means of the screw driver, move the closing rod inside the lock;

(e) make sure that the lock is closed by pulling the link strap.

<u>Note</u> : If the loop of the link strap does not engage the catch lug, turn the lock drum rearward, for which purpose lift the rod of the 215P firing mechanism roller with the help of the lever and fix it in this position by placing a wooden block under the rod (Fig.123).

5. Cock the waist restraint locks and foot catch-locks (Fig.124). To this end:

(a) open the flaps on the seat back to provide for access to the rods of these locks and secure the latter in the open position;

(b) turn the levers with the bell cranks of both foot catch-locks so that the stops become engaged by the ratchet sectors;

(c) turn the upper cross shaft by raising the end levers upward. This will cause the link attached to the lever to move leftward and turn the bell cranks through the system of rods, which will bring the bell cranks to the foot catch-lock levers;

(d) bring the fittings of the waist restraint cables in the seat locks, having previously fastened on the cables the pulleys with buckles for the parachute harness;

(e) close the catches for both locks of the waist restraint and lock them with special clips;

(f) move the cross rod to the left in the direction of flight to place the projections on the levers just in the way of the catches (Fig.124), after which remove the special clips;

(g) pull the cables of the waist restraint to make sure that the cables are locked;

(h) turn the upper cross shaft home by lifting the end levers once more.

This will allow the link connected with the vertical shaft lever to move farther to the left, after which the bell cranks brought to the levers of the foot catch-locks will engage them. The bell cranks should remain in such a position when their bearing surfaces and those of the levers become aligned.

6. Connect the lever which controls the lock of the waist restraint with the rod of the upper cross shaft by inserting the pin.

7. Having made sure that the spring mechanism lever locks the rod in the cocked position, remove the device to cock it.

8. When turning the upper cross shaft of the system for control of pilot's restraint locks, the transmission rollers on the rear side of the seat back and on the seat pan will draw the grip cable in, as a result, the rubber portion of the grip will become drawn in the roller body; consequently, the spring plates with pins should lock the grip in the initial position.

9. Lock with the KOK-0.5 wire and seal the right-side bell crank of the upper cross shaft, grip of the pilot's position fixing locks, lower cross rod and roller of the drive for the pilot's position fixing locks.

10. Close the flaps on the seat back and check operation of the waist and shoulder restraints from the grips on the seat armrests. Besides, make sure that the foot catch-locks are fixed in the open position.

11. Remove the old grease off the hinged joints and coat them with the fresh ЦИАТИМ-201 grease mixed with graphite.

Checking Operation of Collapsible Supports for Canopy Catch-Locks

To check operation of the collapsible supports, use the following procedure:

1. Unscrew the locking shear bolt from the left-side sector of the shaft which controls the collapsible supports (Fig.125, Ref.20), having previously made sure that the supports are provided with ground safety lock pin 5.

2. After taking precautionary measures remove the ground safety pins from each support in succession. Turn the shaft which controls the supports. This will cause the supports to open by 90° and the spring pins will lock them.

3. Unscrew the shear screw of the stops fixing the spring-loaded pin in the support recess, strike the stop with a rod of a 10-mm diameter (the rod being used to simulate the insert for the canopy front catch-lock); this will move out the spring-loaded pin.

Having made sure that the spring-loaded pin operates properly, pull it in and fix with the stop by screwing in the shear screw. Each support (20, Fig.125) should be checked separately.

4. Connect the dynamometer to each of the supports in turn and check to see that the initial force to be applied to fold the supports should be equal to at least 18 kg. The dynamometer should be connected to the support end; to unlock the support, press the pin with the rod which should be inserted through the hole in the bracket upper portion; after pressing the pin remove the rod from the hole.

5. After measuring the spring force, fold the supports and install ground safety lock pins.

8. Checking Seat Mechanisms for Presence and Condition of Seals and Special Locking Screws

After inspecting the seat units for proper operation it is necessary to check the seat mechanisms for presence and condition of seals and special locking screws (Fig.125). To this end use the following procedure:

1. See that the rod for opening of the foot catch-locks is locked with the M1K-0.5 wire without seal.

2. Check to see that the end piece of the cable for control of the TCM-2500-38 firing mechanism is locked with the KOK-0.5 wire without seal.

3. Be sure that the lock actuated by the roller during the АД-3У time mechanism operation is locked with the M1-KO.5 wire and sealed.

4. See that the thrust nut for the flexible casing of the cable of the locks for the restraint emergency opening system is secured with the KOK-0.8 wire and sealed.

5 and 5 a. Check to see that the right-side lever of the upper cross shaft which controls the locks of the pilot's position fixing system is secured with the KO-KO.5 wire (including the aircraft with series number 1620) and with shear bolt АМГКТ (Ø 2mm) beginning from the aircraft with series number 1701.

6. Check to see that the thrust nut at the end of the 215P firing mechanism cable is locked with the KOK-0.5 wire and sealed.

7. Be sure that the lock for attachment of the three-link yoke of the 215П firing mechanism is secured with two shear bolts made of steel, grade 10, and two locking plates made of steel, grade 10, л-0.5.

8. See that the outer sleeve with the bush of the 215П firing mechanism is locked with the screw made of steel, grade 25. The drogue parachute attachment pins as well as arming pin and cable of the 215П firing mechanism are secured with the KO-KO.5 wire and sealed.

9. Check that the nut for the TCM-2500-38 firing mechanism bolt is locked with the KOK-0.8 wire and sealed.

10. Check to see that the 215П firing mechanism cable located in the groove is secured with the KOK-0.5 wire without seal.

11. Be sure that the adjusting rod in the TCM-2500-38 firing mechanism control line is locked with the KOK-0.8 wire (left-hand side) and sealed.

12. Be sure that the horizontal rod for the waist restraint lock control system is locked with the KO-KO.8 wire and sealed.

13. See that the shackles in the drogue parachute rod disconnect system (on the right-side and left-side levers) are secured with the CK-9104-ШС special pins made of АМЦ-К-2 material.

14. Check to see that the nut for the 215P firing mechanism bolt is lockwired with the KOK-0.8 wire.

15. See that the nut for the 215П firing mechanism bolt is secured with the KOK-0.8 wire and locking screw made of steel, grade 25.

16. See that the snaphook which fastens the shock-absorbing cord to the shoulder link-strap lock is secured with the KO-KO. 8 wire without seal.

17. Check to see that the attachment fitting (ball) for the TCM-2500-38 firing mechanism located in the sector on the seat pan back side in its right and left sections is secured with the KOK-0.8 wire without seal.

18. Be sure that the cotter pin for the relief valve of the TCM-2500-38 firing mechanism is locked with the M1K-0.5 wire.

19. See to it that the flexible pin securing the АД-3 time mechanism in

the cocked position is fixed with twisted cord thread removed from the core of the cotton shroud line.

20. See that the left-side sector of the shaft controlling the collapsible supports for the canopy front catch-locks is secured with a special shear screw made of the АМЦ-К2 material.

21. Be sure that the shoulder restraint lock mechanism is secured with the Д1-Т shear screw of a 3.5 mm diameter.

22. See that two stops (the left and right-side ones) for the sliding spring-loaded pins on the collapsible supports for canopy front catch-locks are secured with special shear screws made of the АМЦ-К-2 material.

23. Check to see that the rubber grip for emergency opening of the pilot's position fixing system locks is secured with the KOK-0.5 wire.

24. See that the shackle of the cable on the bell crank for opening of the collapsible supports intended for canopy front catch-locks is secured with a 2-mm diameter shear wire made of the АМЦ-К2 material.

25. Check to see that the plug of the reduction unit for the seat lifting mechanism is secured with the KOK-0.8 wire.

26. See that the 215P firing mechanism release lever is locked with the KOK-0.5 wire and sealed.

Check the locking of all stationary joints of the seat. Restore it, if required. Having finished the checking of the seat mechanisms, clean all the 215 and TCM-2500-38 firing mechanisms in conformity with the Instructions issued by the Manufacturing plant (while cleaning, do not remove the 215П firing mechanism from the seat).

Note. 1. See to it that after assembly the length of the 215Ф firing mechanisms should be exactly the same as their length before disassembly, which is important to avoid improper operation of the mechanisms.

2. When removing the 215P firing mechanism, do not disturb the restraint system adjustment. To this end measure the cable end piece adjusted position so as not to disturb the 215P firing mechanism adjustment during its installation.

Charge the firing mechanisms with live cartridges and insert ground safety lock pins in the mechanisms.

Check the firing mechanisms for presence of lockwires and special lock screws in conformity with the Instructions on firing mechanisms maintenance.

The checks over, the seat is ready for installation on the aircraft. After disjointing the 215 P firing mechanism assemble it with the help of device for loading springs of the 215 P firing mechanism No. 74-7804-190A supplied by the Manufacturing plant.

9. Operations to Be Performed on Seat after Delivery of Aircraft from Manufacturing Plant

1. If the aircraft has been delivered by train, remove the seat from the aircraft and check the seat for presence of lockwires and seals.

Deslush the seat, if it has been slushed. Be sure that the calibrated holes in the 215 P and TCM-2500-38 firing mechanism nozzles are not clogged with dirt and grease, for it may cause failure of the seat mechanisms during ejection and impose excessive G-forces on the pilot.

The nozzle with the calibrated hole is located in the firing mechanism lower portion.

Note: The winter-use TCM-2500-38 firing mechanism has a plug instead of the calibrated hole.

To check the calibrated hole in the nozzle of the TCM-2500-38 firing mechanism and the hole in the 215 P firing mechanism, unscrew the nozzles and wash them in pure gasoline, if necessary:

2. Charge the firing mechanisms with live cartridges.

3. Install the drogue parachute with the container, if it has not been installed.

4. Install the seat on the aircraft .

5. Perform the necessary operations on the seat in conformity with the preliminary preparation procedure.

10. Seat Slushing

If the aircraft is not to be flown for at least 3 months, slush the seat.

Before slushing remove the drogue parachute and deliver it for storage to the personnel concerned.

Before removal of the parachute tie up the metal strips sewn into the container with a 0.8-mm locking wire and seal them.

Note: (a) To tie up the strips thread the wire through the strip end openings.
(b) Slush the firing mechanisms in conformity with the Instructions on cleaning, lubricating and maintenance of the ejection firing mechanisms.

Slushing of Ejection Control System

1. Coat all the cables with graphite grease mixed with ЦИАТИМ 20I grease.

2. Coat lavishly with ЦИАТИМ 20I grease the following units and parts:

(a) all joints of the control system, especially shaft bearings to prevent moisture from getting inside the bearings;

(b) screws of the seat pan lifting mechanism and of the limit switch adjusting system;

(c) guide-rails of the seat pan;

(d) mechanisms for the foot catch-locks;

(e) mechanisms of the collapsible supports for the canopy front catch-locks;

(f) trunnions of the upper beam for the rear catch-locks.

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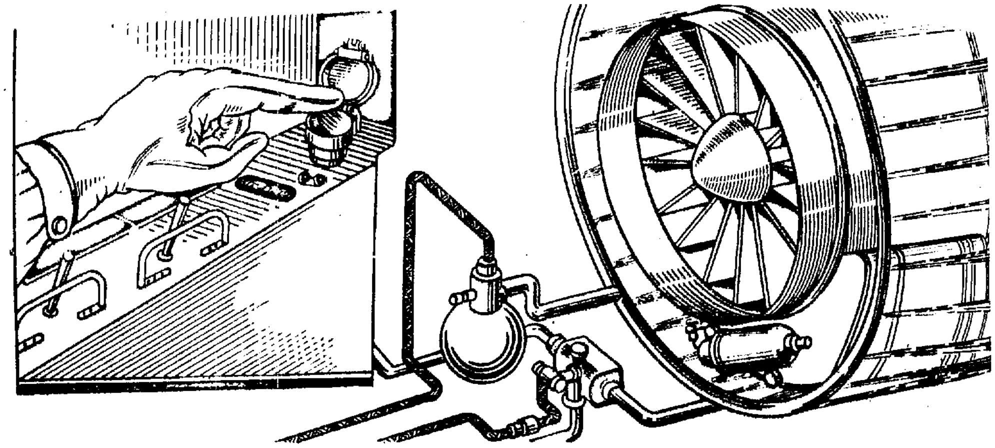


Chapter X

FIRE-FIGHTING EQUIPMENT

1. General

(Fig. 126)

The aircraft fire-fighting equipment ensures extinguishing of fire in the aircraft engine compartment in flight or on the ground.

The fire-fighting equipment consists of the fire warning system and fire extinguishing system.

The ИС-2МС fire warning system is intended for transmitting to the pilot a light signal warning on the fire hazard as well as on fire extinguishing in the engine compartment.

The fire warning system consists of the following components: signal units (transmitters), electronic amplifier and warning light which are electrically interconnected.

The signal unit is made up of two heat-resistant metal pipes which are installed at frame No.29 bottom portion, arranged in a half-ring, the electric current being fed to the rings.

The pipes are attached to frame No.29 by brackets through ceramic insulators, the clearance between the pipes and the aircraft body being 15 - 30 mm. The signal is transmitted through remote control system.

The ionization signal unit operates on the following principle: with a clearance of 15 mm between the pipes and aircraft body (which is a minimum clearance), the air gap keeps the system disconnected, therefore the FIRE warning light on the T-6 light panel does not burn. However, should flame appear in the air gap between the pipes and aircraft body, the air gap due to the presence of ionized air becomes an electro-conductive medium with a potential difference enough to cause operation of the relay provided in the electronic amplifier. The relay switches on the FIRE warning light on the T-6 light panel.

When the flame is extinguished, the FIRE warning light will go out.

The ИС-2МС signal unit is of direct-action type which operates practically instantaneously.

The aircraft fire extinguishing system comprises a special fire-extinguisher and a steel circular spray ring to spray the fire-fighting liquid.

The fire-extinguisher (Fig.127) is a two-litre spherical bottle provided with an electrically operated firing bolt (a bolt cap). The firing bolt is actuated by the ПП-3 explosive charge.

The fire-extinguisher is located on the fuselage bottom beam close to frame No.21.

The circular spray ring is mounted between frames Nos 22 and 23.

Mixture 7 is employed as the fire-extinguishing substance. To switch on the fire-extinguisher press the FIRE-EXTINGUISHER button on the left-hand panel.

Pressing the button will close the explosive cartridge circuit and cause an explosion. The explosion will open the bolt cap of the fire-extinguisher, the charge of the fire-fighting mixture will be forced by the pressure of carbon dioxide and air from the fire-extinguisher and will be ejected through the pipeline and spray ring to the area where fire broke out.

The fire-fighting system should be actuated upon flashing up of the red FIRE warning light on the T-6 light panel.

The bolt cap of the fire-extinguisher serves as a closing valve which is used also for filling, closing and discharge of the mixture. The bolt cap body is provided with four pipe unions to connect the pipeline, with a pressure gauge, explosive charge and protective device calibrated for a pressure of 200±20 kg/sq. cm.

Instructions on Filling Fire-Extinguishers

The fire-extinguisher is filled with fire-fighting mixture 7. The mixture (according to Specifications) consists of methylene bromide, ethyl bromide (State Standard ГОСТ 2658-56) and dehydrated carbon dioxide (State Standard ГОСТ 8050-56).

The fire-extinguisher should be filled at a temperature of from +15° to +20°C up to a pressure of 75±5 kg/sq.cm. strictly observing the safety rules.

The main components which go to make up mixture 7 are toxic substances, therefore the fire-extinguisher should be filled from special reservoirs hermetically by forcing them into the fire-extinguisher with the compressed air from the air bottle, having preliminarily reduced the air pressure to 0.5 - 0.6 kg/sq.cm.

Dehydrated carbon dioxide and compressed air should be delivered to the fire-extinguishers from a container either by gravity or with the help of the KH-2 oxygen pump.

The oxygen pump should be switched on only after the pressure in the carbon dioxide and compressed air bottles has dropped below the required value and the gravity flow has stopped.

As the fire-extinguishers are filled under considerable air pressure, special devices are employed for the purpose.

2. Aircraft Fire-Fighting Equipment Maintenance

Maintenance of the fire-fighting equipment is to be carried out as follows:

1. See that the insulators and transmitters are always clean, as their fouling may result in faulty operation.

When performing the 50-hour scheduled maintenance operations, wipe the warning unit insulators with a clean dry cloth. They may be also washed with kerosene, after which they should be wiped with a clean dry cloth.

CAUTION! It is forbidden to wash the insulators with gasoline.

2. When on the aircraft, the fire extinguishers should be kept under conditions which prevent them from:

(a) gasoline, oil or water getting on the bolt cap;

(b) possible blows on the fire-extinguisher bottle, bolt or pressure gauge;

(c) being heated by the heat sources.

3. After the fire-fighting system has been used or the fire-extinguisher has been spontaneously discharged, remove all traces of mixture 7 from the system giving considerable attention to removing mixture 7 from the dead ends of the system.

To this end:

(a) Remove the fire-extinguisher from the aircraft.

(b) Pour out, if possible, the traces of the fire-extinguishing mixture from the system and scavenge the latter with compressed air (under a pressure of approximately 50 kg/sq.cm.) from the ground air bottle until the mixture is completely removed.

To remove the fire-extinguisher from the aircraft, do the following:

(a) Disconnect the pipeline from the operating pipe union and turn the plug (with openings) on the pipe union.

(b) Disconnect the ignition device from the bolt and remove the explosive cartridge. Screw the plug on the pipe union of the explosive cartridge.

(c) Remove the fire-extinguisher from the bracket and send it for charging.

Remove all traces of mixture 7 from the aircraft compartments by forced ventilation and blowing off air through the hatches. Absence of smell in the compartments indicates that the mixture traces have been completely evaporated.

CAUTION! Under no circumstances attempt to wash the aircraft compartments or the fire-fighting system with the purpose of removing traces of mixture 7.

4. During pre-flight inspection check the pressure against the pressure gauge fitted on the discharge bonnet. Remember that temperature changes will cause pressure changes, i.e. increase in temperature will bring about increased pressure in the bottle, while decreased temperature will cause a decrease in pressure. This is made evident in the following Table:

°C	-55	-45	-35	-25	-15	-5	0	+5	+15	+25	+35	+45
P(pressure) in fire-extinguisher kg/sq.cm.	30	35	40	45	50	55	60	65	70	80	90	100

5. When it becomes necessary to disconnect the plug connectors from the amplifier unit, see that no moisture gets on the connector terminals.

3. Checking Fire Warning Circuit

(to be performed every 7 + 3 days)

To check the fire warning circuit use the following procedure:

1. Turn on the STORAGE BATTERY:AIRCRAFT,GROUND switch located on the right-hand panel and the FIRE. DE-ICER. SHUT-OFF VALVE circuit breaker on the front left-hand switch-board.

2. Insert a 5 - 6-megohm resistance in the air gap between the pipes and aircraft "body". This should cut in the FIRE warning light. Upon insertion of an 8-megohm resistance the light should remain dead.

4. Checking Resistance of Electric Wire Insulation from Amplifier to Transmitters

(to be performed during scheduled maintenance)

To perform this kind of check, use the following procedure:

(a) Disconnect the two-terminal connector from the MC-2MC amplifier.

(b) Measure the resistance value between terminal КЛ1 and the aircraft "body", and between terminal КЛ2 and the aircraft "body".

Carry out the checking with a megohmmeter for 500 or 1000 V. The resistance value should be at least 20 megohms.

(c) Connect the plug connector to the amplifier.

5. Filling of Fire-Extinguisher

The fire-extinguisher may be filled with mixture 7 (on a special installation, Fig.129) if all Certificates for the components which go to make up mixture 7 are at hand and are properly filled in.

Fill the extinguishers to a pressure of $P = 75 \pm 5$ kg/sq.cm., the temperature in the premises being $+15^{\circ}$C. While filling, do not fail to observe the safety rules which will be set forth below.

The charge (mixture) is made up of the following components:

1. Methylene bromide	$2.3^{+0.025}$	kg
2. Ethyl bromide	$0.575^{+0.025}$	kg
3. Dehydrated carbon dioxide	$0.260^{+0.05}$	kg
Total	$3.135^{+0.1}$	kg

4. Air compressed up to pressure of 75 ± 5 kg/sq.cm.

Before filling the fire-extinguishers inspect them in the following sequence:

(a) See that the marking is present on the bottle and that the remaining term of service life of the bottle is at least 6 months.

(b) Inspect all joints and parts of the discharge bonnet for sound condition.

(c) Check to see that the diaphragm is intact and sound.

(d) Be sure that no water or dirt is found in the bottle.

To fill the bottles with the mixture, use the following procedure:

1. Close the bolt of the fire-extinguisher and slacken the pressure screw by 5 - 6 turns using the 2Г3 flywheel.

2. Remove the plug from the working pipe union of the fire extinguisher.

3. Unscrew the pipe union of the warning-and-protection device.

4. Install the empty fire-extinguisher, with the plugs removed, on the scales (the fire-extinguisher should be placed vertically) and check the weight of the empty fire-extinguisher.

5. Connect to the working pipe union of the fire-extinguisher the supply pipeline running from the reservoir with methylene bromide and balance the fire-extinguisher bottle in this position, if necessary.

6. Move the weight on the scales by an amount corresponding to the weight of the methylene bromide to be filled to the fire-extinguisher. This done, open the valve of the bottle with compressed air and the valve of the supply pipeline to feed methylene bromide to the fire-extinguisher and fill the extinguisher until the scales are balanced.

7. Close the valve of the supply pipeline and the valve of the compressed air bottle, disconnect the supply pipeline from the working pipe union of the fire-extinguisher and connect the supply pipeline running from the reservoir with ethyl bromide. Move the weight on the scales by an amount corresponding to the weight of ethyl bromide to be filled to the fire-extinguisher, open the valve of the compressed air bottle and of the supply pipeline which connects the reservoir containing ethyl bromide with the fire-extinguisher. Perform filling the fire-extinguisher with ethyl bromide until the scales are balanced.

8. Close the valve of the supply pipeline and the valve of the low-pressure air bottle, disconnect the pipeline from the bottle, screw in the pipe union of the fire-extinguisher warning-and-protection device, after which move the weight on the scales by an amount which corresponds to the weight of carbon dioxide to be filled in the fire-extinguisher.

9. Connect the supply pipeline running from the carbon dioxide container, open the valve of the container and the valve of the supply pipeline, then fill the fire-extinguisher with carbon dioxide until the scales are balanced.

If the fire-extinguisher has been insufficiently filled with carbon dioxide, actuate the KH-2 oxygen pump and add the required quantity of carbon dioxide to the fire-extinguisher.

10. After the scales have been balanced, close the valve of the supply pipeline, close the valve of the carbon dioxide bottle, screw home the pressure screw of the fire-extinguisher and release extra carbon dioxide to the atmosphere through the discharge valve. Disconnect the supply pipeline from the fire-extinguisher.

11. Fix the scales with the safety lock, connect the supply pipeline from the air bottle, open the valve of the air bottle and the valve of the supply pipeline, slacken the pressure screw by 5 - 6 revolutions and transfer compressed air from the air bottle to the fire-extinguisher. While doing so, see that the pressure gauge fitted on the fire-extinguisher reads not more than 75 ± 5 kg/sq.cm.

12. If pressure in the air bottle reduces to such an extent that the air stops flowing to the fire-extinguisher, actuate the KH-2 oxygen pump and add required quantity of air to the fire-extinguisher in order to obtain required pressure.

13. Using the 2Г3 flywheel, close the valve of the fire-extinguisher bolt, then close the valve of the supply pipeline and the valve of the air bottle, release remaining air from the filling pipeline into the atmosphere through the discharge valve.

14. Disconnect the supply pipeline from the fire-extinguisher, screw the plug on the working pipe union and check the total weight of the fire-extinguisher and mixture filled in.

15. Make an entry in the Service Log stating the date of filling, total charge filled and the amount of mixture 7 components. Enter also the pressure values in the fire-extinguisher during filling.

16. Thoroughly mix the contents of the fire-extinguisher using a special device or shaking the extinguisher for 3 - 4 min.

17. After filling check the fire-extinguisher for leakage by coating its threaded connections with lather.

The test should last at least 3 min. Poor tightness of connections shall not be tolerated.

18. Place the filled extinguisher on special shelves for a 48-hour test.

19. After keeping the fire-extinguisher on the shelves for 48 hours, check its pressure against the pressure gauge and weigh the extinguisher, then seal it where the pressure screw of the bottle discharge bonnet is located.

20. Make an entry in the fire-extinguisher Certificate concerning the date of filling, weight of mixture 7 and pressure in the fire-extinguisher after a 48-hour test.

CAUTION: 1. If the fire-extinguisher has been slightly overfilled with mixture 7 during charging, release excessive charge, for which purpose:

(a) reliably secure the fire-extinguisher with the bolt up (somewhere outdoors);

(b) release the excess charge from the fire-extinguisher into the atmosphere by gradually turning out the pressure screw in the bottle cap with the help of the 2Г3 flywheel.

2. If the extinguisher has not been filled to capacity with carbon dioxide while it was charged with mixture 7, add carbon dioxide checking its amount by its weight and add air in the fire-extinguisher checking the amount of air by pressure. Refill the extinguisher using the KH-2 oxygen pump.

3. The fire-extinguisher may be refilled with carbon dioxide only once. When a pressure drop again occurs in the fire-extinguisher (to a value which is 10% below normal), release the fire-extinguisher charge and refill it anew, having previously checked the extinguisher bolt head for sound condition.

4. Charging the fire-extinguisher with fire-fighting mixture 7 is accompanied by generation of heat; cooling causes the pressure in the fire-extinguisher to drop, which necessitates a pressure check after the fire-extinguisher has been kept charged for 48 hours.

Safety Rules to Be Observed when Filling Fire-Extinguishers with Mixture 7

The personnel in charge of filling the extinguishers with fire-fighting mixture 7 should observe the following safety rules.

1. When dealing with ethyl bromide or methylene bromide which are components of mixture 7 keep away from open fire, for products of thermal decomposition of ethyl bromide and methylene bromide vapours are toxic substances which may cause gas-poisoning.

2. Smoking is strictly forbidden in the premises where fire-extinguishers are filled with mixture 7.

3. The personnel handling mixture 7 should be wearing gas masks, type A, and special clothes (cotton overalls, rubber boots, rubberized aprons).

4. The premises where fire-extinguishers are filled with mixture 7, should be provided with plenum ventilation which ensures air exchange according to the Specifications.

5. Vessels with methylene bromide and ethyl bromide should be stored in separate premises and hermetically sealed.

6. It is strictly forbidden to discharge a fire-extinguisher while holding it in the hands, as a man cannot keep a fire-extinguisher from slipping down during its discharge.

7. When filling the extinguishers with mixture 7, it is strictly forbidden to apply wrenches other than the special 2Г3 handwheel.

8. It is forbidden to pour mixture 7 in the extinguishers with an unserviceable bolt or the fire-extinguisher bottle damaged(attacked by cracks, heavy corrosion, etc.) or in case the time of scheduled inspection of the fire-extinguisher has expired:

9. When pouring mixture 7 into a fire-extinguisher, be sure that the latter is securely connected to the filling device.

10. Do not fill the fire-extinguisher with mixture 7 if the lock has been removed.

11. Under no circumstances store fire-extinguishers charged with mixture 7, if they are not equipped with plugs screwed on the bottle working pipe union.

The plug on the working pipe union serves both for protection of the pipe union from nicks, moisture and dirt getting in the bolt and for decreasing the intensity of spray ejection when the fire-extinguisher is being discharged or in case of spontaneous opening of the discharge bonnet. Provided for the purpose in the plug are two 3-mm openings on opposite sides of the plug. Due to these openings the mixture run is slowed down, and the fire-extinguisher is not subjected to jerks.

12. Store the fire-extinguishers filled with mixture 7 at least 1 m. away from the heating devices.

6. Discharging Fire-Extinguisher

When employed on the aircraft, the fire-extinguishers are to be periodically partially or fully discharged.

The necessity for discharging may arise in the following cases:

(a) when the fire-extinguisher sealing has been spoiled, and the mixture has partially escaped from the extinguisher. To eliminate the defect, the remaining mixture should be released from the fire-extinguisher;

(b) on expiration of the guaranteed service period. If this is the case, discharge the extinguisher and deliver it for inspection;

(c) when a fire-extinguisher requires repairing and in other cases not stipulated by the present Instructions.

When discharging a fire-extinguisher, observe the following rules:

1. To discharge a fire-extinguisher, use should be made of a clamping device. The device should be secured to the base or its mass should be sufficient to resist the jerk occuring when the mixture is being discharged from the fire-extinguisher.

2. Discharge the fire-extinguisher only with the plug (provided with holes) screwed on the working pipe union. The plug is supplied with the fire-extinguisher set.

Under no circumstances discharge a fire-extinguisher even if it contains only small amount of mixture 7, the plug of the working pipe union missing. Do not use the starting lever if it is not provided with a clamping device.

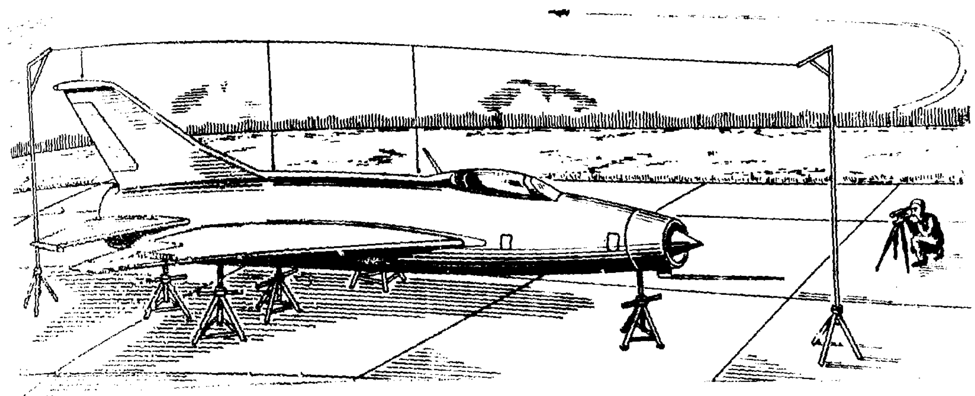
3. Release the mixture gradually turning out the pressure screw by operating 2Г3 handwheel. This will slowly release the mixture into the atmosphere through the holes in the plug, spontaneous openings of the bolt being not dangerous.

4. Discharge a fire-extinguisher into the atmosphere. Under no circumstances attempt to release the mixture indoors.

5. Before discharging make sure that the personnel is at least 10 metres away from the fire-extinguisher in the direction of spray ejection.

6. Wearing of gas mask during discharging a fire-extinguisher is obligatory.

7. The discharge over, cover the site where discharging took place with sand.



Chapter XI

AIRCRAFT LEVELLING

1. General

Level the aircraft with the purpose of checking proper and symmetrical installation of the aircraft airframe units (wings, fuselage tail portion, empennage, landing gear, etc.) after their repair or replacement as well as after the pilot notices abnormal behaviour of the aircraft in flight.

When levelling the aircraft, remember that the measurement values obtained as a result of check levelling in flight units may differ from those registered in the Levelling diagram supplied by the Manufacturer with the aircraft.

If an aircraft is delivered taken to pieces, then after its assembly check only the deflection angles of the control surfaces (stabilizer, rudder, ailerons, etc.). In service the aircraft should be subjected to check levelling by the reference points indicated in the Levelling diagram supplied with the aircraft. Data obtained during check levelling should be entered in the Levelling diagram.

See that the deflection angles of the control surfaces are within the allowances indicated in the Levelling diagram. Slight deviation is allowed only towards increased deflection angles. Asymmetrical deflection angles should be within the allowances indicated in the Levelling diagram.

Measurements taken during levelling are allowed to exceed the limits indicated in the Levelling diagram only in case they do not affect the aircraft performance (i.e. the pilot states that no abnormal operation of the aircraft has been noticed in flight) and no noticeable deformation of the aircraft airframe has been observed which would reduce the airframe strength.

After replacing any of the units and performing check levelling, enter the data obtained during measurements in the Levelling diagram.

After replacing the aircraft units (fuselage tail portion, wings, empennage, etc.) or after major repair of the units, carry out a check levelling with a subsequent check flight. Upon replacement of one or both wings the check levelling should involve both wings, flaps and ailerons, with a subsequent check flight.

When levelling the aircraft, refer to the Levelling diagram supplied with the aircraft. Actual measurement values obtained during levelling should be entered in the Diagram.

Level the aircraft with empty fuel tanks, with an empty cockpit, with no bombs suspended and the ammunition removed, with the aircraft equipment mounted, the access hatches closed and drop tank suspended.

Note: No work is allowed on the aircraft during levelling.

Prior to levelling place the aircraft in the flight attitude by installing jacks under frames Nos 2 and 28 (to break the wheels off the ground). Besides, place protective trestles under the fuselage tail frame No.35 and under the wings 2 m. off the aircraft axis of symmetry. See that a 50 - 60-mm clearance is provided between the trestle and fuselage skin. It is advisable to level the aircraft in a hangar or in the airfield in calm weather and with the level installed in one point and kept there during the entire levelling procedure.

The level is installed 3 - 4 m. off the aircraft so that the measuring stick can be seen applied to any of the reference points. Special attention should be paid to the reference points which are in line with the landing gear.

The reference points on the aircraft are marked red (each point of a 4 - 5 mm in diameter is in the centre of a 18 - 20-mm circle).

For levelling set the fuselage axis horizontally by reference to points 1 and 2 on the fuselage port side (when looking from the aircraft rear).

Elevation of point 1 above point 2 should be 70+3 mm. To ensure proper position of the aircraft laterally, two points 8 - 8 should be aligned in height (allowance in this case should be 0.5 mm).

2. Checking of Wing Setting

Wing setting angle $\varphi = 0^{\circ}$. Dihedral angle $V = -2^{\circ}$. The angle of wing setting relative to the fuselage is determined by reference points.

(a) The difference between measurement values along points 7 - 8 - 9 - 10 (sectionally) should be as follows:

7 - 9 = 34 ± 3.5 mm; 9 - 8 = 62 ± 2 mm; 10 - 8 = 96 ± 2.5 mm.

(b) The difference between measurement values along points 11 - 12 - 13 should be as follows:

11 - 13 = 41.5 ± 3 mm; 12 - 13 = 26.5 ± 2 mm.

(c) The measurement values difference along points 15 - 16 - 17 should be:

16 - 17 = 10.5 ± 1.5 mm; 15 - 17 = 22.5 ± 2.5 mm.

The measurements of elevation of one wing over the other $Y_{stbd} - Y_{port}$ should be registered in the Levelling diagram with a plus for reference points 8 and 9, 8 and 10, 12 and 13, 16 and 17 if Y_{stbd} is less than Y_{port}, and with a plus for reference points 7 and 9, 11 and 13, 15 and 17 if Y_{stbd} exceeds Y_{port}.

With the reverse relation, the data with a minus should be entered in the Levelling diagram. A plus in this case will mean that the starboard wing has a greater setting angle than the port wing. A minus means the same for the port wing.

Elevation of point 8a over point 18a for each wing should be $E = 22^{+10}_{-5}$ mm.

Asymmetry of wing dihedral (V) is determined as the difference between elevations of points 8a over points 18a of one wing relative to the other and should be equal to not over 10 mm:

$$E_{stbd} - E_{port} = E_{port} - E_{stbd} \leqslant 10 \text{ mm.}$$

3. Checking of Fuselage Tail Portion Setting and Fin Deflection Angle

Proper position of the fuselage tail portion relative to the fuselage nose portion is determined by measuring the displacement of point 6 (on fin left side) relative to point 5 (displacement measured in the horizontal plane) and point 3 relative to point 2 left (displacement measured in the vertical plane):

$6 - 5 = 210 \pm 5$ mm; $2 - 3 = 70 \pm 3$ mm.

To check the displacement of the fuselage tail portion, use the following procedure.

Install two poles (on supports) 5m. high in the aircraft line of symmetry, one ahead, the other aft of the aircraft , stretch a cable between the poles to suspend three bobs.

The first bob should be aligned with point 4, the second - with point 5, the third one is to be placed opposite point 6 whose displacement should be determined.

To check the fin for proper setting, refer to points 28, 29, 29a and 30.

The fuselage twist should be determined by reference to points 2 - 2 and 3 - 3 (port side and starboard side). The difference in points 2 - 2 should not exceed 2 mm, while for points 3 - 3 it should not exceed 3 mm.

The fin setting is determined as follows:

(a) in section 25 - 26 - 27 - by difference in measurements of these points:

$25 - 26 = 14 \pm 2$ mm; $25 - 27 = 50 \pm 3.5$ mm;

(b) in section 28 - 29 - 30 - by difference in measurements of the points:

$28 - 29 = 4 \pm 2$ mm; $29a - 30 = 20.5 \pm 3$ mm.

The fin setting in the vertical plane is determined by the difference in the measurements of points 26 and 28:

$26 - 28 = 3.5 \pm 4$ mm.

The ventral fin setting is determined by displacement of point 49 relative to point 48 which should be not over 4 mm.

4. Checking Retractable Cone and Pitot-Static Tube Boom for Proper Setting

Proper alignment of the cone axis relative to the line of flight is determined by measuring points M_{top}, M_{bot}, M_{left} and M_{right} proceeding from point 24:

$$M_{bot} - M_{top} = \pm 3 \text{ mm};$$

$$M_{right} - M_{left} = M_{left} - M_{right} = \pm 3 \text{ mm}.$$

The cone axis displacement in the horizontal plane:

$$h = \pm 2 \text{ mm}.$$

The cone position relative to the intake cone:

Cone retracted (position I)

$T_{top} = 233 \pm 2$ mm
$T_{bot} = 223 \pm 2$ mm
$T_{right} = T_{left} = 228 \pm 2$ mm

Cone extended (position III)

$T_{top} = 146 \pm 2$ mm
$T_{bot} = 149 \pm 2$ mm
$T_{right} = T_{left} = 147 \pm 2$ mm

Cone maximum travel is 170 ±3 mm. Cone extension (i.e. the distance from point 24 to the intake nozzle):

$$K_1 = 321 \pm 5 \text{ mm (position I)}$$

$$K_2 = 451 \pm 5 \text{ mm (position II)}$$

$$K_3 = 491 \pm 5 \text{ mm (position III)}$$

If the cone is installed properly, the intake nozzle diameter should be equal to Д = 663 ±2 mm and cone diameter d= 456 ± 1 mm.

Beginning of the cone extension (which is indicated by the flashing-up of the red signal light) is determined by point 24 moving not more than 3 - 5 mm from the intake nozzle edge.

All measurements should be performed in the horizontal and vertical planes. The position of the Pitot-static tube boom is determined by the difference Ю - Я = 8 ± 7 mm (in the horizontal plane) and Я - Ю = 43 ± 7 mm (in the vertical plane).

5. Checking Control Surfaces, Landing Gear and Drop Tank

The deflection angles for the ailerons, stabilizer and rudder should be measured in degrees normal to their axes of rotation with the aid of a protractor, while the deflection angles of the flaps, control stick and pedals should be measured in mm, with the help of a ruler.

Deflection of the control stick to the right and to the left should be measured in degrees with the help of a protractor.

Checking of Stabilizer

Stabilizer setting angle $\varphi = 0^\circ$, its dihedral $V = 0^\circ$.

Stabilizer setting is determined by reference to points 20 and 22. Elevation of point 22 over point 20 should be 4^{+3}_{-5} mm.

Stabilizer setting angle is determined by reference to points 19 and 20:

$$b - a = 13 + 2 \text{ mm.}$$

The deflection angles of the stabilizer are measured with a protractor which should be installed on the stabilizer trailing edge.

When a measurement is being taken, the protractor scale should be normal to the stabilizer axis of rotation.

The checking is accomplished on the stabilizer port side. The stabilizer misalignment should be checked by measuring distance Д between points 54 and 55 on the stabilizer nose portion.

$$\text{If } Д_{left} = 0, \quad Д_{right} = \pm 1 \text{ mm.}$$

The neutral position of the aircraft control stick is determined by measuring the distance between point T and the instrument panel. This distance should be equal to 250^{+10}_{-3} mm. Point T is taken conventionally as a point at which the pilot's effort is applied. Point T on the control stick should be marked with a special clamp.

Maximum deflection of the stabilizer normal to the axis of rotation will be $28^\circ \pm 1^\circ$ with its nose down and $13^\circ\,{}^{+2^\circ}_{-1.5^\circ}$ with its nose up, which corresponds to the 220^{+14}_{-24} mm control stick travel back from the neutral position and 96^{+24}_{-14} mm forward travel from the neutral position.

Deflection of the stabilizer nose portion is determined by measuring distance Д between points 54 and 55. The stabilizer maximum downward deflection is 243±10 mm, while its maximum upward deflection is 103±30 mm.

Rudder

Pedal forward and backward deflection from the neutral position is equal to 87.5^{+6}_{-3} mm (measure pedal deflection, using the left-side pedal), which corresponds to rudder left- or right-side deflection through $25^{\circ}\pm1^{\circ}$.

Checking the rudder correct position should be made by measuring misalignment of points 27 - 27, with points 30 - 46 being aligned. In this case the misalignment should not exceed 3 mm.

Aileron

With the control stick in the neutral position, the aileron misalignment (the port-wing aileron being placed neutral) should not exceed 8 mm.

Aileron misalignment is determined by reference to points 38 - 38a as the total deflection of the ailerons. It should not exceed 16 mm, each aileron deflection being not in excess of 8 mm. To check the ailerons for proper position, measure their misalignment as referred to points 40 - 41, with points 38 - 38a (on port-wing aileron) aligned.

Control Stick and Pedals

Maximum deflection of control stick from the neutral position is:

(a) 220^{+14}_{-24} mm when deflecting it backward, which corresponds to stabiliser left-side downward deflection of $28^{\circ}\pm1^{\circ}$;

(b) 96^{+24}_{-14} mm when deflecting it forward, which corresponds to stabiliser left-side upward deflection equal to $13^{\circ}{}^{+2^{\circ}}_{-1.5^{\circ}}$.

Right-side and left-side deflection of the control stick should amount to $13.5^{\circ}\pm1^{\circ}$, which corresponds to a $20^{\circ}\pm1^{\circ}$ aileron deflection (with the booster unit being connected).

Pedal travel from neutral position forward and backward should be 87.5^{+6}_{-3} mm.

Air Brakes

The front air brakes (right-side and left-side) should deflect through 25°, which corresponds to a 446 ± 10 mm travel (when taking measurements, refer to points 37). The third (rear) air brake should deflect through 40°, which amounts to 572 ± 10 mm travel (refer to points 51).

Note: Deflection of the third air brake should be determined with the drop tank removed from the aircraft.

Flaps

Deflection of each flap amounts to 25°. When checking the deflection, see that the distance between points 33 and 34 is $M = 368\pm8$ mm. The slit between the wing skin and the flap skin should be equal to 52 ± 4 mm when measured along rib No.2 of the wing.

Landing Gear

For checking the position of the landing gear place sheets of plywood with weights on them under the wheels and frame No.16.

The check should be made using the following procedure:

1. Make sure that the landing gear struts are fully extended.

2. Suspend two weights on a string from the centre of the tire top portion (this should involve all the three wheels).

3. Mark on the plywood sheets the projections of the wheel front and rear points with the help of the suspended weights.

4. Divide the distances between the wheel projection points into two and mark the centre points (which are the projections of the wheel centres) with letters A (for the right-side wheel), Б (for the left-side wheel) and В (for the nose wheel).

5. Connect points A and Б with a straight line.

6. Lower the weight from the point on frame No.16 axis (in the aircraft plane of symmetry). Mark the projection of this point with letter Г.

7. Draw a straight line through points В and Г until it intersects line AБ and mark the intersection point with letter Д.

8. Measure the landing gear track, i.e. the distance between points A and Б, which should be equal to 2692 ± 20 mm.

9. Determine the distance between points В and Г, which should be equal to 3500 ± 20 mm.

10. Determine the distance between points Г and Д (landing gear stagger angle), which should equal 1310 ± 10 mm.

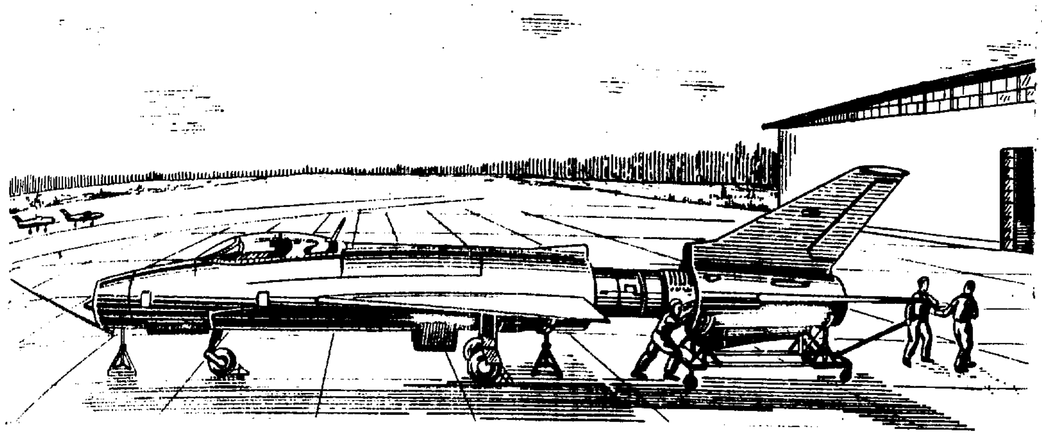
Landing gear base (i.e. the distance between points В and Д) should be equal to 4810 ± 20 mm.

The angle of main wheel tilt should be equal to $1^{\circ}30' \pm 30'$.

Drop Tank

The drop tank of a 490-lit. capacity should be checked by reference to points 56a and 57a. When measured in the vertical plane, point 56a should be 158 ± 10 mm lower than point 57a.

In the horizontal plane points 56a and 57a should be off the axis of symmetry by not over 5 mm to the right and to the left from it.



Chapter XII

DISMANTLING AND MOUNTING OPERATIONS

1. Fuselage Disjointing and Jointing

To disjoint the fuselage tail portion proceed as follows:

1. Place the aircraft on an even site to avoid damaging the aircraft units and engine accessories as well as the pipelines when removing the fuselage tail portion.
2. Jack up the aircraft raising it until the landing gear wheels break contact with the ground.
3. Bring a trolley under the fuselage tail portion and secure the latter to it.
4. Open the access hatches along the fuselage joints and the pipelines and electric wire bunches connections.
5. Deflect the stabilizer nose portion fully down.
6. Remove the tail fairing after having turned out the attachment screws from the anchor nuts and disconnected the vent pipe.
7. Disconnect six attachment fittings for the rods of the afterburner removable portion, disconnect two hydraulic pipes and remove the front ring along with the actuating cylinders for the nozzle flap control.
8. Disconnect the vent pipe of the afterburner.
9. Remove the drag chute container, after which remove the container casing.
10. Remove the МРП-56П marker-receiver loop (to provide access to the thermocouples).
11. Disconnect and remove from the pipe unions four thermo-couple transmitters.
12. Disconnect two wires from the engine afterburner plugs.
13. Disconnect the pipe for pressurizing the fuel system main tanks (left-side access).
14. Disconnect four hydraulic line pipe connections along the split valves, after which disconnect two air pipes. Prior to this bleed pressure in the hydraulic and air systems of the aircraft.
15. Disconnect two rods for stabilizer and rudder control (the rods being located in the fuselage superstructure).
16. Disconnect the power supply plug connectors and radio connectors.
17. Remove the lockwire from the attachment fittings for the rollers of the engine tail pipe next to frame No.36 (Fig.130).

<u>Note</u>: Protect the disconnected plug connectors and pipelines with clean cloth or cellophane to prevent their soiling.

18. Disjoint the fuselage tail portion, for which purpose:

(a) unscrew eighteen nuts from the connecting studs on frame No.28;

(b) insert drifts in the access holes provided on the fuselage starboard and port side along the reference line and carefully move the fuselage tail portion away using the drift as a lever.

CAUTION: 1. When rolling aside the fuselage tail portion, see that the fuselage airframe members do not come in contact with the engine in order to avoid their damage.

2. After the fuselage tail portion has been moved 200 mm back and the rollers of the extension pipe attachment fitting have come off the rails, screw out the rollers to ensure passage of the fuselage tail portion through the nozzle flaps.

Fuselage jointing should be performed in the reverse sequence. While performing jointing, tighten the joint nuts along frame No.28 evenly, i.e. tighten the opposite nuts in turn.

When jointing the fuselage, connect the wires in the fuselage superstructure (in the vicinity of frames Nos 25 - 28) strictly observing the directions inscribed on the cover.

When jointing the plug connectors, care should be exercised not to twist or cross the wire bunches in the cover; do not fit the free length of the bunch in the cover; coil the remaining wire aside from the plug connectors.

Be careful when closing the cover of the fuselage superstructure not to damage the groove above the control rods.

The fuselage jointing over, check operation of the fuel system, aircraft control system and of units located in the fuselage tail portion.

2. Disjointing and Jointing Aircraft Wing

The wing is attached to the fuselage with five attachment fittings along frames Nos 13, 16, 22, 25 and 28 (Fig.129).

Disjoint the wing in the following sequence:

1. Extend the flap (to facilitate access to the attachment fitting on frame No.28).
2. Reduce pressure in the hydraulic system to zero by operating the control stick.
3. Reduce pressure in the pilot's oxygen supply system and in the engine oxygen supply system to zero (only when disjointing the port wing).
4. Reduce pressure in the air system to zero.
5. Remove the fairings and fillets from the wing nose and middle portion.
6. Open the hatches in the wing nose portion close to the fuselage.
7. Hoist the aircraft until the wheels break contact with the ground and bring a trolley under the wing which is to be disconnected.
8. Disconnect the aileron rod from the bell crank next to the wing joint.
9. Disconnect the cable for emergency opening of the main strut suspension lock (i.e. disconnect the shaft on the wing).
10. Disconnect the pipelines of the hydraulic and air systems and plug the holes.
11. Disconnect the fuel system pipelines from the wing fuel compartment and plug them, having previously drained fuel from the compartment.
12. Disconnect the oxygen systems piping and plug them.
13. Disconnect plug and radio connectors.
14. Unsplint the wing attachment bolts and remove the nuts from them.

15. Use pullers to remove the wing-to-fuselage attachment bolts.

CAUTION: First unscrew and remove the lower vertical bolt in the attachment fitting of frame No.16, then proceed to unscrew the horizontal bolt. After removing both bolts, unscrew the upper vertical bolt using a special wrench. The last to be disjointed is the attachment fitting of frame No.13.

16. Carefully move aside the trolley with the disjointed wing placed on it.

To connect the wing to the fuselage employ the reverse procedure. When jointing the wing, use special tools.

The wing jointing accomplished, check the controls, landing gear, all systems and units in the wing for proper operation.

3. Removal and Installation of Stabilizer

For removing the stabilizer (the left- or right-side portion), proceed as follows:

1. Open the access hatch between ribs Nos 2 and 2A of the stabilizer.
2. Remove the upper and lower fairings of the stabilizer.
3. Deflect the stabilizer nose full way down and open the hatch on the stabilizer end-face.
4. Drive out the stabilizer-to-beam attachment bolt.
5. Remove the clamps (8 pieces) provided on the upper and lower skin, unscrew the vertical bolts (4 pieces) and drive out the bolts with internal threading (4 pieces).

Note: The bolts are marked, the first bolt being located nearer to the fuselage.

6. Remove the stabilizer from the beam by slightly rocking it.

To install the stabilizer on the aircraft use the reverse procedure.

4. Dismantling and Mounting Engine

To dismantle the engine, use the following procedure, having previously slushed the engine from inside in conformity with the Instructions on engine operation:

1. Close the fuel shut-off valve.
2. Disjoint the fuselage tail portion.
3. Open the access hatches to gain access to the engine.
4. Remove the afterburner from the engine.

Notes: 1. When removing the afterburner, first of all, before disjointing the fuselage, remove the guide provided on the casing of the hydraulic drive of the afterburner pipe and moving the plate with the hydraulic pipe unions; install the carrier after jointing the fuselage.

2. Unscrew the afterburner attachment rollers with the fuselage tail portion moved 80 - 100 mm backward, after the left-side roller with ribs has disengaged the rail guide.

5. Through the lower access hatches disconnect from the engine the following lines and parts(between frames Nos 22 - 25):

(a) the plug connector of the engine power supply bunched wire;

(b) the engine oxygen supply pipeline;

(c) the rod for engine control from the lever provided on the engine.

6. Remove the fairing and right-side pipe union for releasing air from the fairing, relief chamber and pipe union for bleeding air from the chamber of the rear bearing.

7. Disconnect the following lines and units in the vicinity of frame No.25 (gaining access through the bottom right-side hatch):

(a) the gasoline supply hose from the solenoid-operated valve on the engine;
(b) the vent pipes from two "spiders" located on the load-carrying beam;
(c) the hose and two pipes from the НП-34-2Т right-side hydraulic pump;
(d) the electric wires from the starter-generator block;
(e) remove the pipe union for blowing off the starter-generator.

8. Disconnect the following hoses and pipes located between frames Nos 26 - 28 (on the port side):

(a) the hose and two pipes from the НП-34-2Т hydraulic pump (port-side);
(b) pipes for pressurizing the fuel system located next to frame 27 (where return valve is installed).

9. Remove the fairing and left-side pipe union for pipes evacuating the air from the relief chamber.

10. Disconnect through the port bottom engine inspection hatch the pipeline from the pipe union for supplying fuel to the engine delivery pump.

11. Disconnect the cockpit supply pipe from the pipe union located on the engine.

12. Remove the cover of the fuselage superstructure next to frame No.25, pull out the bolt which fastens the pin of the upper engine-to-fuselage attachment fitting, split and remove the pin.

13. Bring a trolley to the engine and secure the latter on it.

14. Remove the lockwire and disconnect from the fuselage attachment fittings two rods of the engine front attachment fitting (frame No.25).

15. Remove the lockwire and disconnect from the fuselage attachment fittings two rods of the engine additional attachment fitting on the left side (frame No.28) and one rod on the fuselage starboard side.

16. Remove the engine from the fuselage nose portion by rolling the trolley backward.

CAUTION: 1. When removing the engine, see that proper clearances are maintained between the engine and airframe members, particularly between the fuel-and-oil cooler and frame No.25. Remove the engine carefully, see that the engine units do not come in contact with the fuselage members and fittings. Hoist and lower the engine using the trolley.

2. While removing the engine, see that the length of the rods in the side attachment fittings is not changed, which is important to ensure proper installation of the engine back on the aircraft without levelling the engine.

3. During dismantling the engine insert special plugs in all pipelines, close the compressor inlet and air intake openings. Cover the plug connectors with pieces of clean cloth or cellophane.

4. To prevent the fuel system components from corrosion, slush the engine units from the outside not later than three hours after discharging the fuel.

To install a new engine on the aircraft, use the following procedure:

1. Unpack the new engine and remove the corrosion-preventive coating from its outer surface in conformity with the Engine Operating Instructions.

2. Install the engine on the trolley.

CAUTION: When hoisting and mounting the engine take care not to damage the pipelines; see that the cables of the hoisting device do not touch the engine units and fittings.

3. Mount on the new engine the following parts and units removed from the replaced engine or taken out of the spare parts set supplied with the engine:

(a) two НП-34-2Т hydraulic pumps (whose service life still permits installation to ensure their proper functioning for a required time);

(b) rods of the engine attachment fittings;

(c) two tachometer generators (generators of the high-pressure rotor should be fitted on the engine upon installation);

(d) the oil pressure transmitter;

(e) two branch pipes with a screen for evacuating air from the relief chambers;

(f) branch pipe for the oil system centrifugal pump (to be mounted on the engine already installed in the aircraft);

(g) the branch pipe for supplying air to the cockpit;

(h) the branch pipe with a return valve for pressurizing the fuel system;

(i) the branch pipe with a drain valve for feeding fuel to the delivery pump;

(j) the vent pipes for the fuel system;

(k) the ring on the engine inlet flange;

(l) the pipe for the engine oxygen supply;

(m) the carrier for the sliding plate attachment fitting with pipe unions of the hydraulic pipes (the carrier should fix the plate in such a position that the space between the edge of the front pipe union and the front edge of the slot in the guide members is 8 + 1 mm).

4. Before mounting the engine check the pipelines of the engine oxygen supply for cleanliness.

5. Mount the engine in a sequence reverse to that of removal. When mounting the engine, check the clearances between the engine and fuselage inner skin, as well as between the pipelines and units installed in the engine compartment.

Particular attention should be paid to the branch pipes of the relief chamber, see that they should be properly installed, reliably fastened and of a required form. Check the pipelines for proper sealing. Check to see that the engine air relief pipe-to-aircraft pipeline connections are reliably sealed.

When mounting the engine, use utmost care to properly position the shaped rubber seal for the engine nose end. See that no biting of the rubber seal occurs. Be sure that the metallic ring is properly installed between the air cooler and the engine nose end (Fig.131).

CAUTION: Do not connect the oxygen supply pipeline to the engine.

6. Install the tail pipe in the order reverse to that of dismantling. Unscrew the attachment fitting rollers as indicated on the covers of the access hatches.

When inserting the rollers in the bracket bushes (during fuselage jointing) take measurements of points Б and В beginning from the bush end-face (but not from the bracket end-face). Fig.132 illustrates correct and wrong methods of measurement. With points Б and В properly set off from the bush end-face, all the dimensions shown in Fig.132 will be maintained within the required limits, which will preclude the possibility of the afterburner-to-fuselage airframe contact when the afterburner becomes heated, will keep the right-side roller engaged with the rail and prevent the roller jamming.

Remember that dimensions and clearances other than those shown in Fig.132 may cause buckling of the afterburner, disengagement of the right-hand roller (i.e. breaking the roller-to-rail contact) and aircraft vibration induced by the afterburner contact with the fuselage airframe.

In view of the above facts after connecting the fuselage tail portion proceed as follows:

(a) place the rollers of the afterburner attachment unit according to the dimensions for points Б and В as directed in the relative inscriptions on the fuselage;

(b) check the port roller-to-rail engagement. Dimension A = 9 ± 0.5 mm;

(c) check the clearances between the afterburner and the fuselage. The fuselage port clearance should be at least 3 mm, fuselage starboard clearance - at least 8 mm.

7. To install the shaped member and rubber sealing ring of the engine nose end in a proper way, proceed as follows:

(a) check to see that the shaped member and rubber ring are properly arranged in the groove provided in the air cooler. Insert the ring in the groove if it has slipped out;

(b) after the engine has been completely installed, check to see that the clearance between the engine nose end and the air cooler edge is equal to 6 ± 2 mm.

To facilitate engine mounting, install the rubber ring on No.88 glue paste.

8. After mounting the engine remove the corrosion-preventive coating from the engine inner surfaces and check all inner ducts for proper communication in conformity with the relative Instructions on engine maintenance.

Before connecting the oxygen supply piping to the engine return valve make sure that the valve and pipe are not fouled with oil or dirt.

Set the time delay of the КАФ-13Д afterburner control unit operation in compliance with the fuel delivery setting and the position of the jet nozzle flaps as recorded in the engine Service Log.

9. Upon installation of the engine and its attachment in situ, inspect the engine sealing ring. No biting or bulging of the rubber sealing ring is allowed.

10. In mounting the communication lines see that the centrifuge breather pipe is properly installed, i.e. that:

(a) the oil breather pipe is reliably secured;

(b) the packing at the pipe end is fitted in the cylindrical portion of the branch pipe in the engine compartment rear port hatch with a minimum possible misalignment.

11. The clearance between the fuel filter bail and the edge of the air cooler should be at least 2 mm.

12. After mounting in situ the adjustable nozzle check it for free travel deflecting it in the vertical and then horizontal planes.

13. Install the adjustable nozzle on the rollers by screwing the rollers into the fuselage units, the fuselage tail portion remaining 80 - 100 mm away from the rest of the fuselage. With further shifting of the fuselage tail portion forward the rollers should readily enter the guides without any sticking.

Install the port roller in accordance with the inscription on the fuselage. When installing the starboard roller, see that it enters the rail guide by A = 9 ± 0.5 mm (Fig.132).

After accomplishing the roller installation check to see that the clearances between the retractable cone and the fuselage inner casing should be at least 8 mm on the starboard and 3 mm on the port side.

Check the longitudinal travel of the adjustable cone in the engine telescopic connection and see that it is at least 6 mm.

14. Particular attention should be given to the proper sealing of the connections of the vent system pipelines and the vent pipes running through the fuselage skin.

To avoid fuel getting inside the fuselage from the telescopic connection, replace the sealing gasket of the pipe union of the fuel catcher each time the engine is replaced.

5. Dismantling and Mounting Fuel Tanks

Before dismantling the fuel tanks drain the fuel.

After dismantling the bag-type tanks should be thoroughly smoothed out and suspended in their packing containers.

Prior to installation, each bag-type tank should be powdered with talc from the outside. The container inside should be also talced after checking the container riveted seams for proper patching with cloth.

To facilitate mounting the fuel tanks, attach 0.5-m. long KOK-1.2 wire to each lug of the rod and remove the wire after the tank installation.

All union nuts and threaded fittings should be installed on paste БУ and lockwired.

To remove fuel tank No.1 proceed as follows:

1. Remove the fuselage superstructure in the vicinity of frames Nos 11 - 13, disconnect the vent pipelines and pressure pipeline.
2. Dismantle the plate with the vent pipe and float valve.
3. Disconnect the pipeline and plug connector from the pump and remove the pump.
4. Through the hole for the vent plate unscrew the bolts fastening the flanges of tanks Nos 1 and 2 and remove two half-flanges for the pipe attachment fittings and the pipe itself.
5. Remove tank No.1.

To remove tank No.2 proceed as follows:

1. Through the hole between frames Nos 14 - 16 remove the pipeline which interconnects the left- and right-side branches of the tank and joins them to tank No 3.
2. Remove the superstructure cover where frames Nos 13 - 16 are located and disconnect two vent pipes.
3. Screw out three bolts fastening the filler neck to the fuselage skin.
4. Through the hole for the tank filler neck dismantle the tank inner pipe having first accomplished the operations indicated in steps 1, 2 and 4 involving tank No.1.
5. Through the port bottom hole, disconnect the pipeline, dismantle the special valve and remove the return valve from the tank.
6. Remove tank No.2.

To remove tank No.3 (upper section) proceed as follows:

1. Through the wheel wells remove the pipes connecting the tank upper section with the lower section.
2. Remove the superstructure cover between frames Nos 16 - 20, disconnect the vent pipeline and remove the vent branch pipe.
3. Through the access hatch for the float valve between frames Nos 16 - 19, remove the fuel low-level warning unit, disconnect the pipes and remove the float valve.
4. Remove the tank.

To remove tank No.3 (lower section) proceed as follows:

1. Through the wheel wells, remove the pipes which connect the tank lower section with the upper section.
2. Through the port bottom access hatch next to frame No. 16 (ahead of it) disconnect the pipeline from the special valves and remove the special valve.
3. Through the starboard access hatch next to frame No.16 (ahead of it) disconnect the pipeline joining tank No.3 (lower section) with tank No.2.
4. Through the left-hand bottom access hatch aft of frame No.20 disconnect the pipeline from the special valve and remove the latter.

5. Detach the panel of the bottom hatch along with the fairing, between frames Nos 16 - 20, dismantle the CД-3 pressure warning unit for the second group tanks, disconnect the plug connector and pipeline from the 495A pump and remove the pump, after which remove the adapter and plate for the inverted flight special valve. Then remove the valve.

6. Dismantle two pipes installed inside the tank, having previously removed the clips from the tank pipe unions through the wells.

7. Remove the return valve from frame No.16.

8. Remove the tank.

To remove tank No.4 proceed as follows:

1. Detach the superstructure cover in the vicinity of frames Nos 20 - 25, disconnect the vent pipeline and remove the vent pipe.

2. Open the filler neck access hatch next to frame No.22, turn out three bolts fastening the filler neck to the skin.

3. Remove the gasoline tank.

4. Through the bottom left- and right-side hatches between frames Nos 20 - 22 remove the pipe which connects the tank branches.

5. Disconnect the pipeline from the pump for tank No.4 and remove the pump.

6. Through the left- and right-side hatches gain access to the engine accessories between frames Nos 22 - 25, disconnect the pipes running from tank No.4 to tanks Nos 5 and 6.

7. Remove the tank.

To remove tank No.5 proceed as follows:

1. Through the left- and right-side hatches which provide access to the engine accessories located next to frame No.22 remove the pipes connecting tank No.5 with tanks Nos 4 and 6.

2. Remove the superstructure cover in the vicinity of frames Nos 22 - 25 and disconnect the vent pipes.

3. Remove the tank.

To remove tank No.6 from the aircraft proceed as follows:

1. Remove the superstructure cover nearby frames Nos 25 - 28 and disconnect the vent pipeline.

2. Through the bottom hatches between frames Nos 25 - 28 disconnect the flanges of the pipeline connecting tank No.6 with tank No.5.

3. Remove the tank.

All tanks should be removed through the respective access hatches after disconnecting all fittings.

To mount the tanks on the aircraft use the reverse procedure.

6. Dismantling and Mounting Adjustable Cone

To dismantle the air intake cone do the following:

1. Pull out the cone to the fullest extent.
2. Unscrew the fastening bolts arranged circumferentially and remove the cone.
3. Detach the aerials for the radio equipment which are arranged under the cone.
4. Screw out the attachment ring for the aerials.
5. Disconnect the bolt fastening the hydraulic cylinder to the sliding ring.
6. Remove the cone sliding cylinder.

To mount the cone on the aircraft, use the reverse procedure.

7. Removal and Installation of Landing Gear Struts

For removing the landing gear main strut proceed as follows:

1. Jack up the aircraft until the landing gear wheels break contact with the ground.

2. Disconnect the rod of the hydraulic cylinder from the strut.

3. Disconnect the air hoses from the strut, having previously bled the air from the air system.

4. Disconnect the plug connector.

5. Disconnect the rod of the wheel axle turning mechanism from the wing attachment unit.

6. Remove the fuel pump from the wing to gain access to the strut attachment axle.

7. Remove the strut attachment axle with a special puller. While doing this, hold the strut with your hands.

To remove the nose wheel strut:

1. Hoist the aircraft on jacks until the wheels become separated from the ground.

2. Disconnect the rod of the hydraulic cylinder from the strut.

3. Disconnect the electric wires and pipes of the hydraulic and air systems, having previously bled the pressure in the hydraulic system.

4. Turn out the bolt for the nose strut suspension axle (through the right-side hatch).

5. Unscrew the strut suspension axle using a special puller (access should be gained through the left-side hatch).

To mount the struts on the aircraft, use the reverse procedure. Grease all friction surfaces of the struts before mounting them on the aircraft.

After mounting the struts check the axial clearances between the bearings of the strut suspension fittings, as well as the axial and side clearances of the wheel axles. Adjust the length of the rods of the hydraulic cylinders and wheel axle turning mechanism (for the main strut).

Check the adjustment of the sequence valve and operation of the locks for strut and door suspension. Check the clearances between the doors, wheel and strut in the extended and retracted positions, with the strut compressed and during extension.

Check operation of the electric strut position indicating units.

The mounting operations completed, operate the ground pump for check retraction and extension as well as for emergency extension of the landing gear.

8. Removal and Installation of Boosters

For removing the stabilizer booster proceed as follows:

1. Bring the pressure in the hydraulic system to zero.
2. Open the hatches providing access to the booster located in the fin.
3. Disconnect the control rod attached to the booster slide valve.
4. Disconnect the control rod running from the booster to the stabilizer beam.
5. Disconnect the hydraulic pipelines from the booster pipe unions.
6. Unscrew the nuts off the six bolts fastening the booster to frame No.34.
7. Remove the bolts and detach the booster.

To install a new booster proceed in the reverse sequence.

When installing a new booster, see that the clearance between the bell crank and the edges of the holes in the fin beam and frame No.34 is at least 3 mm.

To remove the aileron booster (for the starboard or port wing) proceed in the following way:

1. Reduce pressure in the hydraulic system to zero.
2. Open the wing access hatches to gain access to the booster.
3. Disconnect the booster rod from the aileron bell crank rod.
4. Disconnect the rod running to the booster slide valve.

5. Disconnect the pipelines running to the booster.

6. Unscrew the nuts from the four attachment pins for the cross pieces.

7. Remove the booster together with the cross pieces. To install a new booster proceed in the reverse sequence.

When installing a new booster and connecting it to the bell crank, bear in mind that negative allowance will not be tolerated as it strains the booster rod. Check the booster for coaxiality with the bell crank (in the wing chord plane).

9. Replacing Units of Stabilizer Control System

When replacing all the units, rods and bell cranks of the stabilizer control system, see that:

(a) proper clearance is ensured between the control system units and the aircraft airframe members;

(b) units rotate freely under their own weight; in this case clearances along the suspension or attachment axle should not exceed 0.3 mm, the arm R being equal to 100 mm;

(c) proper clearance is maintained between the control system joints and the airframe members;

(d) the adjustable (threaded) end pieces are screwed in the rod sleeves to a sufficient depth (to be checked by reference to the check holes in the sleeves).

(e) the rods travel freely in the sealed joints;

(f) the rods and units are mounted freely, without any negative allowance.

Replacing Rods

When replacing the control rods, see that their length remains constant (adjust it by turning the end pieces). After replacing the rods check the stabilizer maximum deflection for the APY automatic unit larger arm.

Replacing МП-100М Electric Mechanism

When replacing the МП-100М electric mechanism, see that its length is maintained constant both in the neutral and extreme positions.

After replacing the mechanism check its operation; check also the "trimming effect" mechanism for being correctly set to the neutral position by the flashing of the light.

Replacing Spring Feel Mechanism

When replacing the spring feel mechanism, see that its length is maintained constant.

Adjust the length of the spring feel mechanism with the rod end piece. Precisely adjust the mechanism length by turning the mechanism flange (having special flats) next to the adjusting end piece.

After mounting the spring feel mechanism check its operation by deflecting the control stick to the extreme positions and make sure that the "trimming effect" mechanism is properly set to the neutral position for which purpose the mechanism should be checked by watching the signal lamp flash up.

Replacing APY Automatic Set Units

The APY automatic set comprises:

(a) the automatic (actuating) mechanism;

(b) the control (computing) unit;

(c) the indicating unit.

In operation the automatic mechanism and control unit are an integral whole. If one of them fails, both should be replaced, while the position indicating unit may be left for further operation.

When replacing the automatic mechanism, see that the stabilizer control system adjustment is not disturbed.

To remove the automatic mechanism do the following:

1. Lock the control stick by means of a device provided for the purpose. See that the stabilizer control system units are de-energized (their power supply is switched off).

2. Disconnect the rod running from the spring feel mechanism (from the automatic mechanism rod).

3. Disconnect from the automatic mechanism the rod running to the bell crank found between frames Nos 27 - 28.

4. Disconnect the spring feel mechanism.

5. Unscrew the nuts fastening the side brackets which are fitted on the pins and remove the brackets from the pins along with the automatic mechanism.

6. Remove the control unit located in the cockpit on the right-hand side.

To install a new automatic mechanism on the aircraft, the order should be reversed.

Note: When adjusting the "trimming effect" mechanism neutral position, see that the length of the unscrewed portion of the APУ-3B automatic unit threaded tang does not exceed 15 mm, which will ensure required strength of the APУ-3B unit-to-spring feel mechanism connection.

After the automatic mechanism has been installed, check and adjust, if required, the stabilizer control system. Check operation of the APУ-3B automatic unit when adjusting the stabilizer control system according to the speed and altitude.

10. Removal and Installation of Flaps

To remove the flap (from the port or starboard wing) proceed as follows:

1. Remove the fairing provided at the rail end.

2. Extend the flap.

3. Pull out the bolt connecting the hydraulic cylinder with the flap.

4. Roll the flap back until the carriages come out from the rails. To install the flap, use the reverse procedure.

11. Removal and Installation of Ailerons

To remove the aileron (from the port or starboard wing) perform the following:

1. Open the access hatch in the wing tail portion, next to rib No.6.

2. Remove the bolt connecting the control rod with the aileron attachment unit.

3. Remove the fairing from the aileron to provide access to the aileron attachment unit.

4. Remove two bolts from the attachment unit.

5. Deflect the aileron and remove from the middle suspension joint two bolts which connect the aileron shackle with the wing bracket.

6. Lower the aileron to bring the shackle of the middle suspension out of the wing bracket.

7. Pull the aileron to the fuselage and detach the suspension joint. Remove the aileron.

To mount the aileron, follow the reverse sequence of operations.

12. Removal and Installation of Rudder

For removing the rudder do the following:

1. Remove the port fillet.

2. Open the access hatch on the fin right side.

3. Remove from the bottom suspension unit four bolts which attach the flange to the bell crank.

4. Remove the bolt from the upper suspension unit and screw out the locking bolt.

5. Turn the slightly released rudder, pull it backward until the middle suspension unit becomes free, after which remove the rudder.

To install the rudder, employ the reverse procedure.

13. Removal and Installation of Air Brakes

To remove the front air brake (the port or starboard one) carry out the following operations:

1. Open the air brakes.

2. Disconnect the rod of the actuating hydraulic cylinder.

3. Remove two bolts fastening the air brake.

4. Remove the air brake.

The installation procedure is the reverse of removal. For removing the third (rear) air brake, proceed as follows:

1. Open the air brake.

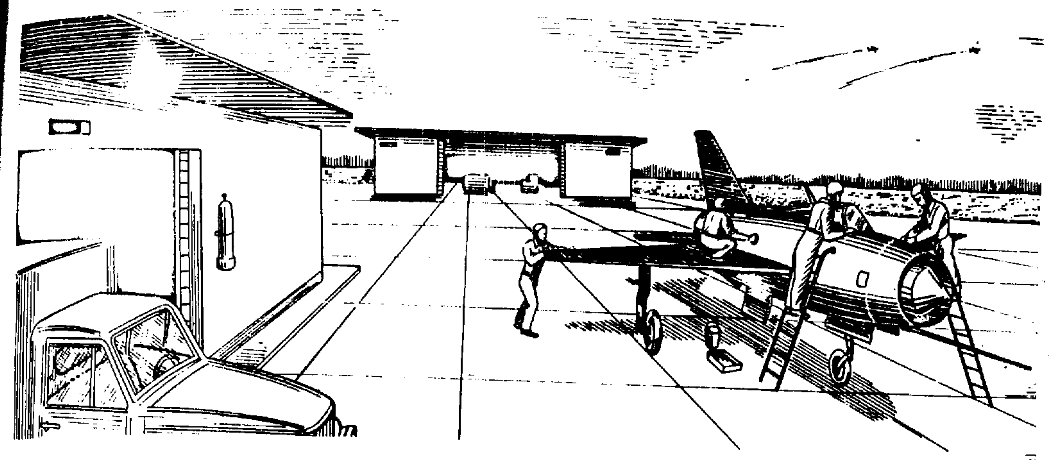
2. Open the engine inspection hatches.

3. Open the lock on the air brake, thereby disconnecting the rod of the hydraulic cylinder.

4. Remove two bolts fastening the air brake.

5. Remove the air brake.

To install the air brake, employ the reverse sequence of operations.



Chapter XIII

AIRCRAFT MAINTENANCE

General

1. Aircraft and power plant maintenance operations should be performed according to the established schedule depending on the total number of aircraft flying hours or its storage period.

2. After the first 10 and 25 flying hours have expired, carry out one-time scheduled maintenance operations which should not be repeated any more.

3. Scheduled maintenance operations should be performed every 50 and 100 flying hours and every 10 days, 30 days and 3 months, irrespective of the aircraft flying hours.

Simultaneously with the 100-hour maintenance operations carry out the 50-hour maintenance operations and when performing the 3-month maintenance schedule, simultaneously carry out the 30-day and 10-day maintenance operations. When performing the 30-day schedule, perform also the 10-day maintenance.

4. If for any reason the aircraft is not flown for a period of 30 days or more, it should be slushed in conformity with the Instructions on aircraft slushing for 3-month storage.

No maintenance operations are allowed on the aircraft which has been slushed for storage. Upon expiration of a 3-month storage period the aircraft is subjected to re-slushing with previously performing all maintenance operations specified in this case.

5. When the aircraft is not operated for a long time without being slushed, it should be subjected to 10-day and 30-day storage maintenance.

6. Non-scheduled maintenance operations are allowed in the following cases:

(a) when preparing the aircraft for a long-term continuous operation without any breaks for maintenance;

(b) when it is necessary to bring the aircraft maintenance date closer to the engine maintenance date;

(c) when the climatic conditions adversely affect the engine and aircraft operation (extreme humidity, dusty soil, etc.).

7. Before getting down to the maintenance operations discharge the canopy and drop tank firing mechanisms.

8. When inspecting the aircraft or carrying out maintenance operations, clean the outer surfaces of the aircraft units from dirt and old lubricant.

ЦИАТИМ-201 lubricant is used as the main lubricant on the aircraft. Besides, the following lubricants are employed:

(a) ЦИАТИМ-221 - for aircraft and engine control system hinged joints;

(b) НК-50 - for wheel bearings;

(c) ОКБ-122-14 - for turbo cooler bearings;

(d) МК-8 oil or transformer oil - for flexible cables;

(e) ОКБ-122-7 - for the АРУ-3В automatic unit rod;

(f) УССА graphite lubricant - for threaded portions of the screws fastening the fuselage parts located in the high-temperature regions.

9. Maintenance operations on the engine should be carried out according to the Instructions on engine maintenance.

Maintenance Operations to Be Performed Every 10±2 Flying Hours

Fuel System

1. Remove and wash the control pressure line filter installed under the 3rd tank.

Hydraulic System

2. Replace the fine refinement elements in the following filters:

(a) ФГ-11-100-2 filter at the НП-34-2Т pump outlet in the main hydraulic system;

(b) ФГ-11-100-2 filter at the tank inlet in the main hydraulic system return line;

(c) 11ГФ4-1 filter at the tank inlet in the by-pass line running from the НП-34-2Т pump of the main hydraulic system;

(d) 11ГФ4-1 filter at the БУ-51МС booster inlet from the main hydraulic system pressure line.

Wash the coarse refinement elements in pure gasoline and check them for reliable attachment.

Maintenance Operations Every 25±5 Flying Hours

Hydraulic System

3. Without removal or washing the hydraulic tank replace АМГ-10 hydraulic oil in the main hydraulic system and in the hydraulic boosters.

4. After draining the oil carry out a single washing of the throttle fitted ahead of the anti-surge shutters actuating cylinders.

5. Remove, wash and check the gauze filter mounted in the return system of hydraulic boosters at the hydraulic tank inlet, on the fuselage port side.

6. Replace the fine filtering elements of the following filters:

(a) the ФГ-11-100-2 filter at the НП-34-2Т pump outlet in the main hydraulic system;

(b) the ФГ-11-100-2 filter at the tank inlet in the return line of the main hydraulic system;

(c) the 11ГФ4-1 filter at the tank inlet in the by-pass line from the main hydraulic system НП-34-2Т pump;

(d) the 11ГФ4-1 filter at the БУ-51МС booster inlet from the delivery line of the main hydraulic system;

(e) the ФГ-11-100-2 filter at the НП-34-2Т pump outlet in the system of hydraulic boosters;

(f) the 11ГФ4-1 filter at the inlet of the БУ-51МС booster from the hydraulic boosters delivery line.

Wash the coarse filtering elements in pure gasoline and check the reliability of their attachment.

In case any metal particles are found in the filtering elements, check the hydraulic booster inlet filters. If metal particles or chips are found on the inlet filters, replace the hydraulic boosters.

Note: In the course of the first 25 flying hours the fine refinement filtering elements should be replaced twice: after the first 10 flying hours and 15 hours later upon expiration of 25 flying hours. Further replacement of the fine filtering elements should be performed every 25 flying hours in the main hydraulic system and every 50 flying hours when the hydraulic booster system is involved. In view of the fact that the 25-hour maintenance operations are not listed in the scheduled maintenance Instructions, it is necessary to register the flying hours for the filters separately for their replacement in due time.

Every 50±5 and 100±10 Flying Hours

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
	Fuselage		
7	Disjoint the fuselage tail portion and inspect its inner skin for sound condition . Make sure that the inner skin of the fuselage tail portion, engine casing and drag parachute compartment screen are free from deformation, warping, burns, cracks, and soot.	+	+
	Inspect the units, pipelines and vent pipes of all the systems located in the engine compartment close to fuselage frame No.28 and in the fuselage tail portion.		
	Open the access hatches inside the fuselage tail portion and check the pipelines, electric wiring and their attachment for condition.		
8	Check the rollers of the tail pipe attachment fitting (on both sides of the fuselage) for free rotation.	+	+
	If the rollers would not rotate, remove them, wash in gasoline and inspect for damage and wear. Replace the rollers, if necessary.		
9	Inspect the packing rubber on frame No.28 for sound condition, check the locks of the fuselage access hatches for proper operation.	+	+
10	On a removed engine check:	–	+
	(a) condition of the shaped rubber member for the engine nose end sealing provided with a groove; make sure that the sealing rubber does not bulge or give in;		
	(b) condition of the air cooler plate valves. The restricting ends of the valves regulating the air flow should be bent to be at a 8-mm distance from the surface of the cooler shell.		
11	Remove the upper superstructure and check condition of the pipelines and units and their attachment.	+	+
12	Open the anti-surge shutters and inspect the rods, suspension units, hinged connections and their nuts (for proper lockwiring).	+	+
13	After jointing the fuselage check operation of the drag parachute system.	+	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
14	Pour ОКБ-122-14 oil(55 gr)into the turbo cooler body through the specially provided holes, the oil being intended for lubricating the bearings. Note: When mounting fuselage parts located within the high-temperature region, coat the threaded portions of the screws for attachment of the tail cone, drag parachute compartment screen and engine cooling casing with УССА graphite lubricant.	+	+
	Wing		
15	Remove the wing fillets, wash, inspect and lubricate the wing-to-fuselage joints. See that the fillet attachment screws are sound. Check the pipelines and bunched wires in the wing connections for sound condition and proper attachment. See that the attachment fittings have no contact points, attrition or loose parts.	-	+
16	Open the wing hatches, wash, inspect and lubricate the aileron suspension units.	+	+
17	Remove the ailerons, inspect the root ribs for cracks, wash, inspect and lubricate the suspension units. Make sure that the bearings rotate freely, bearing cages and races are intact. Check the locking wire of the aileron weight compensating bolts. Lubricate the suspension units and replace the ailerons.	-	+
18	Remove the flaps and examine them. Wash and lubricate the mechanisms, see that the bearings and their races are intact. Mount the flaps and check them for proper adjustment.	-	+
	Control System		
19	With the wing and fuselage access hatches open and the fuselage superstructure removed, wash, inspect and lubricate with ЦИАТИМ-221 grease all open-type hinged joints in the aircraft control system. (Hinged joints with ball bearings of a closed type should be washed and lubricated by coating their outer surfaces with a thin layer of ЦИАТИМ-221 lubricant). Check to see that the clearance between the rollers of the supports and the end pieces of the rods is within 0.05 - 0.3 mm (if necessary, adjust the clearance by turning the eccentric bolt on the support with the tetrahedral head). Check to see that proper clearance is ensured between the control system parts and other elements and units of the aircraft airframe. Inspect the control system parts for corrosion.	+	+
20	Check the stabilizer and rudder balance weights for proper attachment.	+	+
21	Inspect the rudder and aileron control system for play accompanied by knocking (the check should be performed with the control stick and pedals fixed in position).	+	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
22	Remove the pedals and inspect the locks fastening the foot straps to the pedals; make sure that the lyre-pieces and cotter pins are serviceable; see that each lock opens readily yielding to hand effort.	–	+
23	Using an oil gun, feed ЦИАТИМ-201 lubricant into the bearings of the stabilizer beams.	+	+
24	Coat with ЦИАТИМ-221 lubricant the surfaces of the end pieces for the stabilizer and rudder control rods passing through the cockpit pressurized outlets. Through the fuselage bottom hatch between frames 11 and 13, lubricate the surfaces of the end pieces of the oblique rod for the aileron control system and the engine control rod, both rods passing through the cockpit pressurized outlets. Move the aircraft control stick, pedals and engine control lever to force the lubricant into the pressurized outlets.	+	+
	Landing Gear		
25	Wash the landing gear struts in gasoline and inspect them through a magnifying glass. Pay particular attention to the welded seams of the joints and places where the bush of the strut axle of rotation or bush of the hydraulic cylinder bolt adjoins the strut cylindrical portion.	+	+
26	With the aircraft hoisted up on jacks, check the clearances of the landing gear struts. Measure the clearances of the wheel axles longitudinally and laterally. See that after hoisting the aircraft the nose wheel is aligned with the direction of flight. Smooth application of a 15-kg force to the wheel axle (in the forward and backward directions) should result in a clearance amounting to: (a) 8-mm longitudinal and side clearances for the main strut; (b) 5-mm longitudinal and side clearances when the nose strut is involved.	+	+
27	Check the AMГ-10 fluid level in the landing gear shock absorbing struts and refill them if required. Note: Every 3 service years completely replace the AMГ-10 fluid in the landing gear shock absorbing struts.	+	+
28	Check the operation of the wheel automatic brake release system as indicated in Chapter "Take-Off and Landing Mechanisms".	+	+
29	Check the maximum pressure in the main wheel brakes, operation of the УП-24 pressure amplifier and emergency valve 563600. For this purpose disconnect from the wheels the brake hoses one by one, install a pressure gauge and by alternately pressing the brake lever and opening the emergency braking valve make sure that the maximum air pressure supplied from the main brake system amounts to 16 ± 0.5 kg/sq.cm., while that supplied from the emergency system is equal to 16 ± 4 kg/sq.cm. Connect the pipelines to the wheels and check the system airtightness.	+	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
30	Check to see that the value of maximum air pressure supplied to the nose wheel amounts to 10.5 ± 0.5 kg/sq.cm.	+	+
31	Remove, wash, inspect and lubricate with ЦИАТИМ-201 grease the bolts of the cross pieces for the main and nose struts. After replacing the bolts they should be tightened up with a standard torque wrench.	+	+
32	Remove, wash, inspect and lubricate with ЦИАТИМ-201 grease the bolts and shafts of the hinged joints for the main wheel turn mechanism rods, the drives for hinged door lock control system and the door suspension hinges.	+	+
33	With the help of the feeler gauge check the clearance between the stop on frame 6 and the upper lever of the nose strut. When a force of 15 - 20 kg is applied to the strut axle in the flight direction (the landing gear control lever remaining in the neutral position), the clearance should amount to at least 0.45 mm.	+	+
34	Check the condition of the cable lines running from the main strut locks to the wheel door locks. Remove corrosion (if any) with waste soaked in kerosene, then wipe dry and lubricate with ЦИАТИМ-201 grease.	+	+
35	Check the cable lines provided for opening the nose strut autonomous release lock and the cable sealing boot.	+	+
36	Check the nose strut shimmy damper for filling with the АМГ-10 fluid. Re-fill the compensating chamber, if required.	+	+
37	Replace the fluid in the shimmy damper.	-	+
38	Perform check retraction and extension of the landing gear. When doing this, check: (a) the landing gear for proper retraction and extension, and the sequence valves for proper operation; (b) the clearances between the strut doors and fuselage (or wing) skin (See clearance diagram in Chapter "Take-Off and Landing Mechanisms"); (c) nose strut autonomous extension system; (d) landing gear emergency extension system; (e) proper setting of all three struts to the "uplock" and "downlock" positions and secure setting of the doors to the "uplock" position; (f) operation of the landing gear up and down position warning system and proper adjustment of the limit switches according to the instructions given in Chapter "Take-Off and Landing Mechanisms"; (g) wheel automatic brake system when retracting the landing gear; (h) proper adjustment of the main strut semiaxle locks; see that the check holes are aligned; be sure that the clearance etween the stop on the semiaxle and the shock absorber bottom is hin 0.1 - 0.25 mm; check the alignment of holes and the clear- size only after hoisting up the aircraft. Notes: 1. After the landing gear emergency extension check the mechanical locks of the actuating cylinders for proper operation, for which purpose bleed air from the cylinders and apply a 50-kg force to each wheel towards retraction and extension. With serviceable locks the struts should not fold.	+	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
	2. Make sure that the air has been completely released from the hydraulic system after landing gear emergency extension; retract and extend the landing gear 8 or 10 times. 3. After performing autonomous extension of the nose strut check the position of the parts which go to make up the nose strut suspension lock. The lock should be closed. If the lock is open, close it by pulling the handle for the nose strut autonomous extension.		
	Cockpit		
39	Check the canopy frame for sound condition. See that the protective coating is intact and the magnesium alloy parts are not attacked by corrosion.	+	+
40	Check the canopy glass for notches, scratches and silvery spots. Remove shallow notches and scratches as instructed in Chapter "Cockpit Canopy".	+	+
41	Wash with gasoline and coat with ЦИАТИМ-201 lubricant the mechanisms of the canopy inside and outside control handles and the mechanisms for canopy attachment locks on the fuselage (the locks should not be stripped in this case).	+	+
42	Check the de-icer system for proper spraying. If necessary, clean the de-icer manifold holes with a soft wire, having previously removed the shielding plate.	+	+
43	Remove the de-icer system tank and wash it with hot water. This done, replace the tank.	-	+
44	Check the de-icer system for proper sealing under an operating pressure of 3 kg/sq.cm. Before checking disconnect the system from the manifold and plug the open end.	+	+
45	Check to see that the nuts in the connections of the pipelines for the canopy pressurization system are properly tightened.	-	+
	Hydraulic System		
46	Replace the fine filtering elements in all filters of the booster and main hydraulic systems. When replacing the fine filtering elements, wash the coarse filtering elements and check their attachment. Remember: The fine filtering elements of the main hydraulic system should be replaced every 25 hours.	+	+
47	Remove, wash and inspect the gauze filter installed on the fuselage left side in the return line of the booster hydraulic system at the hydraulic tank inlet. Prior to this drain the AMГ-10 fluid from the hydraulic tank booster compartment through the suction pipe union for the ground hydraulic pump.	+	+
48	Remove, wash and check the throttle valve ahead of the anti-surge shutter cylinders.	+	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
49.	Remove the hydraulic system pressurization unit in the main port wheel well, compress the thrust ring, remove the air dust filter from the bottle, after which wash and dry the filter. Drain the sediment from the bottle.	+	+
50.	After jointing the fuselage and carrying out all maintenance operations on the hydraulic system, check the main and booster hydraulic systems for inner and external leaks; check the НП-27Т emergency pumping unit and the НП-34-2Т hydraulic pumps for reliable operation.	+	+
51.	Check the pipeline of the hydraulic tank pressurization system for airtightness (to be checked simultaneously with the fuel system).	+	+
52.	Inspect the cylindrical hydraulic accumulators for inner leaks. Note: Every 200 flying hours (but at least once in a 2-year period) thoroughly wash both hydraulic systems removing the hydraulic tank and replacing the АМГ-10 fluid in the hydraulic systems. The procedure for washing the system and replacing the oil, as well as the sequence of fulfilling operations indicated in steps 50 - 52 are specified in Chapter "Aircraft Hydraulic System Maintenance".	–	+
	Hydraulic Boosters		
53.	Remove, inspect and wash in pure gasoline the gauze filters installed in the inlet pipe unions of the hydraulic boosters. In case any metal particles or chips are found in the filter, the hydraulic boosters should be sent to the repair shop for disassembly and checking.	+	+
54.	With the access hatches for the БУ-45А aileron hydraulic boosters and the БУ-51МС stabilizer boosters open, check to see that no fluid leaks through the outer packing of the hydraulic boosters. Deflect the control stick, with the operating pressure in the hydraulic systems being normal, to check pressing-out of the fluid through the outer packing of the hydraulic boosters. Inadequate airtightness in the rubber packings registered during breaks in the hydraulic booster operation might disappear when the hydraulic boosters start operating under normal operating pressure.	+	+
55.	Check the attachment of the hydraulic boosters, secure connection of the rods and pipelines and their safe locking. Feed the ЦИАТИМ-201 lubricant into the oil boxes of the БУ-51МС hydraulic booster. Note: Upon fulfilling operations on the hydraulic boosters and hydraulic system check the aircraft control system with the hydraulic boosters switched on.	+	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
	Air System		
56	Take the air system filter to pieces, wash it, dry, check and assemble.	+	+
57	Check for airtightness the return valve installed aft of the ejection seat in the canopy toss system (for the procedure used in this case see Chapter "Cockpit Canopy").	+	+
58	Remove the air system canopy toss emergency bottle, inspect it and its attachment pieces and drain the sediment. Replace the bottle, fill it with air up to a pressure of 110 - 130 kg/sq.cm. making use of a special device and, without servicing the main air system, check the canopy toss system for proper tightness (by the absence of pressure drop as indicated by the pressure gauge installed on the device).	–	+
59	Check the air system for proper tightness (by testing its separate portions); check operation (closing) of the pneumatic valve for the cooling system of the fuselage pressurized compartment. Act as specified in Chapter "Air System".	+	+
	Fire-Fighting Equipment		
60	Check condition and attachment of the units and pipelines for the fire-fighting equipment system. With the engine removed check the manifold holes for soiling. Together with the electricians check the portion of the electric circuit from the fire-extinguisher button to the firing mechanism of the fire-fighting bottle. Check also the insulation resistance and fire warning system.	+	+
	Fuel System		
61	Remove the filter in the special valve control pressure line, inspect and wash it.	+	+
62	Remove, inspect and wash in pure gasoline the protective screen installed in the wing fuel tanks consumption line (Fig.15).	+	+
63	Unscrew the drain plug from the drop tank, wash the gauze filter and make sure that the tank bottom is not soiled around the hole for the plug.	+	+
64	Remove the inverted-flight valve from the lower section of the 3rd tank, inspect its parts, connections and locking, after which check operation of the valve mechanism. Through the inspection hole check the tank inner surface, clean its bottom and walls.	–	+
65	Remove from the upper portion of service tank No.3 and from tank No.1 the plates of the float valves and floats. Make sure that their surfaces are intact and bear no traces of corrosion. With the float in the down position the spring-loaded valves should fit tightly into their co rated openings.	–	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
66.	Jack up each wing successively by 200 mm, drain sediment from the wing fuel compartments and trapped fuel through the drain plugs in the bottom skin of each wing.	-	+
67	Check all fuselage fuel tanks for secure attachment and make sure that their locking is sound.	-	+
68.	Through the fuselage left-side hatch check the lower portion of the fuel service tank for condition. If the rubber covering (the upper layer) is cracked or frayed and the braiding shows up, replace the tank.	+	+
69	Remove the gasoline system pressurization unit in the well for the starboard wheel, compress the thrust ring and remove from the bottle the air filter, after which wash and dry it. Drain sediment from the bottle.	+	+
70	Remove, wash and inspect the gasoline system filter installed between the tank and ПНР10-9М pump.	+	+
71	Check the airtightness of the fuel and gasoline systems as indicated in Chapter "Fuel System".	+	+
	Power Plant		
72	Pull out (manually) the cone to the extreme front position and remove it from the aircraft. Check to see that the cone limit switch is serviceable, clean the cone control mechanism from dirt, make sure that it is free of wear and scratches, after which coat the mechanism with a thin layer of ЦИАТИМ-201 grease and install on the aircraft. Together with the aircraft mechanic check the serviceability of the cone, anti-surge shutters and engine control lever interlock system according to M-number.	+	+
73	Check the engine control system in the cockpit and in the engine compartment. Make sure that the control system rods bear no traces of attrition and the control system has no play. See that the locking wires are intact and secure. Check the attachment fittings of the НР-21Ф unit lever and the ПУРТ-1Ф panel lever for presence of the lockwire and its intactness. Coat the hinged joint with ЦИАТИМ-221 grease.	+	+
74	Check the engine control lever for smooth travel and reliable stopping at all rests.	+	+
75	With a cut-off engine check to see that the engine control lever positions in the cockpit under the main power ratings correspond to the relative positions of the levers on the НР-21Ф unit and the ПУРТ-1Ф panel on the engine (as indicated in the Instructions on Engine Operation).	+	+
76	Check visually the engine-to-aircraft attachment fittings.	+	+
77	Check tightening of the nuts in the pipe connections of the engine piping. Tighten up the nuts, if required.	+	+

No.	Maintenance Operations	Every 50 hrs	Every 100 hrs
78	After 50-hour maintenance operations and jointing the fuselage, check (with the engine running): (a) engine and aircraft fuel, oil and hydraulic systems for external leaks; (b) operation of the nozzle flap emergency control system, of the generator, instruments, hydraulic systems, aircraft control system and cockpit air supply system.	+	+
79	Replace the engine whose service life has expired. Before mounting a new engine perform the following: (a) check the engine-to-aircraft attachment fittings; (b) wash and coat with ЦИАТИМ-221 grease the open-type hinged joints in the engine control system. CAUTION: Do not spoil the adjustment of the engine control rods when mounting a new engine.	-	+

Maintenance Operations to Be Performed on Parking Days

No.	Maintenance Operations	To be carried out every 7 + 3 days	30 + 5 days	3 months + 10 days
	Wing			
1	Extend the flaps, wash, inspect and lubricate the guide rails of the flaps. Check the hydraulic cylinder for proper attachment and the fastening nuts for presence of locking wire. Make sure that the guide rollers are not jammed. Check to see that the flap actuating cylinders are airtight.	-	-	+
2	Make certain that the locking wire of the horizontal bolt in the wing-to-fuselage attachment unit at frame No.28 is intact and the flap rail-to-fuselage attachment is reliable.	-	-	+
	Control System			
3	Check operation of the АРУ automatic unit when adjusting it according to airspeed and altitude; check complete changing-over of the rod from one extreme position to the other. Coat the АРУ-3Б unit rod with a thin layer of the ОКБ-122-7 lubricant (the check is to be carried out by the aircraft mechanic and aircraft equipment specialists). Use ЦИАТИМ-201 lubricant for the rod of the stabilizer control system spring feel mechanism.	-	-	+
4	Feed ЦИАТИМ-201 grease in the outer bearings of the stabilizer beams. Wash, inspect and lubricate the rudder suspension units.	-	-	+

No.	Maintenance Operations	To be carried out every		
		7 + 3 days	30 + 5 days	3 months + 10 days
	Landing Gear			
5	Check the nose strut doors for play. When an effort of 2 - 3 kg is applied to the door end, the play at the ends of the doors should not exceed 7 mm.	-	-	+
6	Check the play of the main strut wheel doors. With the strut extended the play of the wheel door as measured at its end with a 2 or 3-kg force being applied should not exceed 12 mm (no play is allowed for the doors fixed rigidly on the strut).	-	-	+
7	Feed the ЦИАТИМ-201 lubricant in the oil box of the landing gear hinges.	+	+	+
8	Remove the wheels from the main and nose struts and check the condition of their brake devices. Remove, inspect and lubricate with the НК-50 lubricant the wheel bearings. For the inspection procedure to be emplcyed when checking the brake devices see Chapter "Take-Off and Landing Mechanisms". Note. Check condition of the brake devices each time the wheels are removed for replacement of tires.	-	-	+
9	Scavenge the wheel brake pipelines, for which purpose disconnect the pipes from each of the wheels and carefully press the brake lever provided on the aircraft control stick, after which release the lever thereby opening the emergency brake valve. Connect the pipelines and check them for airtightness.	-	-	+
10	Use the pressure gauge to check the tires inflation.	-	-	+
11	Jack up the aircraft and check nitrogen pressure in the shock absorbers by the pressure gauge.	-	-	+
12	Wash and lubricate the parts of the mechanical lock for fixing the semiaxle; check operation of the lock, for which purpose (with the aircraft hoisted up on jacks and the landing gear extended) insert a 3-mm dia. feeler rod gauge in the check hole of the mechanical lock link. The lock being fully closed (the feeler gauge will not pass through the holes), adjust the lock links as deep as 22 mm. If the check holes appear to be misaligned (i.e. the feeler rod will not pass through the holes), adjust the lock changing the length of the semiaxle turn mechanism rod by means of the adjustable bush.	-	-	+
13	Perform check retraction and extension of the landing gear. During this operation check the following: (a) proper retraction and extension of the landing gear main struts and proper functioning of the sequence valves;	-	-	+

No.	Maintenance Operations	To be carried out every		
		7 + 3 days	30 + 5 days	3 months + 10 days
	(b) nose strut autonomous extension; (c) proper setting of all three struts to the uplock and downlock positions and of the strut doors to the uplock position; (d) indicating system for proper functioning; (e) automatic wheel brake system operation during landing gear retraction.			
	Cockpit			
14	Check secure fastening of the screw on the gear wheel of the canopy control valve, having previously removed the switch panel on the cockpit port side.	-	-	+
15	Check condition of the flexible casing and control cable of the ПУ-7 valve, the ПУ-8 valve attachment, control levers and rods. Wash the hinges in gasoline, inspect them, lubricate the hinges and the ПУ-7 valve rod.	-	-	+
16	Check condition of the canopy frame and glass. See that the glass bears no scratches, the protective covering and glass sealing coating are intact.	-	-	-
17	Inspect the cockpit pressurization hose for cracks, fraying and damage of the light-and-ozone resistant covering.	-	-	+
18	Check visually through the fuselage left-side bottom hatch the electric air distributor (unit 525) for proper operation. Complete change-over time for the distributor should be not over 30 sec.	-	-	+
19	Check the cockpit for proper pressurization (the procedure is specified under Items 18 and 19 in Chapter "Pressurized Cockpit").	-	-	+
	Hydraulic System			
20	Check to see that the drain hole of the sump installed ahead of the hydraulic tank pressurizing unit is clean.	+	+	+
21	Check with a pressure gauge that the nitrogen pressure in the spherical hydraulic accumulators should be equal to 50 + 5 kg/sq.cm. with the hydraulic systems under zero pressure.	-	-	+
22	With the engine running check the hydraulic systems pressurization. For this purpose before starting the engine install the special device with a pressure gauge in place of the hydraulic tank filler cap (in the hydraulic booster system chamber).	-	-	+

No.	Maintenance Operations	To be carried out every		
		7 + 3 days	30 + 5 days	3 months + 10 days
	With the r.p.m. being 70 - 80% of the high-pressure rotor r.p.m., excessive pressure should range within 1.6 to 2.55 kg/sq.cm. (this kind of check should be performed simultaneously with checking pressurization in the fuel system).			
23	With the АПА-2М unit connected and the hydraulic booster system being under pressure, check serviceability of the НП-27Т emergency pump unit in a scope indicated in Chapter "Care of Aircraft Hydraulic System".	-	+	+
	Fire-Fighting Equipment			
24	Together with the electric equipment specialists check the fire warning circuit.	+	+	+
	Fuel System			
25	With the engine running check the amount of pressurization in the fuel and gasoline systems (simultaneously check the amount of pressurization in the hydraulic tank). For procedure used when checking pressurization see Chapter "Fuel System".	-	-	+
26	Check clean condition of the drain hole in the sump installed ahead of the gasoline tank pressurizing unit.	+	+	+
	Power Plant			
27	Together with specialists on aircraft equipment check serviceability of the cone, anti-surge shutters and the engine control lever interlock according to M-number. For the procedure employed in checking refer to Chapter "Power Plant Control".	-	-	+

Maintenance Work to Be Performed Every 12 Months

Canopy

Scheduled maintenance operations on the aircraft canopy, with the exception of those indicated in Section "Cockpit", are to be performed once a year simultaneously with scheduled maintenance involving the ejection seat.

1. Check operation of the diaphragm valve, firing gun and relief valve of the ТСМ-2500-38 firing mechanism.

2. Remove the sliding portion of the canopy from the aircraft and place it on a special support.

Check operation of the canopy emergency opening locks.

3. Install the canopy sliding portion on the aircraft and check the opening and closing of the canopy.

Note: All operations should be carried out as specified in Chapter "Cockpit Canopy". After completing all kinds of operations and checks give particular attention to the locks which should be closed and to the movable parts which should be safetied.

Ejection Seat

The purpose of maintenance operations on the ejection seat is to check the ejection mechanisms, to inspect the seat parts for proper condition and to change the lubricant.

Remove the seat from the aircraft, place it on a special trestle and perform the following:

4. Check to see that the primer caps of the firing mechanisms are hit as a result of operation of the respective control systems.
5. Check to see that the locks for the pilot's restraint mechanism operate in response to the emergency grip actuation.
6. Check operation of the collapsible supports; check the effort required to fold them.
7. Check for presence and security the locking screws of the seat units.
8. Inspect the seat parts made of magnesium alloys (seat pan, cross beams, foot pedals) and make sure that no traces of corrosion are evident.

Clean the parts and mechanisms from dust and lubricant.

9. Inspect all cable wires, clean them from dirt and make sure that the threads are intact. If required, coat them with ЦИАТИМ-201 lubricant.
10. Coat with ЦИАТИМ-201 lubricant all friction connections.
11. Remove the case from the lifting screw of the seat adjusting mechanism and coat it with ЦИАТИМ-201 grease.
12. Lubricate the guides of the seat pan.
13. Replace the lubricant in the МУ-100 АП motor reduction unit case, for which purpose screw out the plug in the case bottom, wash the reduction unit compartment in gasoline and fill it with fresh ЦИАТИМ-201 lubricant.
14. Check the condition of the electric wiring and plug connector of the supply line for the МУ-100 АП motor.
15. Remove the drogue parachute, check and pack it according to the relative Instructions.
16. Replace the explosive cartridges of the firing mechanisms for new ones.

Install the seat and TCM-2500-38 firing mechanism on the aircraft and perform the necessary operations within the scope of the aircraft preliminary preparation.

Note: 1. The firing mechanisms should be cleaned in conformity with the Instructions issued by the Manufacturer.
2. The sequence of operations used for seat maintenance is indicated in Chapter "Ejection Seat".
3. When performing scheduled maintenance operations on the 215 П firing mechanism replace the locking plates of the three-link yoke by new ones for they are used only once.

Cockpit

With the seat removed perform the following:

17. Check the condition of thermal insulation of the cockpit pressurization system "hot" line. If required, restore the insulation. Make sure that the nuts are properly tightened and the lockwire is intact.
18. Wash and lubricate with ЦИАТИМ-221 grease the surface of the engine control rod which passes through the cockpit pressurized outlets. See that the lubricant gets inside the outlets; to this end, actuate the engine control lever.
19. With the protective case removed and sealing cover unlaced, wash and lubricate the aileron control oblique rod which passes through the cockpit pressurized outlet.

Force the lubricant into the pressurized outlet by deflecting the aircraft control stick to the right and left.

20. After removing the cockpit floor check to see that the clearances between the control rods and adjacent members of the fuselage within the entire deflection range of the engine, rudder, stabilizer and aileron controls are at least 4 mm. Bent aircraft and engine control rods should be replaced by new ones.

Note: When performing all kinds of operations in the cockpit with the seat removed, spread the protective cockpit floor available in the ground equipment set 1 : 4.

Aircraft and Engine Maintenance in Storage

If for any reason an aircraft is not allowed to be flown for some time and is not subject to slushing during this period, perform the following operations:

Every 10 ± 2 Days

1. Carry out pre-flight inspection on the aircraft.
2. With the access panels and plugs removed from the air intake and adjustable nozzle, inspect visually the external parts of the engine and make sure that no traces of corrosion are present.

Corroded spots should be processed according to the Instructions on Engine Operation.

3. Start the engine and check its operation at every power rating according to the Chart provided for the purpose.
4. With the engine running check operation of the armament, instruments and the aircraft control system.

Under normal operating pressure in the booster hydraulic system 8 or 10 times deflect the control stick forward - backward, to the right - to the left and diagonally. While doing this, make sure that the hydraulic boosters operate properly.

5. When preparing the aircraft for flights after storage retract and extend the landing gear, flaps, and air brakes; check operation of the retractable cone and anti-surge shutters.
6. If the aircraft is not planned to be flown, change lubricant in the rods of the struts, hydraulic cylinders, hydraulic boosters and APY-3B automatic unit.

Every 30 Days

7. Carry out operations included in the 10 ± 2 day routine maintenance.
8. Wash and lubricate the surfaces of the stabilizer, rudder and aileron control rods passing through the cockpit pressurized outlets.

By moving the control stick and pedals force the lubricant inside the pressurized outlets.

9. When the aircraft is to be prepared for flights, check the cockpit for pressurization.
10. Check the hydraulic accumulators, landing gear shock absorbers and wheel tires for proper filling.
11. Drain fuel sediment from the drain lower points and send it for analysis.
12. Inspect the electron-alloy parts.

CAUTION: The engine fuel system should be filled with fuel in the course of the entire storage period to prevent corrosion of the fuel system parts.

APPENDIX I

Preparation for Storage

Subject the aircraft to anti-corrosive treatment, if it is not planned to be flown for a period exceeding 30 days, or before packing it for shipping.

Before slushing remove dust, dirt , moisture and used lubricant from the parts surfaces wiping them with a clean cloth soaked in non-leaded gasoline; wipe the parts and joints dry with a clean piece of cloth.

For slushing use the ЦИАТИМ -201 lubricant and petrolatum. Parts with varnish and paint coating should not be slushed with lubricant.

1. Lubricate for slushing all mechanisms of the aircraft, ball bearings of the disconnected rods, as well as bell cranks and cables.
2. When the aircraft is to be shipped, all non-painted parts and joints should be slushed with petrolatum heated up to 60-80° C.
3. The landing gear wheel bearings should be slushed with HK-50 lubricant.
4. When slushing, coat all parts and joints with a thin even layer of lubricant applied with a soft brush.
5. All rubber units, such as the cockpit pressurization hose, hoses for the hydraulic, fuel and air systems, as well as the packing rubber used for edging the access panels should be wiped with talc.
6. If the paint coating of parts is damaged, restore it by painting the part anew when preparing the aircraft for storage.
7. If the aircraft is to be shipped, slush its push-rods (which should be disconnected for the purpose), wrap them up in two layers of paraffin paper, then in cloth, after which wind them up with twine.
8. All open ends of the pipelines should be plugged with rubber caps or inserts and sealed.
9. With the aircraft units disjointed cover all holes in the fuselage and wings with thick cloth to protect the aircraft inside from dirt.
10. When slushing the aircraft, remember that it is strictly prohibited to apply lubricant to the oxygen system fittings.
11. The hydraulic and fuel systems should be filled to capacity unless the aircraft is to be shipped.
12. Protect the canopy with a soft cloth cover.
13. Plug and seal the intake duct and jet nozzle.
14. The units which are assembled at the Manufacturing plant should be treated according to the Manufacturer's Instructions.
15. The slushing completed, protect the aircraft with a cover.
16. After removal of the slushing compound from the aircraft perform scheduled maintenance operations depending on the storage period. Do not undertake any maintenance operations on a slushed aircraft. The aircraft is allowed to be slushed for 3 months.

APPENDIX 2

Care of Magnesium Alloy Parts

The aircraft has parts and units made of magnesium alloys which are much more subject to corrosion than parts made of other materials. Therefore they need thorough and systematic care.

The magnesium alloy parts and units are likely to be attacked with corrosion under the following conditions:

(a) damaged protective coating;

(b) excessive sweating due to absence of ventilation or sharp temperature changes within a 24-hour period;

(c) water getting on these parts;

(d) sea water, acid, alkali or chemically active gases getting on the parts.

Corrosion of magnesium alloys is detected due to bulging of paint coating and greyish damp thin coating appearing on their surfaces.

When inspecting the aircraft, check to see that the magnesium alloy parts are not attacked by corrosion, particularly under end pieces of bonding strips.

To tell the magnesium alloy parts from other ones, they are painted blue, except for those belonging to the landing gear wheels (which are painted green), footsteps of control pedals (which are painted black) and instruments (which are painted gray). When sea water, salt solutions, acid, alkali or foam from the fire-extinguishers get on magnesium alloy parts, they should be thoroughly washed with warm water, dried and washed with pure gasoline.

Clean the parts from corrosion and restore their paint coating either just on the spot or after removing the affected part from the aircraft (depending on the part accessibility and its degree of corrosion).

Parts whose dope coating has bulged and which are affected by corrosion (that has not yet penetrated deep into the part) should be treated as follows:

(a) thoroughly clean the affected surface with glass paper No.180 or No.200; clean corrosion pits with a scraper until corrosion traces are completely removed;

(b) remove grease from the corroded surface by washing it with pure non-leaded gasoline;

(c) coat the cleaned place with a 10% selenic acid solution and dry it up;

(d) coat the cleaned surface with a layer of АЛГ -1 primer, dry it under a +25° or +35°C temperature for at least 24 hours (under +12° or +17°C- at least for 36 hours).

If quick-dry АЛГ-10 primer is used, drying should last 3 or 4 hours at a temperature of from +18° to +35°C;

(e) cover the treated surface with A-9 or A-9Ф enamel if the part is installed inside the aircraft or with A-24Г enamel, if it belongs to the landing gear wheel; dry up this surface for a 24-hour period at a temperature of +18° to +35°C or for at least 36 hours at a temperature of from +12° to +16°C (for lower temperatures the drying time should be increased);

(f) if the part gets fouled while it is being dried, wipe the surface with clean cloth soaked with non-leaded gasoline before placing the next layer on it;

(g) see that no moisture gets on the part in operation.

Replace badly corroded parts with a considerable number of deep pits all over the surface as well as parts with separate deep corrosion pits.

Replace parts corroded at the places where bearings are pressed in.

It is forbidden to match parts made of magnesium alloys with chrome-, silver- or copper-plated ones. Steel, bronze or brass parts when mated with those of magnesium alloys should be zinc-plated or cadmium-plated, while aluminum alloy parts should be anodized. The ball bearing races should not necessarily be plated with zinc, but they should be installed on ЦИАТИМ-201 lubricant. The places on the parts made of magnesium alloys skinned for installation of bonding strips should be coated with АЛГ-1 primer, if they show up from under the strips.

CAUTION: Vapours of selenious acid are harmful to human health; therefore, when using solutions of this acid see that the solution does not get on the skin and clothes.

Note: When selenious acid solution is not available, prepare it from 1 lit. of water, 20 gr of selenious acid and 10 gr of sodium bichromate.

APPENDIX 3

Care of Aircraft External Surfaces

To protect the aircraft metal parts from corrosion and to improve the aircraft aerodynamic performance, the aircraft metal surfaces should be dope-coated.

The protective properties of dope coating deteriorate when the coating is affected by fuel, oil, acid or alkali or is simply damaged.

When performing aircraft maintenance, remember that inobservance of the above-mentioned rules will cause deterioration of the protective properties of the coating and will reduce their service life.

The following parts of the aircraft are most liable to corrosion:

(a) the bottom skin of the wing, the fuselage and empennage;

(b) the skin in the region of exhaust gases;

(c) the skin close to the aircraft storage battery.

Subjected to corrosion most frequently are those aircraft which have prolonged intervals between flights.

To protect the aircraft external surfaces from mechanical damage, harmful effects of sunrays and precipitation, the following rules should be observed:

1. When carrying out maintenance operations on the aircraft skin, place on it rubber or fabric rugs which should be cleaned of dust and dirt before starting the maintenance operations.

2. Do not place on the skin tools, parts, pieces of cloth saturated with oil, kerosene, etc.

3. Use ladders and steps covered with cloth or rubber.

4. To avoid damaging dope coating of the skin do not wear rough and dirty shoes when walking on the aircraft skin.

5. When parked outdoors, the aircraft should be kept covered irrespective of the season.

6. It is forbidden to place dirty or wet covers on the aircraft.

7. See that the aircraft covers are always clean. Do not use torn covers.

8. In case condensed water is found under the aircraft covers on the skin, remove the covers, wipe the skin dry with pieces of cloth, dry the covers and place them on the aircraft.

9. Take care not to spill acid or alkali on the aircraft skin. Be particularly careful when installing and removing the aircraft storage batteries. All maintenance operations involving aircraft storage batteries should be performed with the storage batteries removed from the aircraft.

Should acid get on the aircraft skin or other parts, immediately wash the affected spot with warm water several times, after which wipe this spot with a clean piece of cloth. Places where traces of spilt acid are likely to settle down (such as clearances, seams, etc.) should be washed with utmost care and blown off subsequently with compressed air.

All cases of washing the aircraft skin to remove traces of spilled acid should be recorded in the aircraft Service Log. For three months systematically check the affected area to make sure that the skin remains sound. Should traces of corrosion be found on these portions of the skin, immediately report the fact to the unit engineer.

10. If oil has got on the aircraft skin, wipe the surface with a clean piece of cloth soaked in non-leaded gasoline.

11. Treat corroded spots on the skin as follows:

(a) wipe the affected area with a clean piece of cloth soaked in non-leaded gasoline;

(b) clean this area with soft or bristle brushes; if the corrosion traces persist, treat the surface with sand dust No.200 applied with a piece of gasoline-soaked cloth;

Note: When skinning the corrosion affected surface, do not try to completely eliminate corrosion pits; it is sufficient to remove the corrosion products alone.

(c) once more wash the affected surface with a piece of cloth soaked in gasoline and dry it;

(d) spray on or brush on this area АЛГ-1 primer with 5% aluminum powder;

(e) dry the primer at a temperature of +12° to +17°C for 24 hours;

(f) after the primer dries up, spray on or apply with a brush 170A dope adding to it 10% aluminum powder when processing the outer colourless skin of the airframe or without adding aluminum powder when processing the inside parts of the airframe (which should be of a golden colour);

(g) dry the varnish coating at temperatures of +12° to +17°C during 36 hours or at +18° to +35°C during 24 hours.

12. Non-corroded spots of the skin with damaged dope coating should be treated with 170A dope.

13. To restore the dope coating, proceed as follows:

(a) remove the damaged coating with a piece of cloth soaked in special solution СЛ;

(b) spray on or brush on the skin a layer of 170A dope;

(c) dry up the coating at a temperature of from +12° to +35°C for 36 hours.

14. When finishing the skin of the fuselage tail portion aft of frame No.34, use heat-resistant K-1 enamel which should be dried for 2 or 3 hours at a temperature of at least 12°C.

15. The aircraft skin paint finishing is accomplished on a site protected from dust; the site around the aircraft should be watered.

16. To reduce the drying time of the oil primer and enamel, the surface is allowed to be blown off with air heated up to 80°C.

17. It is forbidden to apply dope coating with subsequent drying in the blazing sun as well as on foggy, wet or windy days.

18. Finish the aircraft skin with oil enamels under conditions of the air relative humidity not exceeding 80% and at a temperature of at least +12°C.

19. In fog or rain the aircraft may be operated only upon expiration of 12 hours since the paint coating complete drying-up.

20. To prolong the service life of the aircraft skin protective coating, regularly wipe it with soft brushes to remove dust.

It is good practice to wash the aircraft skin with water at least once a month.

To this end use the following procedure:

(a) wash with a soapy solution (350-400 gr of soap per 10 lit. of water) and then with water the skin portions having an oxide and dope coating;

(b) wash with water those portions of the skin which have an oxide coating only. Before washing remove dust with soft brushes.

APPENDIX 4

Maintenance Operations to Be Performed upon Aircraft Delivery to Using Arms

After the aircraft has been shipped by water or delivered by train to the using arms, do the following:

1. Unpack the container and roll out the aircraft parts; inspect thoroughly the airframe units; make sure that they have not been damaged in transit, loading and unloading.
2. Before jointing the aircraft inspect the connections, checking them for damage ; see that the pipe connections are plugged and no foreign objects are present in the aircraft compartments.
3. Remove the anti-corrosive coating from the aircraft parts.
4. After assembling the aircraft check the deflection angles of the ailerons, flaps, air brakes, rudder and stabilizer according to the Levelling Diagram.
5. Check and refill (if required) with nitrogen the ball and cylindrical hydraulic accumulators; pour АМГ-10 fluid into the system.
6. Using the ground hydraulic pump at least 5 times retract and extend the landing gear, flaps, air brakes; check operation of the ailerons, stabilizer, pump unit and their signal systems.
7. Check operation of the anti-surge shutters from the manual and automatic control systems; check the anti-surge shutter interlock system.
8. Check the air intake retractable cone for reliable operation.
9. Check the pressure of nitrogen in the landing gear shock absorbers and refill the accumulators, if required.
10. Check operation of the АРУ automatic unit from the manual and automatic control system.
11. Check the airtightness of the hydraulic system.
12. Check the systems of L.G. wheel manual and automatic braking and the time required for braking and releasing the wheels. Check the wheel emergency braking system.
13. Check the cabin pressurization.
14. Check the air system for proper tightness.
15. Check operation of the drag parachute system.
16. Before filling the fuel system drain the remaining fuel and sediment from all the drain holes. After filling up the fuel system drain 1 or 2 litres of fuel through every drain hole to make sure that all sediment has been removed from the system.

    Check operation of the fuel system. Lock the shut-off valve in the open position.
17. Check the locking wires of the ejection seat and canopy for presence and serviceability.
18. Check the fire-fighting system for sound condition and the fire-extinguisher bottle for charging.
19. Deprocess the engine in conformity with the Instructions on engine maintenance.

APPENDIX

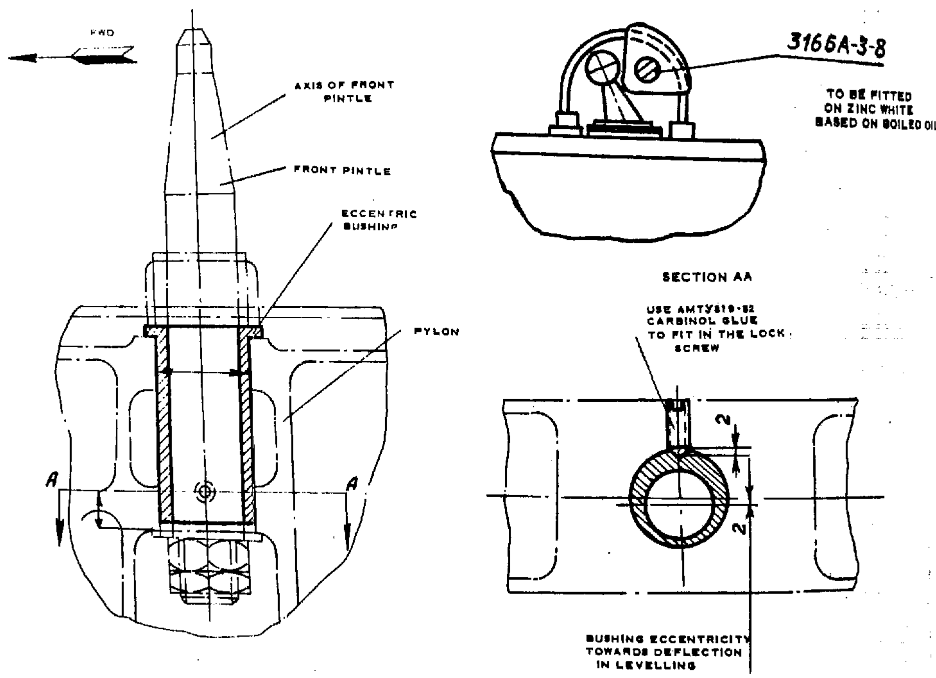
1. On all aircraft the pipe running from the electro-pneumatic valve (unit 695000M) to the fuel shut-off valve has been disconnected and removed.

The spare connections on the actuating cylinder of the shut-off valve and on the electro-pneumatic valve have been plugged and lockwired.

The removed pipe is attached to the single set of spare parts. The fuel shut-off valve is lockwired with KOK-1 wire in the open position.

2. For the sake of levelling the fuel tank pylon in the horizontal plane the pylons are sometimes provided with an eccentric bushing fitted near the front pintle.

Should necessity arise to replace those pylons for new ones, to retain the tank levelling, fit the eccentric bushing from the old pylon onto the new one, having previously reamed the hole for the bushing to $\varnothing 38A_3$.



3. The 74-22-05 ejection seat has on its starboard side (as viewed in flight direction) a trunnion whose axis is displaced relative to the landing plane axis by 2 mm (upward). The actual difference in clearances "d" on this aircraft comes to 1 mm, which complies with the clearance difference of not above 2 mm specified in the drawing.

When replacing the canopy or ejection seat check the value of clearance difference and the engagement of seat and canopy to determine whether to fit the eccentric trunnion on the seat or to dispense with it.

A standard trunnion is included into the aircraft single set of spare parts.

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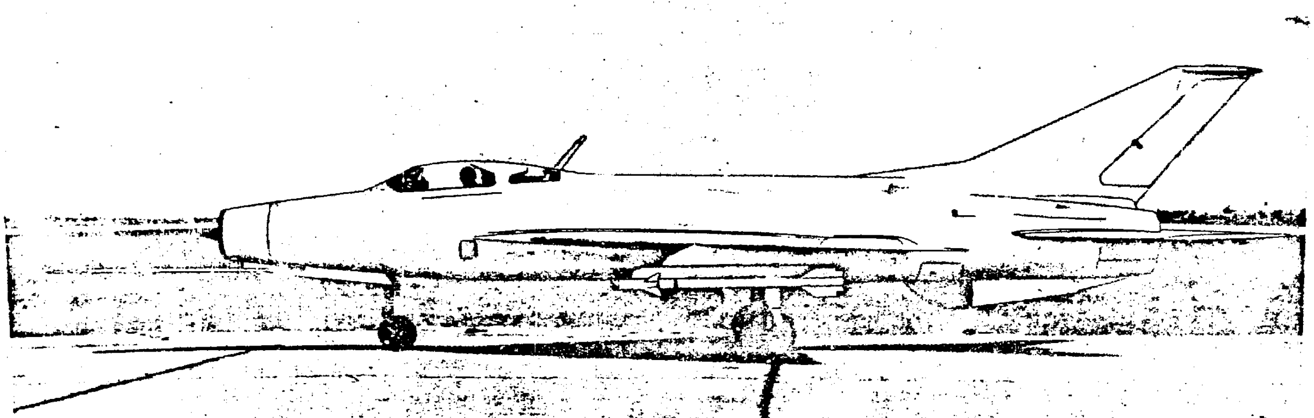

FIG. 1. AIRCRAFT, TYPE МИГ 21Ф-13 (SIDE VIEW)

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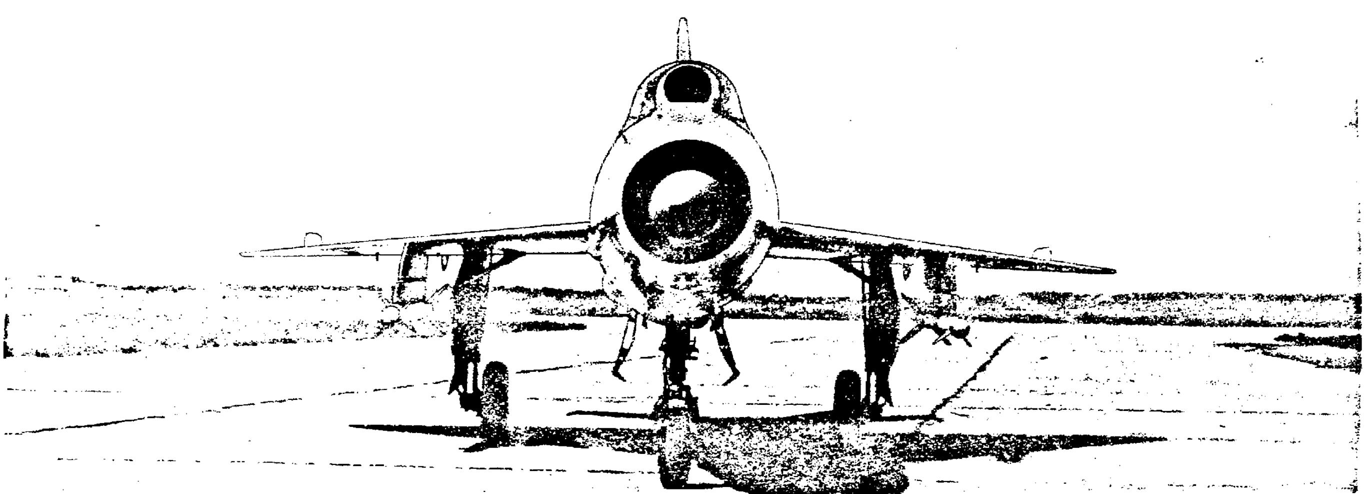

FIG. 2. AIRCRAFT, TYPE МиГ21ф-13 (FRONT VIEW)

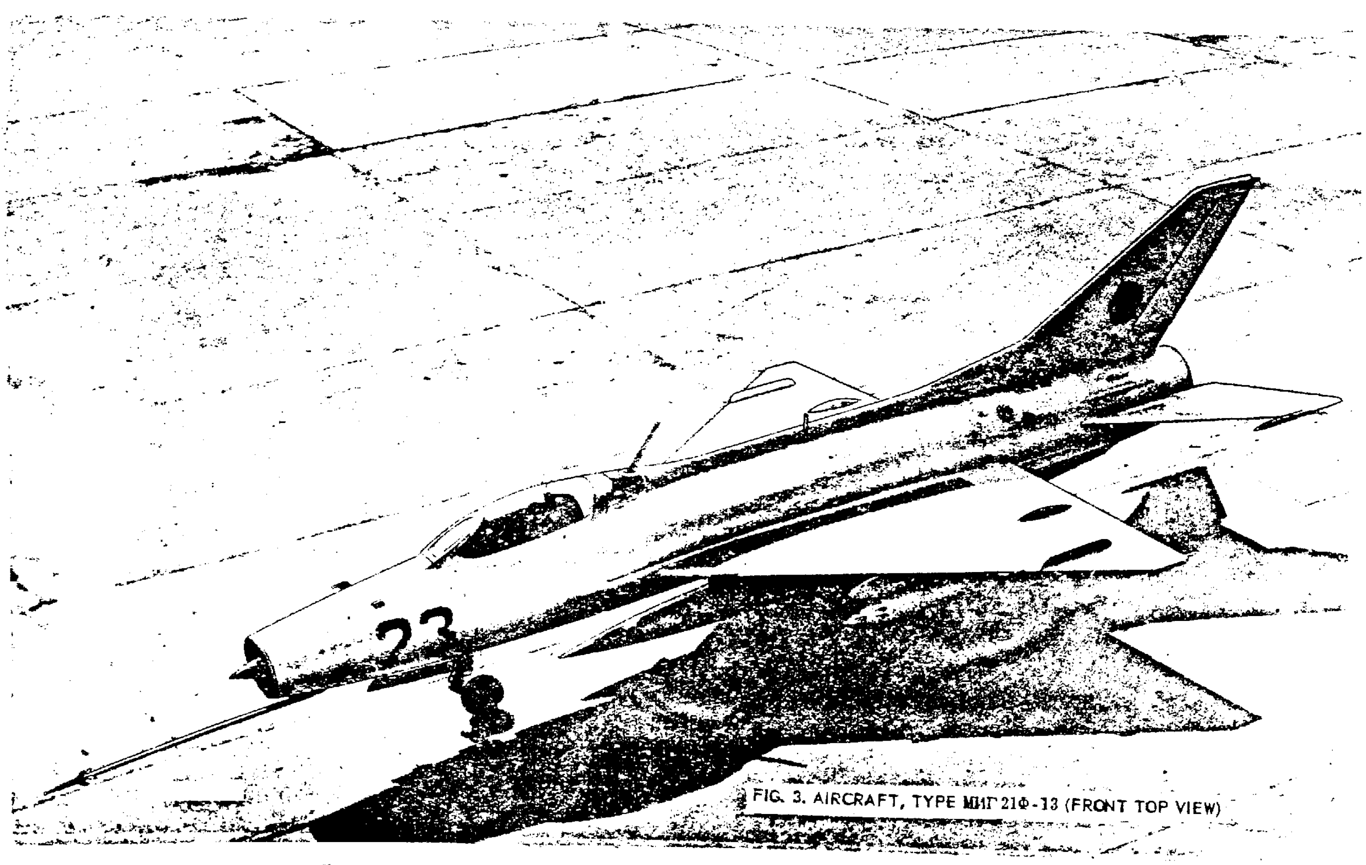

FIG. 3. AIRCRAFT, TYPE МИГ 21Ф-13 (FRONT TOP VIEW)

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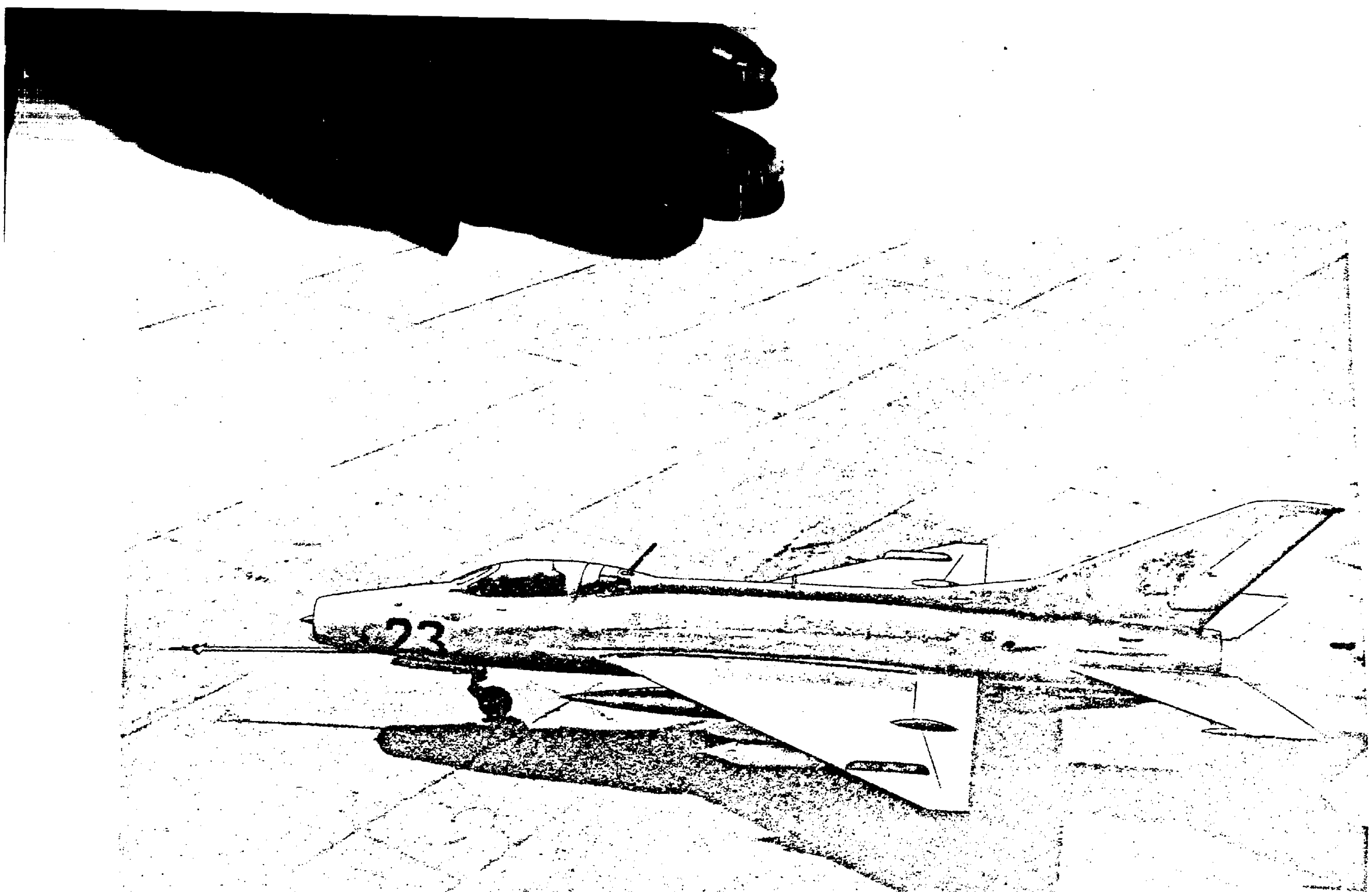

FIG. 4. AIRCRAFT, TYPE МИГ 21Ф-13 (TOP SIDE VIEW)

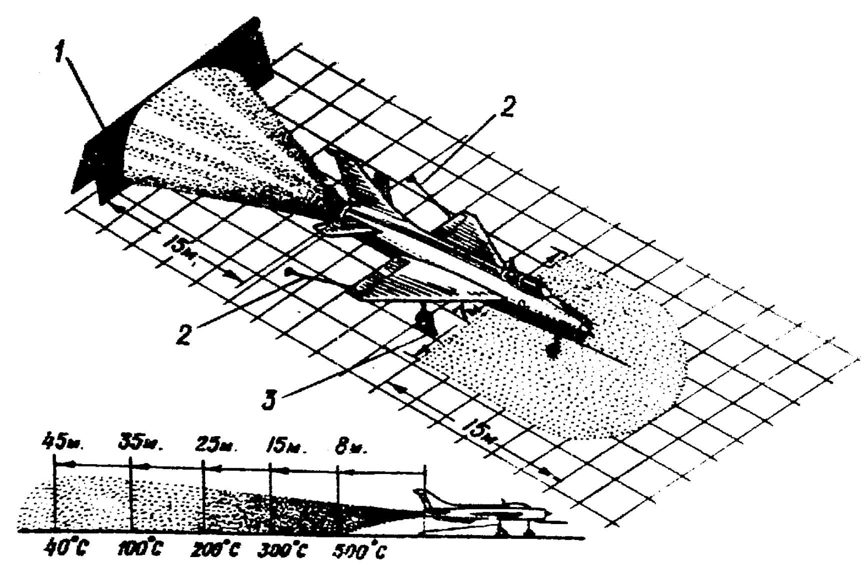

FIG. 5. GROUND RUN-UP DANGER AREAS
1 – exhaust gas shield; 2 – brake cable; 3 – chock.

[redacted]

FIG. 6. SCREEN INSTALLED ON SHUTTER OF ADDITIONAL AIR INTAKE

FIG. 7. COVER INSTALLED ON SHUTTER OF ADDITIONAL AIR INTAKE

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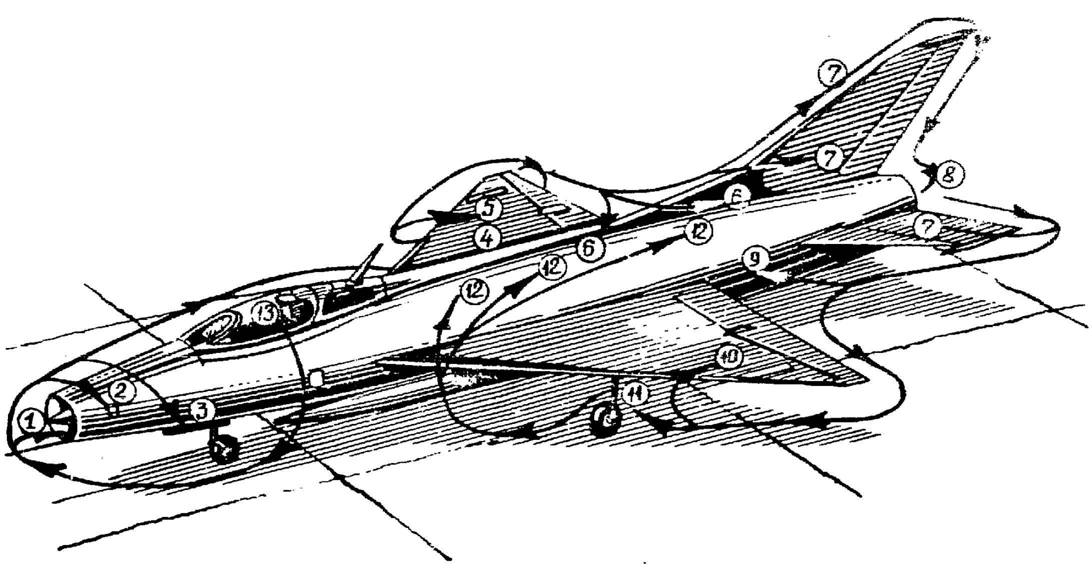

FIG. 8. PRE-FLIGHT INSPECTION ROOT

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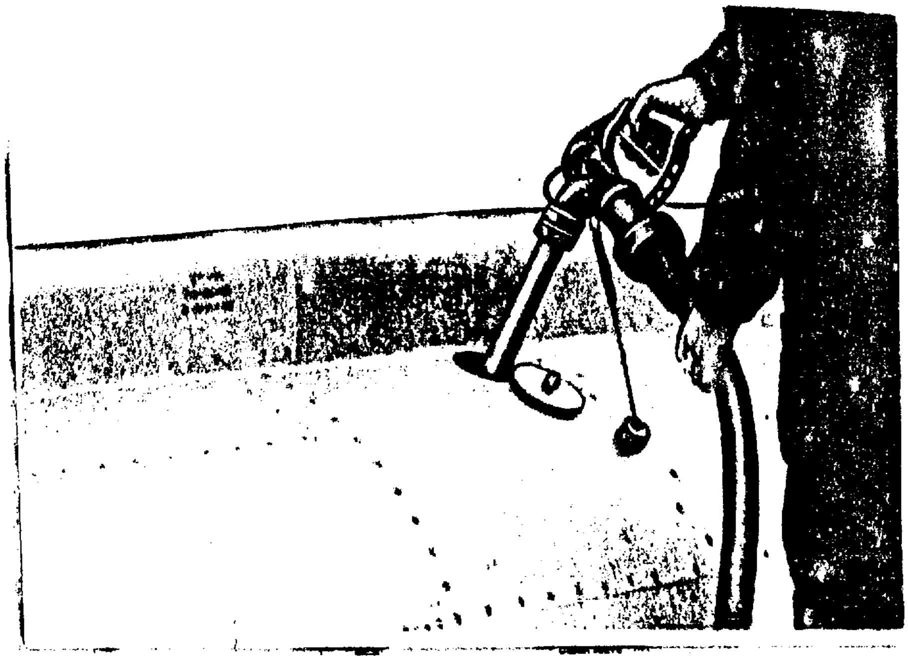

FIG. 9. FILLING 3rd GROUP TANKS WITH FUEL (THROUGH FILLER NECK OF TANK NO. 4)

FIG. 10. DROP TANK FILLING

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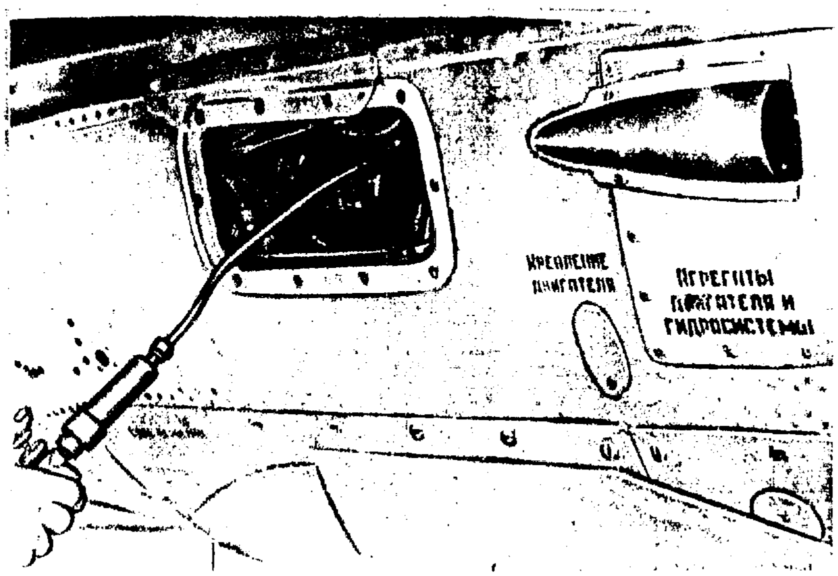

FIG. 11. OIL FILLING

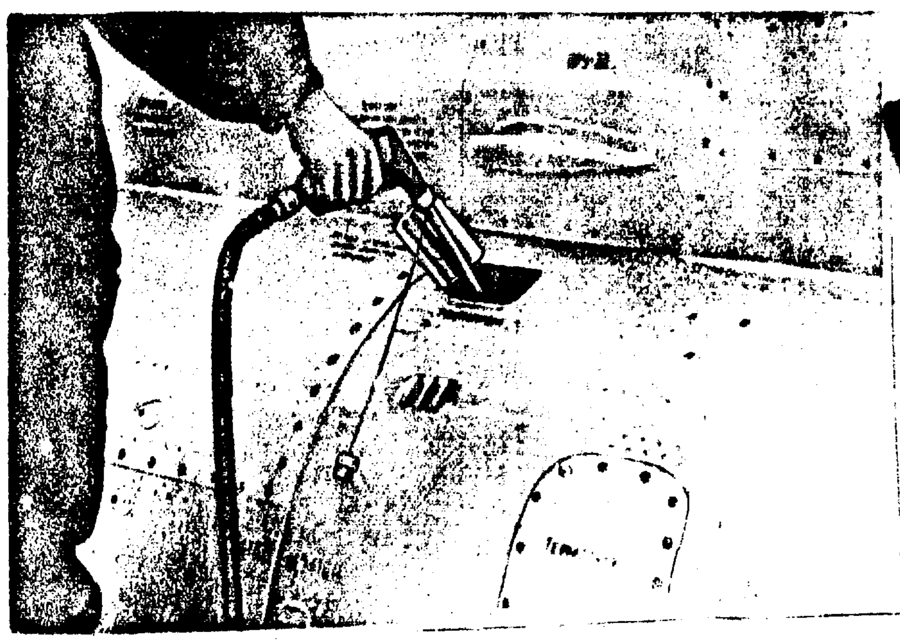

FIG. 12. FILLING HYDRAULIC TANK WITH АМГ-10 FLUID

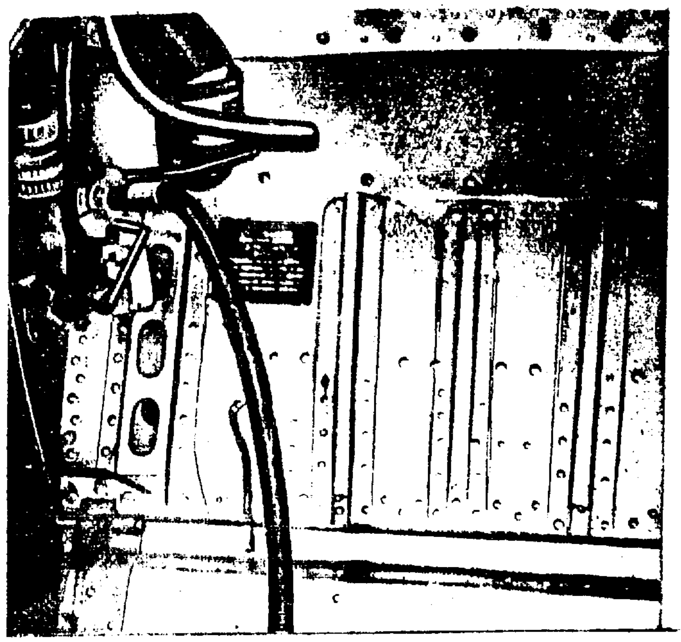

FIG. 13. AIR CHARGING

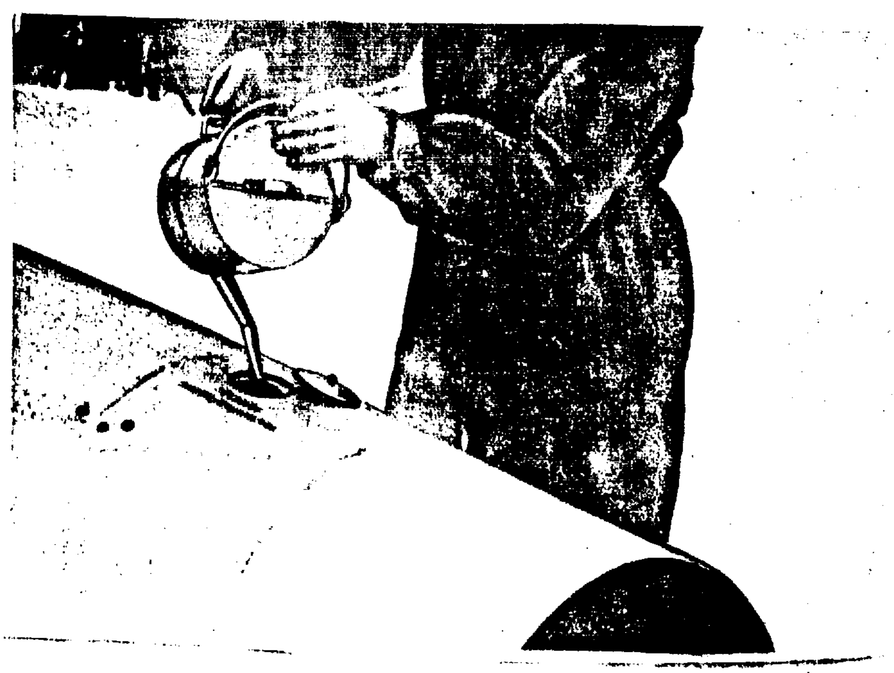

FIG. 14. FILLING ALCOHOL IN DE-ICER SYSTEM TANK

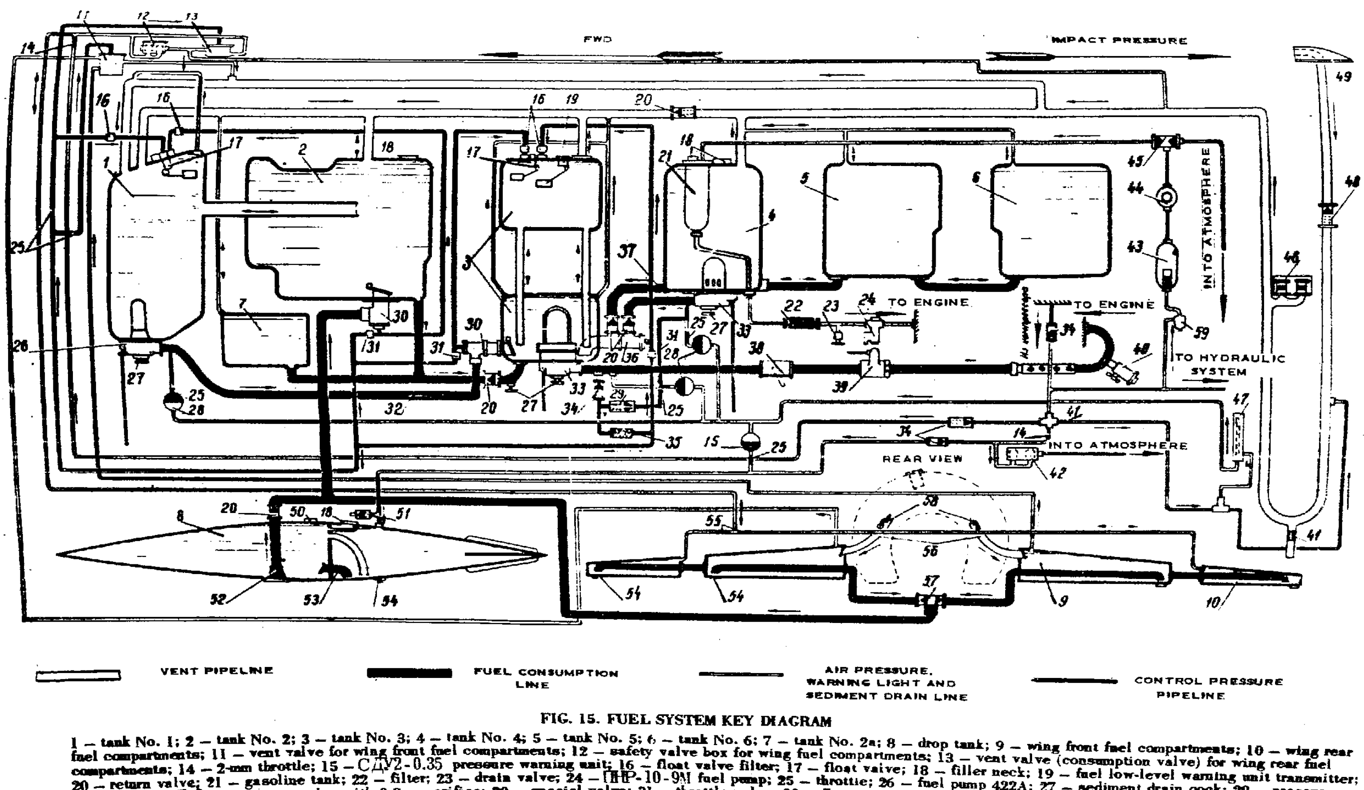

FIG. 15. FUEL SYSTEM KEY DIAGRAM

1 – tank No. 1; 2 – tank No. 2; 3 – tank No. 3; 4 – tank No. 4; 5 – tank No. 5; 6 – tank No. 6; 7 – tank No. 2a; 8 – drop tank; 9 – wing front fuel compartments; 10 – wing rear fuel compartments; 11 – vent valve for wing front fuel compartments; 12 – safety valve box for wing fuel compartments; 13 – vent valve (consumption valve) for wing rear fuel compartments; 14 – 2-mm throttle; 15 – СДУ2-0.35 pressure warning unit; 16 – float valve filter; 17 – float valve; 18 – filler neck; 19 – fuel low-level warning unit transmitter; 20 – return valve; 21 – gasoline tank; 22 – filter; 23 – drain valve; 24 – ПНР-10-9М fuel pump; 25 – throttle; 26 – fuel pump 422A; 27 – sediment drain cock; 28 – pressure warning unit СД-3; 29 – return valve with 0.8-mm orifice; 30 – special valve; 31 – throttle valve; 32 – flow restrictor with 17-mm orifice; 33 – 495A2 fuel pump; 34 – return valve; 35 – control pressure filter; 36 – special valve; 37 – flow restrictor with 25-mm orifice; 38 – shut-off valve; 39 – PTC-16A fuel flowmeter transmitter; 40 – fuel drain and engine slushing cock; 41 – 3-mm orifice; 42 – safety valve for drop tank; 43 – receiver; 44 – PB-0.4 reducing valve; 45 – return and safety valves; 46 – safety valves for fuselage tanks; 47 – fuel trap; 48 – return valve with 3-mm orifice; 49 – vent live air intake pipe; 50 – filler neck; 51 – vacuum-valve; 52 – drain plug with filter; 53 – pipe union with return valve for fuel flow from rear compartment; 54 – drain plug; 55 – 7-mm orifice; 56 – filling pipe with return valve; 57 – tee-piece with return valves and protective gauge; 58 – inertia valves; 59 – sediment trap with 1-mm orifice.

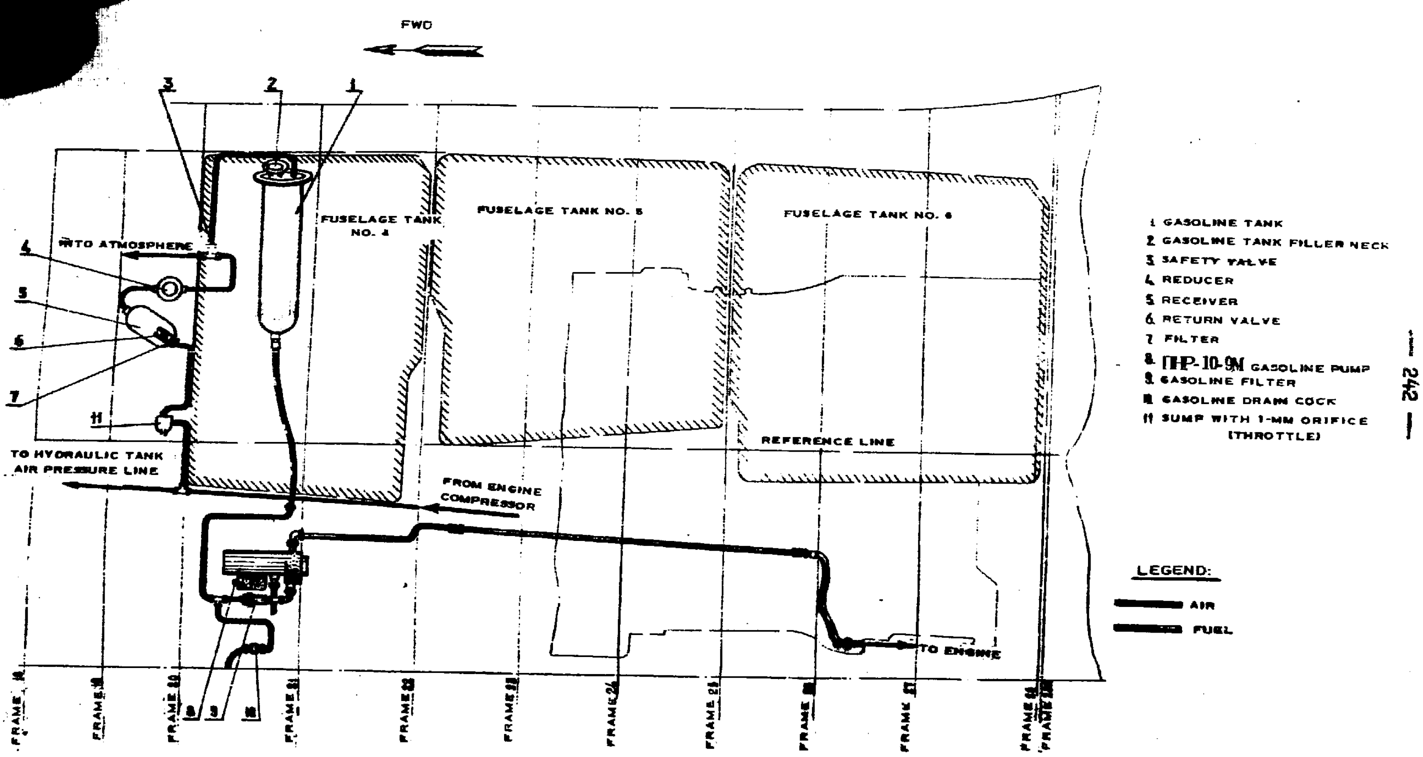

FIG. 16. ARRANGEMENT OF GASOLINE SYSTEM

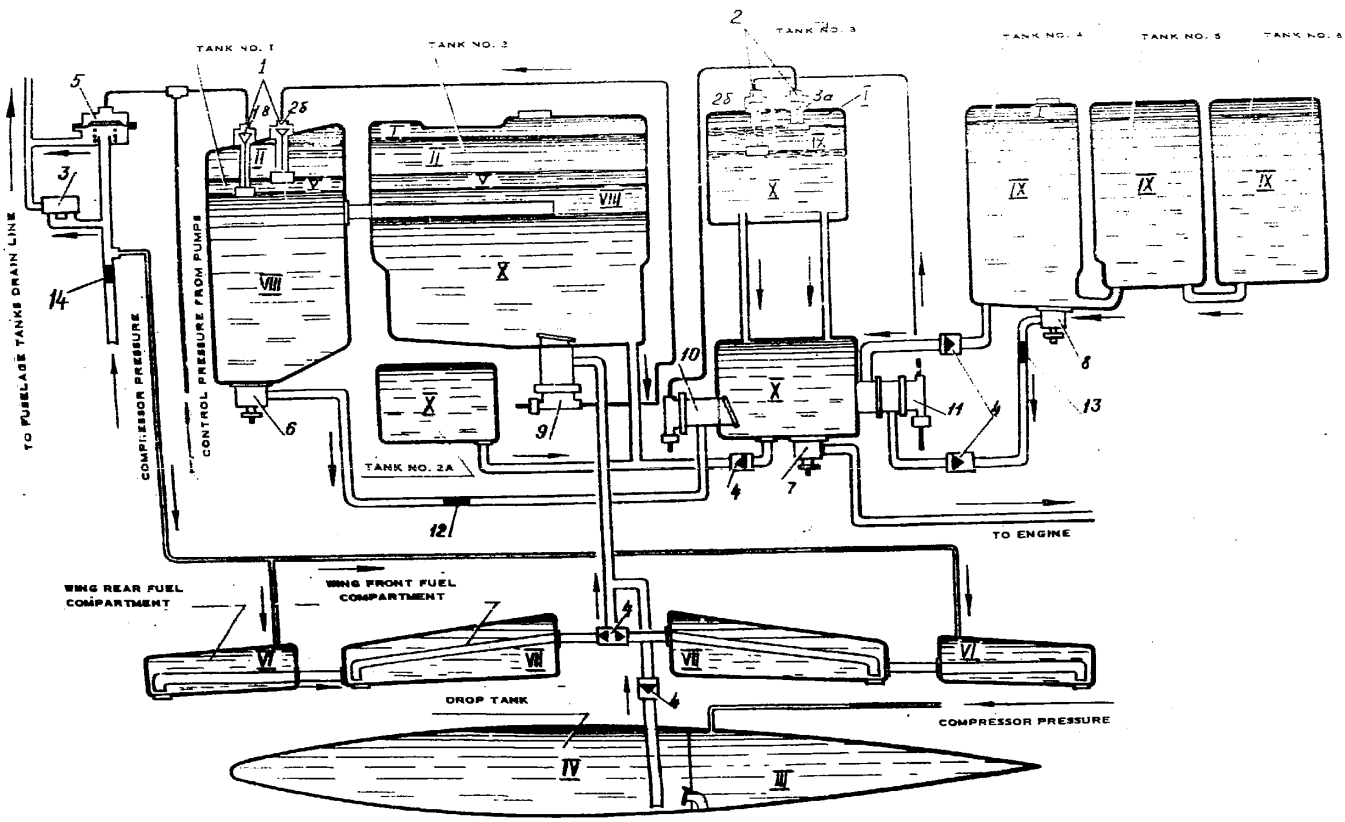

FIG. 17. FUEL CONSUMPTION DIAGRAM (SEQUENCE OF FUEL CONSUMPTION IS SHOWN WITH ROMAN NUMERALS)

1 – float valve, tank No. 1; 2 – float valve, tank No. 2; 3 – safety-valve box; 4 – return valve; 5 – vent valve (fuel consumption valve for wing fuel compartments); 6 – pump for 1st group tanks; 7 – pump for 2nd group (service) tanks; 8 – pump for 3rd group tanks; 9 – special valve for drop tank fuel consumption line; 10 – special valve for 1st group tanks; 11 – special valve for 3rd group tanks; 12 – 17-mm orifice; 13 – 25-mm orifice; 14 – 2-mm orifice.

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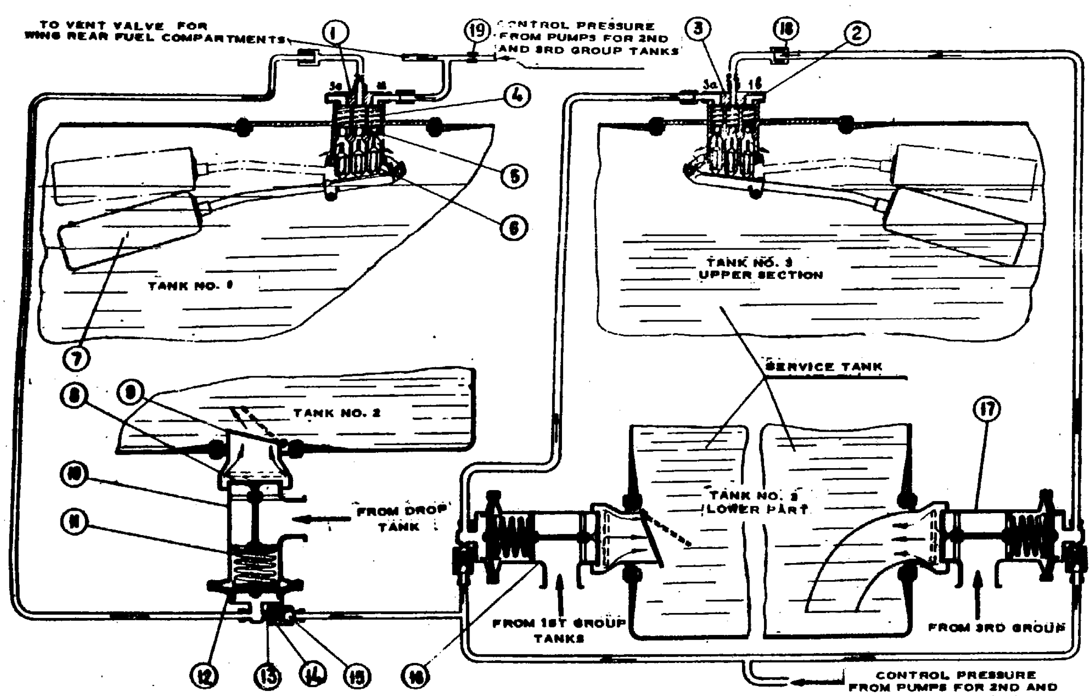

1. FLOAT VALVE FOR 1ST TANK
2. PLUG
3. FLOAT VALVE FOR 3RD TANK
4. SPRING
5. SPHERICAL VALVE
6. ROD
7. FLOAT
8. VALVE PLATE
9. RETURN VALVE
10. DROP TANK SPECIAL VALVE
11. SPRING
12. DIAPHRAGM
13. 0.7-MM ORIFICE
14. STRAINER
15. SPHERICAL RETURN VALVE
16. SPECIAL VALVE FOR 1ST GROUP TANKS
17. SPECIAL VALVE FOR 3RD GROUP TANKS
18. STRAINER
19. 0.8-MM ORIFICE

FIG. 18. OPERATION OF FUEL SYSTEM SPECIAL VALVE
(VALVES IN CLOSED POSITION, I.E. PUMPS FOR 2nd AND 3rd GROUP TANKS ARE OFF)

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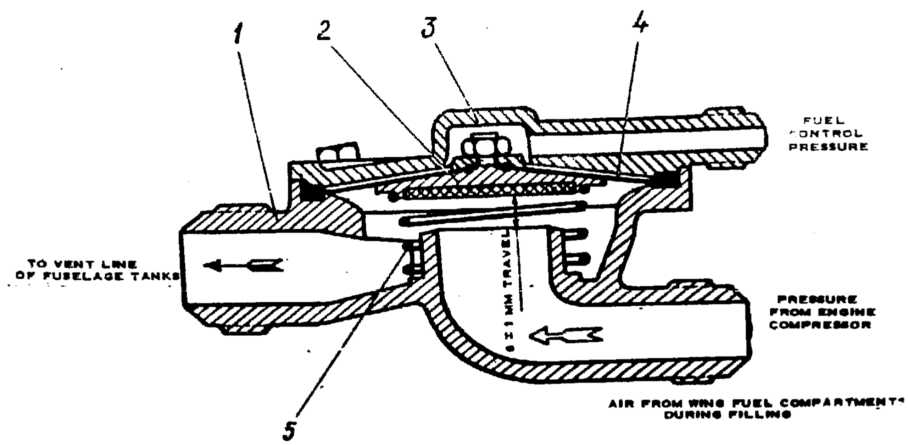

FIG. 19. VENT VALVE
1 – body; 2 – valve; 3 – cover; 4 – diaphragm; 5 – spring.

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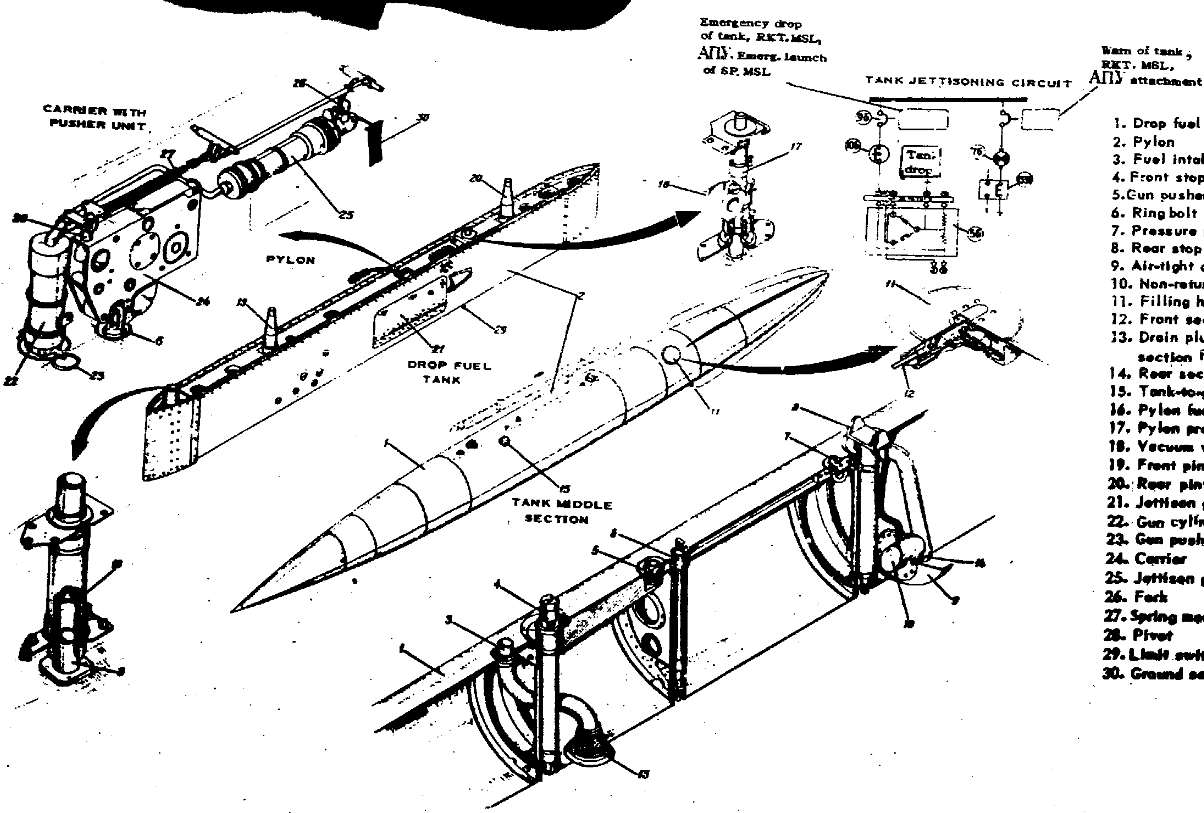

1. Drop fuel tank
2. Pylon
3. Fuel intake pipe union
4. Front stop
5. Gun pusher bushing
6. Ring bolt
7. Pressure pipe union
8. Rear stop
9. Air-tight dividing plate
10. Non-return valve
11. Filling hole
12. Front section vent pipe
13. Drain plug with front section filter
14. Rear section drain plug
15. Tank-to-ground fuel pumping hole
16. Pylon fuel intake pipe line
17. Pylon pressure pipe line
18. Vacuum valve
19. Front pintle
20. Rear pintle
21. Jettison gun access hatch
22. Gun cylinder
23. Gun pusher key
24. Carrier
25. Jettison gun
26. Fork
27. Spring mechanism
28. Pivot
29. Limit switch
30. Ground safety lock

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FIG. 20. DROP FUEL TANK WITH PYLON

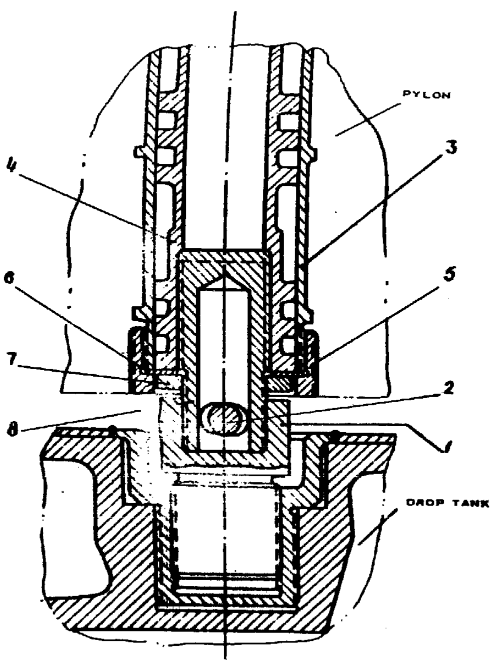


FIG. 21. ATTACHMENT OF DROP TANK FIRING MECHANISM PUSH ROD

1 — support for firing mechanism push rod; 2 — pin; 3 — cylinder; 4 — piston; 5 — union nut; 6 — washer; 7 — clamp nut; 8 — firing mechanism push rod.

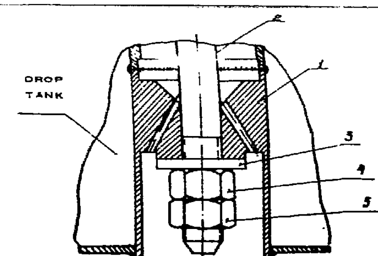


FIG. 22. ATTACHMENT OF DROP TANK EYE-BOLT

1 — suspension pipe; 2 — eye-bolt; 3 — 238A55-4-14-35 washer; 4 — 1411c14 nut; 5 — 1411c14 check nut.

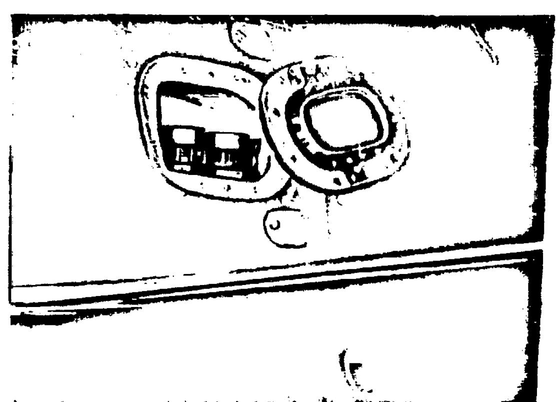


FIG. 23. FUEL SYSTEM SAFETY VALVES (FUSELACE STARBOARD SIDE)

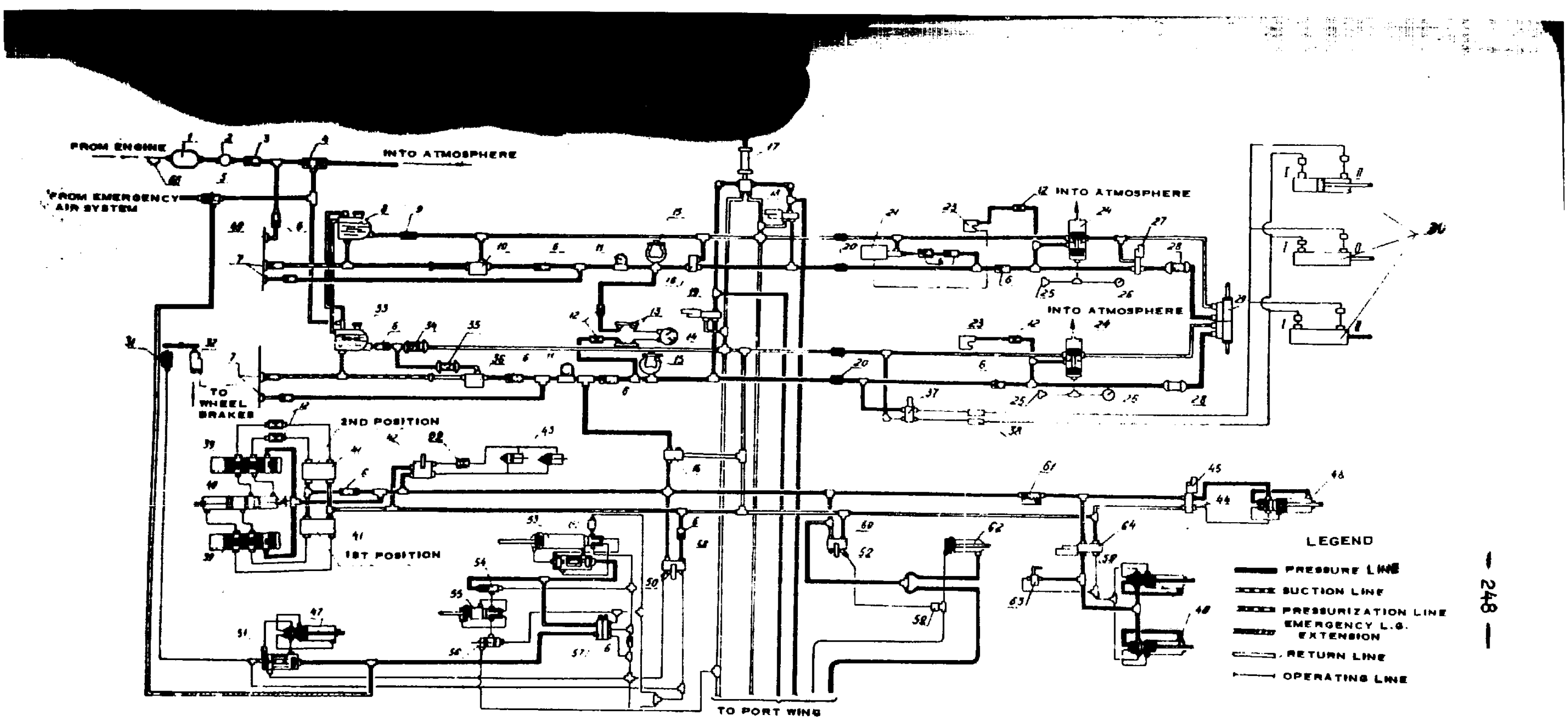
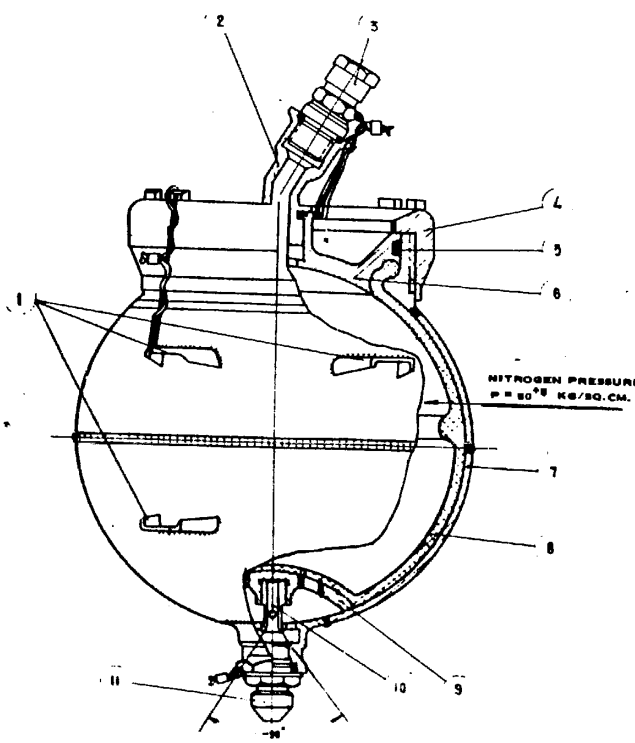


FIG. 24. HYDRAULIC SYSTEM KEY DIAGRAM

1 — pressurization unit with filter and return valve ; 2 — PB-1.5 reducing valve; 3 — return valve; 4 — pressurization valve with safety valve; 5 — emergency valve; 6 — return valve; 7 — valves for switching on ground pump for main and booster systems; 8 — section of hydraulic tank for booster system; 9 — screen filter; 10 — 1НІ-342Г booster system pump; 11 — ФГ-11-100-2 fine filter; 12 — damper; 13 — ДВ-250 pressure gauge transmitters; 14 — 2ДМ-250 pressure gauge indicator; 15 — spherical hydraulic accumulator; 16 — ГА-186М safety valve; 17 — БУ-45А aileron booster; 18 — ГА-190Б valve for disconnecting ailerons from booster system; 19 — valve ГА-190В for disconnection of ailerons from main system; 20 — split valve; 21 — pump unit; 22 — throttle valve; 23 — ГА-135/32 pressure relay; 24 — cylindrical hydraulic accumulator; 25 — filling pipe union; 26 — МВ-250 nitrogen pressure gauge; 27 — ГА-190Б valve for disconnecting БУ-51МС booster from booster system; 28 — 11ГФ4 fine filter; 29 — БУ-51МС stabilizer booster; 30 — engine nozzle flap actuating cylinders; 31 — cylinder for automatic braking of wheels during landing gear retraction; 32 — ПУ-7 valve; 33 — section of hydraulic tank for main hydraulic system; 34 — ФГ-11-100-2 fine filter; 35 — 11ГФ-4 fine filter; 36 — 1НІ-34-2Т pump for main hydraulic system; 37 — ГА-164М valve for engine nozzle flap control; 38 — ГА-173-00 metering valves; 39 — hydraulic lock; 40 — cone cylinder; 41 — ГА-185 valve for cone control; 42 — ГА-184 valve for anti-surge shutter control; 43 — anti-surge shutter actuating cylinders; 44 — throttle with 1.5-mm orifice; 45 — ГА-184 valve for fuselage bottom air brake; 46 — cylinder for fuselage bottom air brake; 47 — nose strut actuating cylinder with hydraulic lock; 48 — cylinders for fuselage side air brakes; 49 — pressure pipe union to be connected to ground pump; 50 — throttle with 3.0-mm orifice; 51 — throttle with 2.5-mm orifice; 52 — throttle with 1.0-mm orifice; 53 — [illegible] strut actuating cylinder with hydraulic lock; 54 — emergency valve; 55 — wheel door actuating cylinder; 56 — [illegible] lock; 58 — ГА-142/1 landing gear control valves; [illegible]



1 ATTACHMENT BRACKETS
2 PIPE UNION
3 FILLING PIPE UNION
4 OUTER COVER
5 RUBBER RING
6 INNER COVER
7 CASE
8 INNER RUBBER DIAPHRAGM
9 MUSHROOM BOTTOM
10 BUSHING
11 HYDRAULIC PIPE UNION

FIG. 25. SPHERICAL HYDRAULIC ACCUMULATOR

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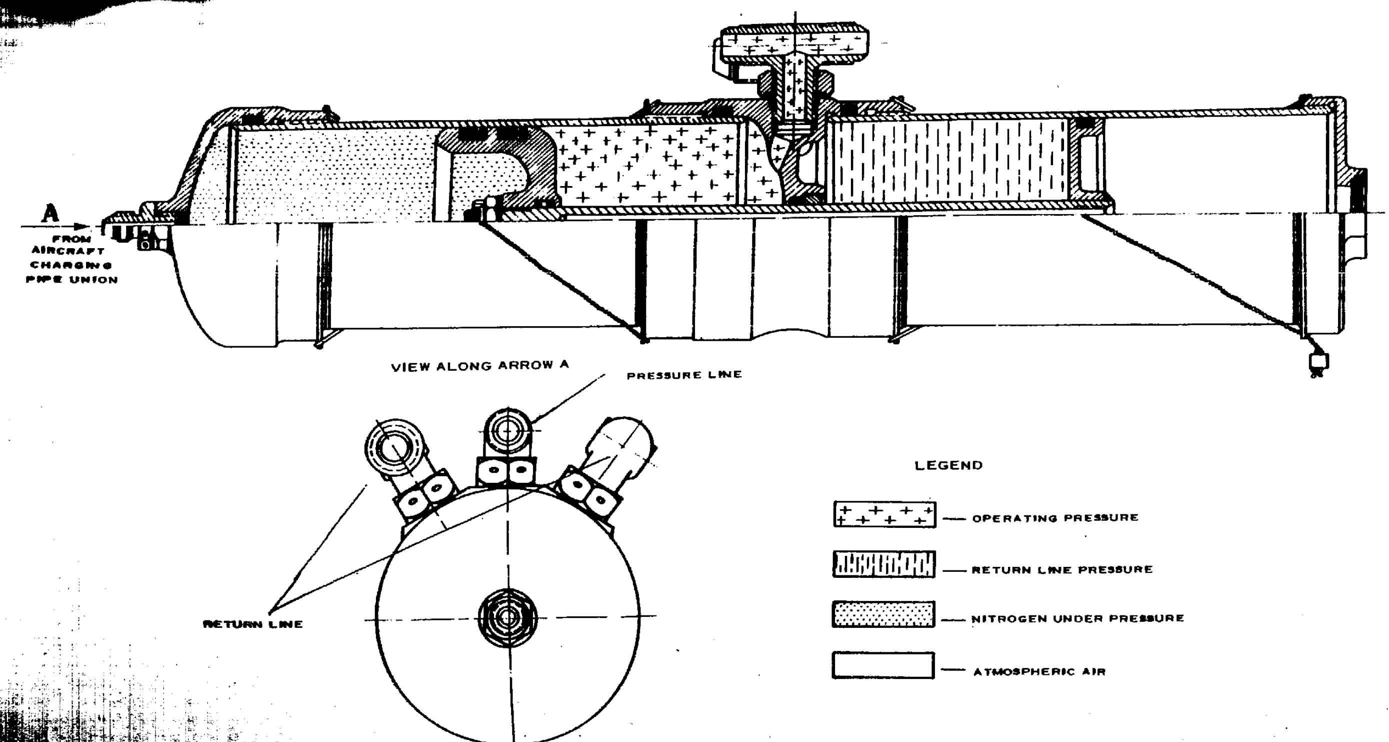
[redacted]



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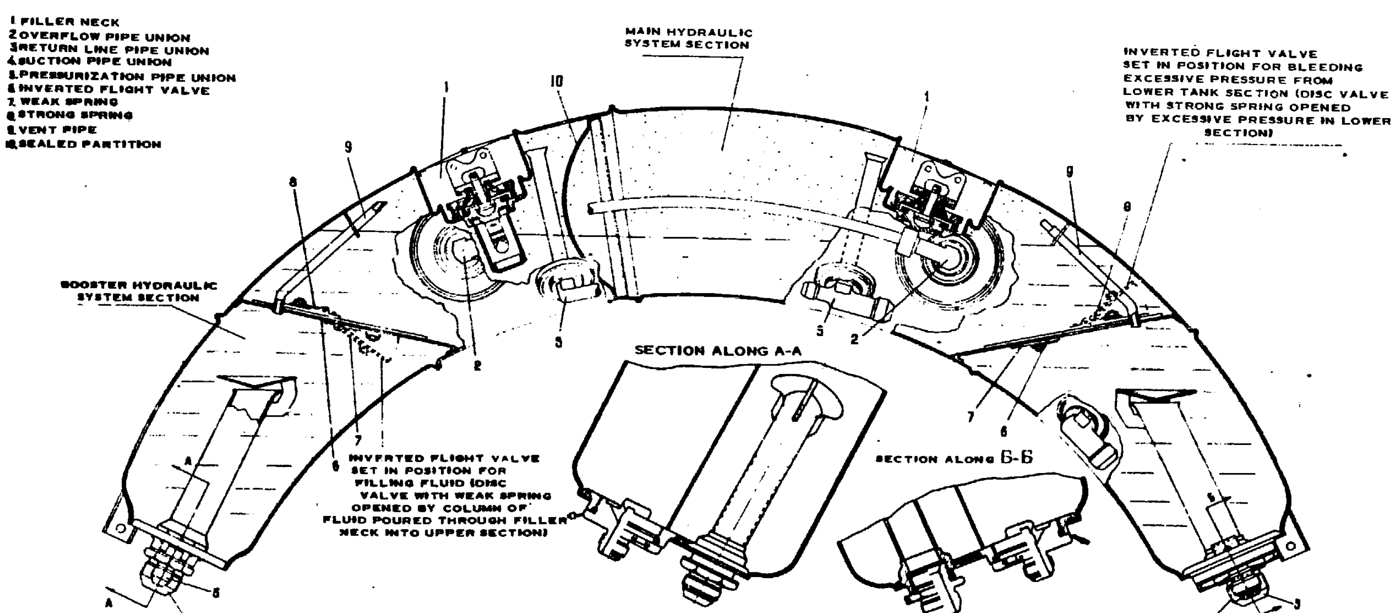


FIG. 27. HYDRAULIC TANK

[redacted]

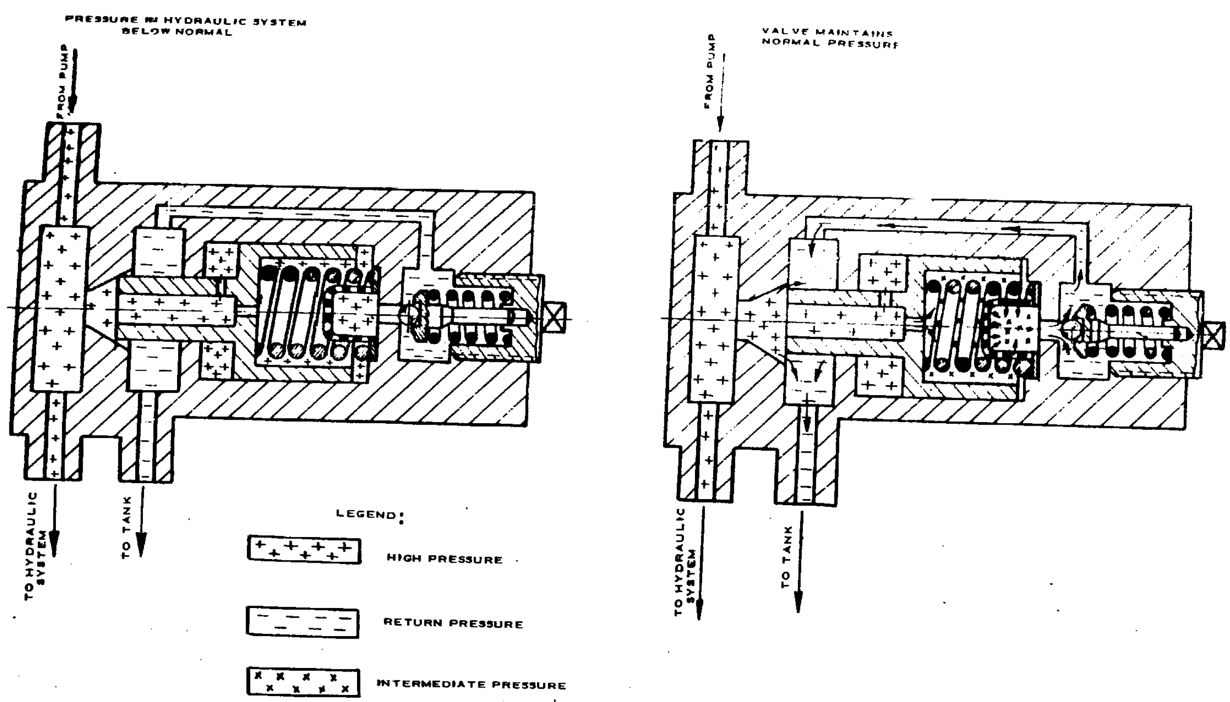


FIG. 28. ГА-186M SAFETY VALVE

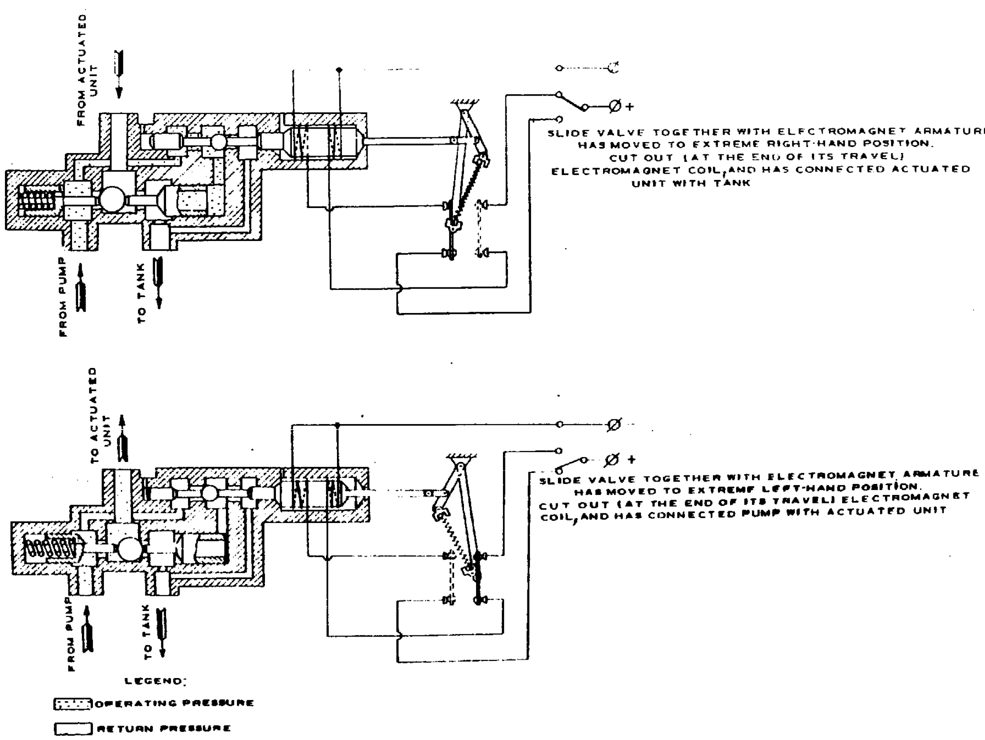


FIG. 29. ГА-190Б SOLENOID-OPERATED CONTROL VALVE

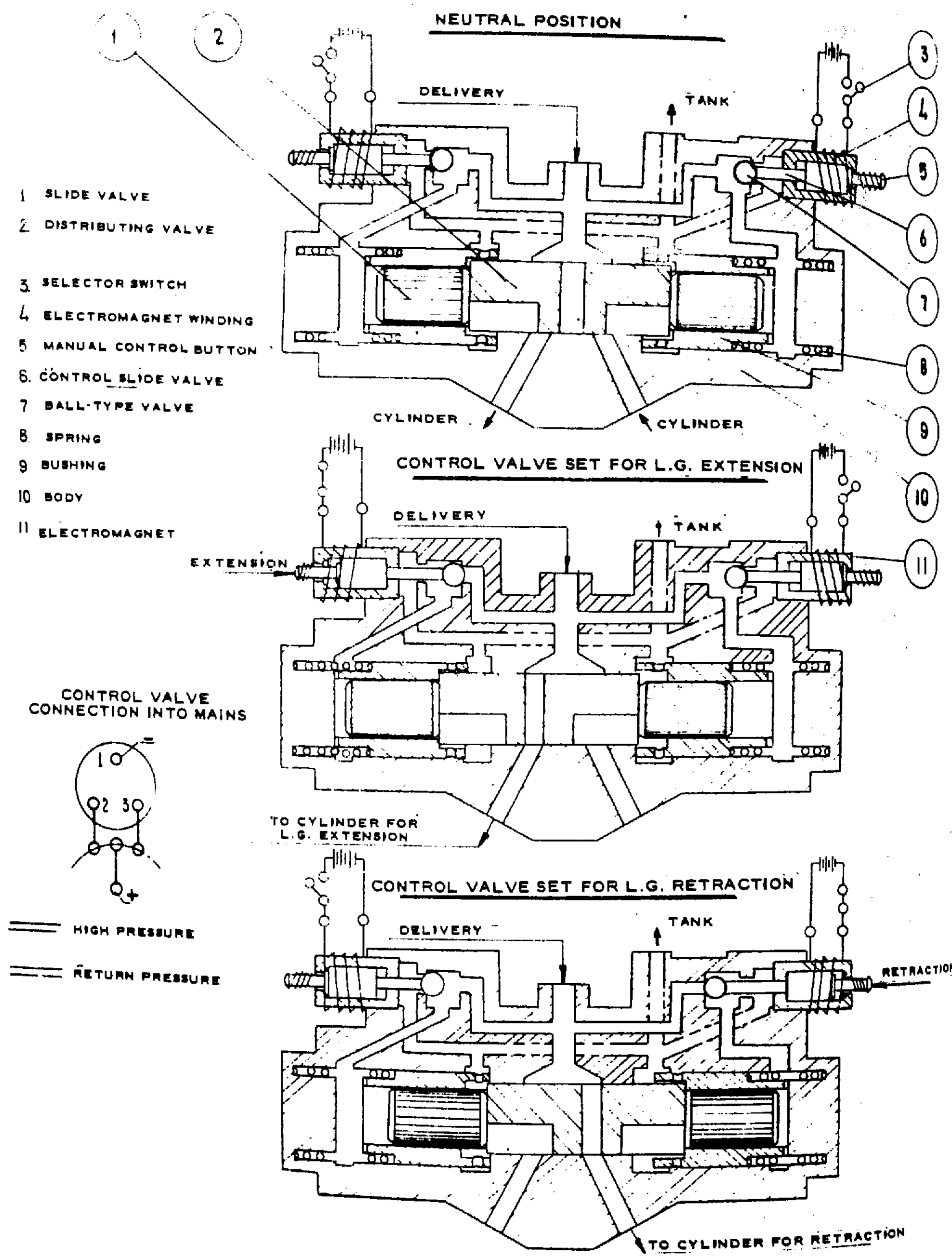
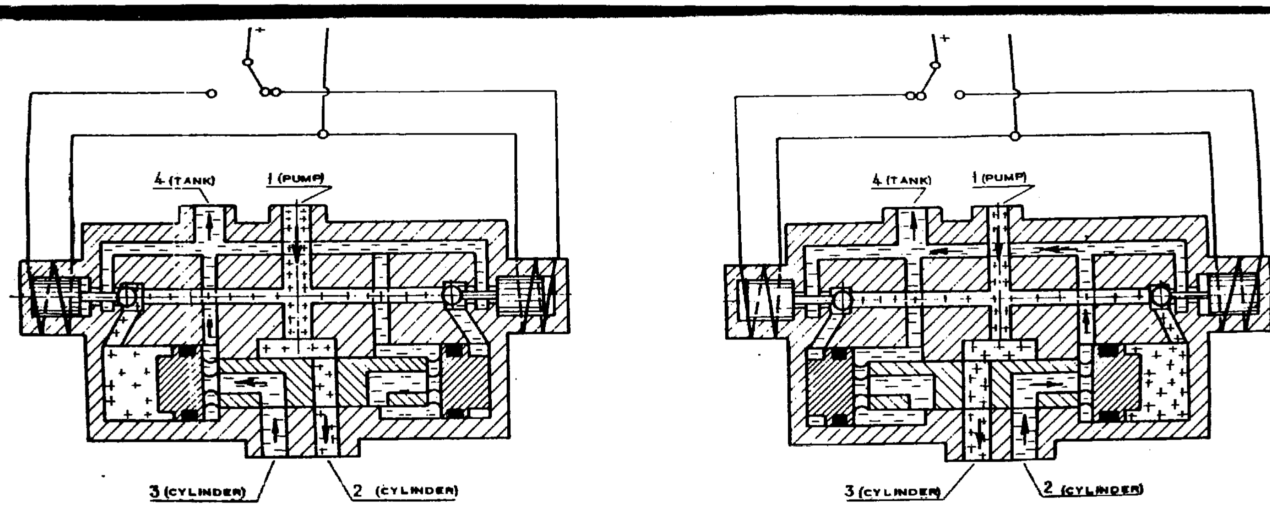


FIG. 90. ГА-142/1 SOLENOID-OPERATED CONTROL VALVE



RIGHT-HAND ELECTROMAGNET IS ENERGIZED.
SLIDE VALVE HAS MOVED
TO EXTREME RIGHT-HAND POSITION
AND CONNECTED PIPE UNION 1 (PUMP) WITH
PIPE UNION 2 (CYLINDER)
AND PUMP UNION 3 (CYLINDER) WITH
PIPE UNION 4 (TANK)

LEFT-HAND ELECTROMAGNET IS ENERGIZED.
SLIDE VALVE HAS MOVED
TO EXTREME LEFT-HAND POSITION
AND CONNECTED PIPE UNION 1 (PUMP)
WITH PIPE UNION 3 (CYLINDER)
AND PIPE UNION 2 (CYLINDER)
WITH PIPE UNION 4 (TANK)

OPERATING PRESSURE

RETURN PRESSURE

FIG. 31. ГА-185 SOLENOID-OPERATED CONTROL VALVE

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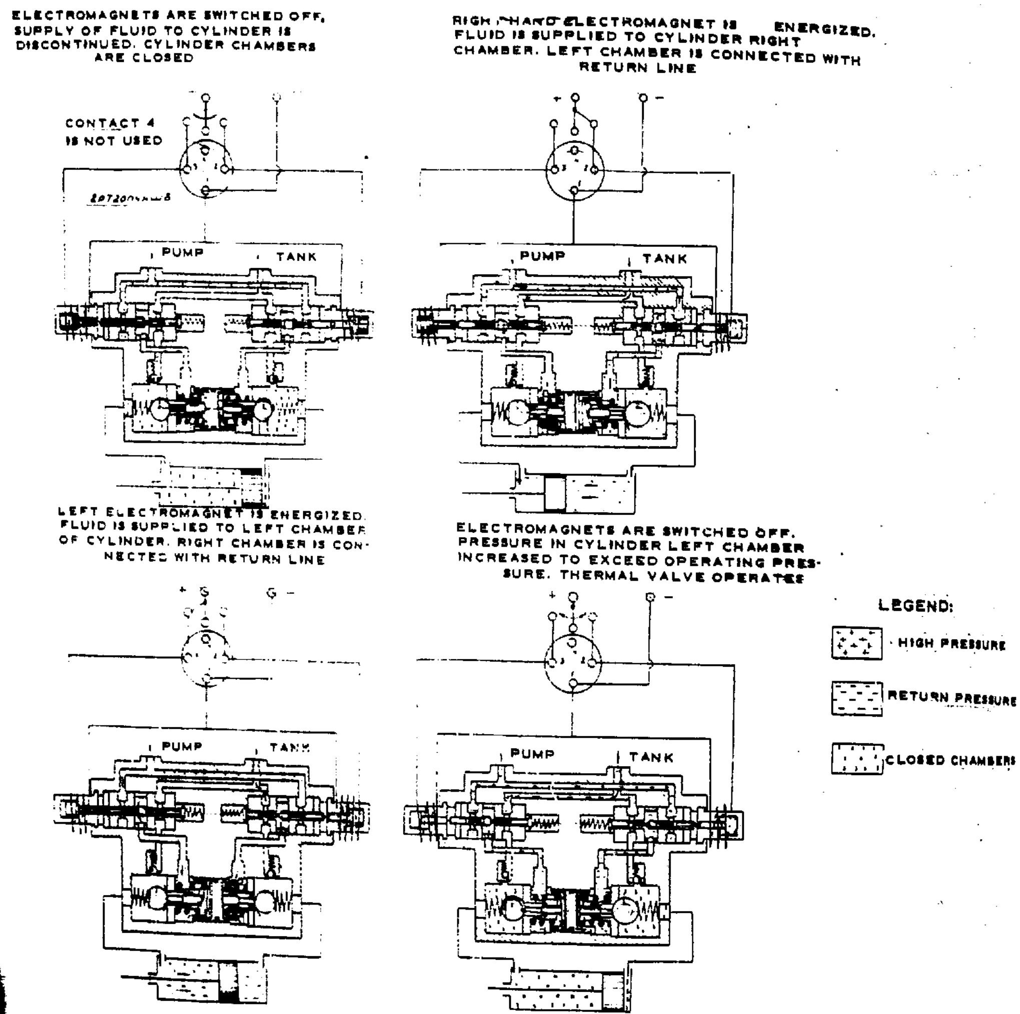


FIG. 32. ГА-164М SOLENOID-OPERATED VALVE FUNCTIONAL DIAGRAM

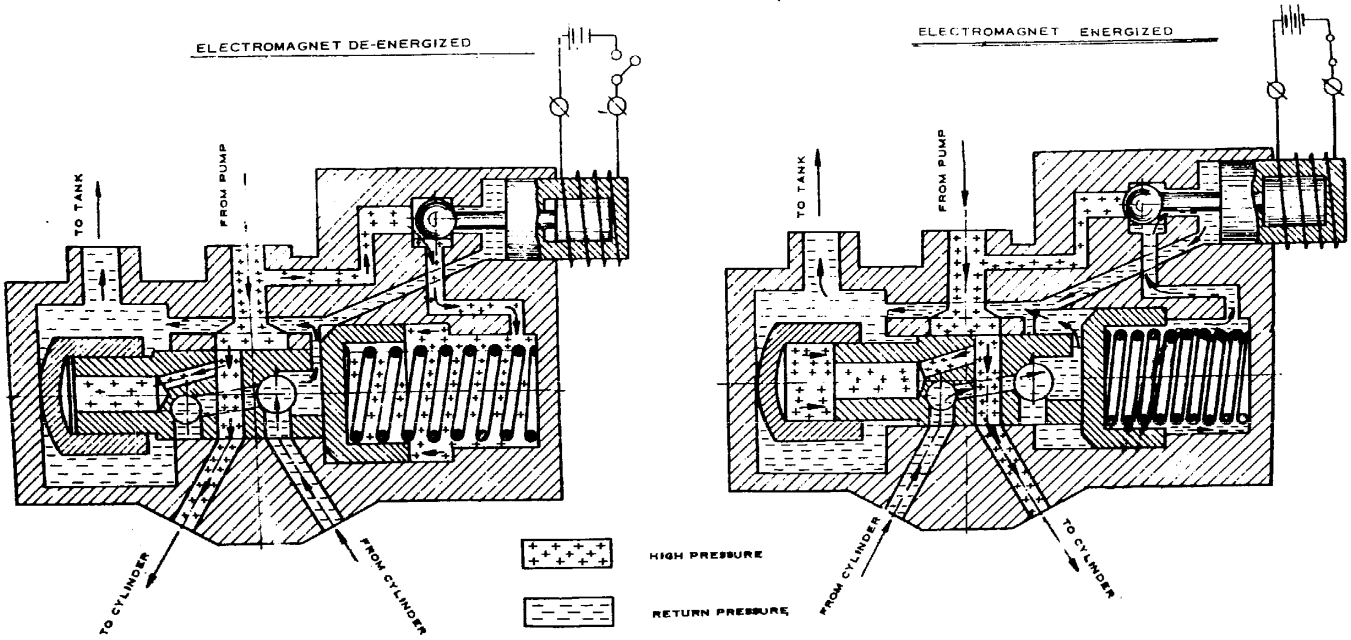
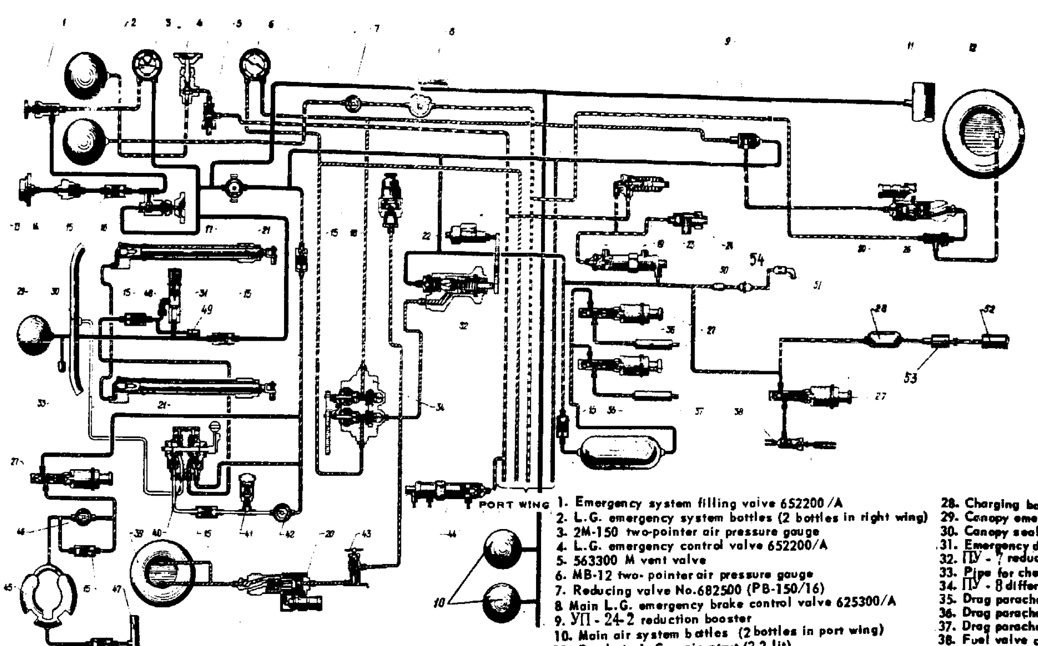


FIG. 33. ГА-184 SOLENOID-OPERATED VALVE

INSET No. 1



LEGEND

- main air system, 110 — 130 kg/sq.cm.
- emergency air system, 110 — 130 kg/sq.cm.
- main air system, 50 kg/sq.cm.
- drag parachute air system, 50 kg/sq.cm.
- canopy lift system, 50 kg/sq.cm.
- control of fuselage pressurized front porti on (РСИУ - 5г)
- fuel valve control, 50 kg/sq.cm.
- main L.G. wheel brake system, 16 ± 0.5 kg/sq.cm. (after boosters)
- main L.G. wheel emergency brake system, $16 \pm ^{4}_{1}$ kg/sq.cm.
- L.G. brake system, $10.5^{+0.5}$ kg/sq.cm.
- canopy de-icer system, 3 kg/sq.cm.
- canopy seal system, 15 kg/sq.cm.

1. Emergency system filling valve 652200/A
2. L.G. emergency system bottles (2 bottles in right wing)
3. 2M-150 two-pointer air pressure gauge
4. L.G. emergency control valve 652200/A
5. 563300 M vent valve
6. MB-12 two-pointer air pressure gauge
7. Reducing valve No.682500 (PB-150/16)
8. Main L.G. emergency brake control valve 625300/A
9. УП - 24-2 reduction booster
10. Main air system bottles (2 bottles in port wing)
11. Bottle in L.G. main strut (2.2 lit)
12. Main L.G. right-side wheel KT-92
13. Aircraft air system filling pipe 642800
14. 723900-4 air filter
15. 561200 M return valve
16. Main air system filling valve 652200/A
17. PB-50M reducing valve
18. УП - 22 switch valve
19. Main strut emergency extension cylinder
20. УП - 53/1-2 solenoid-operated valve
21. Canopy actuating cylinder
22. Wheel automatic brake cylinder (for L.G. retraction)
23. Main L.G. hydraulic lock with thermal valve
24. L.G. door emergency valve 676400 M
26. Emergency valve 563600
27. 69500 M electro-pneumatic valve
28. Charging bottle (1.8 lit)
29. Canopy emergency bottle (2 lit.)
30. Canopy sealing hose
31. Emergency diaphragm valve (canopy [illegible] valve)
32. ПУ - 7 reducing valve
33. Pipe for checking pressure in reserve bottle
34. ПУ - 8 differential unit
35. Drag parachute air bottle (1.3 lit.)
36. Drag parachute drop cylinder
37. Drag parachute release cylinder
38. Fuel valve control cylinder
39. Nose strut wheel KT - 38
40. Canopy control valve
41. Safety valve
42. PB-1.5 reducing valve
44. Hydraulic lock with thermal valve for L.G. [illegible]
45. De-icer alcohol tank
46. PB-3 reducing valve
47. De-icer atomizer
48. Filter
49. Cylinder for opening canopy lock
50. Choke
51. Fuselage pressurized portion pneumatic valve
52. Charging cylinder
53. ЭК - 48 electropneumatic valve
54. ЭК - 69 electropneumatic valve

FIG. 34. AIR SYSTEM CIRCUIT DIAGRAM

INSET No. 2

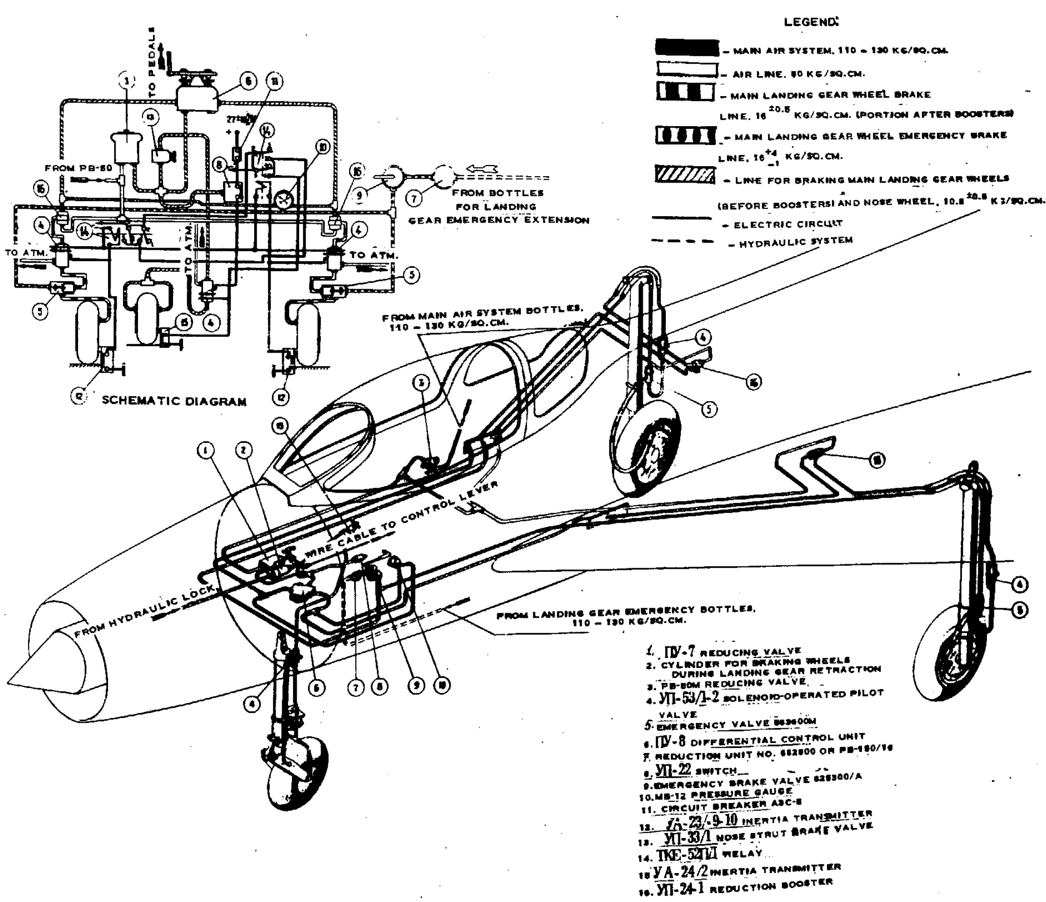


FIG. 35. LANDING GEAR WHEEL BRAKE SYSTEM

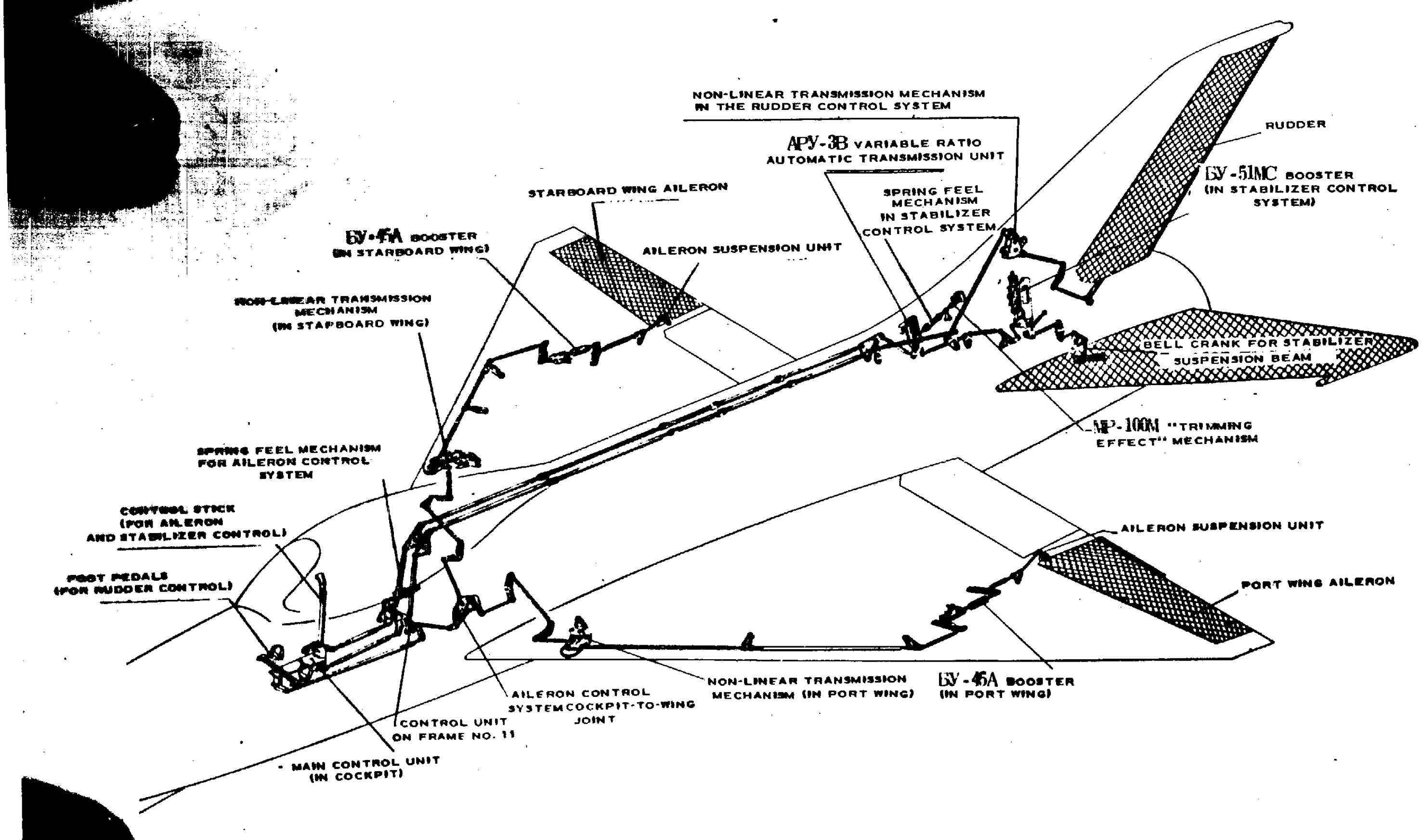


FIG. 36. AIRCRAFT CONTROL SYSTEM

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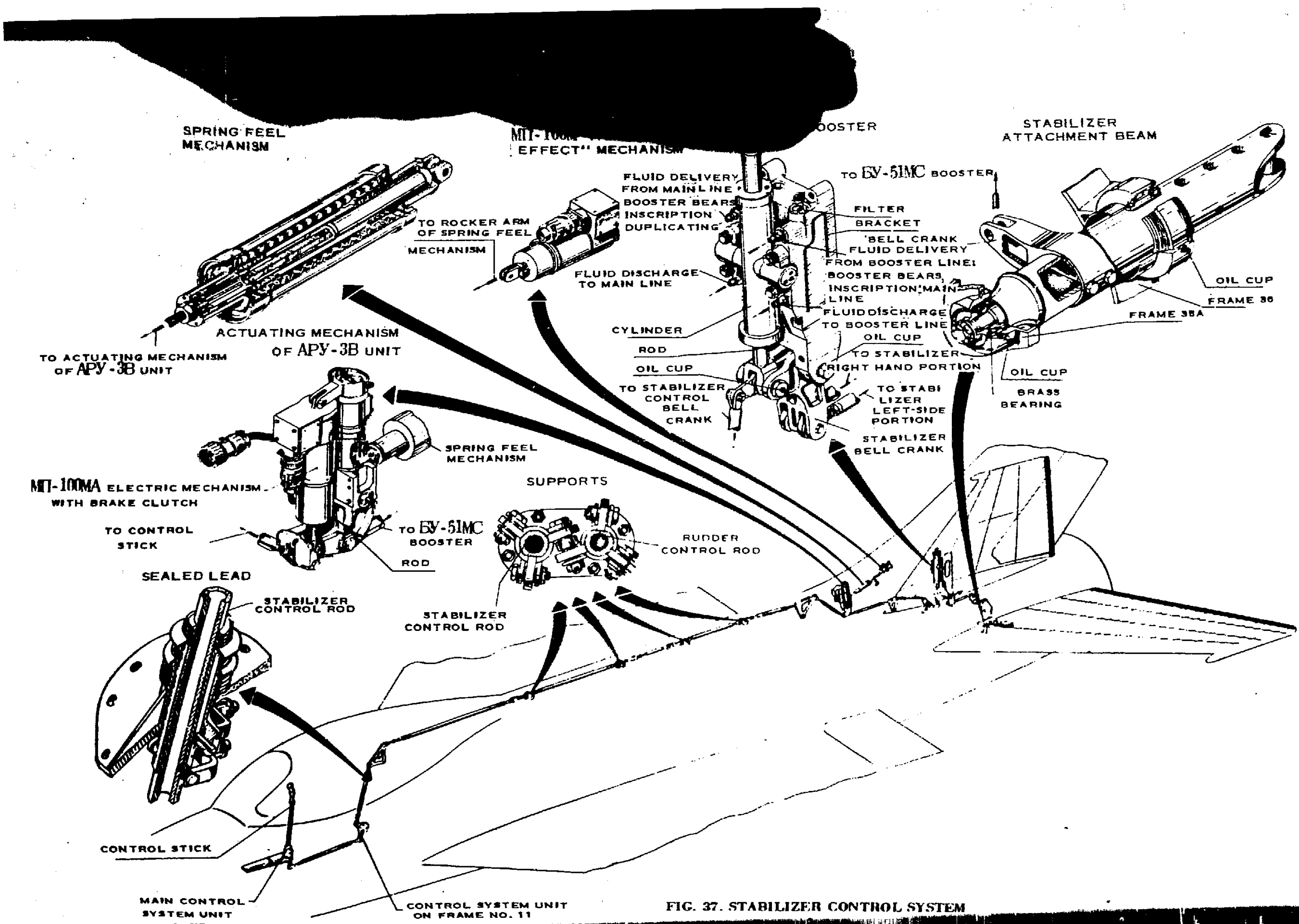

FIG. 37. STABILIZER CONTROL SYSTEM

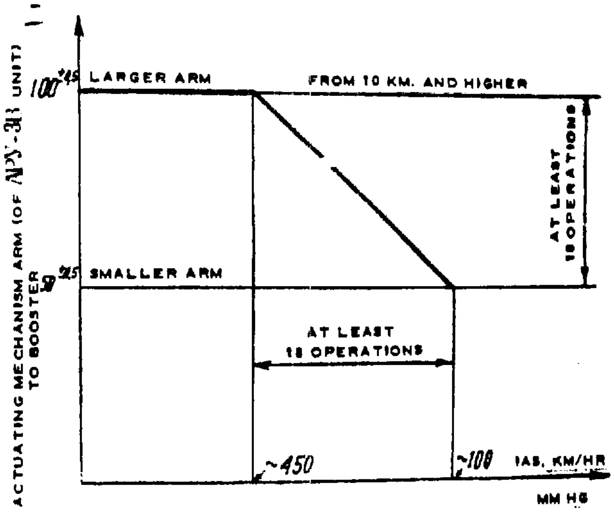

FIG. 38. LAW OF OPERATION OF АРУ-3В UNIT

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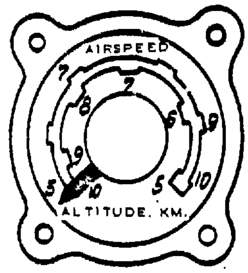
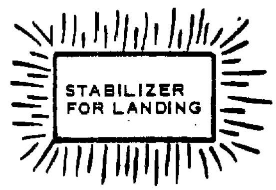
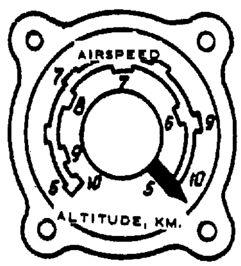
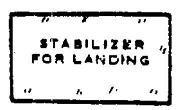
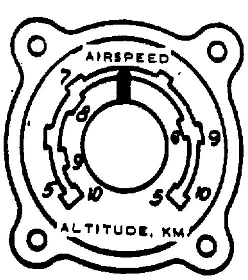
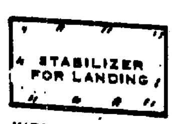
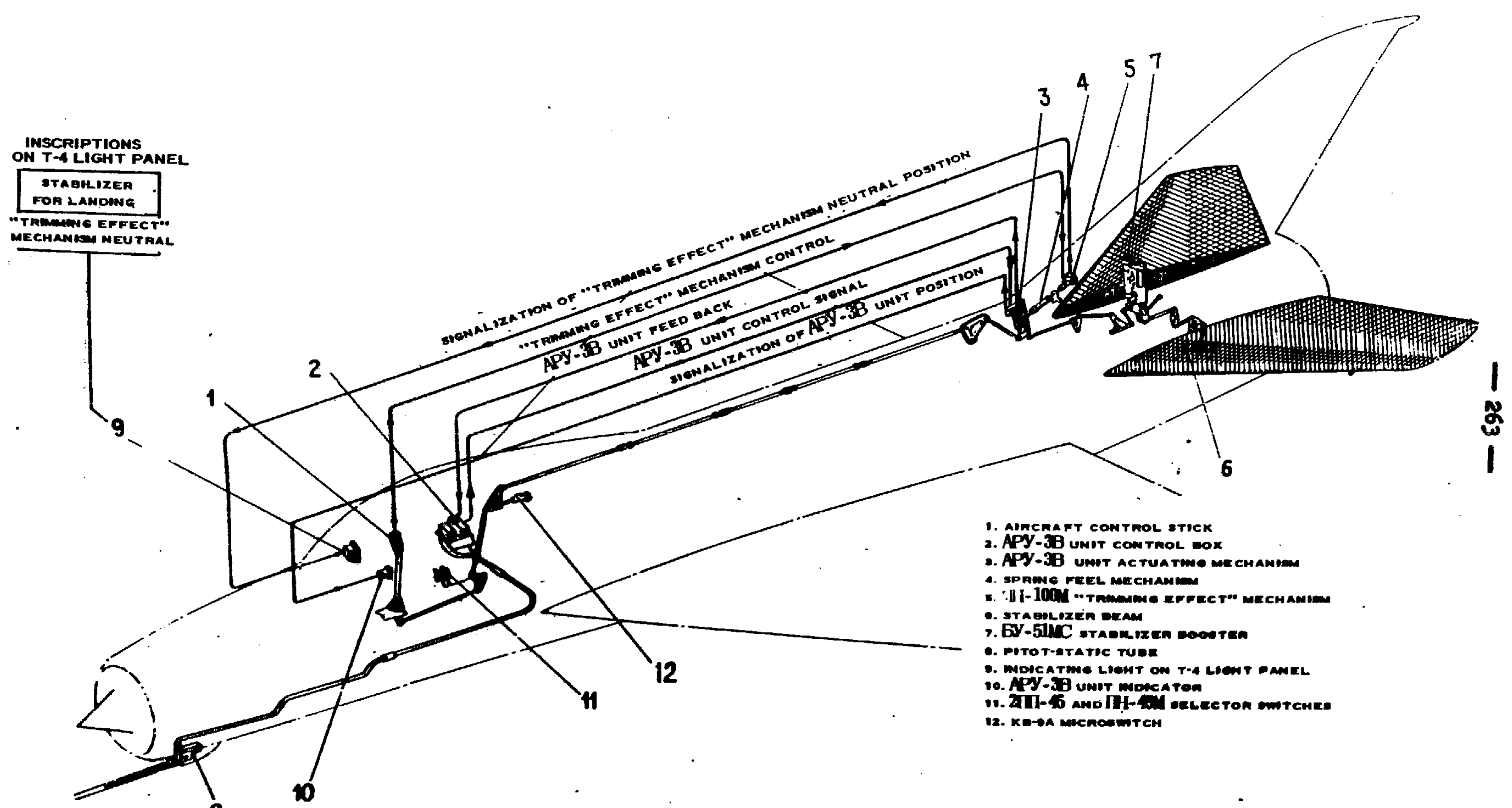
MEANS EMPLOYED TO CONTROL OPERATION OF APY AUTOMATIC UNIT	FLIGHT CONDITIONS
 POINTER AT LEFT REST  INDICATING LAMP ON T-4 LIGHT PANEL ON	1. FLYING AT IAS BELOW 450 KM/HR AT ALL ALTITUDES 2. FLYING AT IAS OVER 450 KM/HR AT ALTITUDES FROM 10 KM. AND HIGHER 3. DURING LANDING APPROACH
 POINTER AT RIGHT REST  INDICATING LIGHT ON T-4 LIGHT PANEL DEAD	FLYING AT IAS OVER 1010 KM/HR AT ALTITUDES FROM 0 TO 5 KM.
 POINTER IN SCALE MIDDLE POSITION  INDICATING LIGHT ON T-4 LIGHT PANEL DEAD	FLYING AT IAS OVER 750 KM/HR AT AN ALTITUDE OF 7 KM.

FIG. 39.



1. AIRCRAFT CONTROL STICK
2. АРУ-3В UNIT CONTROL BOX
3. АРУ-3В UNIT ACTUATING MECHANISM
4. SPRING FEEL MECHANISM
5. [illegible]-100М "TRIMMING EFFECT" MECHANISM
6. STABILIZER BEAM
7. БУ-51МС STABILIZER BOOSTER
8. PITOT-STATIC TUBE
9. INDICATING LIGHT ON T-4 LIGHT PANEL
10. АРУ-3В UNIT INDICATOR
11. 2ПП-45 AND ПН-45М SELECTOR SWITCHES
12. КВ-9А MICROSWITCH

FIG. 40. STABILIZER CONTROL SYSTEM WIRING

[redacted]

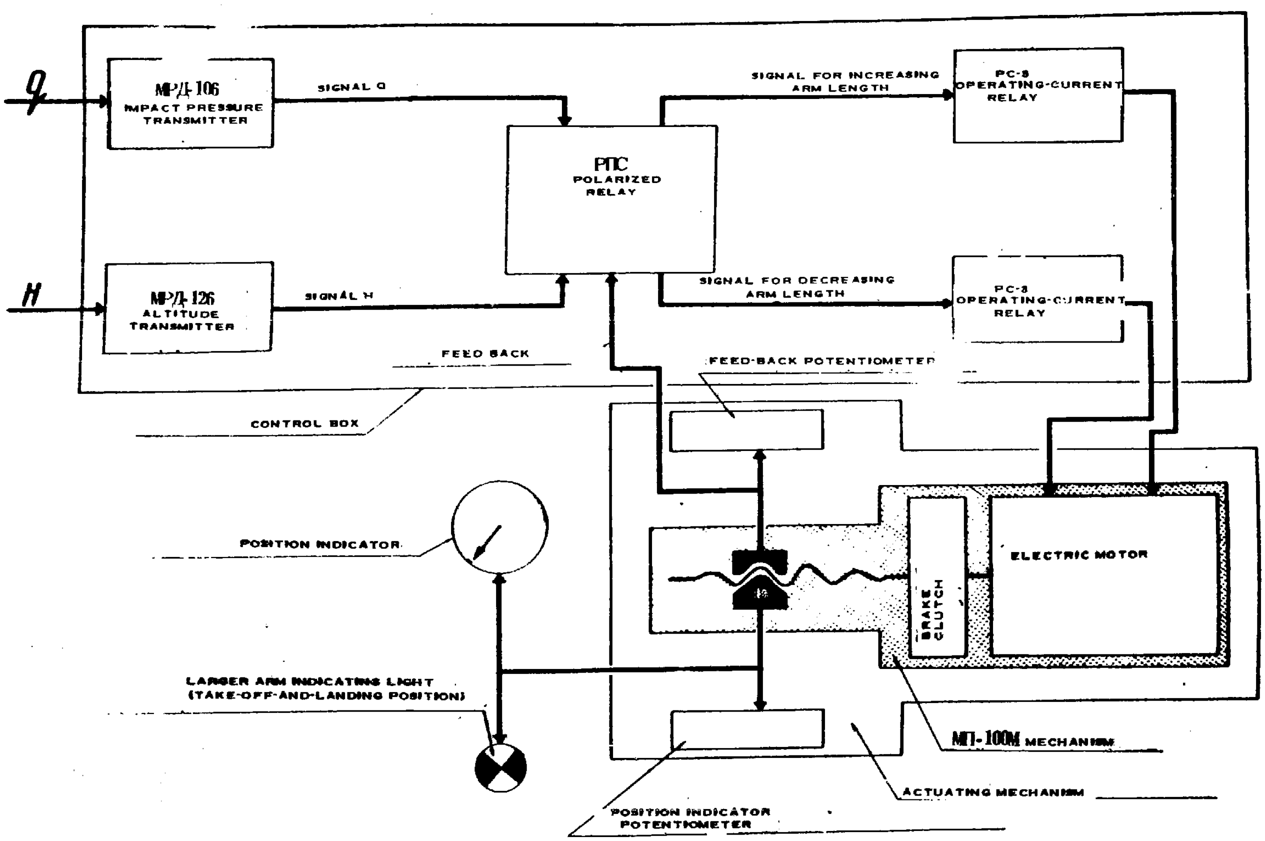


FIG. 41. АРУ-3В AUTOMATIC UNIT FUNCTIONING DIAGRAM

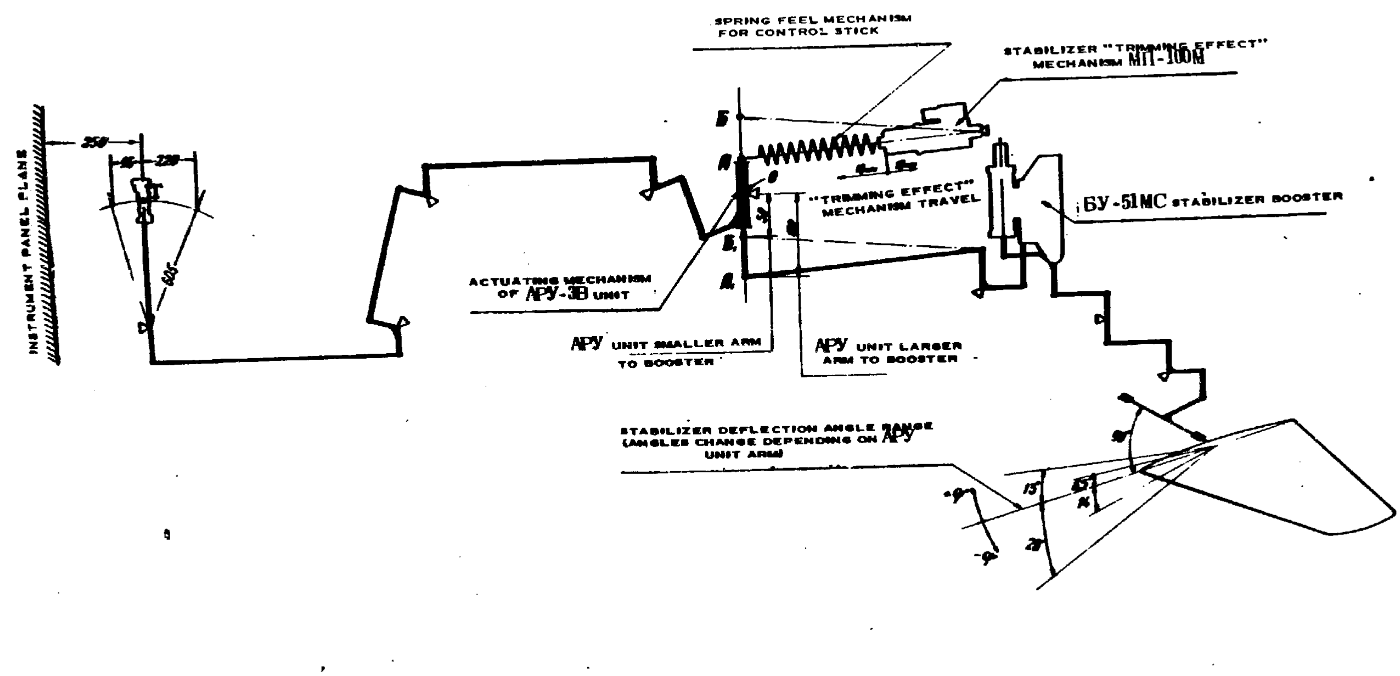


FIG. 43. LONGITUDINAL CONTROL LINKAGE OPERATION

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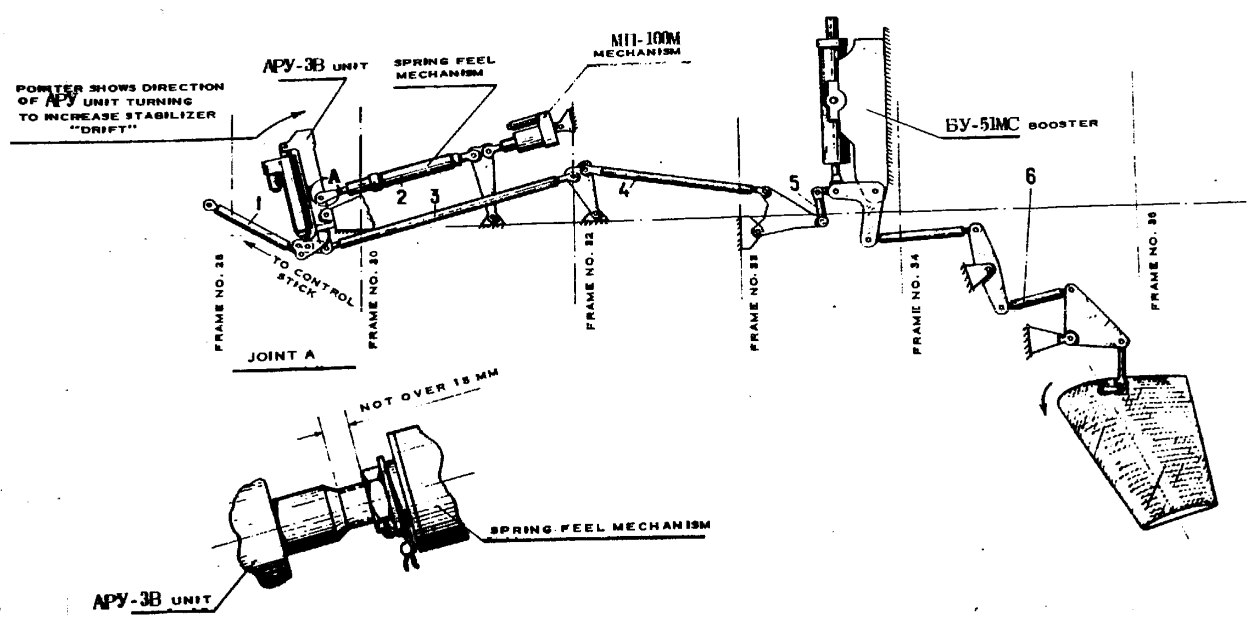


FIG. 49. STABILIZER CONTROL SYSTEM ADJUSTMENT DIAGRAM

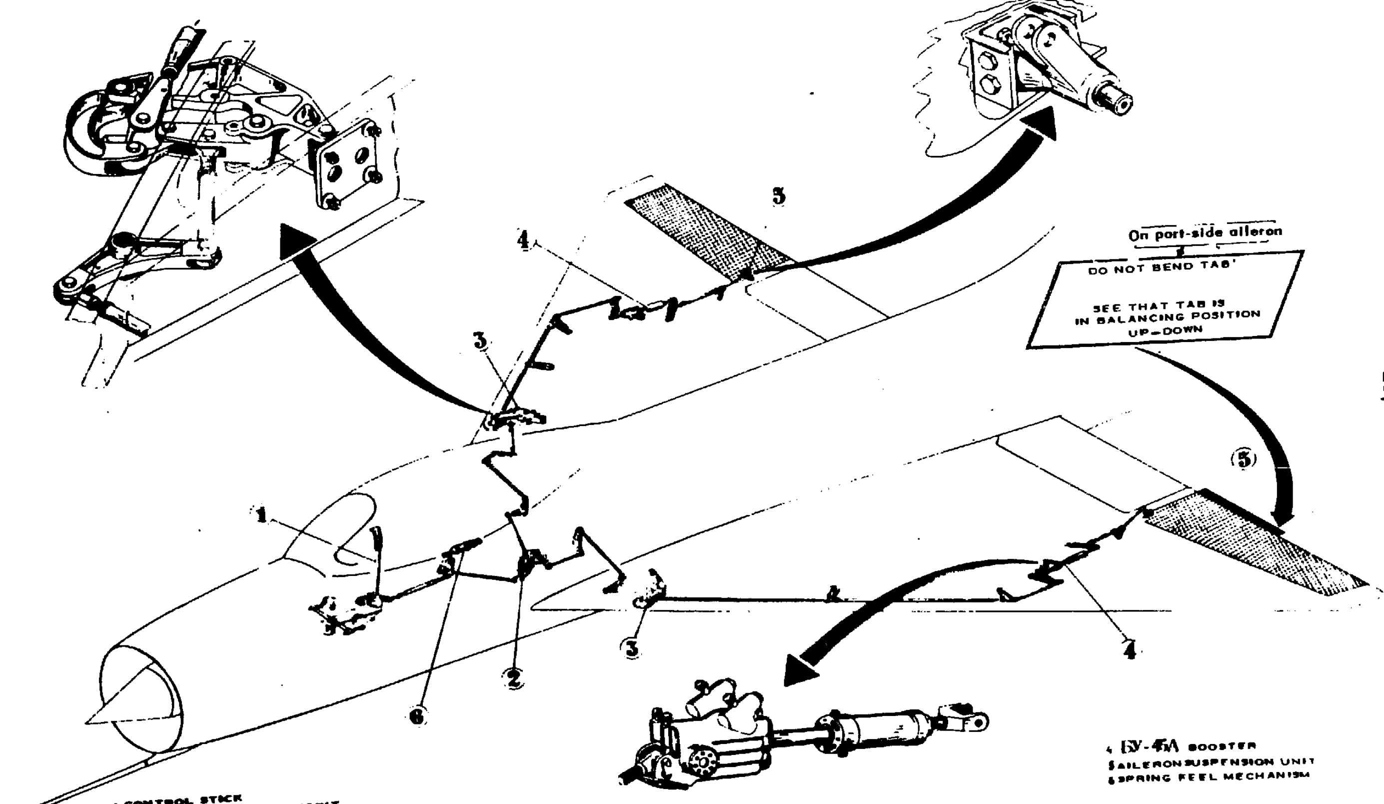


FIG. 44. AILERON CONTROL SYSTEM

[redacted]

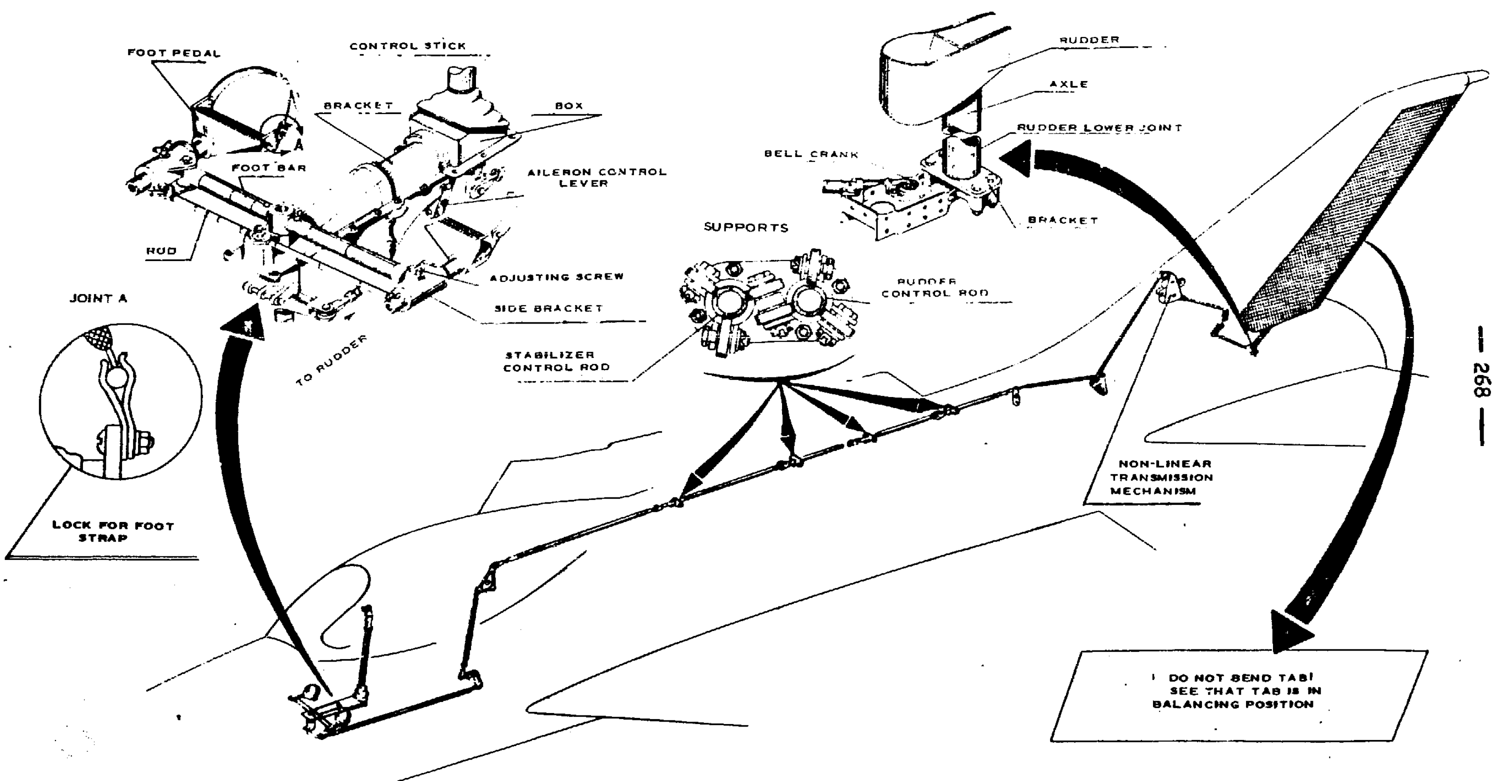


FIG. 45. RUDDER CONTROL SYSTEM

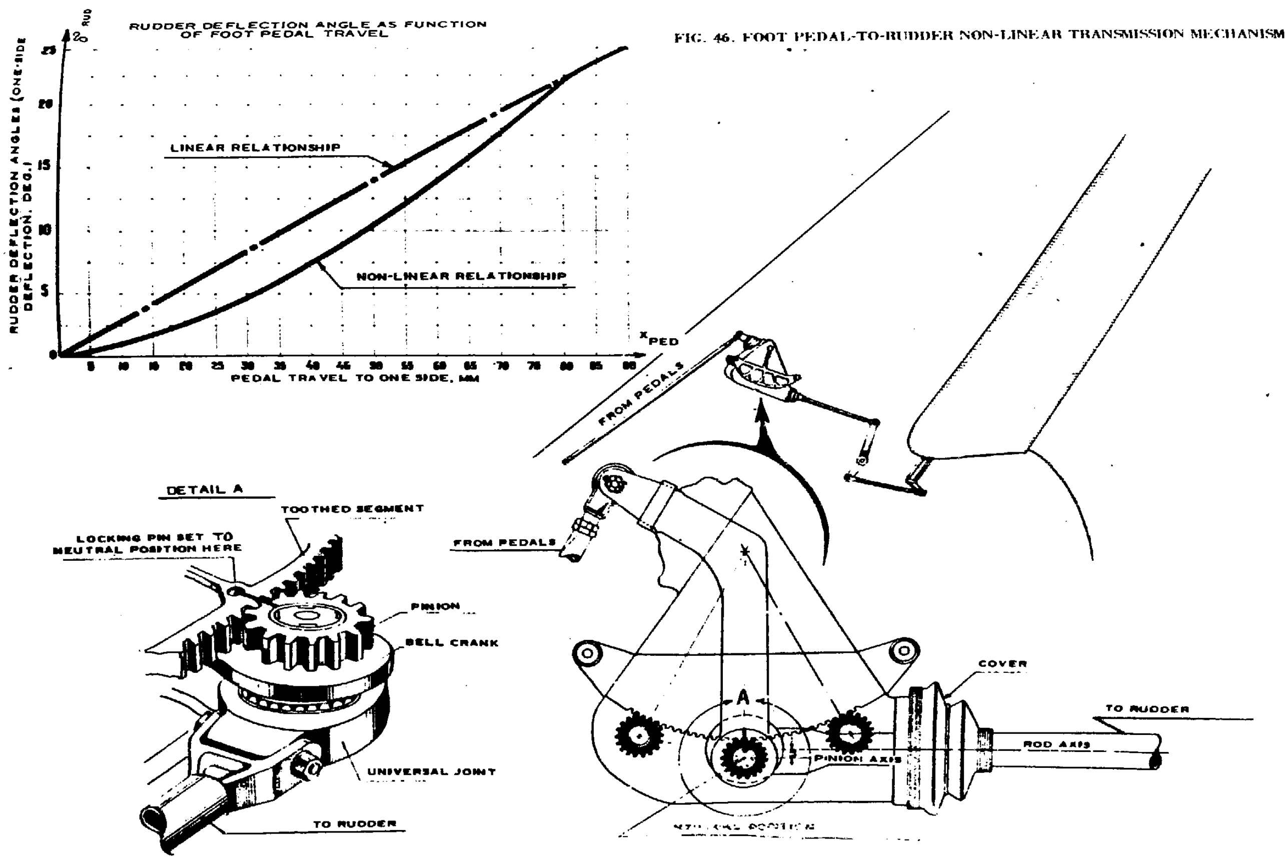
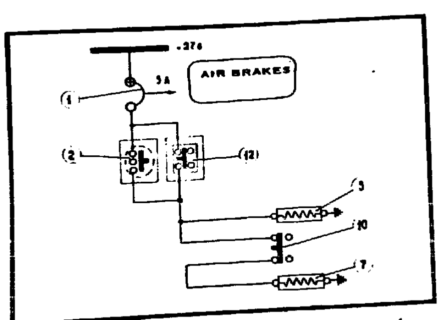


FIG. 46. FOOT PEDAL-TO-RUDDER NON-LINEAR TRANSMISSION MECHANISM

[redacted]

1 CIRCUIT BREAKER АЗС-5
2 AIR BRAKE EXTENSION BUTTON 204-K ON CONTROL STICK
3 FRONT AIR BRAKES
4 CROSS-FEED VALVE
5 AIR BRAKE VALVE ГА-140 FOR EXTENDING TWO FRONT AIR BRAKES
6 RETURN VALVE WITH THERMAL VALVE
7 ГА-184 VALVE FOR EXTENSION OF REAR AIR BRAKE
8 REAR AIR BRAKE
9 AIR BRAKE ACTUATING CYLINDERS
10 KB-9A LIMIT SWITCH IN DROP TANK-AND-AIR-BRAKE INTERLOCK SYSTEM
11 THROTTLE VALVES
12 KB-6 SWITCH ON ENGINE CONTROL SECTOR



CIRCUIT DIAGRAM

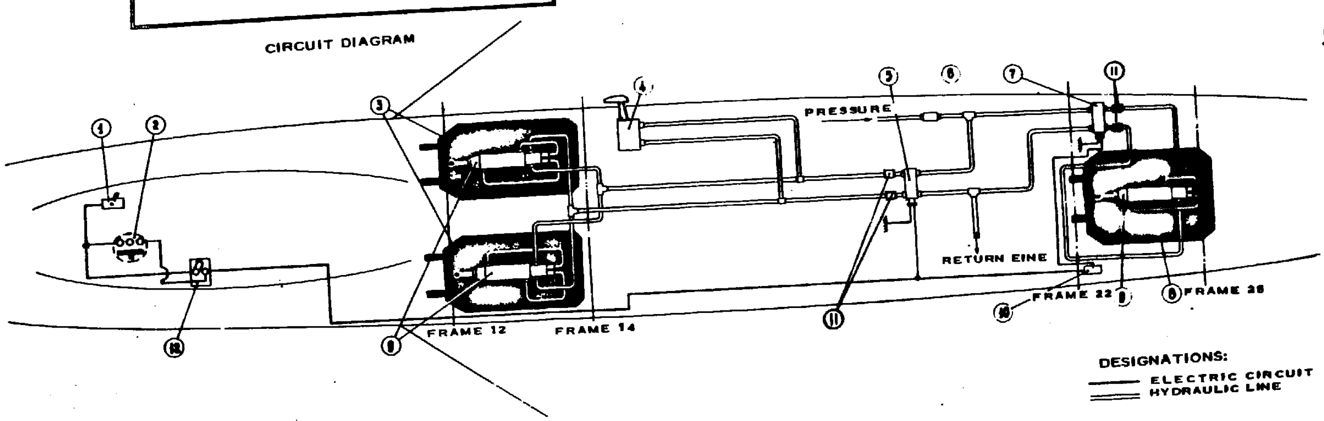
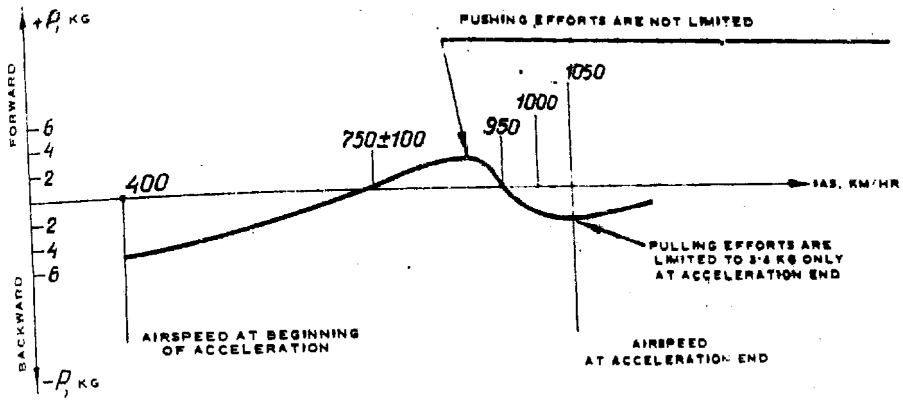
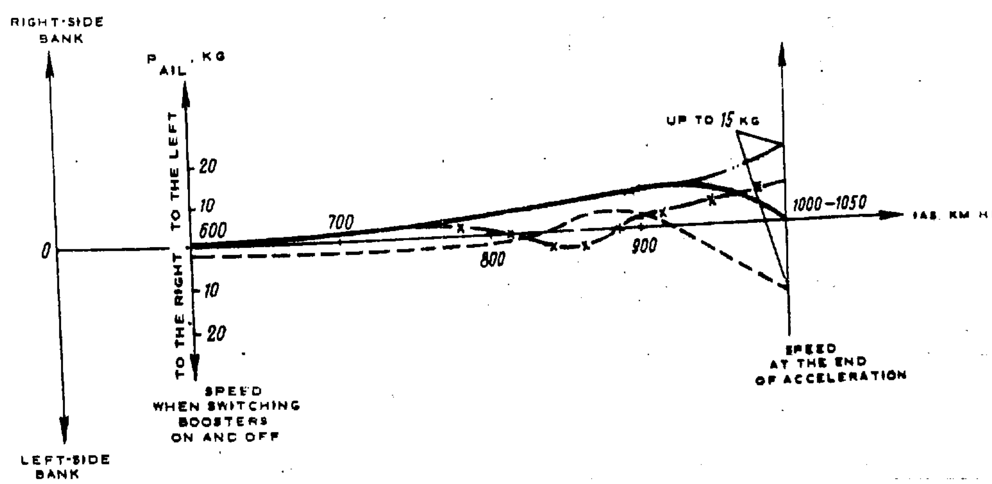


FIG. 47. AIR BRAKE CONTROL



$+P_1$ KG
FORWARD
BACKWARD
$-P_1$ KG
6
4
2
2
4
6
PUSHING EFFORTS ARE NOT LIMITED
1050
1000
950
750±100
400
IAS, KM/HR
PULLING EFFORTS ARE LIMITED TO 3-4 KG ONLY AT ACCELERATION END
AIRSPEED AT BEGINNING OF ACCELERATION
AIRSPEED AT ACCELERATION END

FIG. 48.



RIGHT-SIDE BANK
LEFT-SIDE BANK
P_{AIL}, KG
TO THE LEFT
TO THE RIGHT
20
10
10
20
0
600
700
800
900
1000–1050
IAS, KM HR
UP TO 15 KG
SPEED WHEN SWITCHING BOOSTERS ON AND OFF
SPEED AT THE END OF ACCELERATION

FIG. 49.

[redacted]

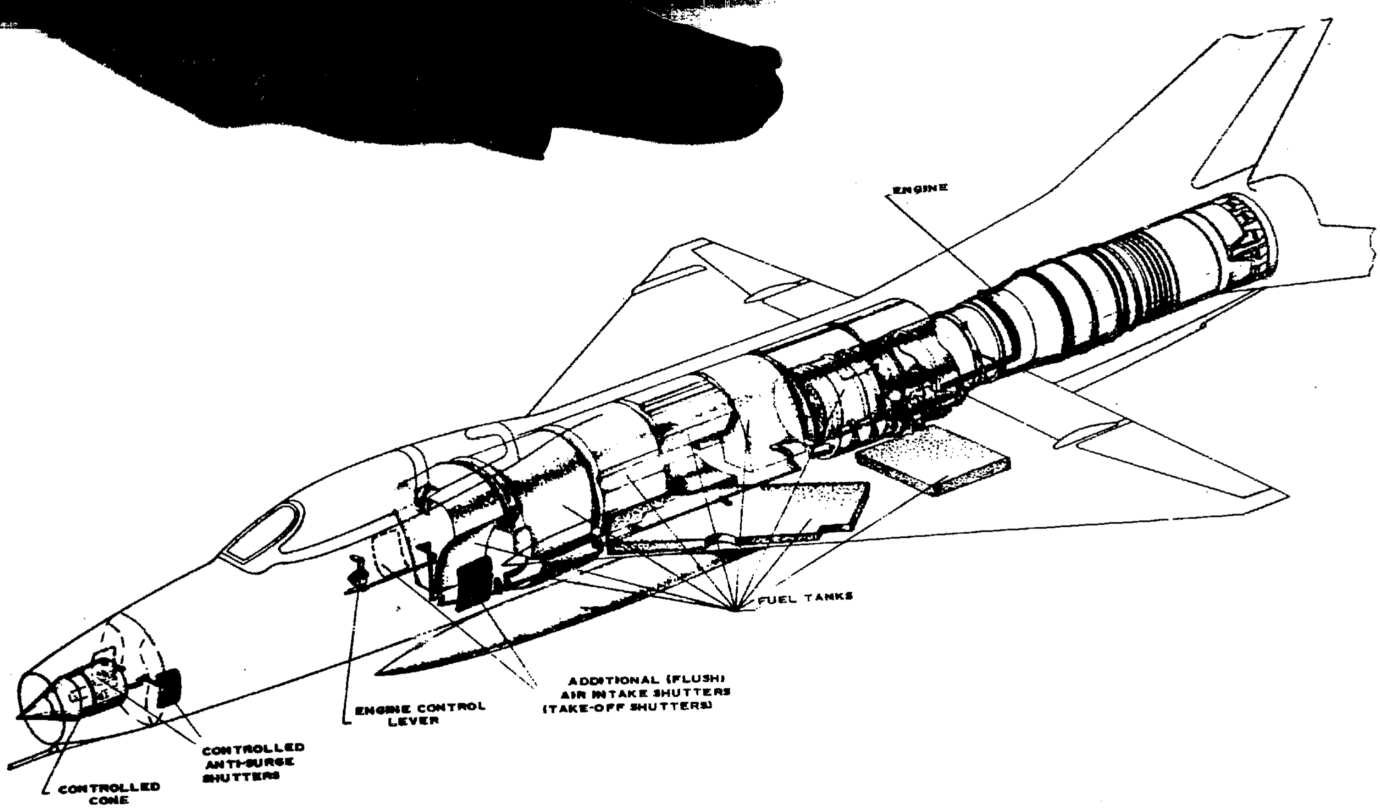


FIG. 80. POWER PLANT

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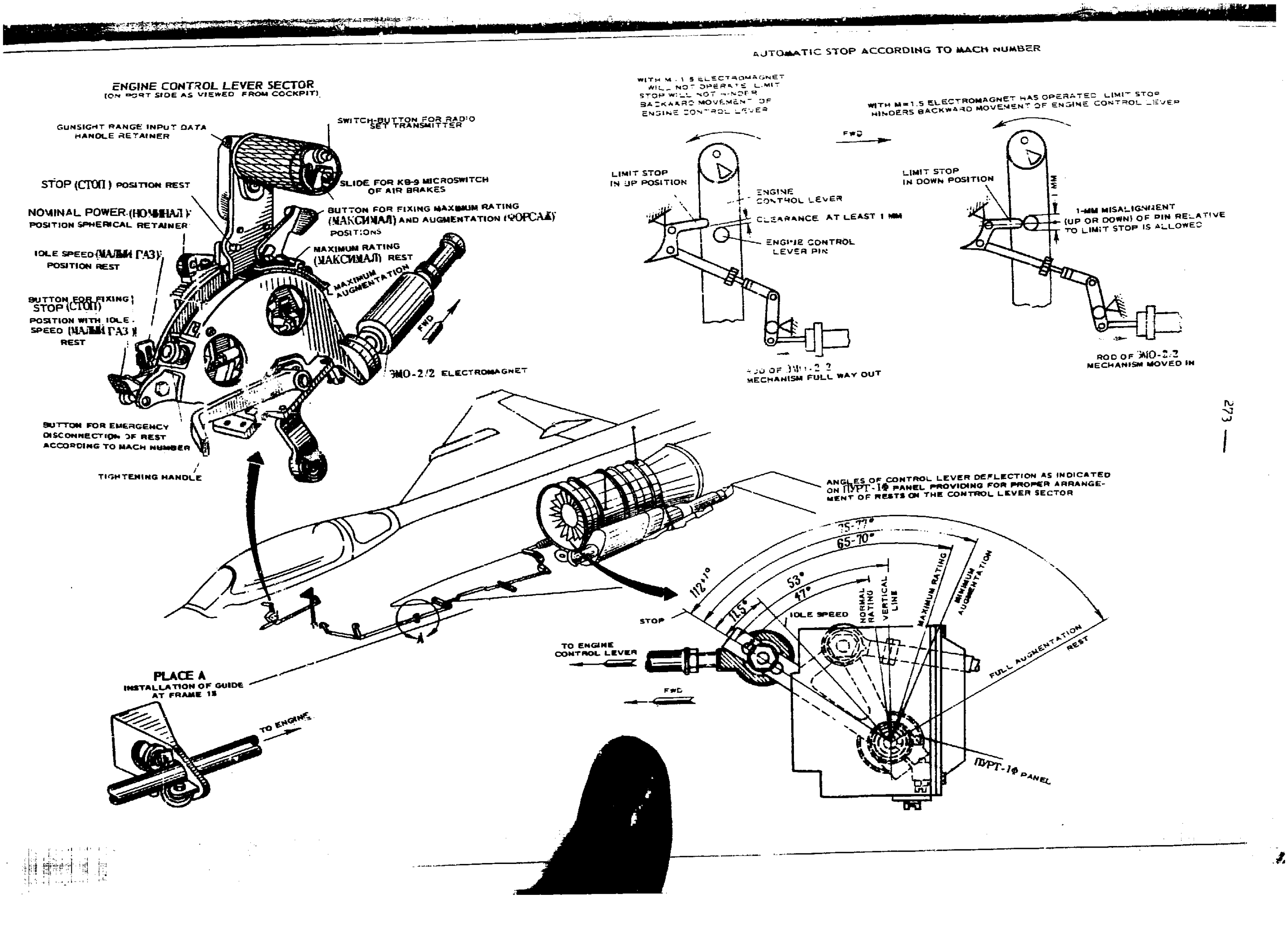
ENGINE CONTROL LEVER SECTOR
(ON PORT SIDE AS VIEWED FROM COCKPIT)
GUNSIGHT RANGE INPUT DATA HANDLE RETAINER
SWITCH-BUTTON FOR RADIO SET TRANSMITTER
STOP (СТОП) POSITION REST
SLIDE FOR KB-9 MICROSWITCH OF AIR BRAKES
NOMINAL POWER (НОМИНАЛ) POSITION SPHERICAL RETAINER
BUTTON FOR FIXING MAXIMUM RATING (МАКСИМАЛ) AND AUGMENTATION (ФОРСАЖ) POSITIONS
IDLE SPEED (МАЛЫЙ ГАЗ) POSITION REST
MAXIMUM RATING (МАКСИМАЛ) REST
MAXIMUM AUGMENTATION
BUTTON FOR FIXING STOP (СТОП) POSITION WITH IDLE SPEED (МАЛЫЙ ГАЗ) REST
FWD
ЭМО-2/2 ELECTROMAGNET
BUTTON FOR EMERGENCY DISCONNECTION OF REST ACCORDING TO MACH NUMBER
TIGHTENING HANDLE
AUTOMATIC STOP ACCORDING TO MACH NUMBER
WITH M<1.5 ELECTROMAGNET WILL NOT OPERATE. LIMIT STOP WILL NOT HINDER BACKWARD MOVEMENT OF ENGINE CONTROL LEVER
WITH M=1.5 ELECTROMAGNET HAS OPERATED. LIMIT STOP HINDERS BACKWARD MOVEMENT OF ENGINE CONTROL LEVER
FWD
LIMIT STOP IN UP POSITION
ENGINE CONTROL LEVER
CLEARANCE AT LEAST 1 MM
ENGINE CONTROL LEVER PIN
ROD OF ЭМО-2/2 MECHANISM FULL WAY OUT
LIMIT STOP IN DOWN POSITION
1 MM
1-MM MISALIGNMENT (UP OR DOWN) OF PIN RELATIVE TO LIMIT STOP IS ALLOWED
ROD OF ЭМО-2/2 MECHANISM MOVED IN
ANGLES OF CONTROL LEVER DEFLECTION AS INDICATED ON ПУРТ-1Ф PANEL PROVIDING FOR PROPER ARRANGEMENT OF RESTS ON THE CONTROL LEVER SECTOR
75-77°
65-70°
112±1°
53°
47°
11.5°
STOP
IDLE SPEED
NORMAL RATING
VERTICAL LINE
MAXIMUM RATING
MINIMUM AUGMENTATION
FULL AUGMENTATION REST
TO ENGINE CONTROL LEVER
FWD
ПУРТ-1Ф PANEL
A
PLACE A
INSTALLATION OF GUIDE AT FRAME 15
TO ENGINE

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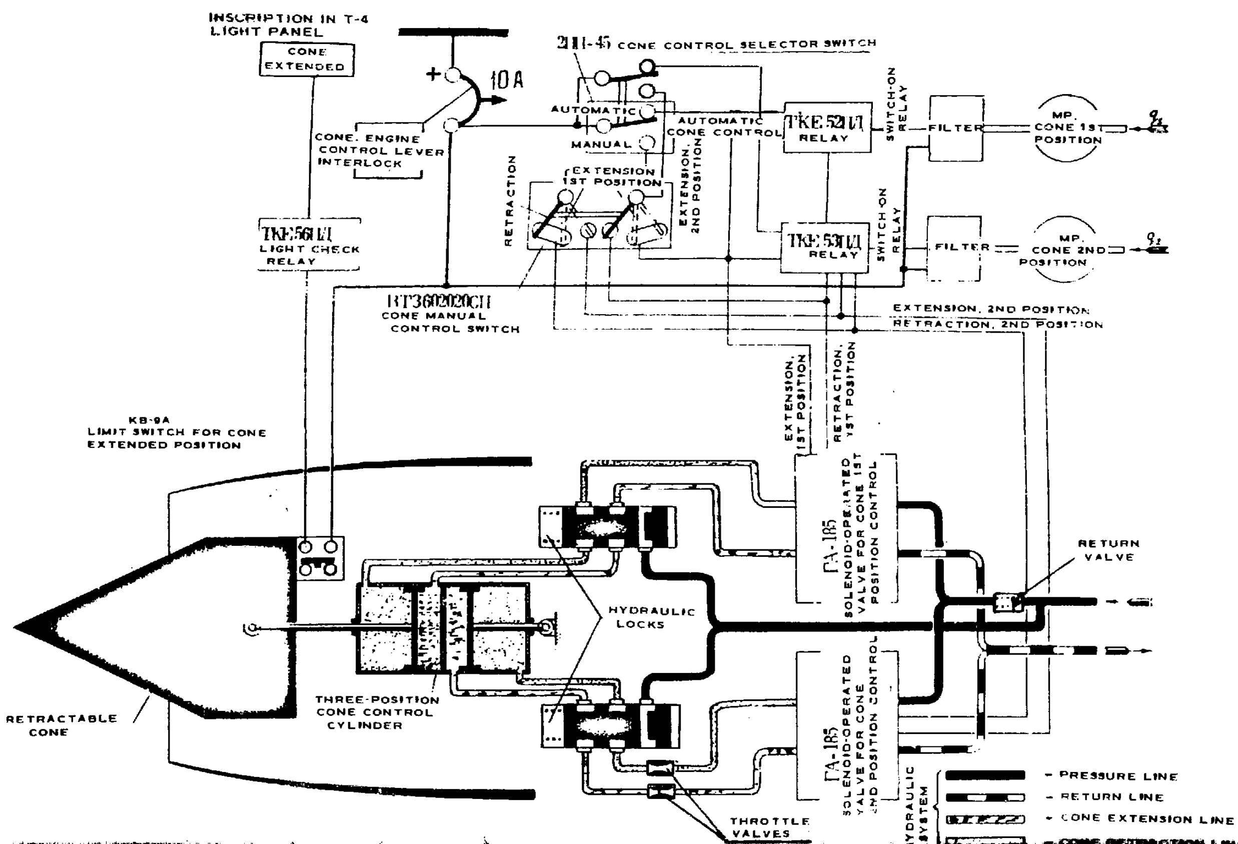
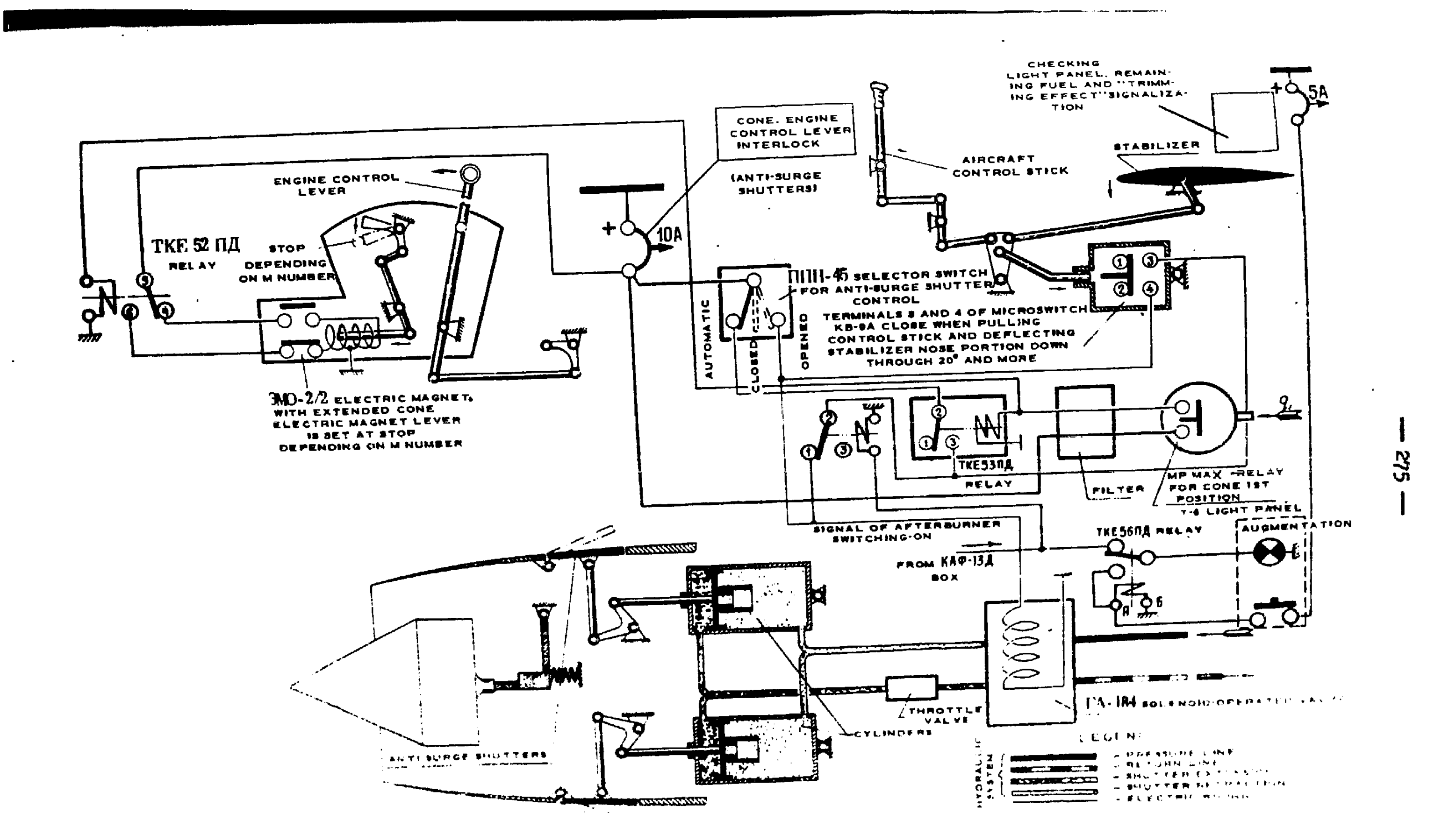


FIG. 52. CONE CONTROL KEY DIAGRAM



CHECKING LIGHT PANEL, REMAINING FUEL AND "TRIMMING EFFECT" SIGNALIZATION
+
5A
CONE. ENGINE CONTROL LEVER INTERLOCK
(ANTI-SURGE SHUTTERS)
AIRCRAFT CONTROL STICK
STABILIZER
ENGINE CONTROL LEVER
TKE 52 ПД RELAY
STOP DEPENDING ON M NUMBER
+
10A
ПШ-45 SELECTOR SWITCH FOR ANTI-SURGE SHUTTER CONTROL
AUTOMATIC
CLOSED
OPENED
TERMINALS 3 AND 4 OF MICROSWITCH KB-9A CLOSE WHEN PULLING CONTROL STICK AND DEFLECTING STABILIZER NOSE PORTION DOWN THROUGH 20° AND MORE
ЭМО-2/2 ELECTRIC MAGNET, WITH EXTENDED CONE ELECTRIC MAGNET LEVER IS SET AT STOP DEPENDING ON M NUMBER
TKE53ПД RELAY
FILTER
MP MAX - RELAY FOR CONE 1ST POSITION
Y-6 LIGHT PANEL
AUGMENTATION
SIGNAL OF AFTERBURNER SWITCHING-ON
FROM КАФ-13Д BOX
TKE56ПД RELAY
THROTTLE VALVE
CYLINDERS
ГА-184 SOLENOID-OPERATED
ANTI-SURGE SHUTTERS
HYDRAULIC SYSTEM
LEGEND

[illegible]

— 275 —

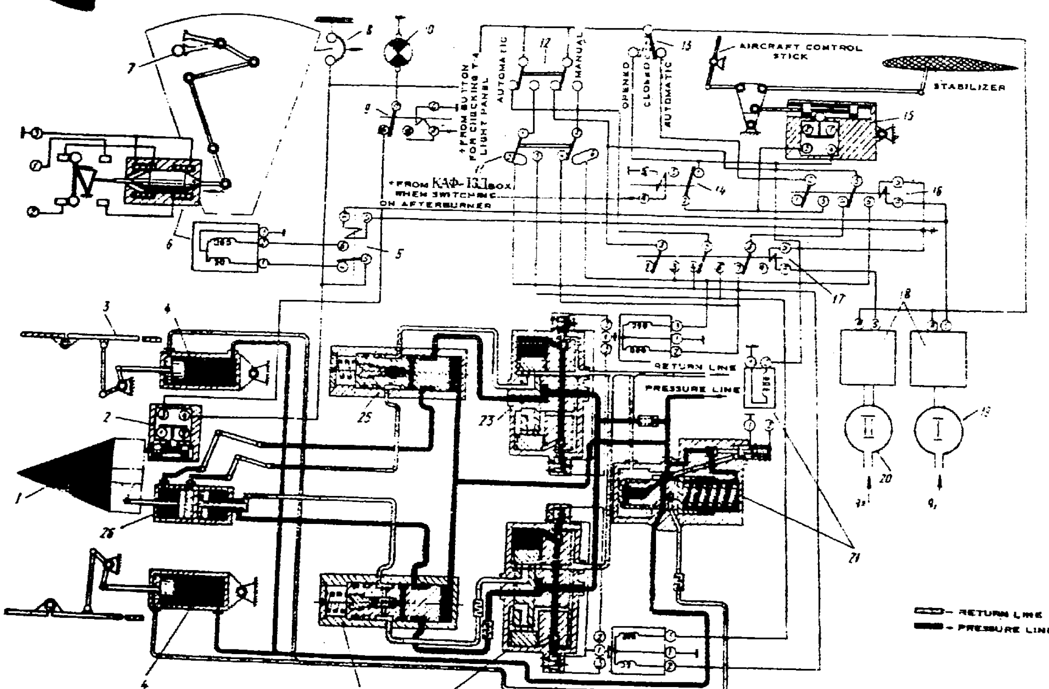


FIG. 54. KEY DIAGRAM FOR CONTROL OF CONE. ANTI-SURGE SHUTTERS AND ENGINE CONTROL LEVER AS DEPENDS ON MACH NUMBER

1 – retractable cone; 2 – KB-9A microswitch; 3 – anti-surge [redacted]; 4 – hydraulic cylinders; 5 – TKE-52ПД relay for engine control lever interlock; 6 – ЭМО-2/2 electric magnet for engine control lever interlock; 7 – stop depending on Mach number; 8 – CONE. ENGINE CONTROL LEVER INTERLOCK (КОНУС, БЛОКИРОВКА СЕКТОРА ГАЗА) circuit breaker; 9 – TKE-56ПД relay for control of lights, light panel and hydraulic system signalization; 10 – light in T-4 CONE EXTENDED (КОНУС ВЫПУЩЕН) light panel; 11 – cone manual control switch; 12 – cone control switch; 13 – anti-surge shutter control switch; 14 – TKE-21ПД relay for anti-surge shutter interlock depending on afterburner operation; 15 – KB-9A microswitch in anti-surge shutter circuit; 16 – TKE-53ПД relay for cone 1st position control; 17 – TKE-53ПД relay for cone 2nd position control; 18 – filters in circuit for MP-1.5T and MP-1.9T transmitters; 19 – Mach number transmitter MP-1.5T; 20 – Mach number transmitter MP-1.9T; 21 – anti-surge shutter control valve ГА-184; 22 – ГА-185 valve for cone extension to 2nd position; 23 – ГА-185 valve for cone extension to 1st position; 24 – hydraulic lock; 25 – hydraulic lock; 26 – three-position cylinder for cone control.

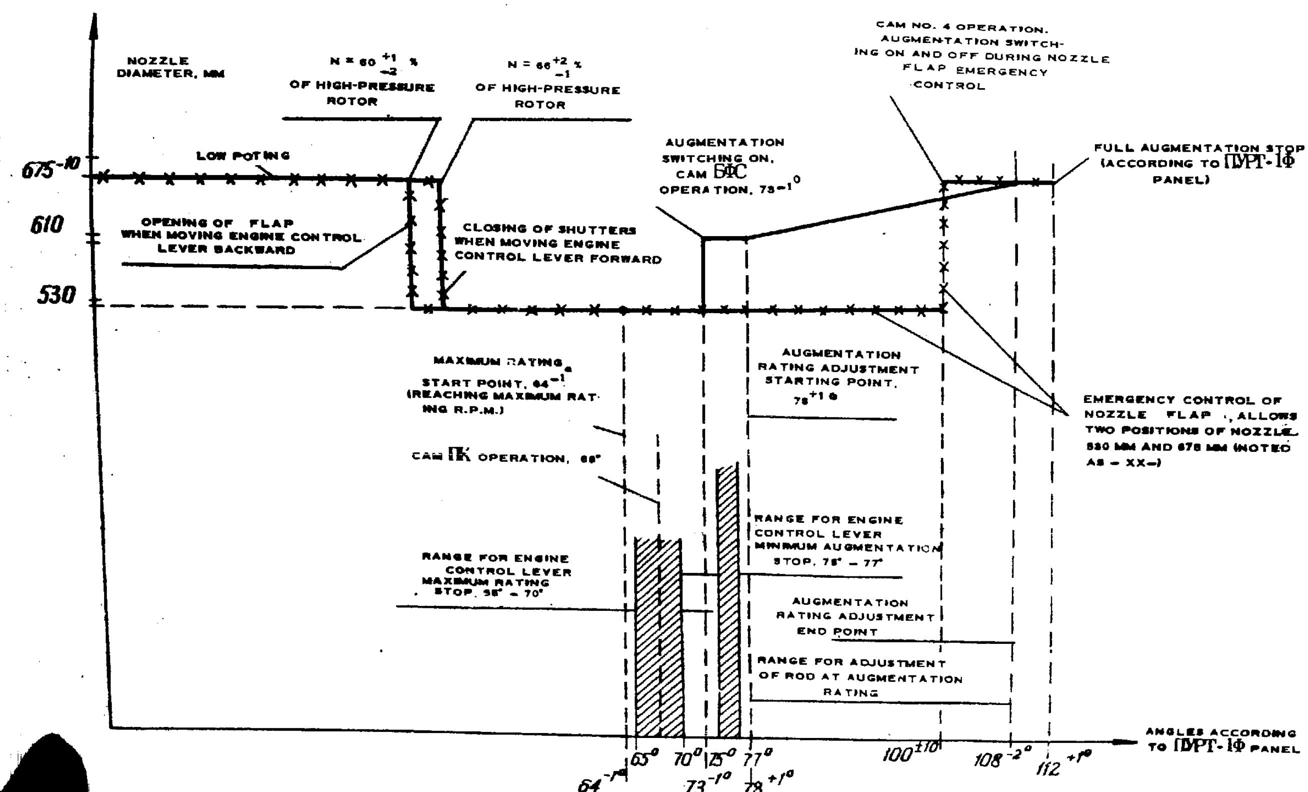


FIG. 56. NOZZLE DIAMETER AS FUNCTION OF ENGINE CONTROL LEVER DEFLECTION ANGLES MEASURED ON ПУРТ-1Ф PANEL

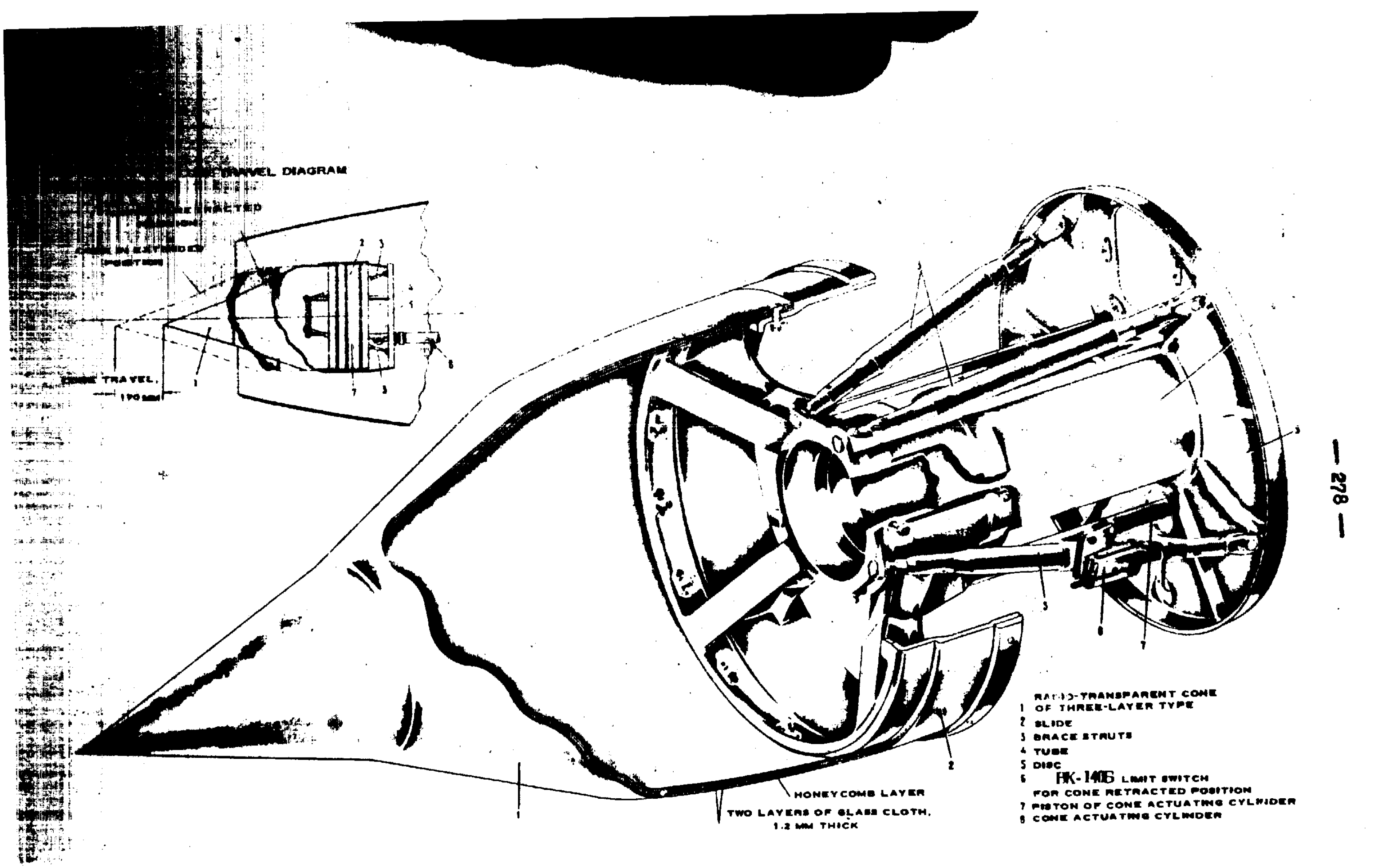


FIG. 56. AIR INTAKE CONE

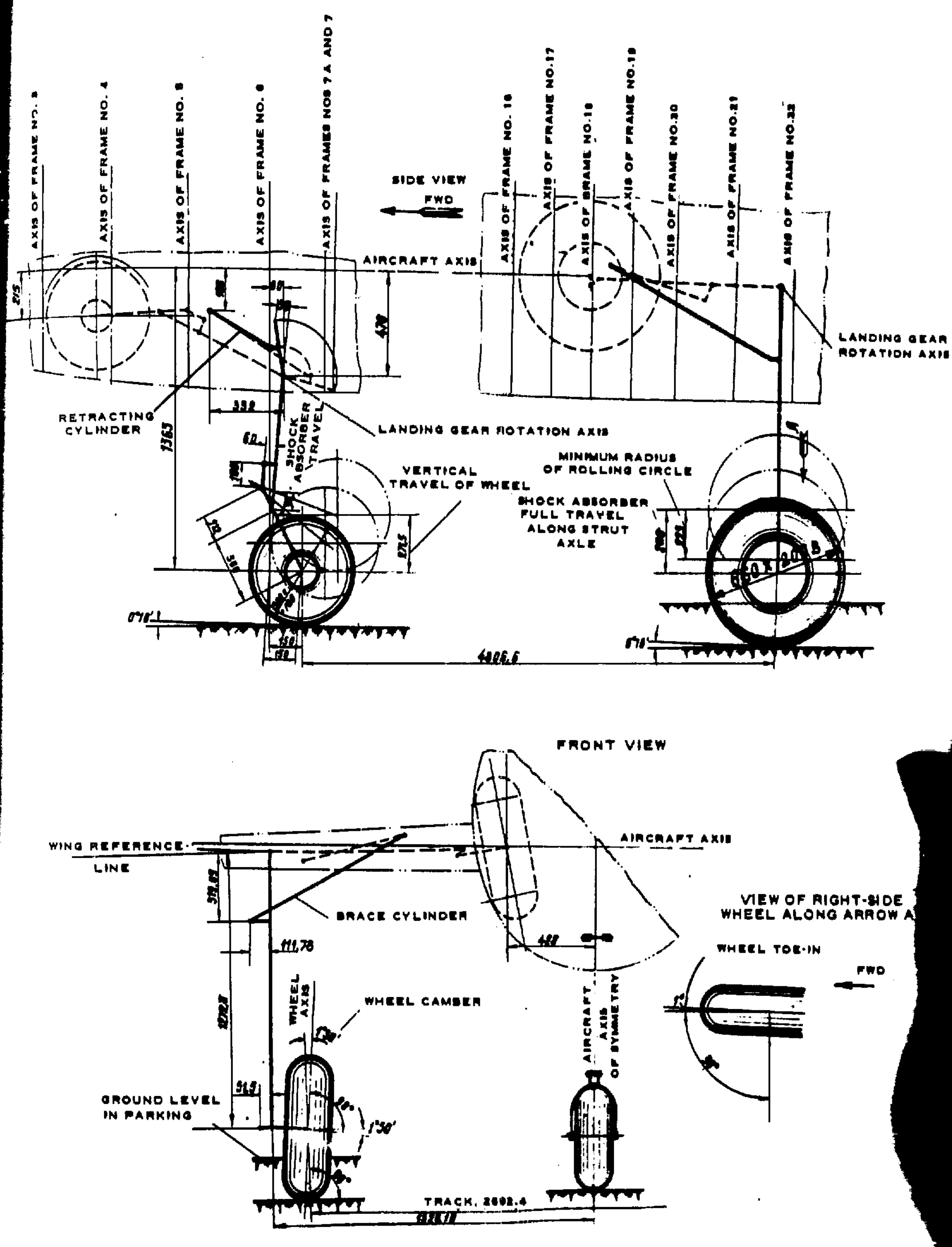


FIG. 57. LANDING GEAR DIMENSION CHART

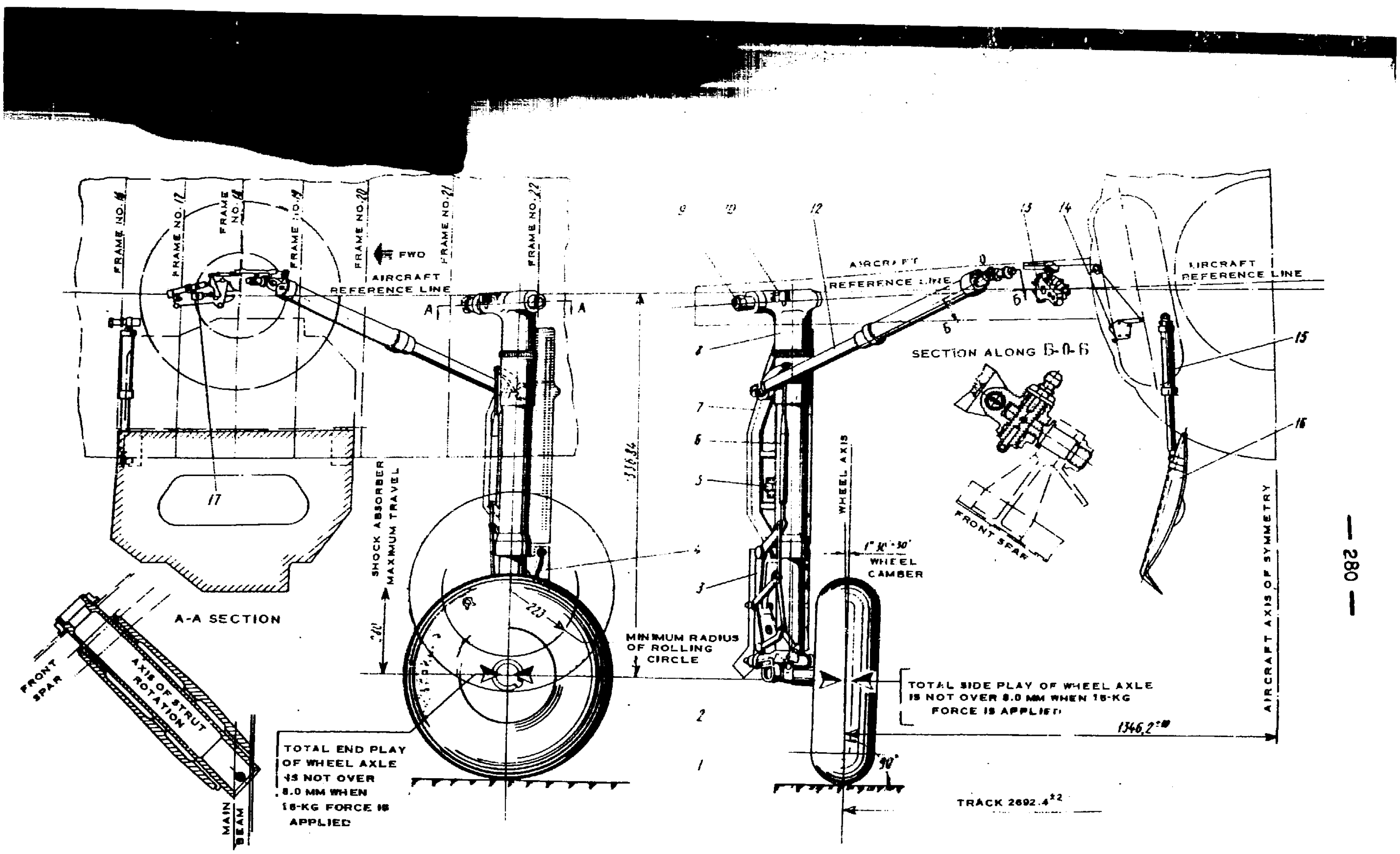
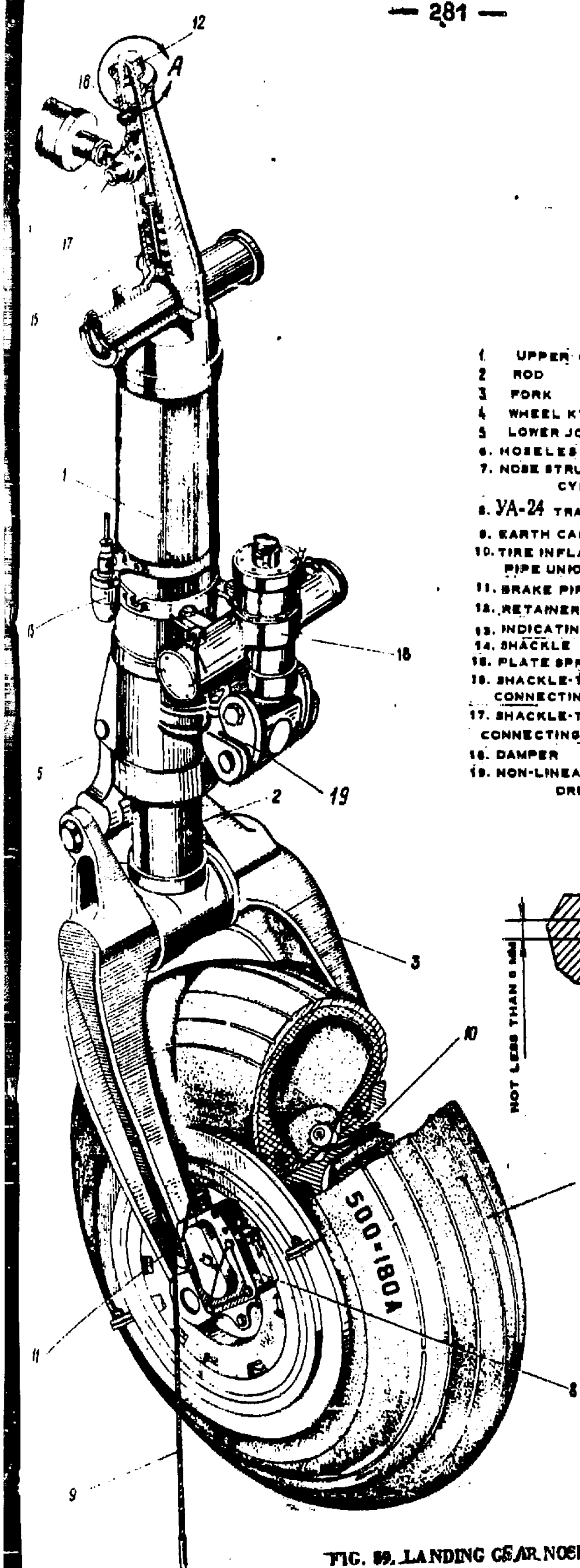


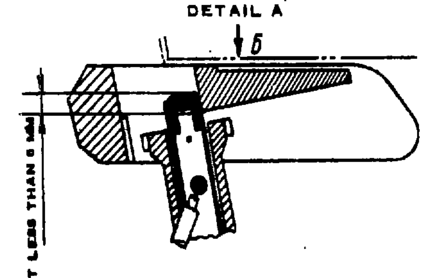
FIG. 58. LANDING GEAR MAIN STRUT SETTING

1 – wheel KT-82M; 2 – landing gear suspension clamp; 3 – wheel turning mechanism (of a parallelogram type) with semiaxle; 4 – brace strut door; 5 – external indicating light; 6 – wheel turning mechanism rod; 7 – main strut door; 8 – main landing gear strut; 9 – strut axle of rotation; 10 – limit switch for main strut down position indicating system; 12 – main landing gear actuating cylinder; 13 – main strut suspension lock; 14 – door lock; 15 – door actuating cylinder; 16 – wheel door; 17 – limit switch for main strut up position indicating system.

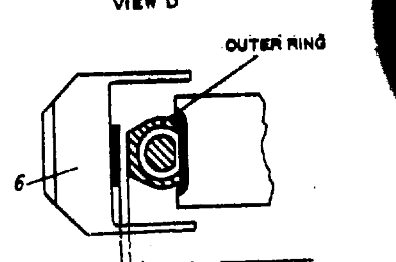


1. UPPER CYLINDER
2. ROD
3. FORK
4. WHEEL KT-38
5. LOWER JOINT
6. HOSELESS CONNECTION
7. NOSE STRUT RETRACTION CYLINDER
8. УА-24 TRANSMITTER
9. EARTH CABLE
10. TIRE INFLATION PIPE UNION
11. BRAKE PIPE UNION
12. RETAINER
13. INDICATING LIGHT
14. SHACKLE
15. PLATE SPRINGS
16. SHACKLE-TO-RETAINER CONNECTING BOLT
17. SHACKLE-TO-CYLINDER CONNECTING BOLT
18. DAMPER
19. NON-LINEAR TRANSMISSION DRIVE

DETAIL A



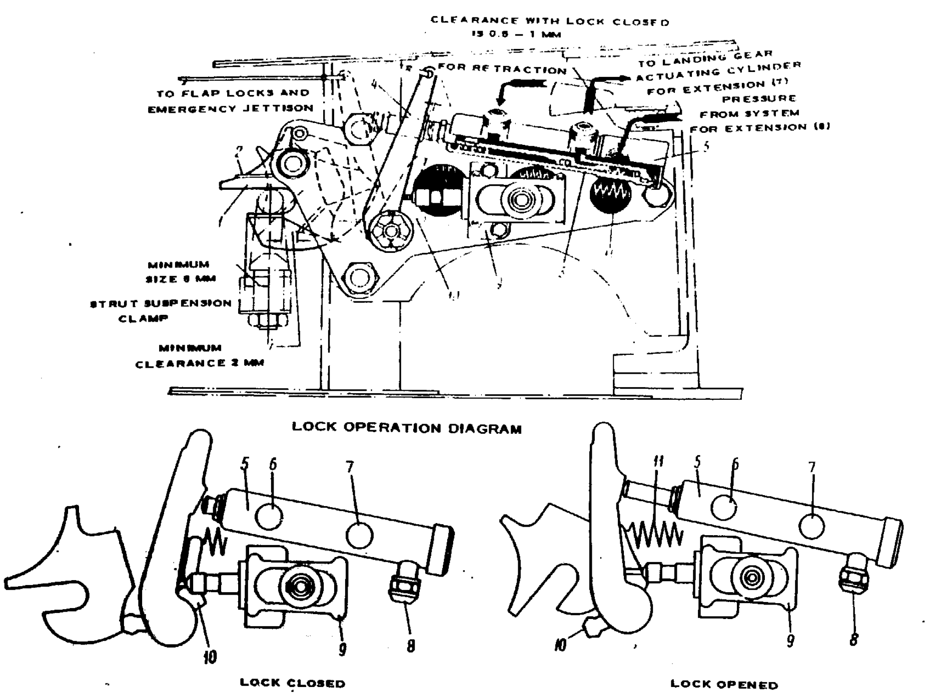
VIEW Б



PERMISSIBLE CLEARANCE, 0.05 – 0.1 MM. WITH CLEARANCE TAKEN UP TO BE 0.05 – 0.1 MM, MINIMUM CONTACT AREA OF OUTER RING IS 60%. PERMISSIBLE OPERATIONAL CLEARANCE IS 0.45 MM

FIG. 89. LANDING GEAR NOSE STRUT

[redacted]



1. HOOK
2. HOOK SPRING
3. LOCK BODY
4. LEVER
5. LOCK HYDRAULIC CYLINDER
6. PIPE UNION FOR RETRACTION PRESSURE
7. PIPE UNION FOR EXTENSION PRESSURE SUPPLIED TO HYDRAULIC CYLINDER
8. PIPE UNION FOR EXTENSION PRESSURE
9. LIMIT SWITCH
10. CAM
11. CAM SPRING

FIG. 60. MAIN LANDING GEAR STRUT UPLOCK

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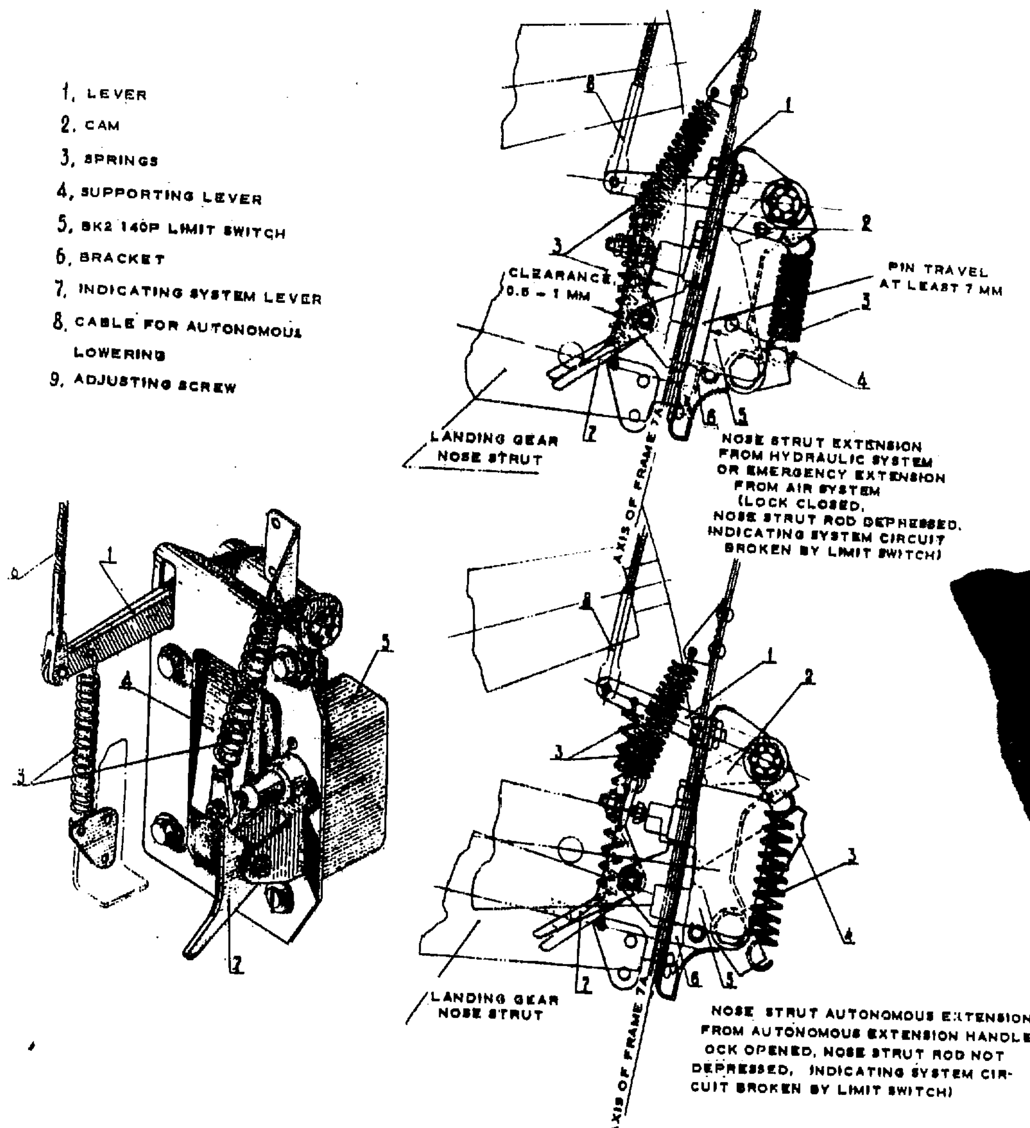

FIG. 61. LANDING GEAR NOSE STRUT UPLOCK

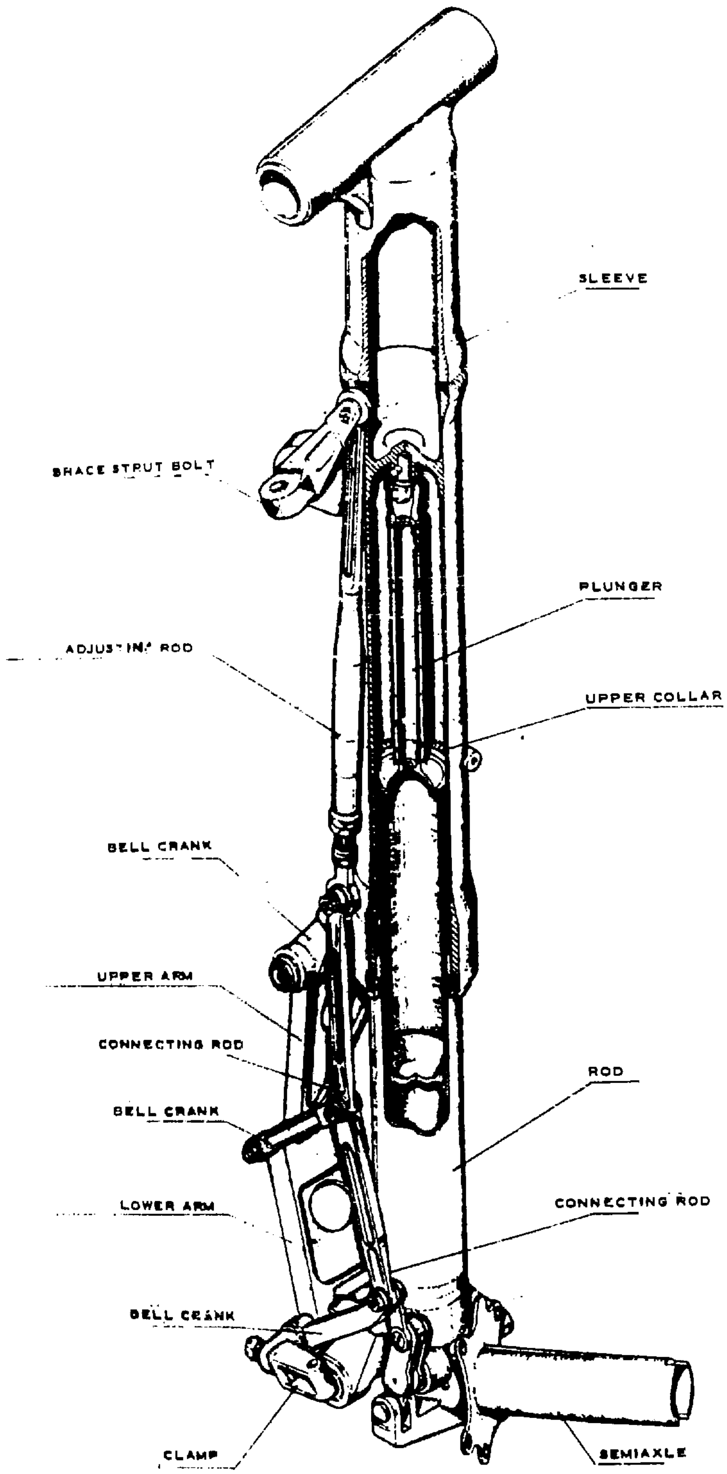

FIG. 62. LANDING GEAR MAIN STRUT

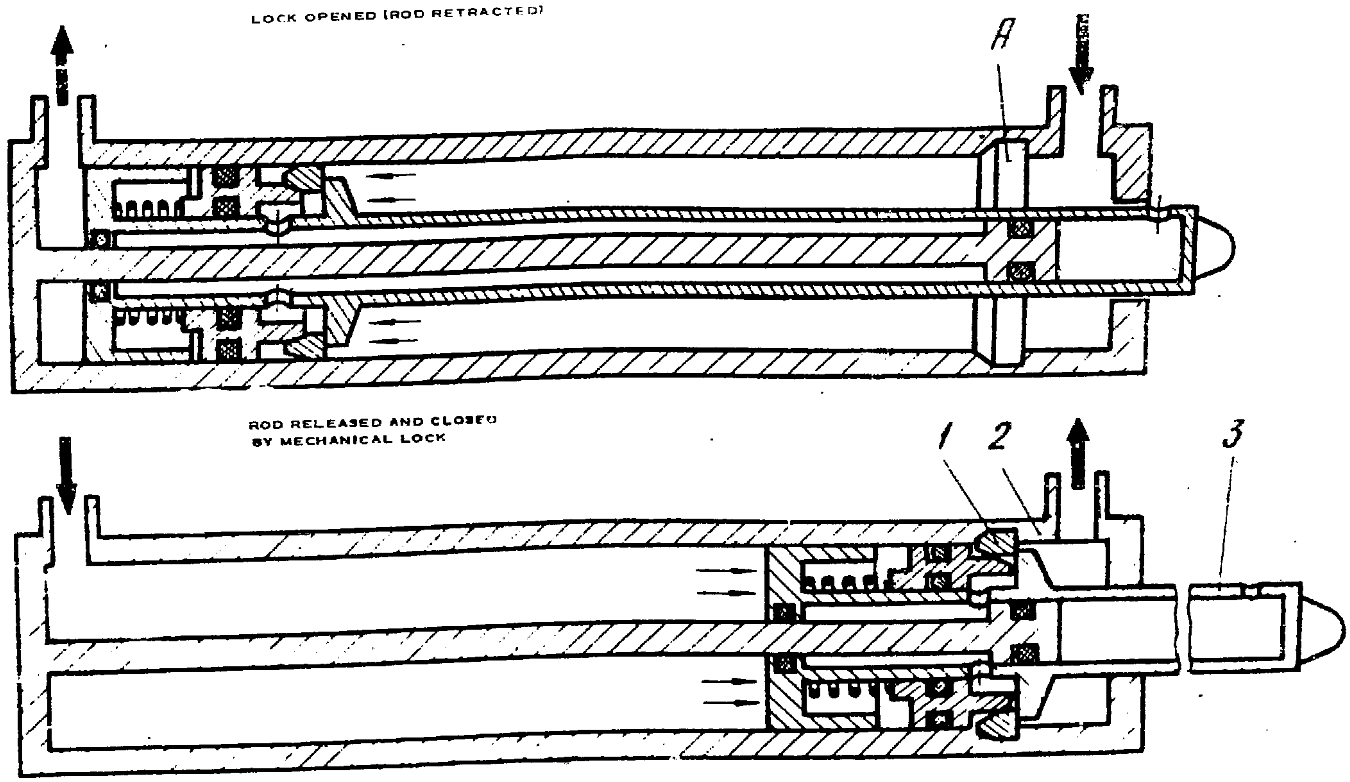

FIG. 63. OPERATION OF MECHANICAL LOCK FOR MAIN STRUT ACTUATING CYLINDER

1 – spring ring; 2 – hydraulic cylinder; 3 – rod; 4 – lock seat.

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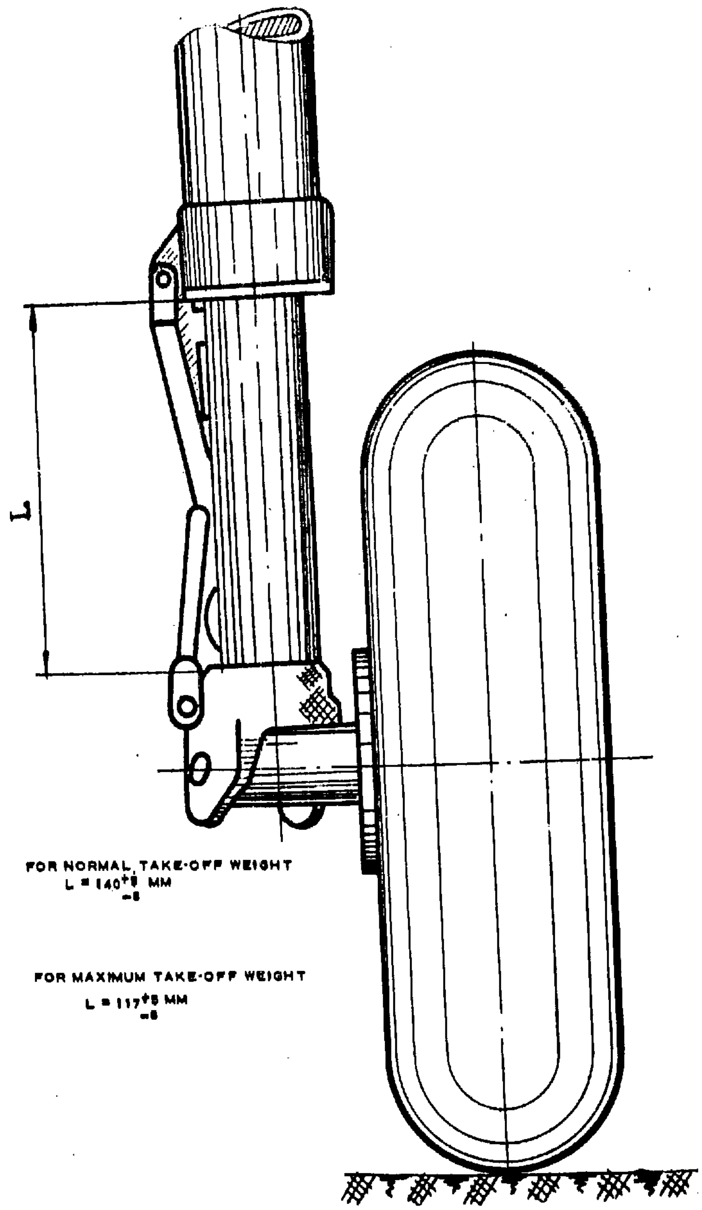

FIG. 64. MAIN STRUT SHOCK ABSORBER PARKING CLOSURE

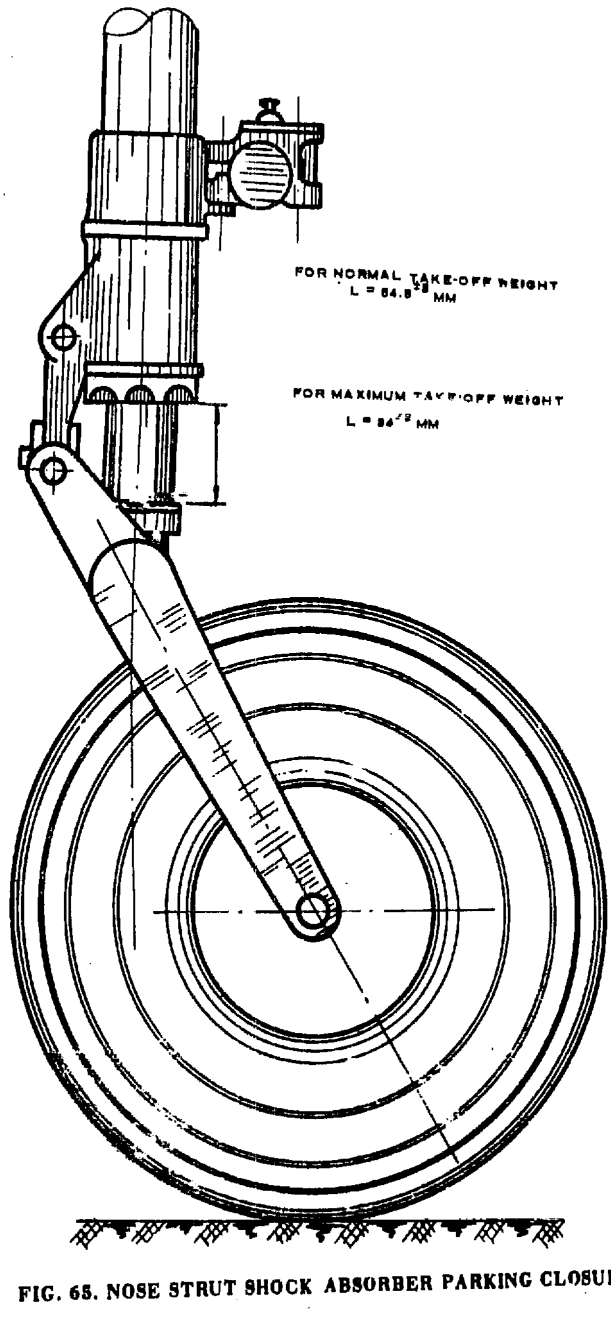

FIG. 65. NOSE STRUT SHOCK ABSORBER PARKING CLOSURE

1. FLIGHT-AND-LANDING INDICATING PANEL ШПС-2
2. M3-1 FLAP CONTROL MECHANISM
3. CIRCUIT BREAKERS
4. SEALED CONNECTIONS
5. RELAY BOX
6. WING PLUG CONNECTORS
7. ГА-185 VALVE
8. RETRACTION AND EXTENSION CYLINDER
9. KB-9A MICROSWITCHES

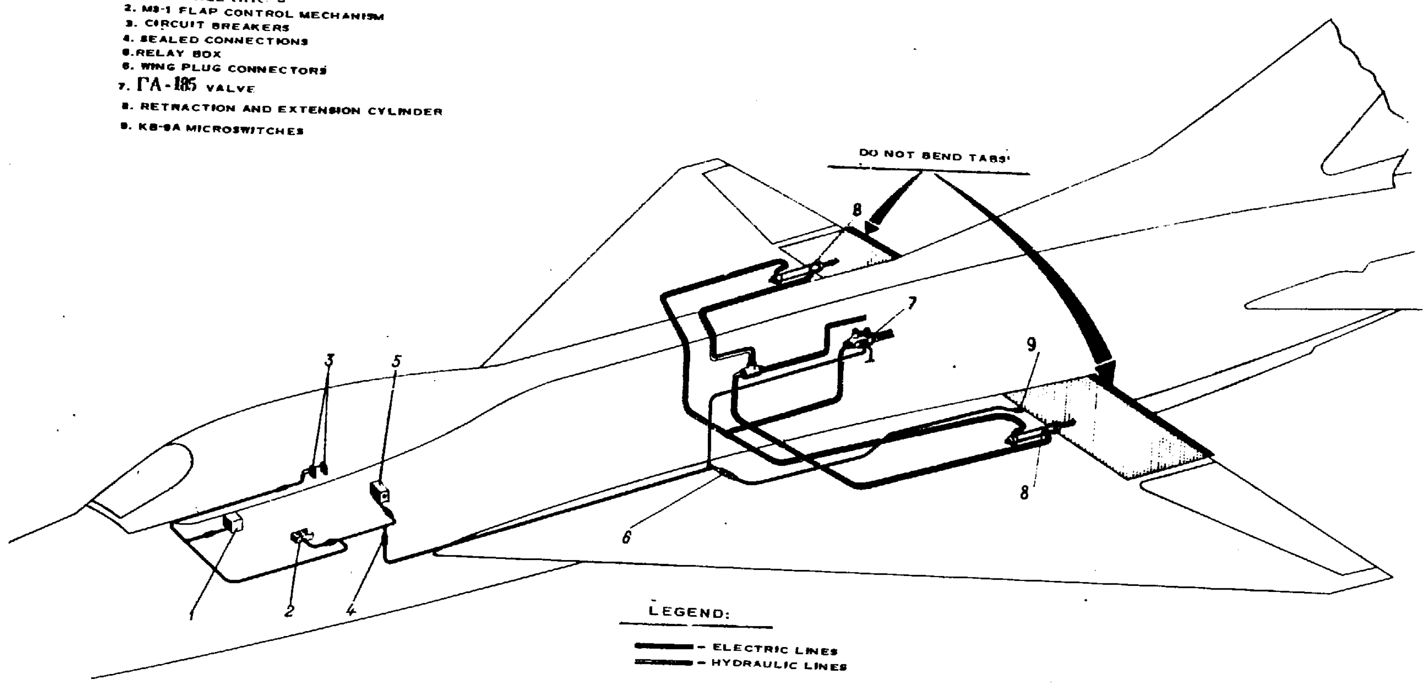

FIG. 66. FLAP CONTROL SYSTEM

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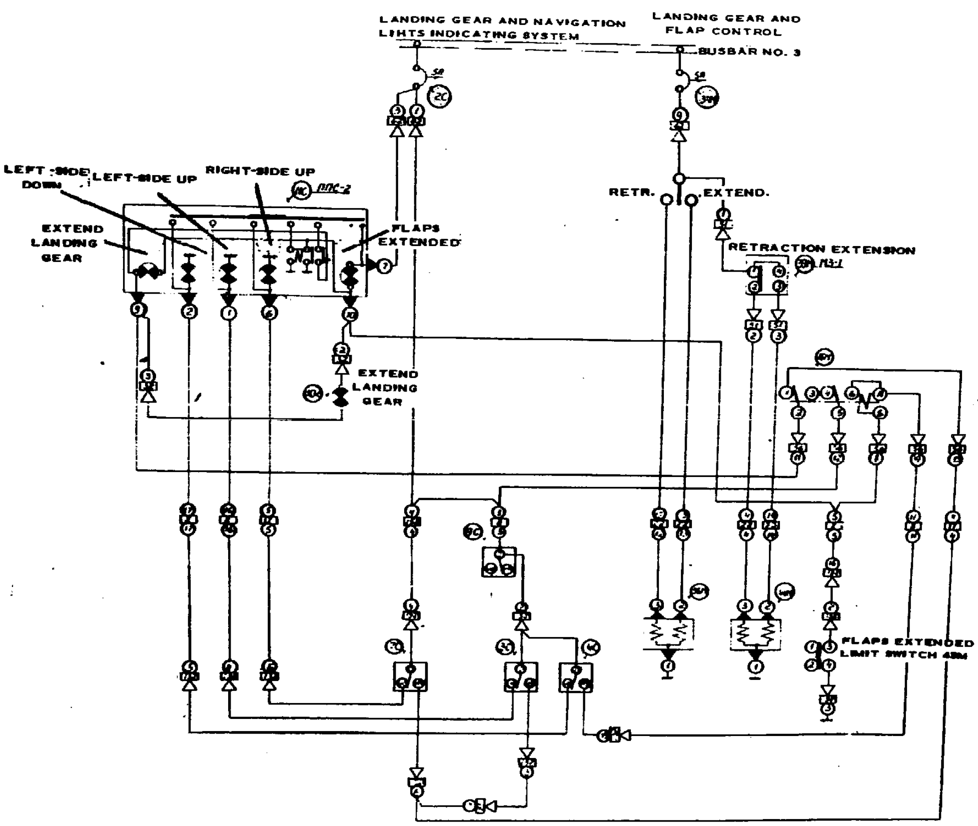
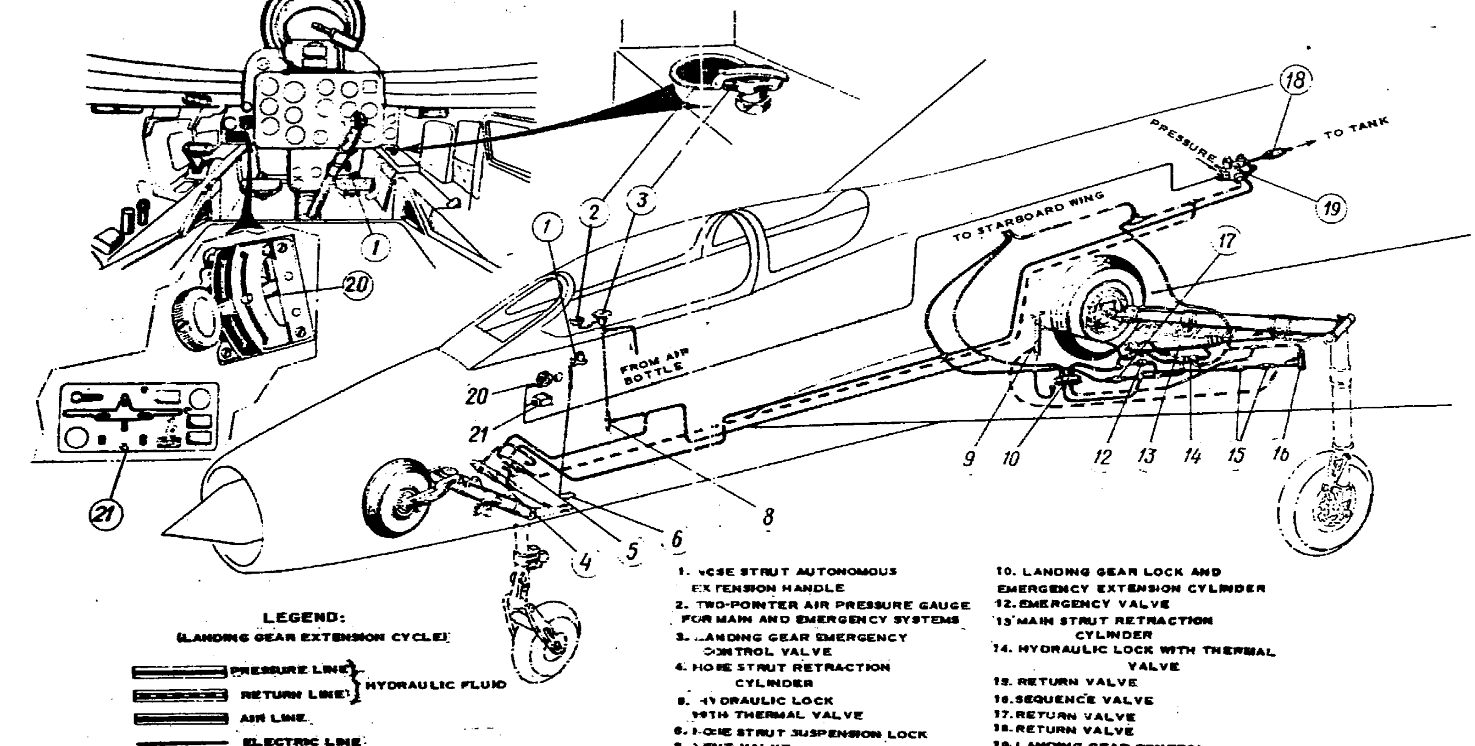


FIG. 67. LANDING GEAR AND FLAP CONTROL WIRING DIAGRAM

DESIGNATIONS:

2C – AUTOMATIC CIRCUIT BREAKER АЗС-5
3C – LIMIT SWITCH FOR LEFT-SIDE STRUT EXTENSION
4C – LIMIT SWITCH FOR LEFT-SIDE STRUT RETRACTION
7C – LIMIT SWITCH FOR RIGHT-SIDE STRUT EXTENSION
9C – LIMIT SWITCH FOR AIR BRAKE EXTENSION INDICATING SYSTEM
10C – LANDING GEAR EXTENSION INDICATING LIGHT СЛЦ-51 (RED)
11C – ППС-2 FLIGHT-AND-LANDING PANEL
34M – AUTOMATIC CIRCUIT BREAKER АЗС-5
36M – ГА-142/1 SOLENOID-OPERATED VALVE FOR LANDING GEAR EXTENSION
39M – МЗ-1 FLAP CONTROL MECHANISM
43M – КВ-5А MICROSWITCH FOR FLAP POSITION INDICATING SYSTEM
44M – ГА-185 SOLENOID-OPERATED VALVE FOR FLAP EXTENSION
76M – ТКЕ 52ПД RELAY FOR FLAP EXTENSION AND INDICATING SYSTEM

[redacted]



1. NOSE STRUT AUTONOMOUS EXTENSION HANDLE
2. TWO-POINTER AIR PRESSURE GAUGE FOR MAIN AND EMERGENCY SYSTEMS
3. LANDING GEAR EMERGENCY CONTROL VALVE
4. NOSE STRUT RETRACTION CYLINDER
5. HYDRAULIC LOCK WITH THERMAL VALVE
6. NOSE STRUT SUSPENSION LOCK
8. VENT VALVE
9. LANDING GEAR DOOR ACTUATING CYLINDER
10. LANDING GEAR LOCK AND EMERGENCY EXTENSION CYLINDER
12. EMERGENCY VALVE
13. MAIN STRUT RETRACTION CYLINDER
14. HYDRAULIC LOCK WITH THERMAL VALVE
15. RETURN VALVE
16. SEQUENCE VALVE
17. RETURN VALVE
18. RETURN VALVE
19. LANDING GEAR CONTROL VALVE ГА-142/I
20. LANDING GEAR CONTROL VALVE SWITCH
21. ППС-2 PANEL

FIG. 68. LANDING GEAR CONTROL SYSTEM

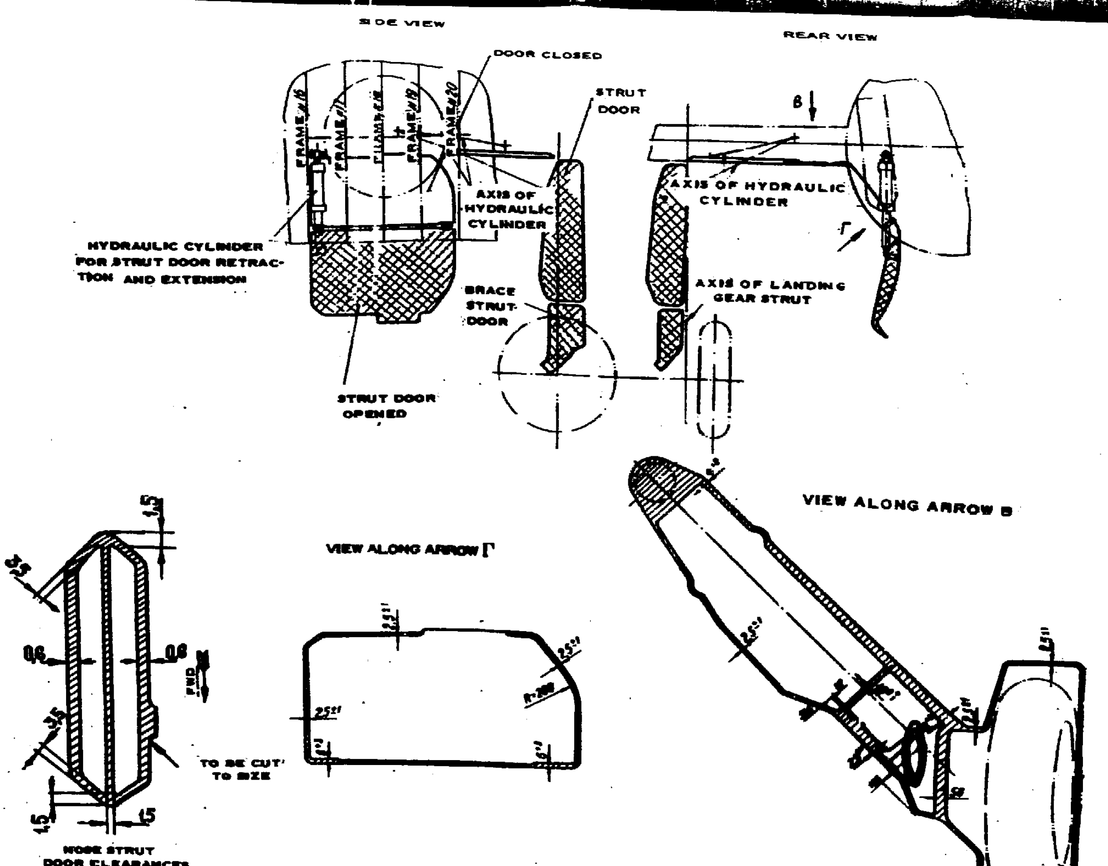
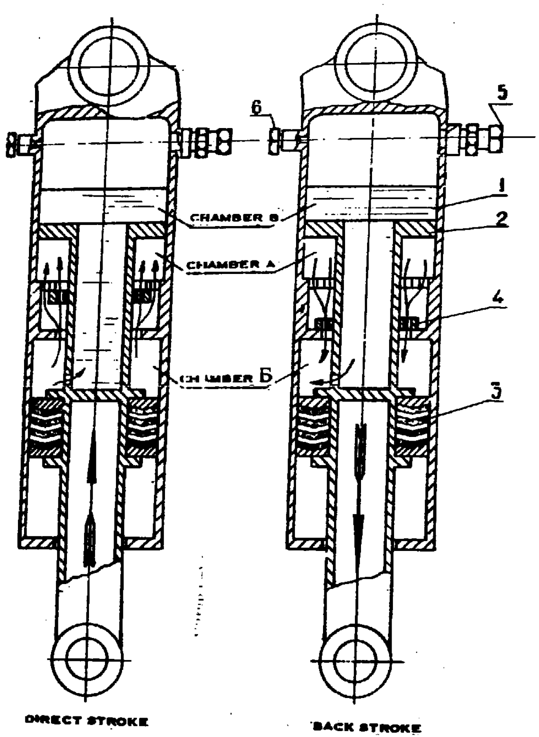


FIG. 69. CLEARANCES BETWEEN FLAPS AND MEMBERS OF WING AND FUSELAGE



1. CYLINDER
2. PISTON
3. PACKING SEAL
4. VALVE RING
5. PIPE UNION FOR FILLING SHOCK ABSORBER WITH АМГ-10 FLUID AND NITROGEN
6. PIPE UNION FOR АМГ-10 FLUID DISCHARGE

FIG. 70. DIAGRAM FOR FLUID OVERFLOW DURING NOSE STRUT SHOCK ABSORBER OPERATION

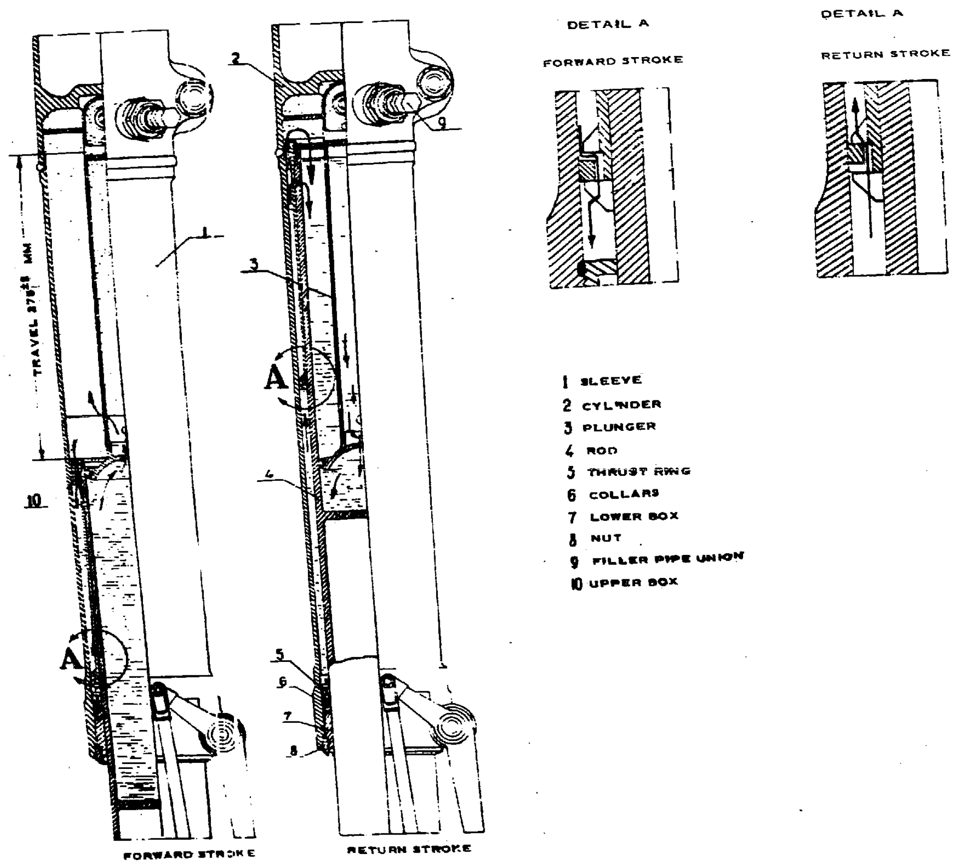


FIG. 71. MAIN STRUT SHOCK ABSORBER OPERATION

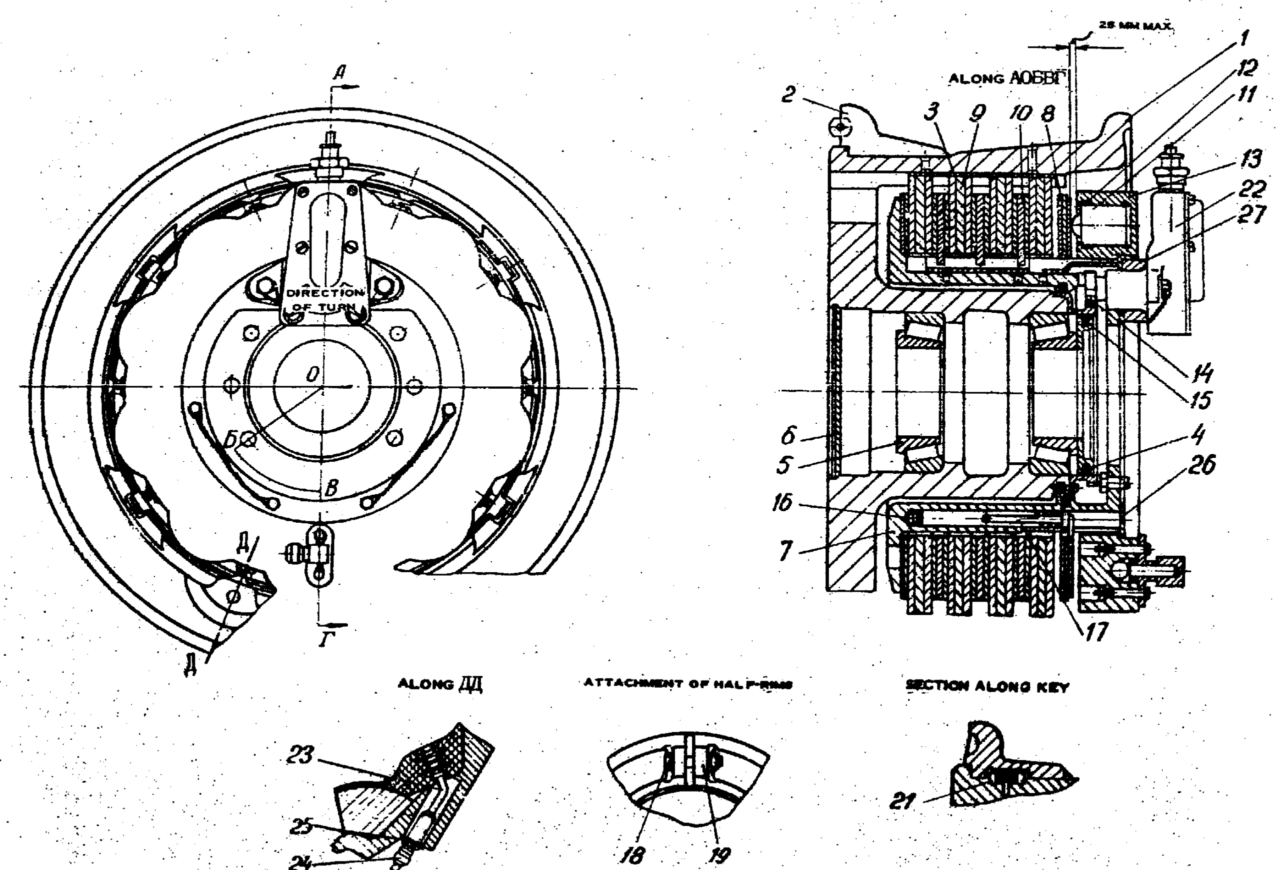


FIG. 72. KT-82M WHEEL

1 — drum; 2 — half-rim; 3 — guide sleeve; 4 — packing gland; 5 — roller bearing; 6 — cover; 7 — body; 8 — pressure plate; 9 — bimetallic disc; 10 — metal-and-ceramic disc; 11 — piston; 12 — packing ring; 13 — cylinder unit; 14 — gear wheel; 15 — gear wheel; 16 — return spring; 17 — rod; 18 — bolt; 19 — eye; 21 — key; 22 — transmitter; 23 — valve; 24 — cap; 25 — nut; 26 — door; 27 — flange.

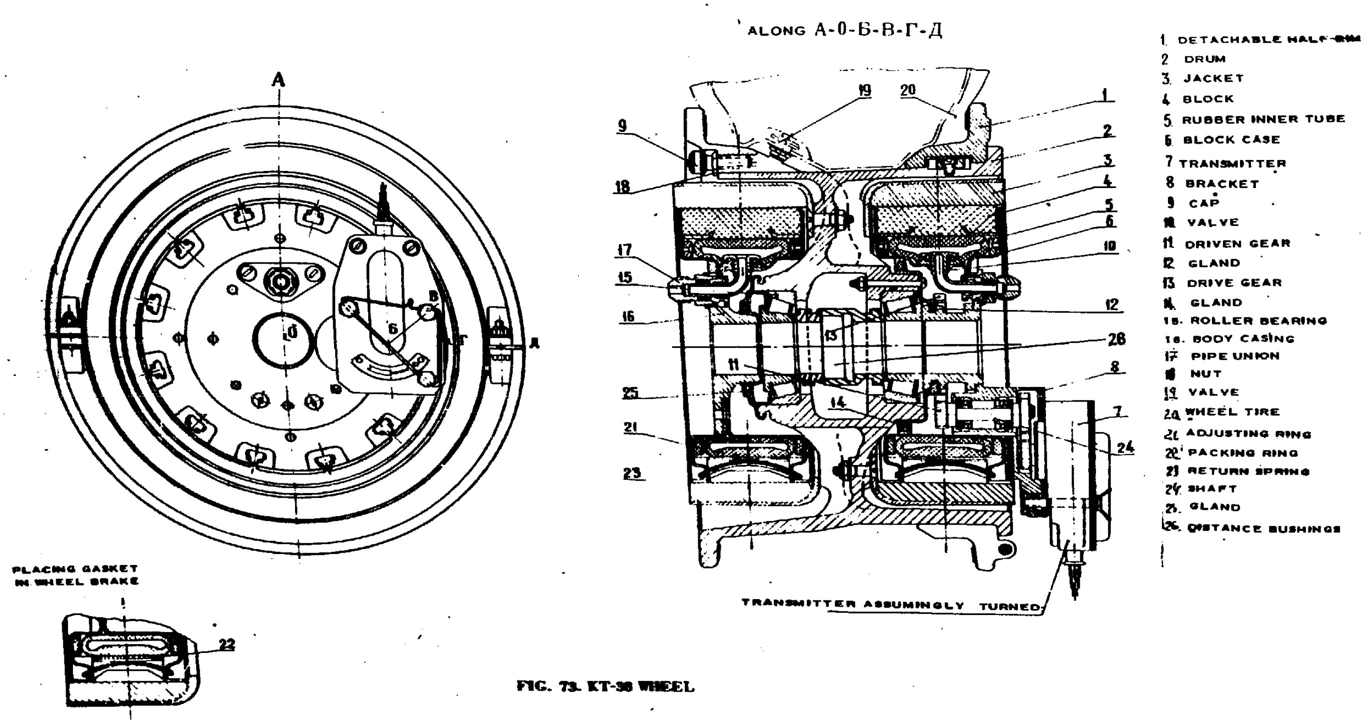


FIG. 73. KT-38 WHEEL

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[redacted]

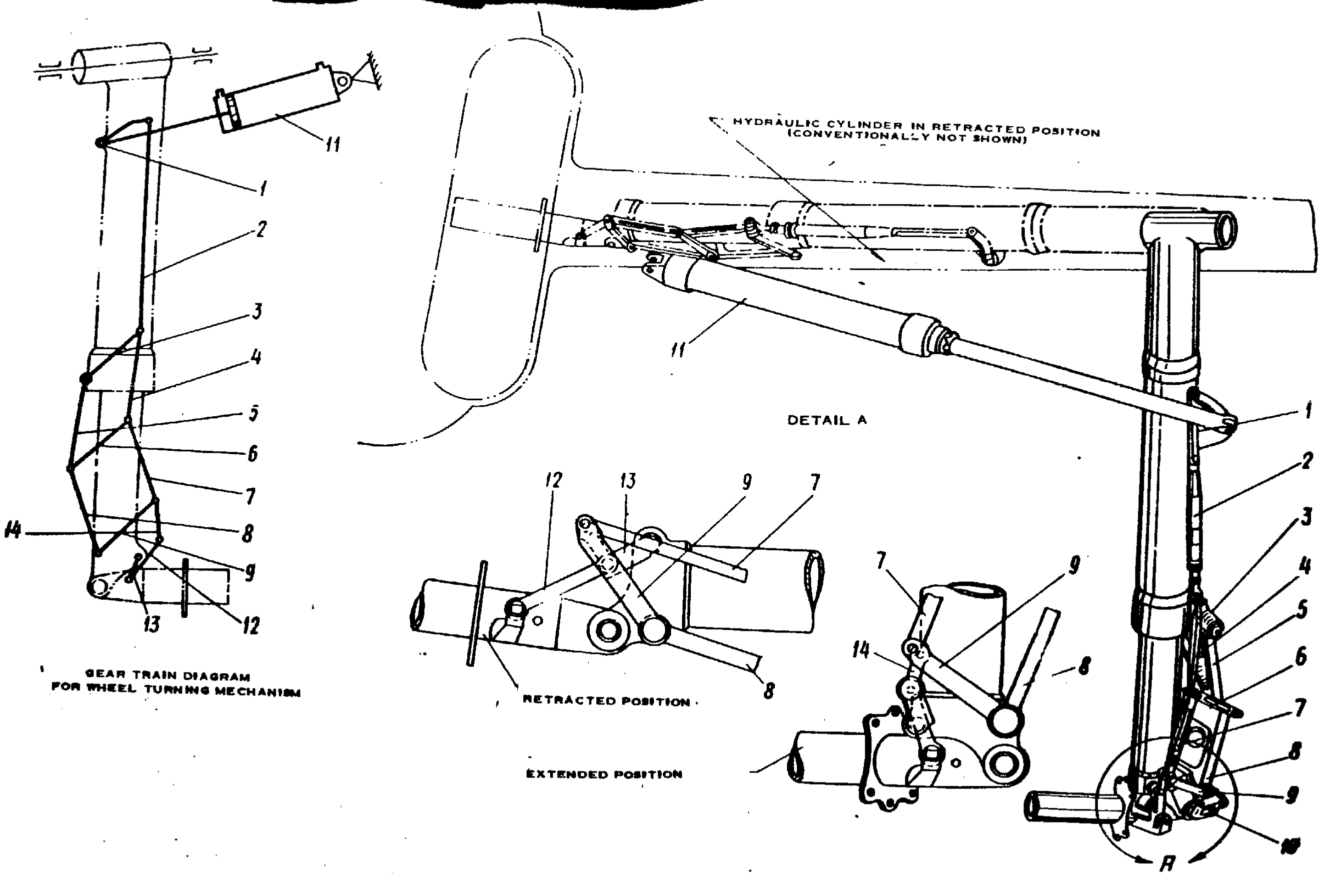


FIG. 74. MAIN STRUT WHEEL TURNING MECHANISM

1 — hinged attachment for hydraulic cylinder rod; 2 — adjusting rod; 3 — bell crank; 4 — rod; 5 — upper cross piece; 6 — bell crank; 7 — rod; 8 — lower cross piece; 9 — bell crank; 10 — clamp; 11 — hydraulic cylinder [redacted]

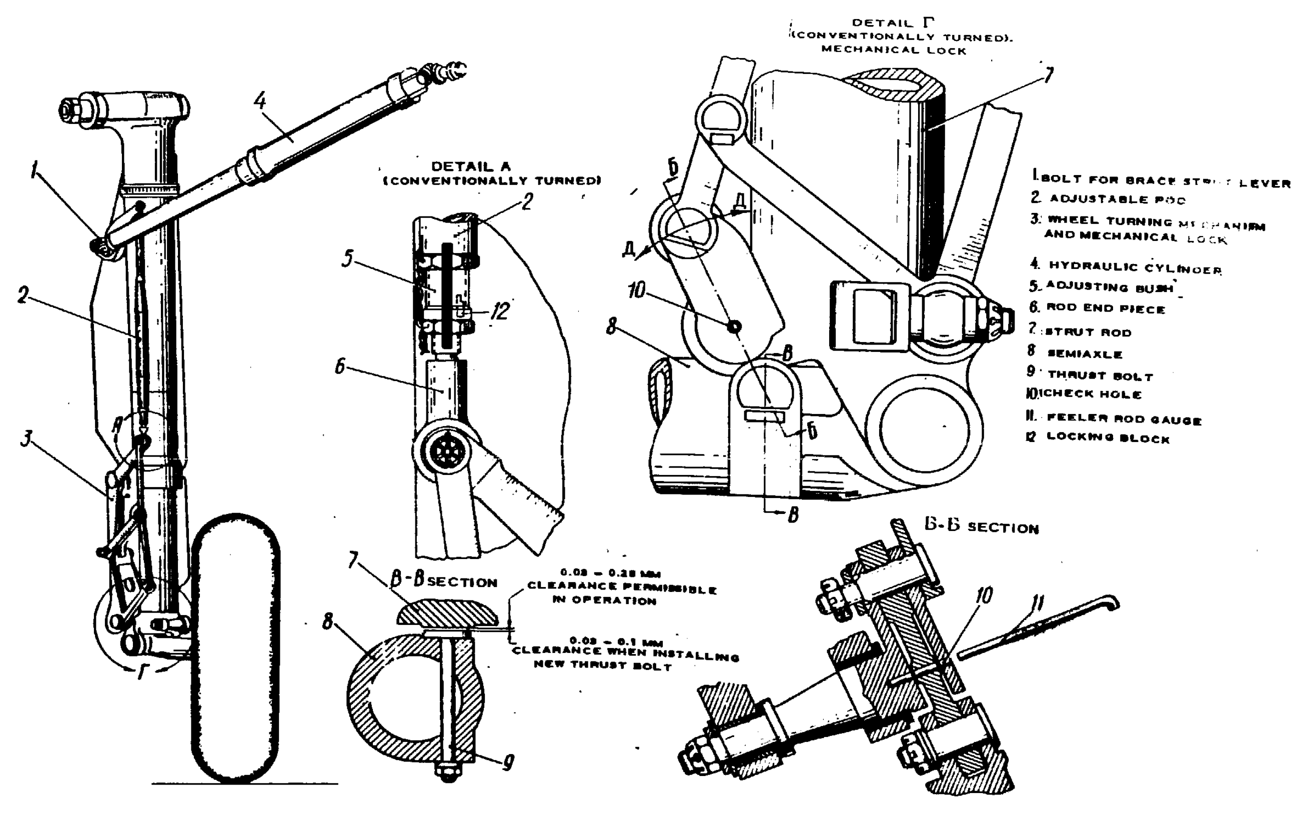
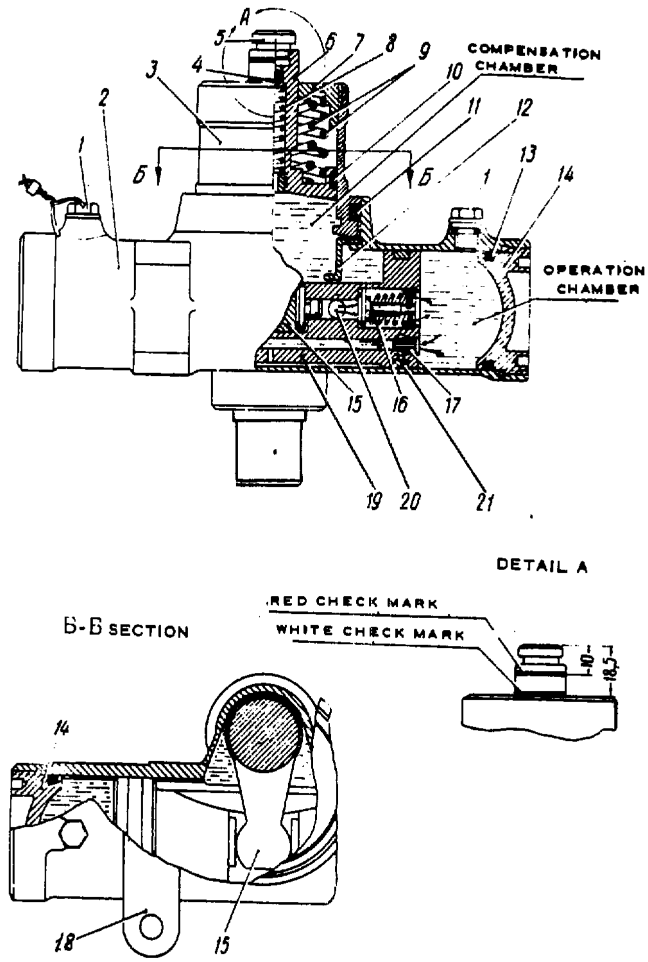


FIG. 75. MAIN STRUT WHEEL TURNING MECHANISM



1. FILLER HOLE PLUGS
2. DAMPER BODY
3. COMPENSATOR BODY
4. SPHERICAL RETURN VALVE
5. FILLER PLUG
6. ROD WITH PISTON
7. UPPER COVER
8. SPHERICAL VALVE SPRING
9. COMPENSATOR ROD SPRINGS
10. PISTON PACKING RING
11. COMPENSATOR BODY PACKING RING
12. RESTRICTING BUSH
13. SHIMMY DAMPER BODY PACKING RING
14. COVER
15. GUIDE
16. RETURN VALVE
17. THROTTLE PLATE
18. ATTACHMENT LUG
19. PISTON
20. SIDE BORE IN PISTON
21. RUBBER COLLAR

FIG. 76. SHIMMY DAMPER

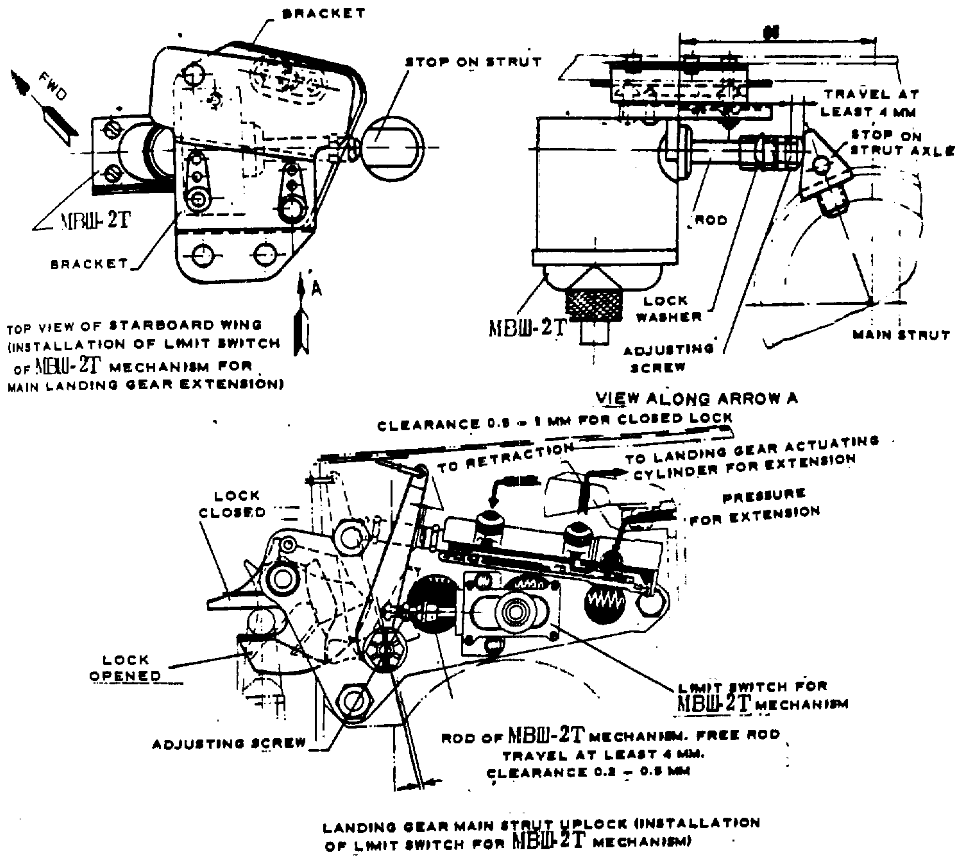


FIG. 77. ADJUSTMENT OF MAIN STRUT POSITION INDICATING SYSTEM

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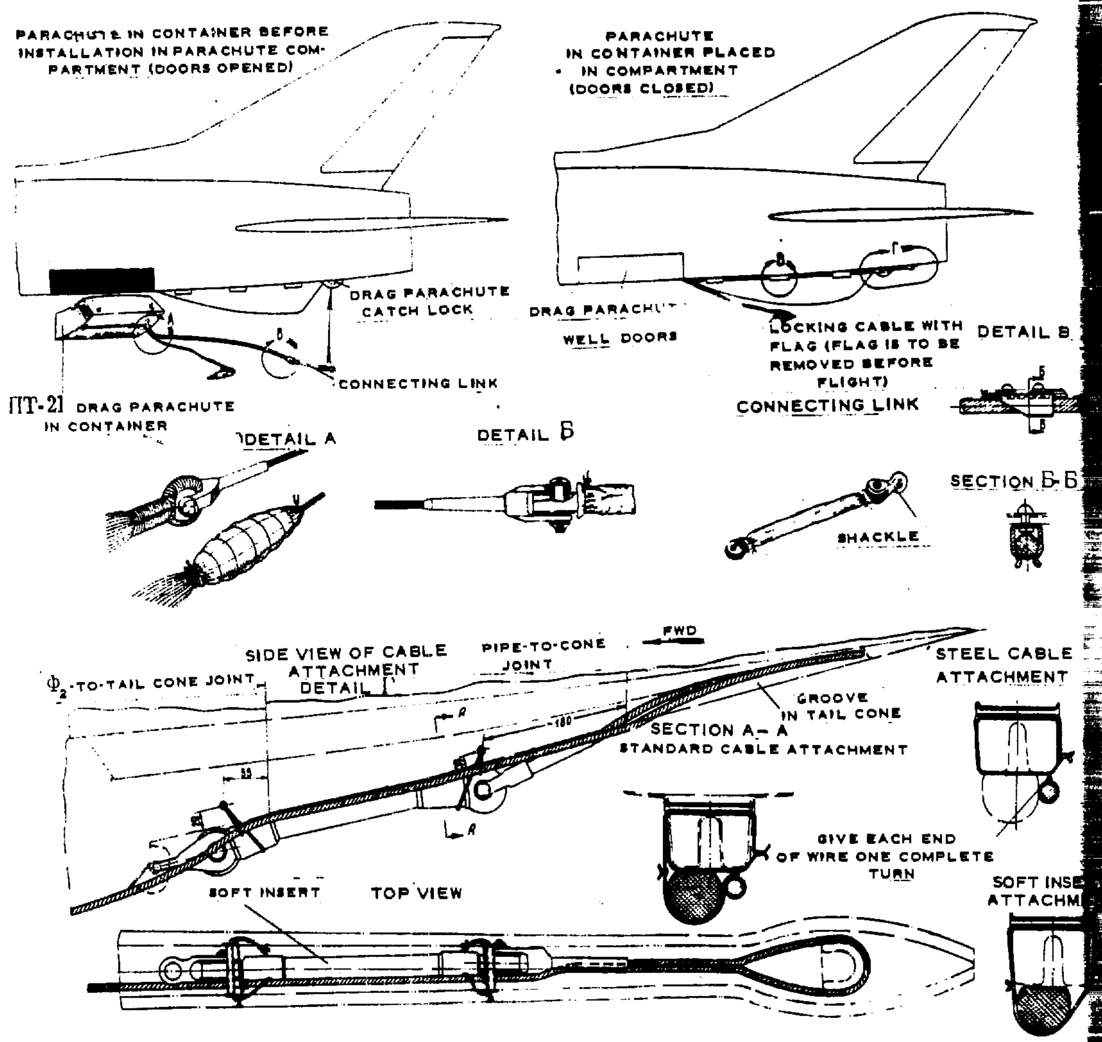


FIG. 78. INSTALLATION OF CONTAINER WITH DRAG PARACHUTE IN PARACHUTE COMPARTMENT

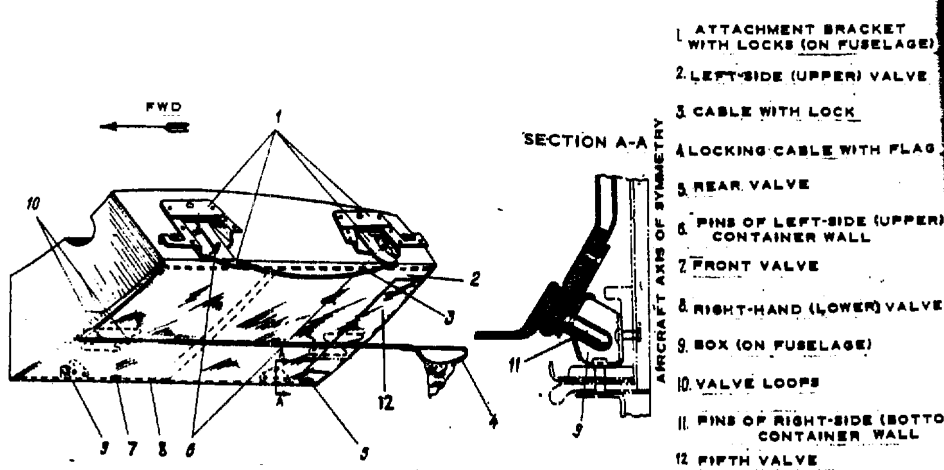


FIG. 79. DRAG PARACHUTE CONTAINER ATTACHMENT

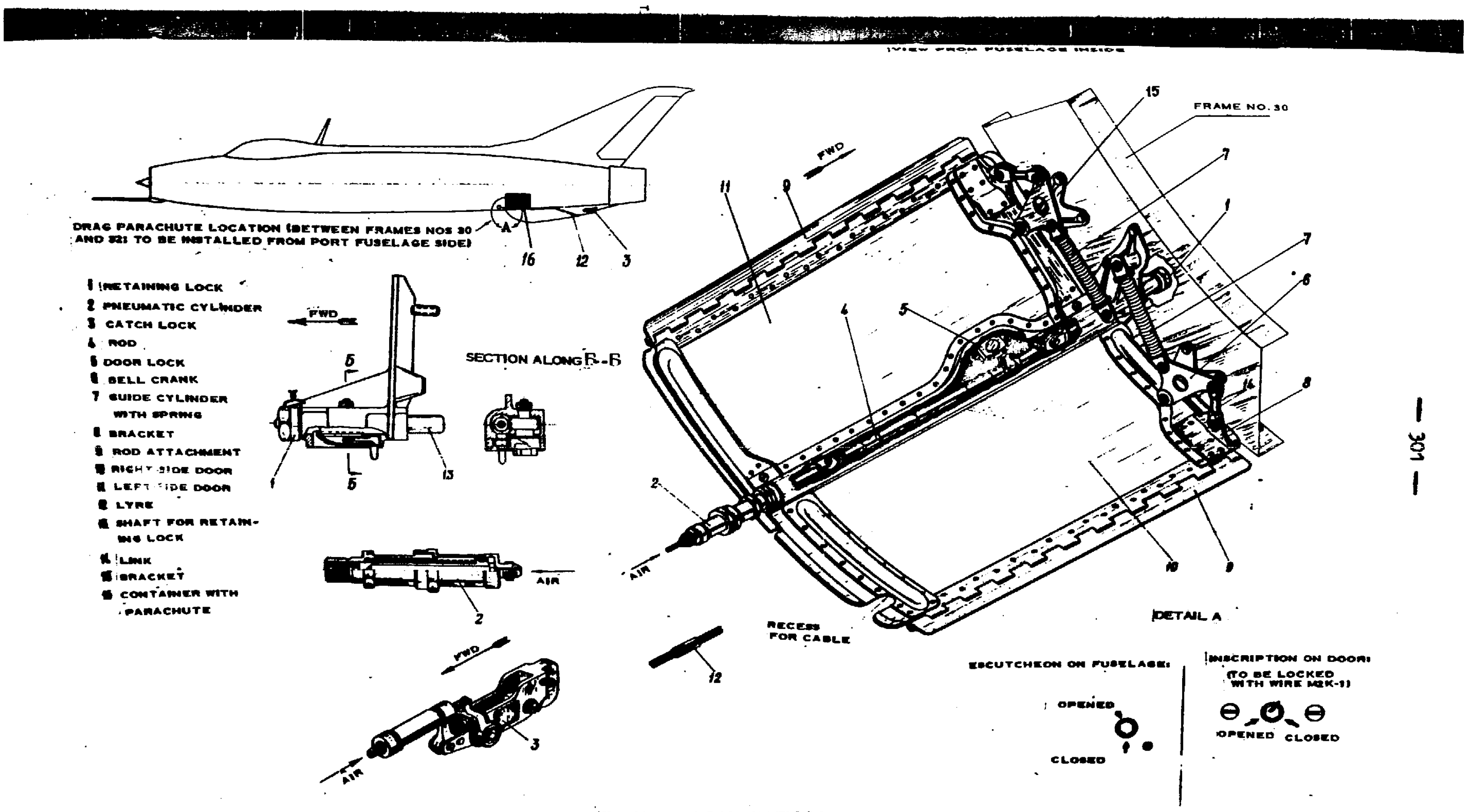
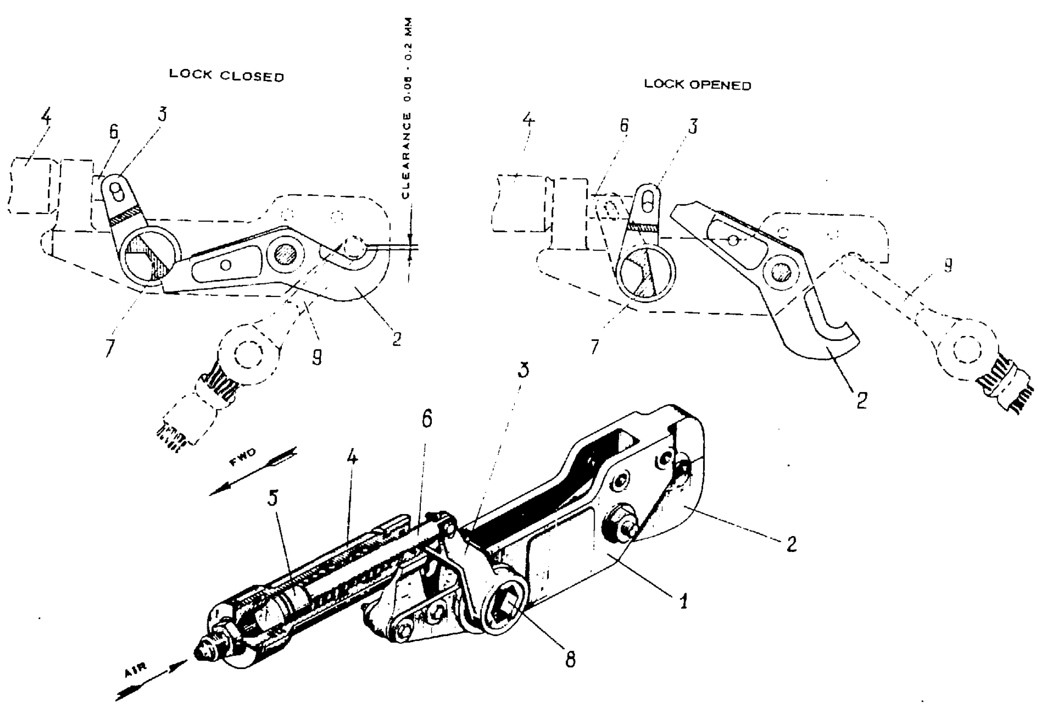


FIG. 80. DRAG PARACHUTE DOORS

[redacted]



1 LOCK BODY
2 MOVABLE HOOK
3 BELL CRANK
4 PNEUMATIC CYLINDER
5 PISTON
6 ROD
7 THRUST AXLE
8 SEAT FOR SOCKET WRENCH
9 CABLE WITH RING FOR DRAG PARACHUTE SHACKLE

FIG. 81. DRAG PARACHUTE CATCH LOCK

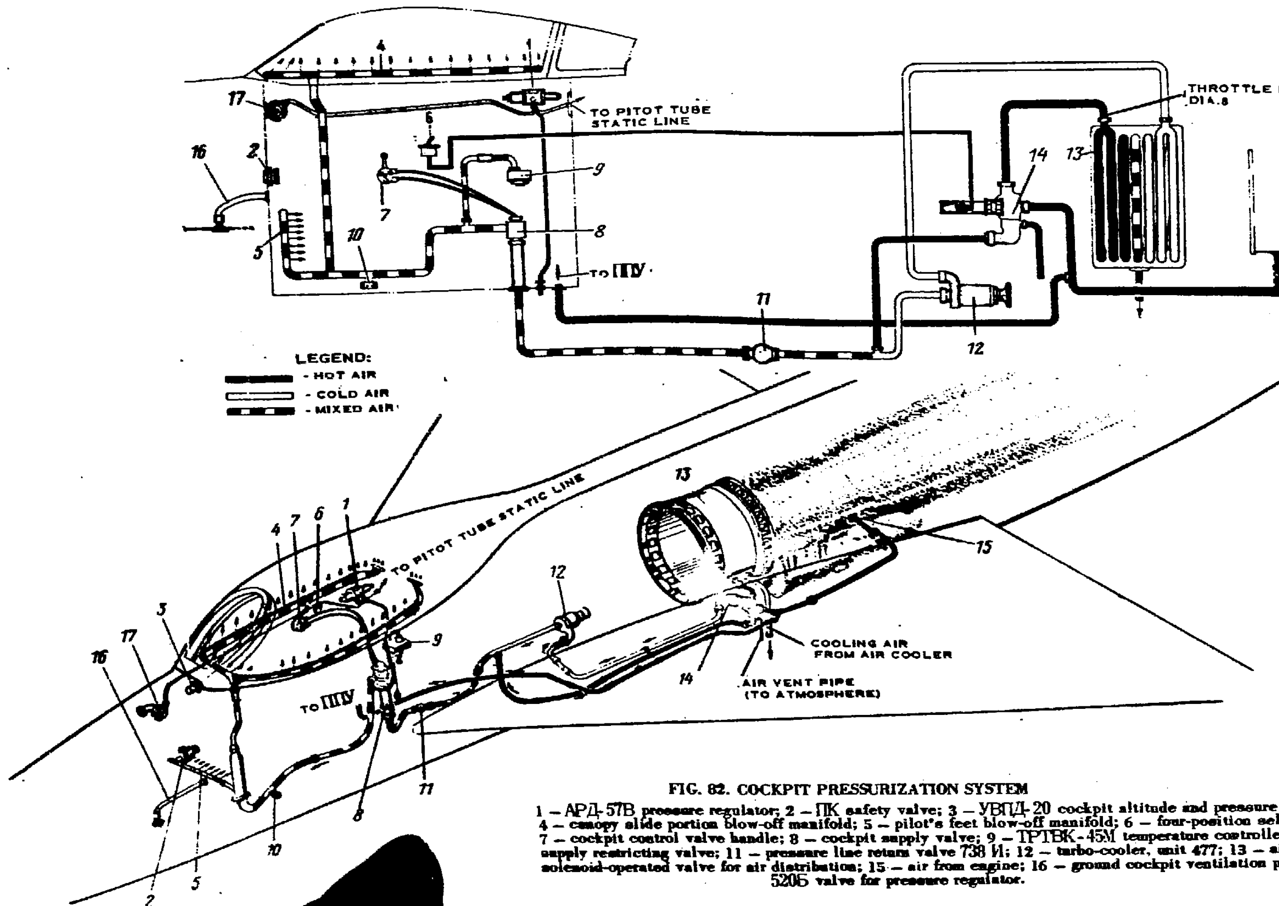


FIG. 82. COCKPIT PRESSURIZATION SYSTEM

1 – АРД-57В pressure regulator; 2 – ПК safety valve; 3 – УВПД-20 cockpit altitude and pressure drop indicator; 4 – canopy slide portion blow-off manifold; 5 – pilot's feet blow-off manifold; 6 – four-position selector switch; 7 – cockpit control valve handle; 8 – cockpit supply valve; 9 – ТРТВК-45М temperature controller; 10 – air supply restricting valve; 11 – pressure line return valve 738 И; 12 – turbo-cooler, unit 477; 13 – air cooler; 14 – solenoid-operated valve for air distribution; 15 – air from engine; 16 – ground cockpit ventilation pipe; 17 – 520Б valve for pressure regulator.

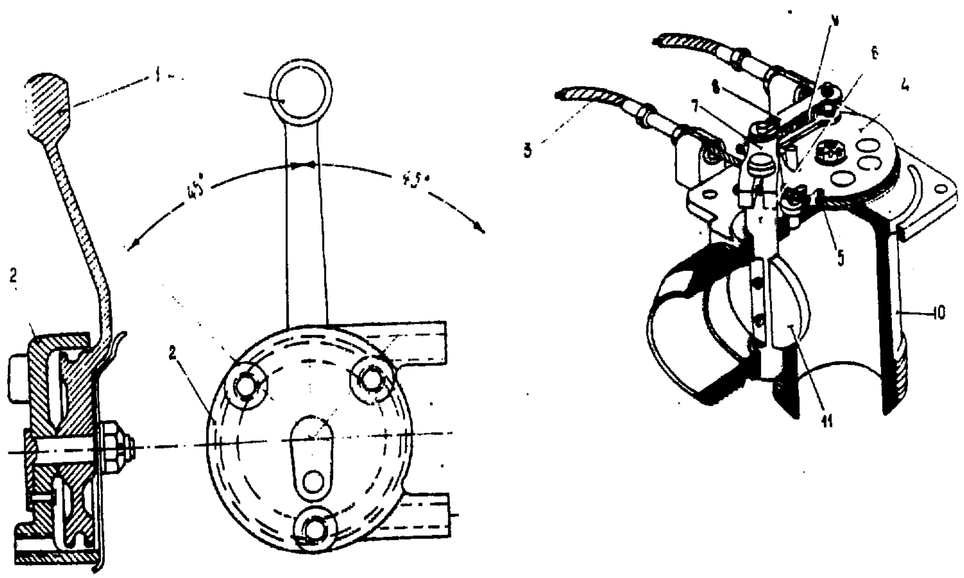


FIG. 83. COCKPIT AIR SUPPLY VALVE

1 – supply valve control handle; 2 – supply valve body; 3 – bowden cable; 4 – roller; 5 – small cylinder; 6 – axle; 7 – guide; 8 – link; 9 – spring; 10 – shut-off valve; 11 – flap.

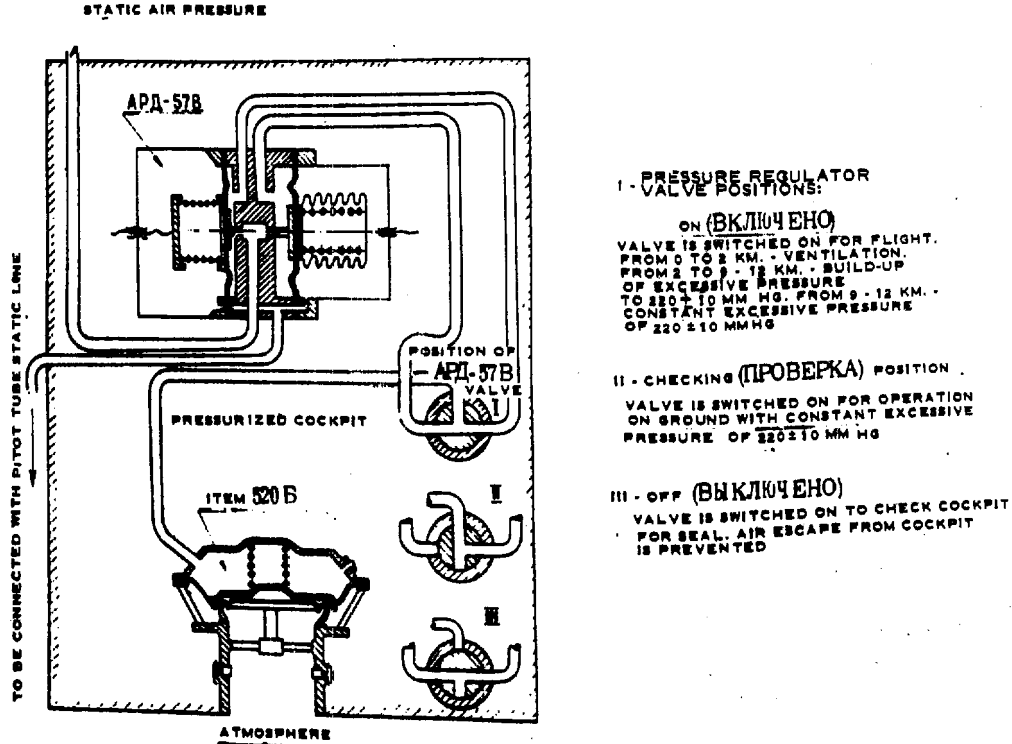
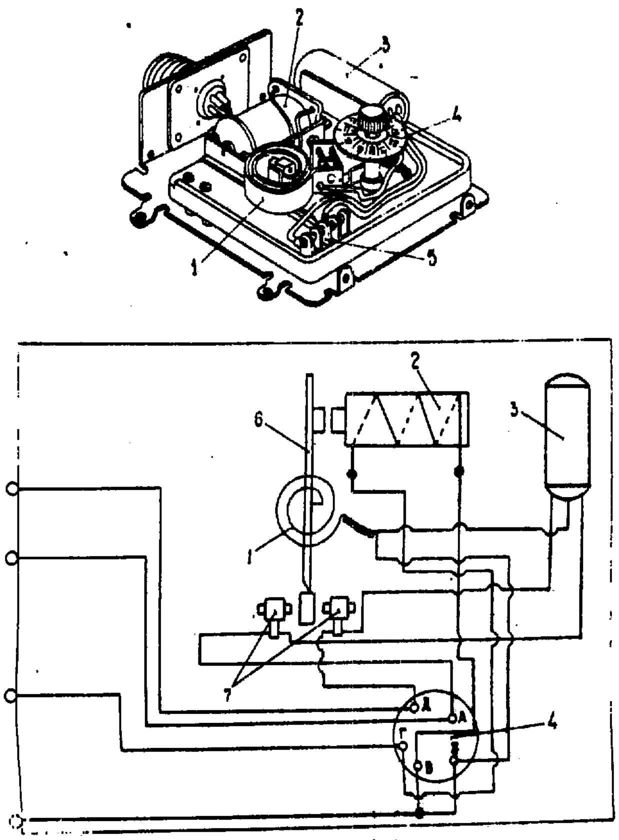


FIG. 84. KEY DIAGRAM SHOWING OPERATION OF АРД-57В PRESSURE REGULATOR WITH 520Б VALVE



1 BIMETALLIC SPIRAL WITH ARMATURE
2 FEEDBACK ELECTROMAGNET
3 SPARK-QUENCHING CAPACITOR
4 LIMB
5 CONTACTOR PANEL
6 SLIDE CONTACT
7 STATIONARY CONTACT

FIG. 85. TPTBK-45M Temperature Controller

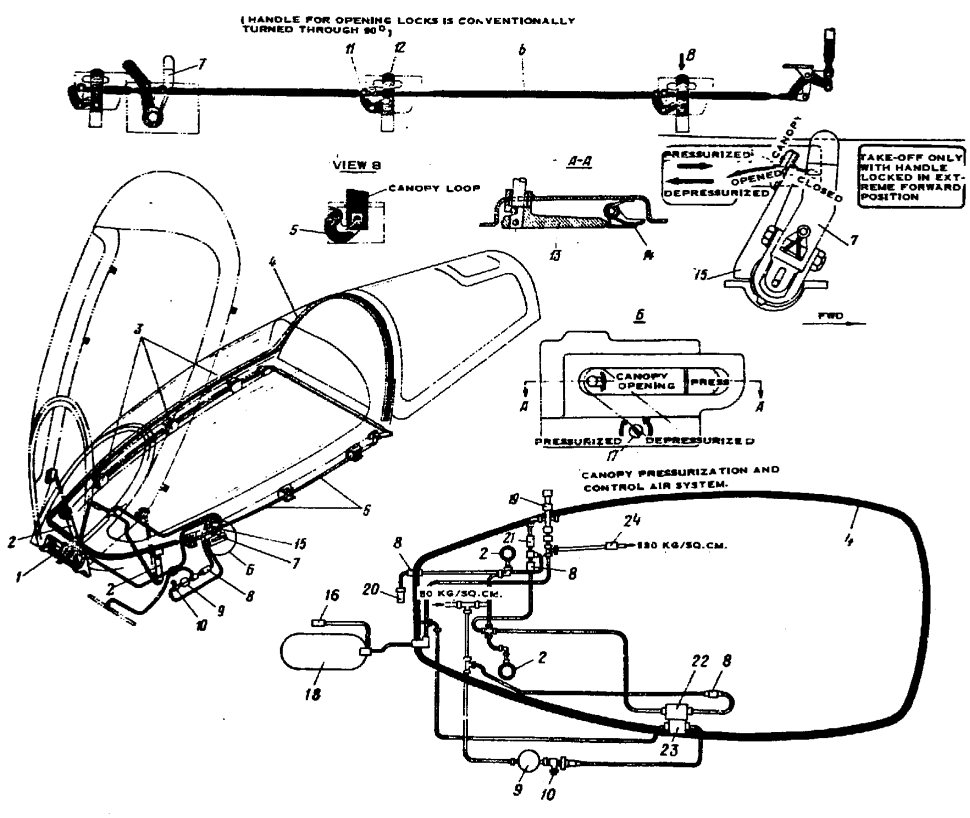


FIG. 86. CANOPY PRESSURIZATION AND CONTROL SYSTEM

1 – bracket for front hinged locks; 2 – canopy actuating cylinders; 3 – canopy-to-fuselage attachment locks; 4 – canopy pressurization hose; 5 – closing pin retainer (on left-hand side); 6 – control rod for side locks; 7 – canopy control lever; 8 – return valve; 9 – PB-1.5 reducing valve; 10 – safety and return valves; 11 – lever for side lock closing pin; 12 – side lock closing pin; 13 – handle for canopy external opening; 14 – latch for locking canopy external opening handle; 15 – canopy sealing actua[illegible] – filler pipe union; 17 – slot for cockpit outside pressurization and depressurization; 18 – emergency air bottle; 19 – emer[illegible]ency [illegible]aphragm [illegible]valve; 20 – time-lock actuating cylinder; 21 – fragmentation filter; 22 – chamber for canopy control; 23 – cha[illegible]er for canopy pressurization; 24 – return valve for air system and canopy emergency jettison system.

INSET No. 3

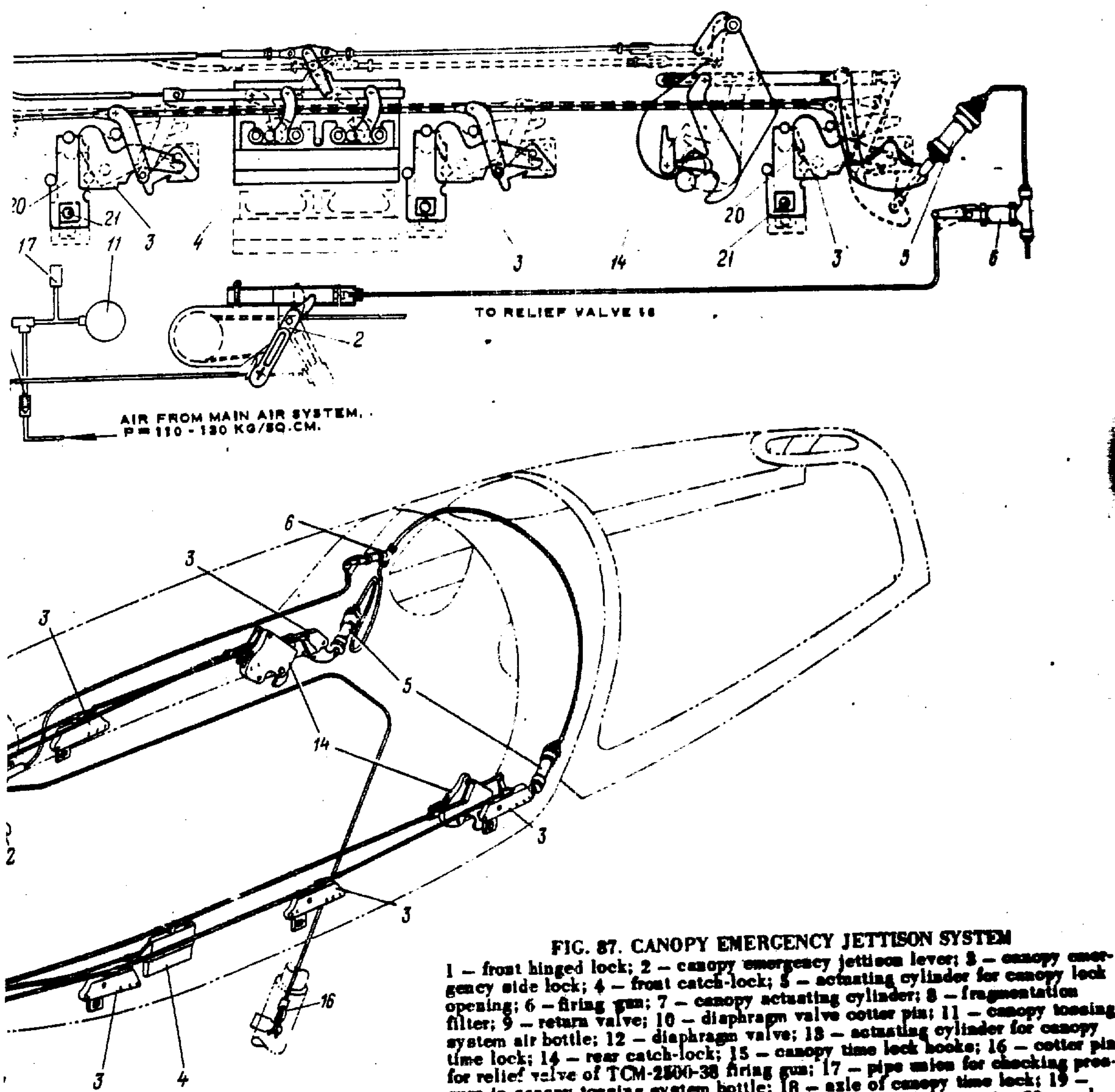
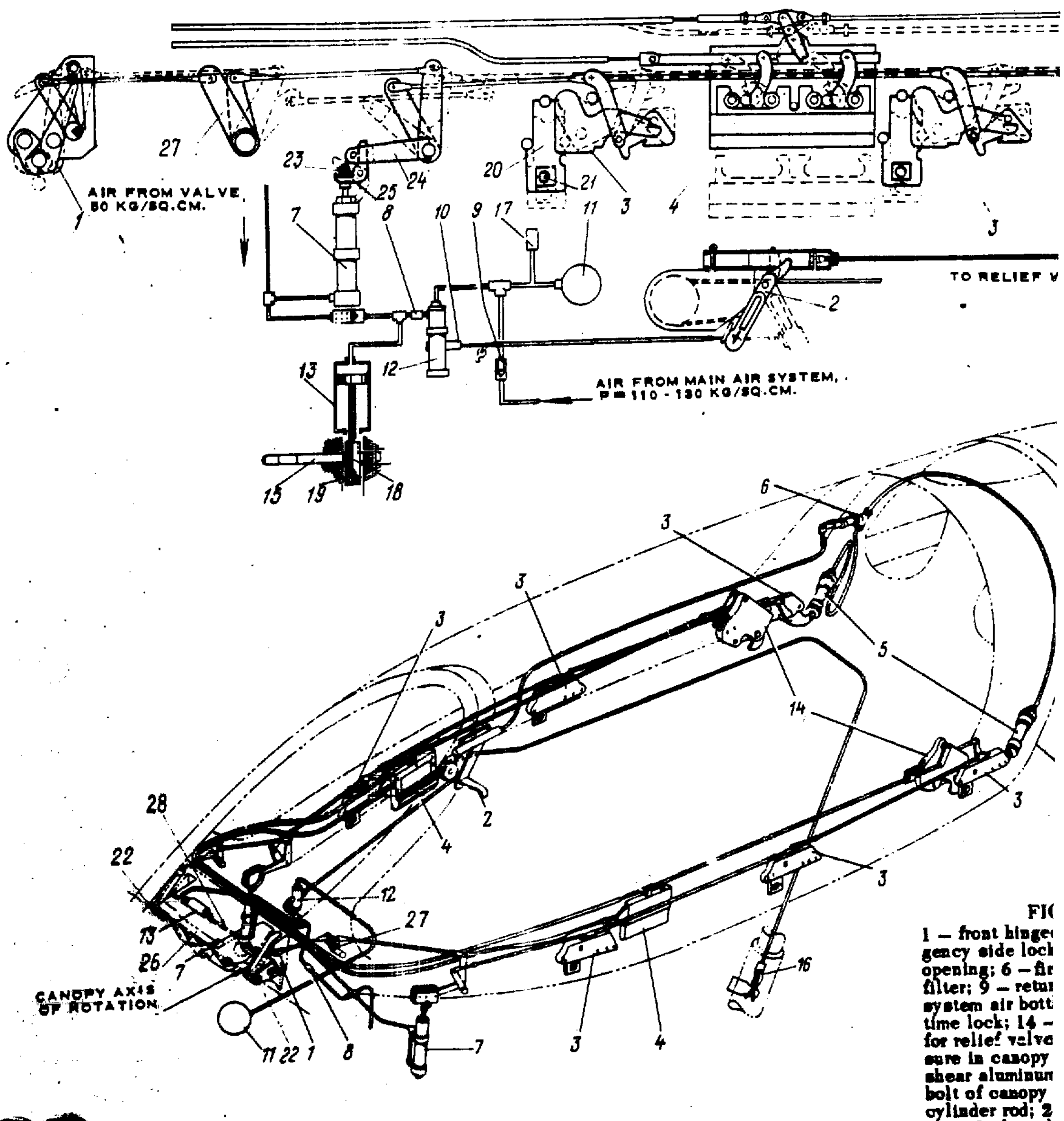


FIG. 87. CANOPY EMERGENCY JETTISON SYSTEM

1 – front hinged lock; 2 – canopy emergency jettison lever; 3 – canopy emergency side lock; 4 – front catch-lock; 5 – actuating cylinder for canopy lock opening; 6 – firing gun; 7 – canopy actuating cylinder; 8 – fragmentation filter; 9 – return valve; 10 – diaphragm valve cotter pin; 11 – canopy tossing system air bottle; 12 – diaphragm valve; 13 – actuating cylinder for canopy time lock; 14 – rear catch-lock; 15 – canopy time lock hooks; 16 – cotter pin for relief valve of TCM-2500-38 firing gun; 17 – pipe union for checking pressure in canopy tossing system bottle; 18 – axle of canopy time lock; 19 – shear aluminum rivet 3520A-2-6; 20 – loop of side lock; 21 – pin; 22 – axle-bolt of canopy attachment; 23 – pin for attachment of canopy to actuating cylinder rod; 24 – double-arm bell crank of canopy emergency jettison system; 25 – C-shaped hook; 26 – hinged joint with two front locks; 27 – double-arm lever; 28 – axle of front lock rotation.



FI(
1 — front hinge(
gency side lock
opening; 6 — fir
filter; 9 — retu
system air bott
time lock; 14 —
for relief valve
sure in canopy
shear aluminum
bolt of canopy
cylinder rod; 2
25 — C-shaped
lever; 28 — axi

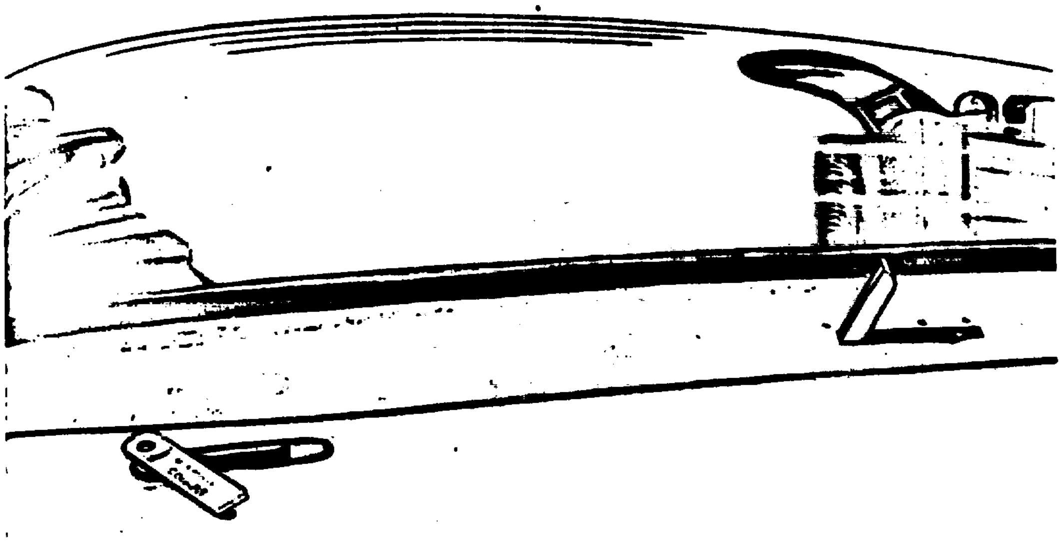


FIG. 88. HANDLE FOR CANOPY EXTERNAL OPENING (LEFT-SIDE HANDLE). HANDLE FOR CANOPY OPENING IN NO-PRESSURE CONDITIONS (RIGHT-SIDE HANDLE)

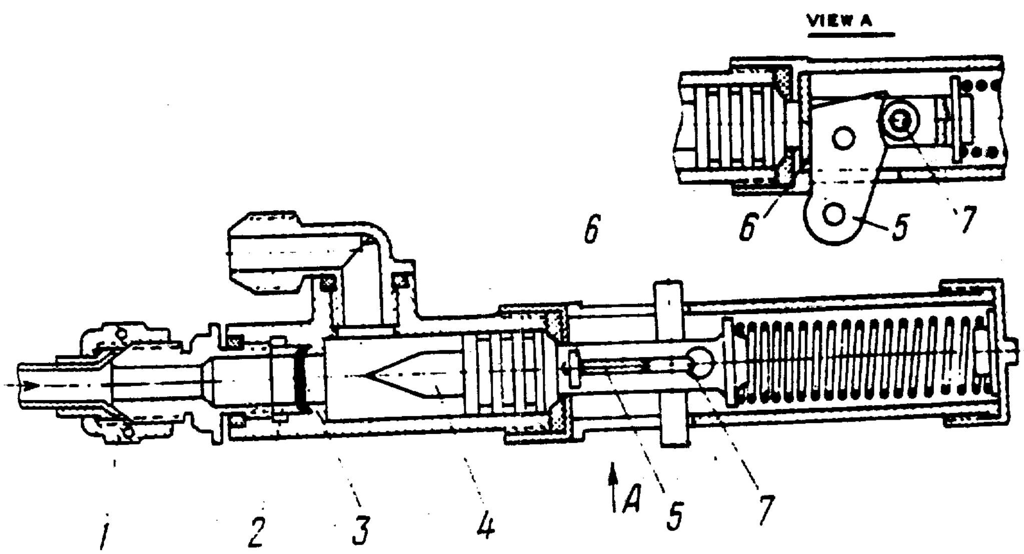


FIG. 89. DIAPHRAGM (EMERGENCY) VALVE

1 – union nut; 2 – bush with diaphragm; 3 – diaphragm of steel 1x18H9T-Л10.1; 4 – striker; 5 – cotter pin; 6 – float washer; 7 – roller.

[redacted]

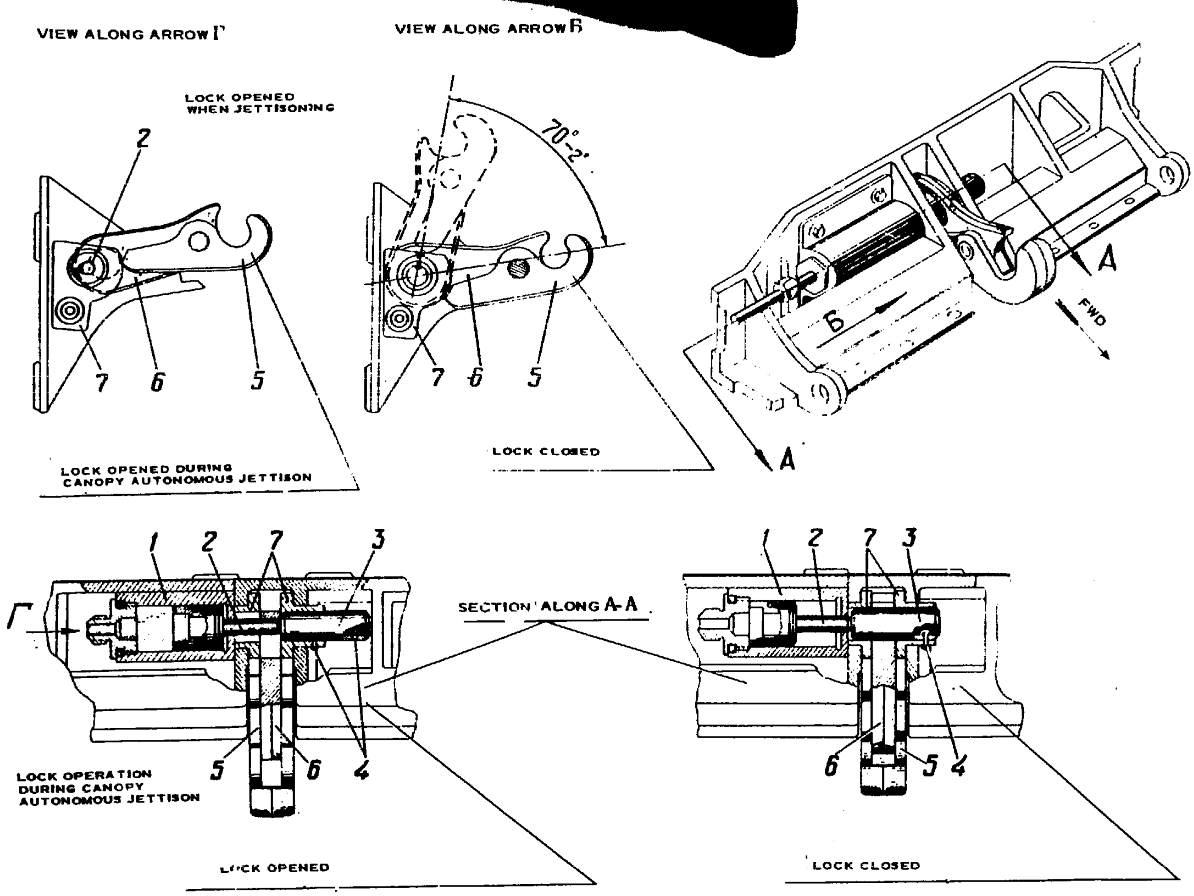


FIG. 90. CANOPY TIME LOCK

1 – pneumatic cylinder; 2 – piston and rod; 3 – lock axle; 4 – shear aluminum rivet 3520A-2-6; 5 – hook; 6 – clamp; 7 – bushing with flat

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1 — pneumatic cylinder, 2 — piston and rod, 3 —

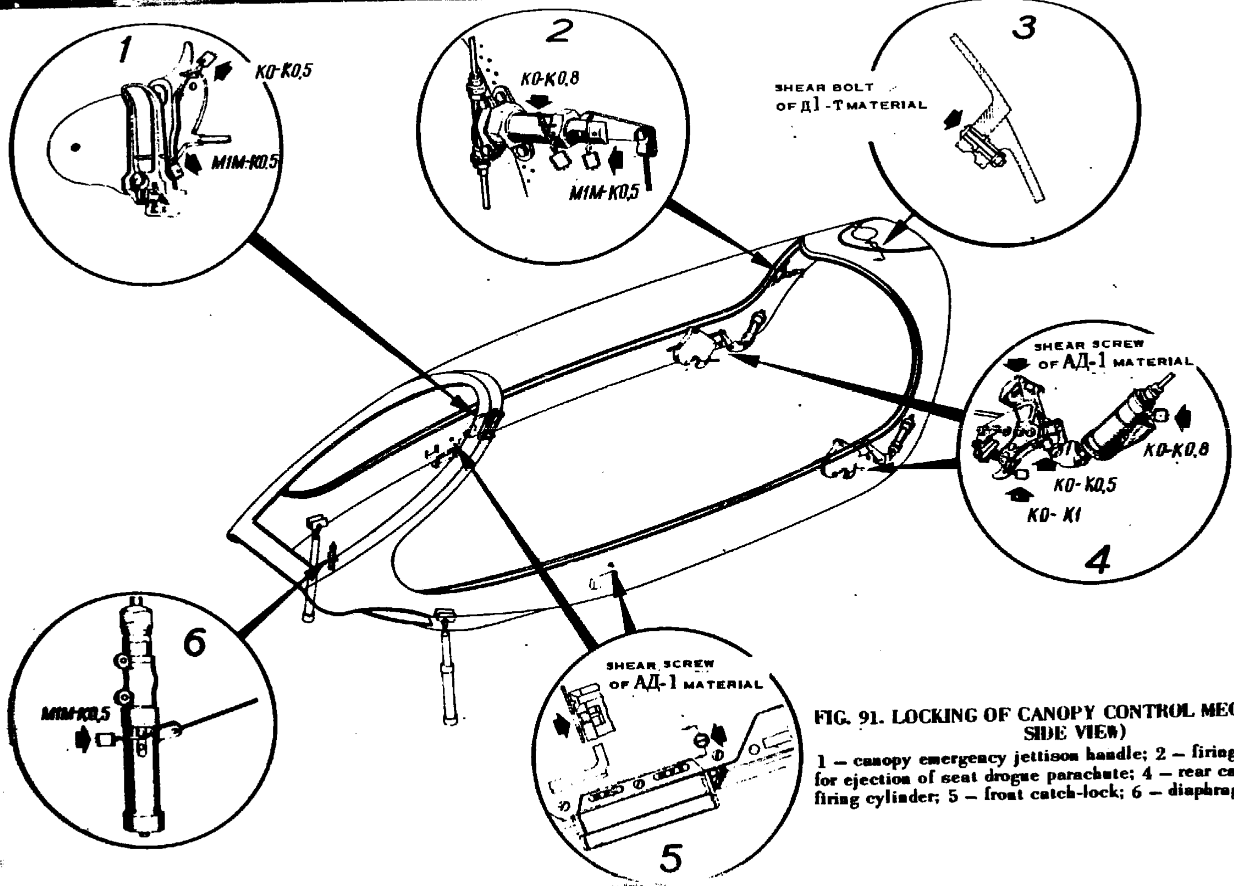

FIG. 91. LOCKING OF CANOPY CONTROL MECHANISM (LEFT SIDE VIEW)

1 — canopy emergency jettison handle; 2 — firing gun; 3 — hatch for ejection of seat drogue parachute; 4 — rear catch-lock with firing cylinder; 5 — front catch-lock; 6 — diaphragm valve.

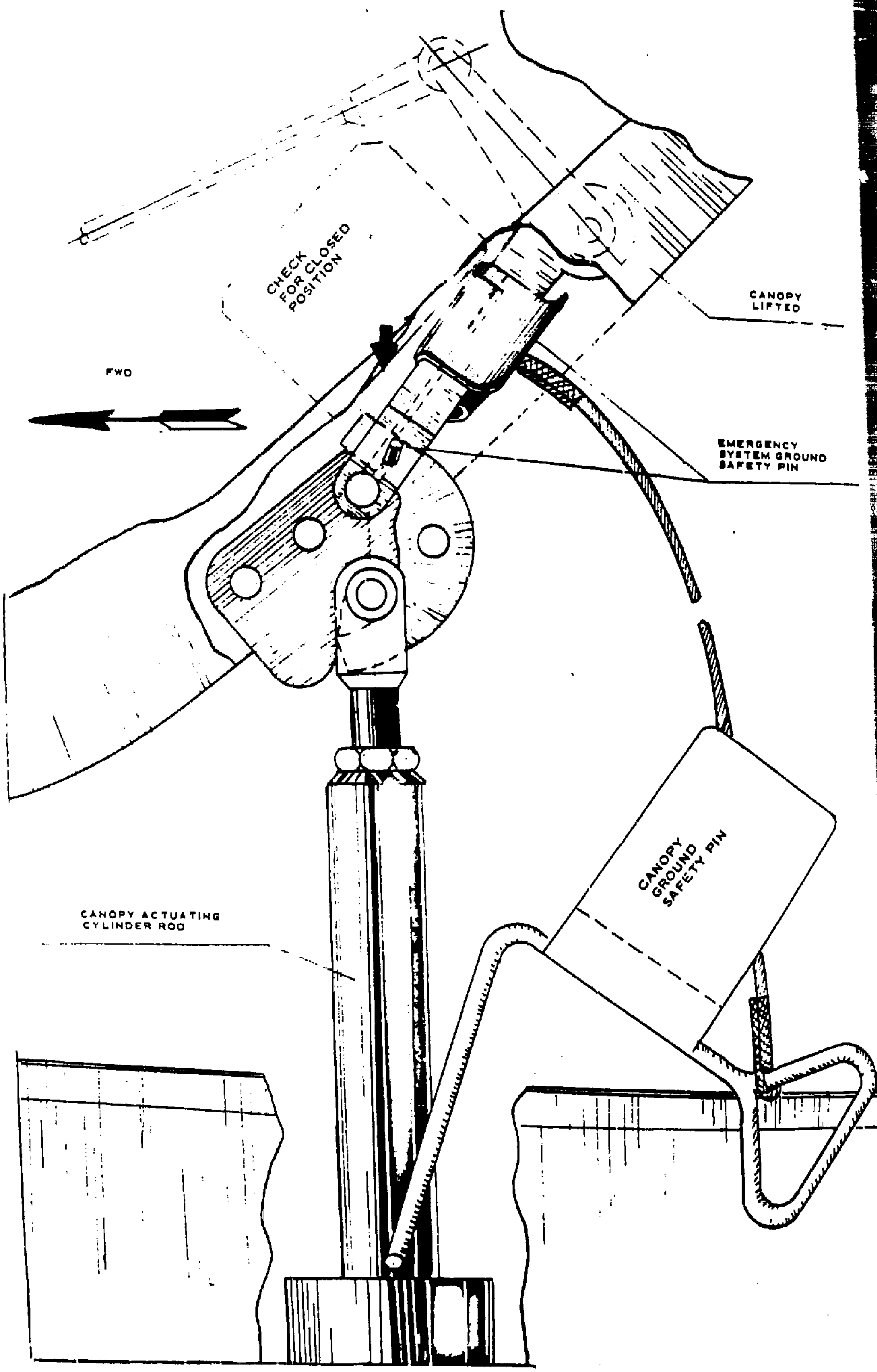

FIG. 92. GROUND SAFETY PIN INSTALLATION

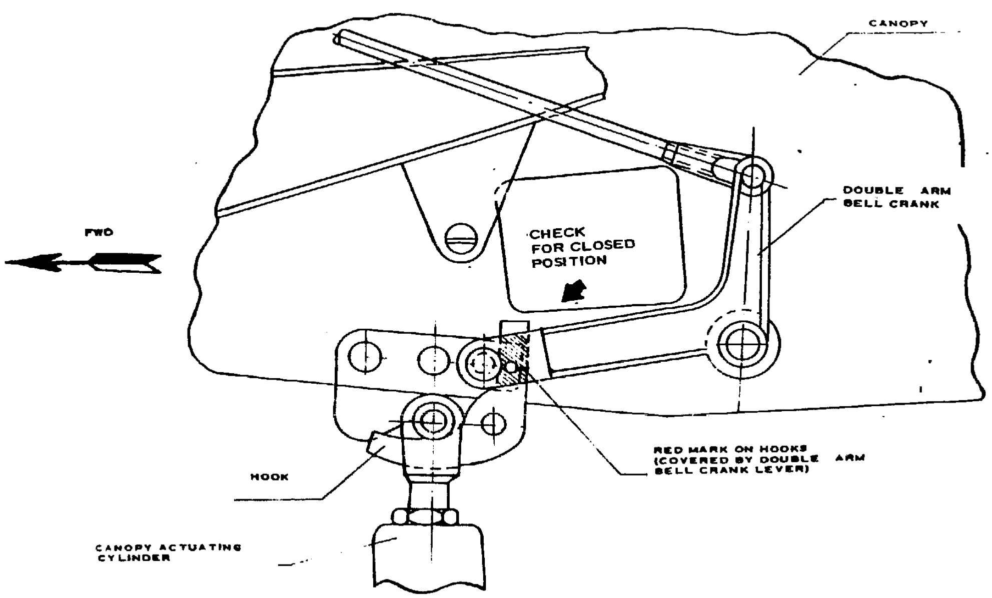

FIG. 93. CHECKING CANOPY EMERGENCY JETTISON SYSTEM FOR CLOSED POSITION

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[redacted]

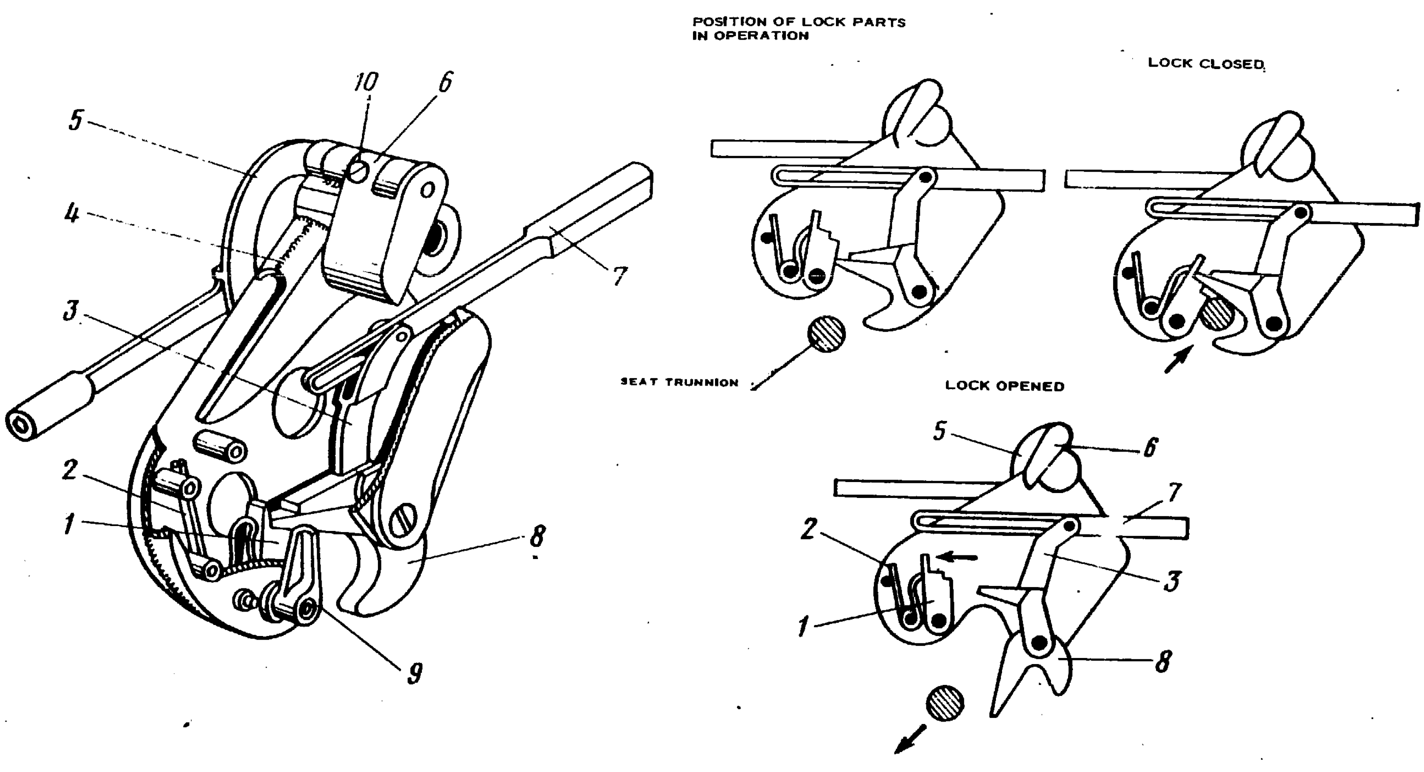

FIG. 94. REAR CATCH-LOCK

1 -- stop; 2 — spring; 3 — lever; 4 — body; 5 — bell crank; 6 — trigger; 7 — push rod; 8 — hook; 9 — guide; 10 — shear screw, of АД-1 material, sheared dia. 3 mm, to be screwed in position with previous application of zink white based on boiled oil.

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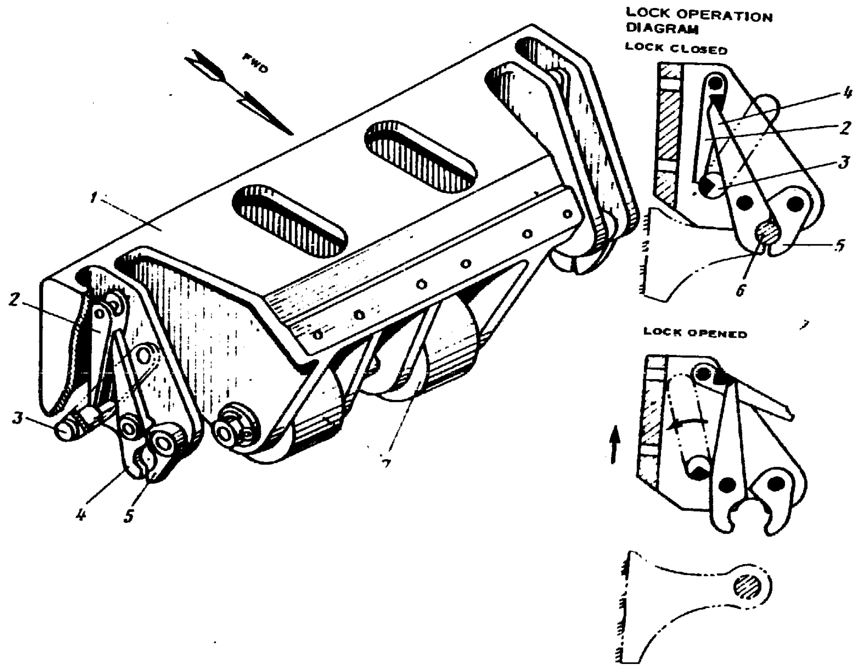


FIG. 95. FRONT HINGED LOCK
1 – bracket; 2 – closing lever; 3 – bell crank with sector shaft; 4 – larger catch; 5 – smaller catch; 6 – canopy attachment bolt; 7 – rollers.

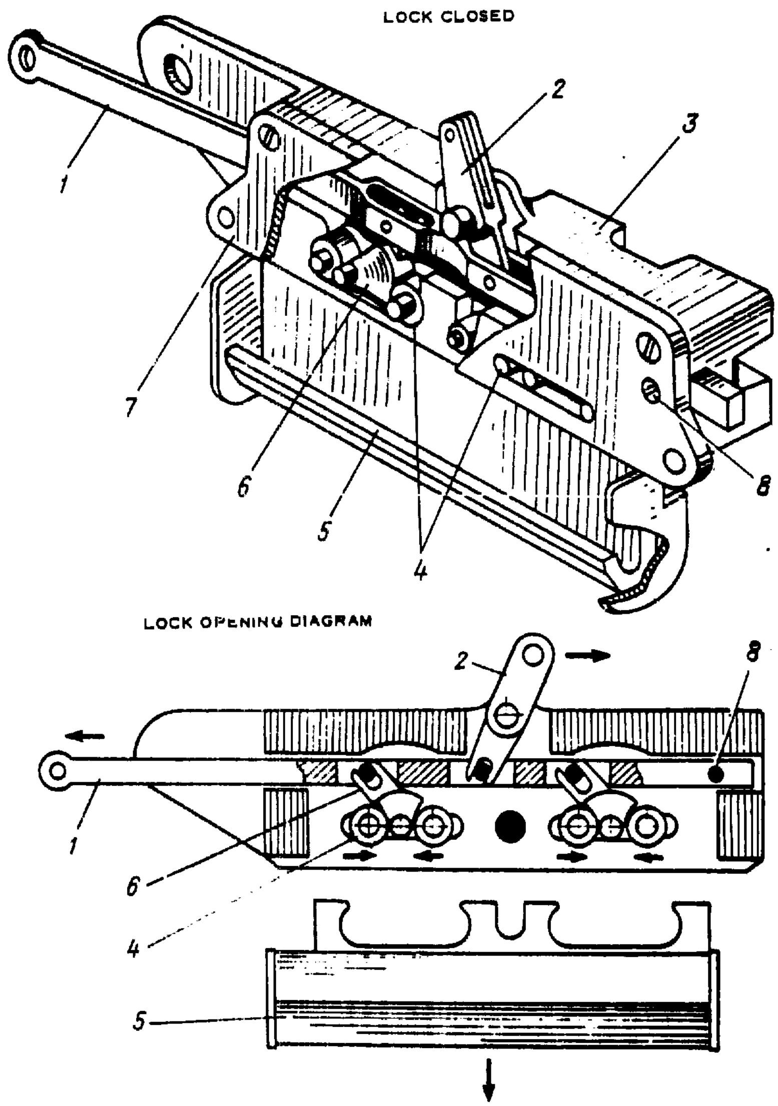


FIG. 96. FRONT CATCH-LOCK
1 – rack; 2 – drive bell crank; 3 – body; 4 – roller; 5 – catch; 6 – cam; 7 – cover; 8 – shear bolt made of АД-1 material, dia. 2 mm.

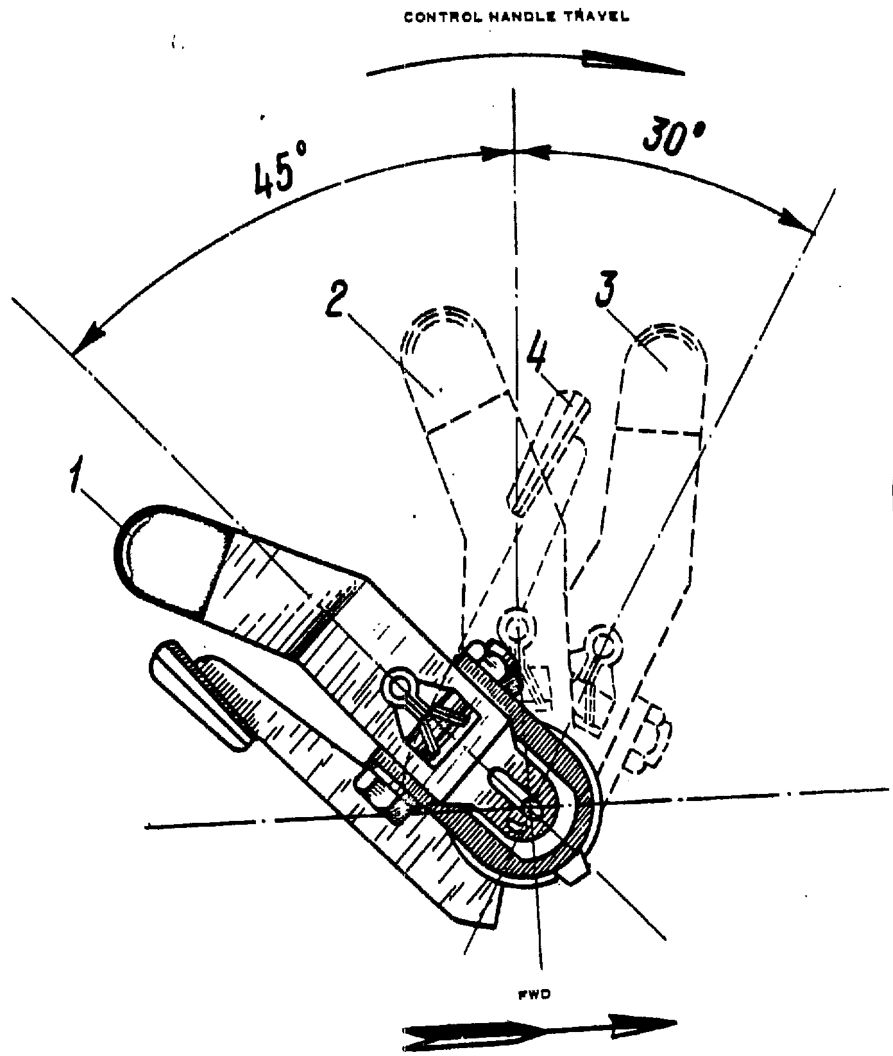


FIG. 97. OPERATION OF CANOPY CONTROL VALVE AND LOCKS WHEN CONTROL HANDLE IS MOVED FORWARD (TO CLOSE CANOPY)

1 – canopy lifted; while moving handle to position 2, air is released from canopy actuating cylinders; 2 – handle locked up until the canopy is completely lowered and retaining pin depressed; handle movement to position 3 causes closing of side lock loops by pins; 3 – canopy lowered, side lock loops closed by pins, canopy depressurized. Moving actuator to position 4 fills canopy sealing hose with air; 4 – canopy pressurized.

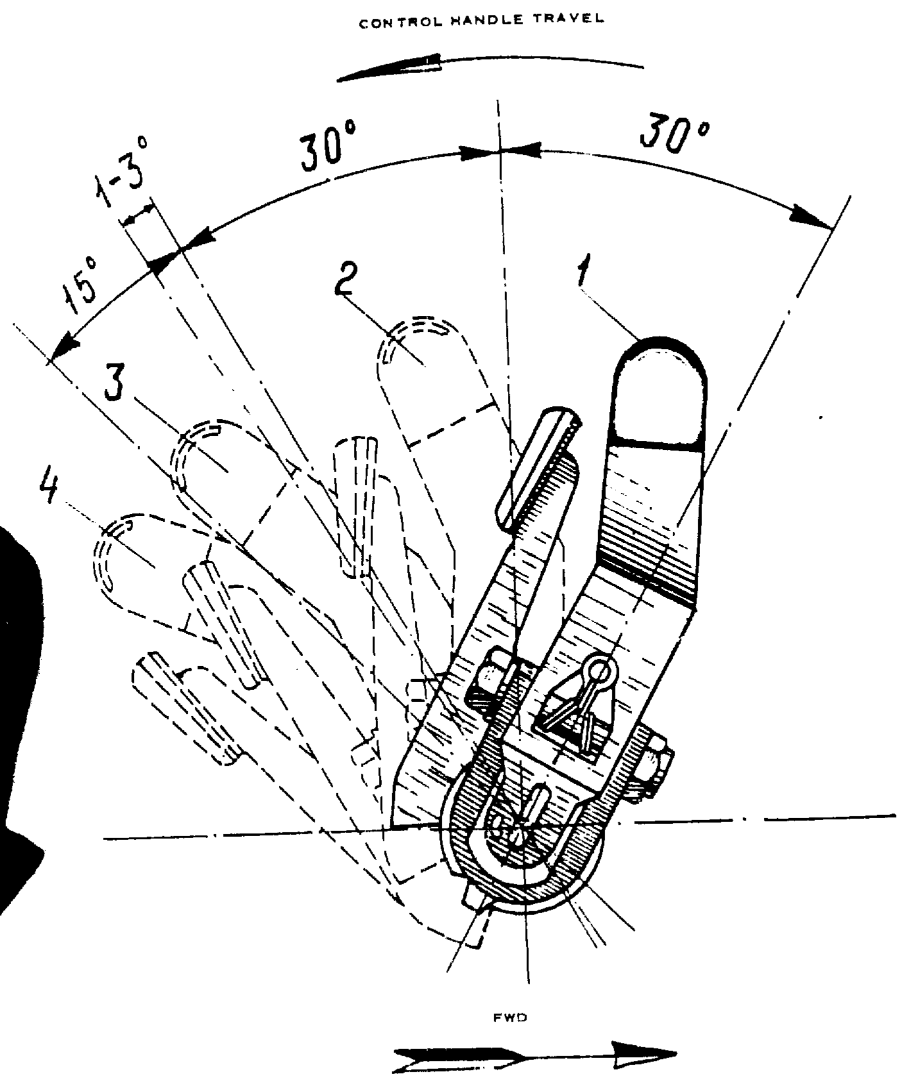


FIG. 98. OPERATION OF CANOPY CONTROL AND PRESSURIZING VALVE WHEN MOVING CONTROL HANDLE REARWARD

1 – canopy closed and pressurized. As control handle and actuator move to position 2 canopy is depressurized; 2 – canopy depressurized. As control handle moves from position 2 to position 3 closing pins come out of side lock loops; 3 – canopy not lifted, though closing pins have come out of side lock loops. Pulling control handle from position 3 to position 4 lifts the canopy (air is supplied to actuating cylinders). Control handle travel within 3° to 6° is a free travel necessary to prevent accumulation of air in actuating cylinders previous to pins leaving lock loops; 4 – canopy lifted.

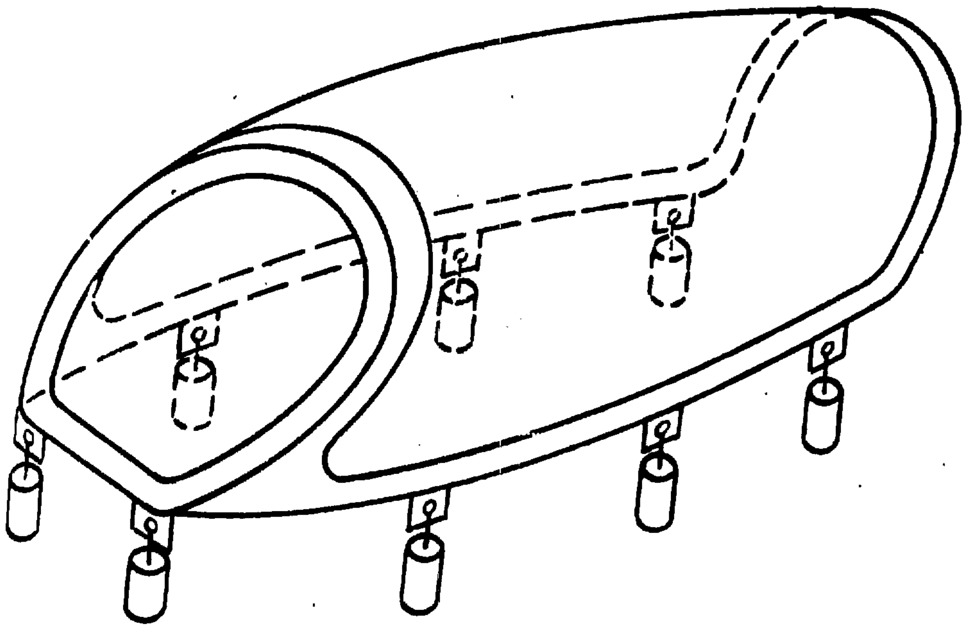
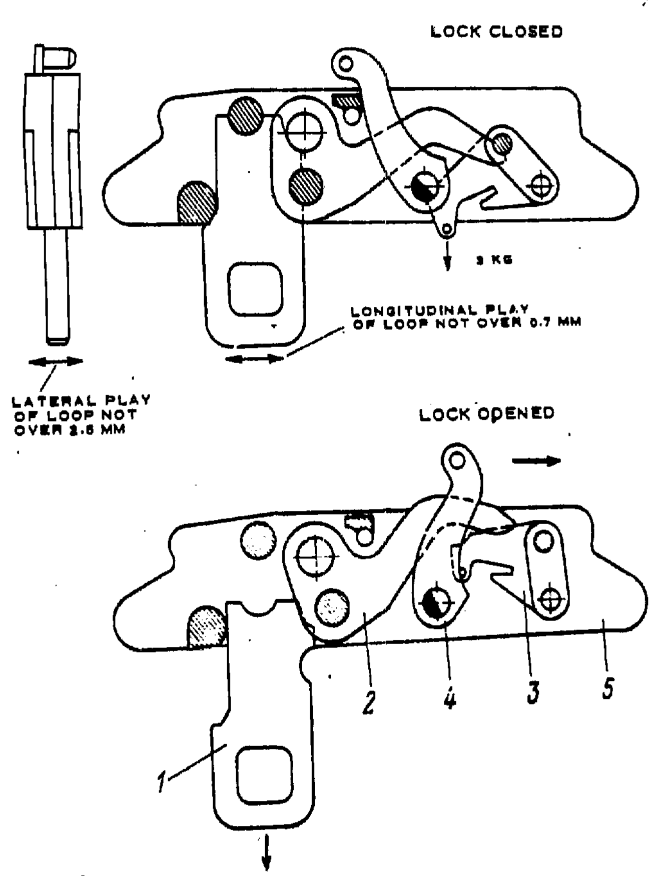
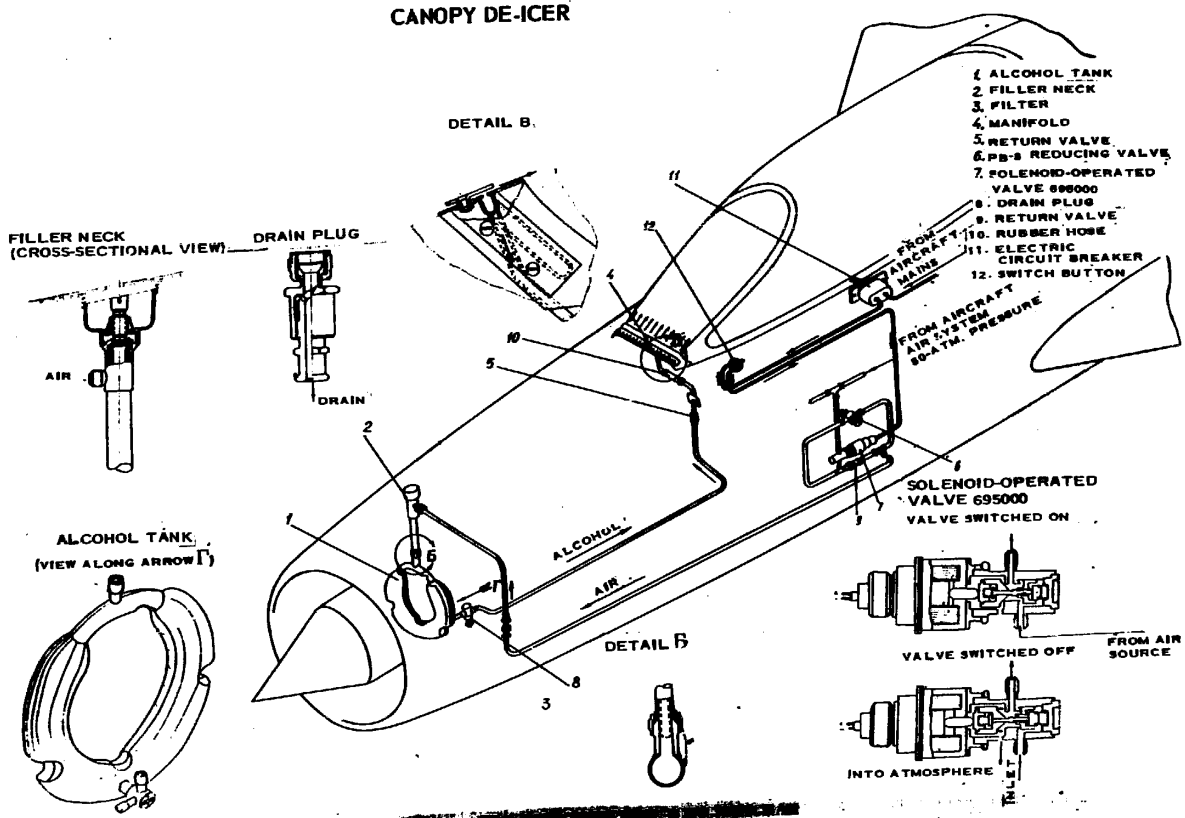


FIG. 99. SUSPENSION OF LOADS WHEN CHECKING OPERATION OF EMERGENCY LOCKS



CANOPY DE-ICER



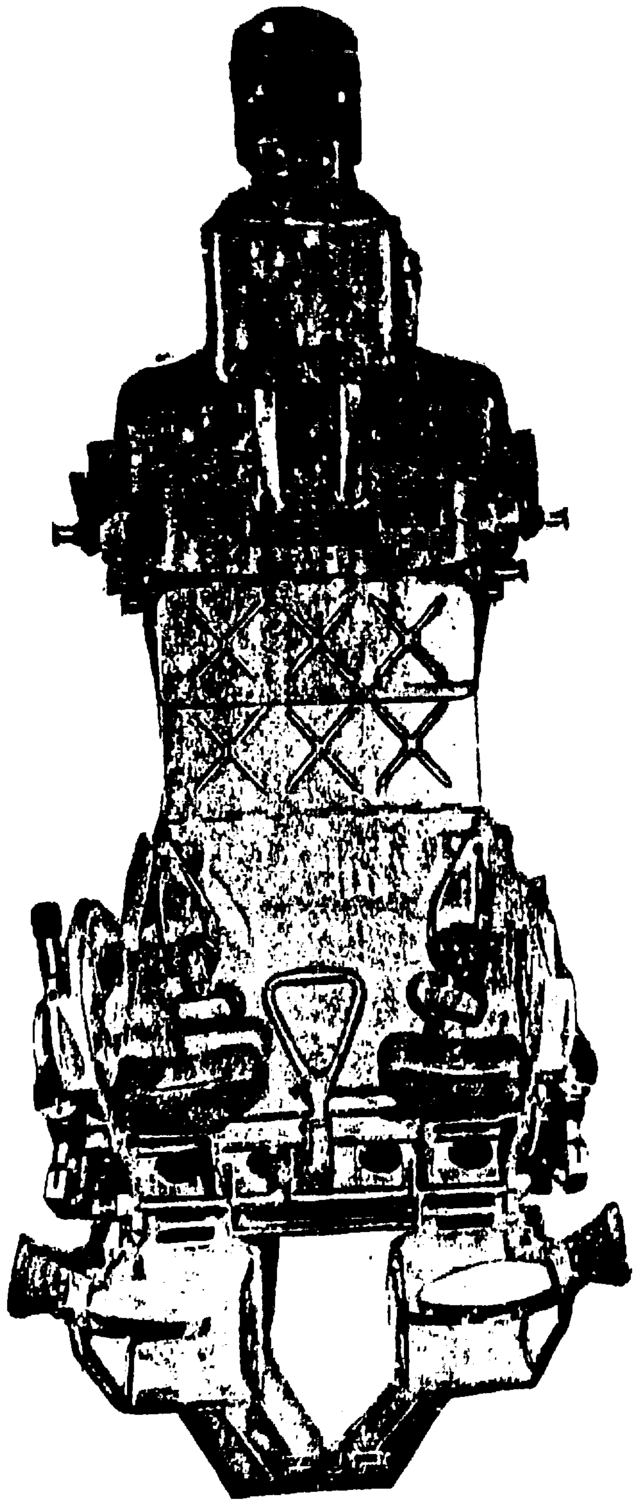


FIG. 102. EJECTION SEAT

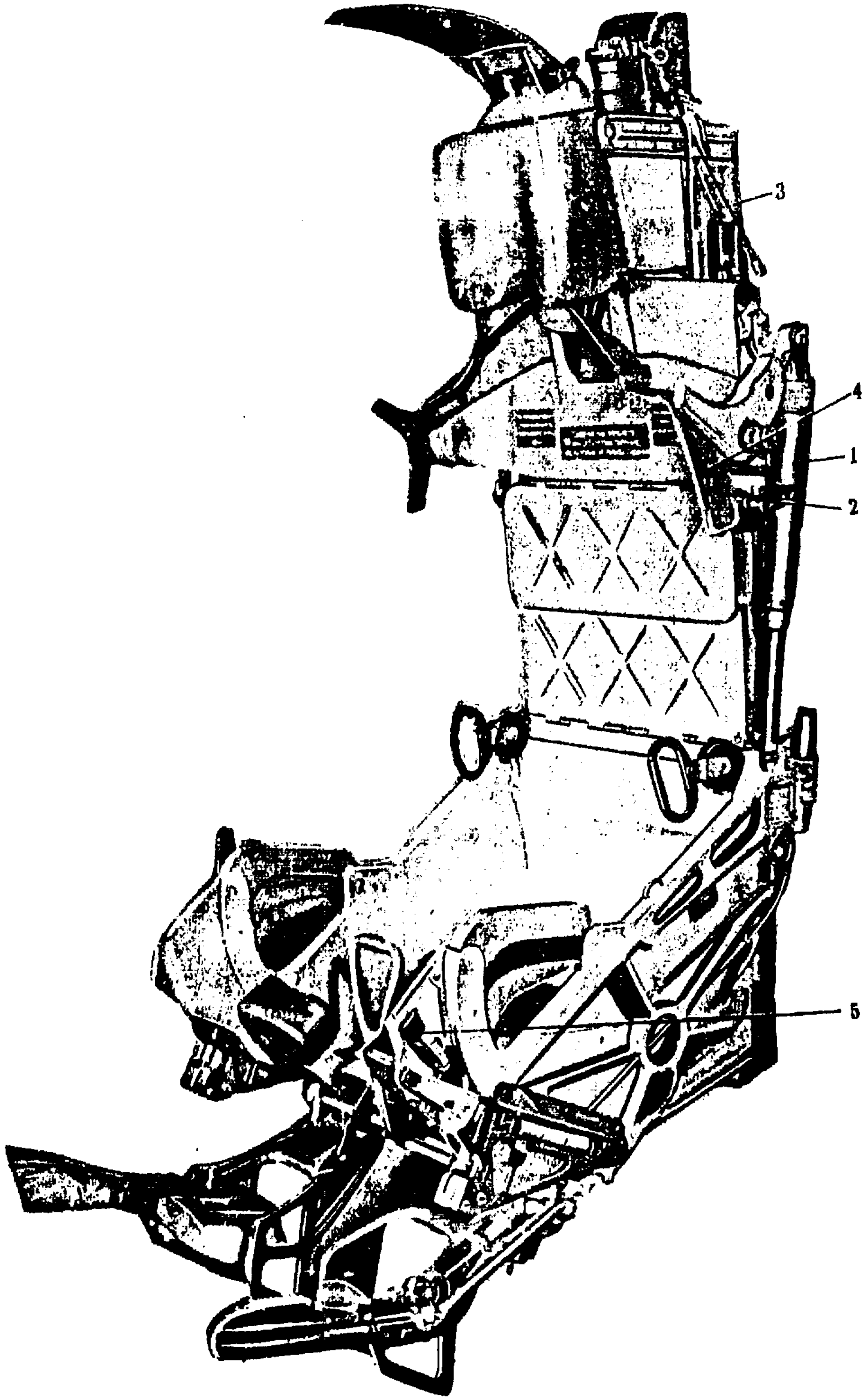


FIG. 108. EJECTION SEAT (FRONT LEFT-SIDE VIEW, ASPECT ANGLE 3/4)
1 – 215Φ firing mechanism; 2 – upper cross shaft control lever for opening pilot's restraint locks; 3 – cable for cotter pin of 215Π firing mechanism; 4 – shoulder restraint straps; 5 – shoulder restraint control handle.

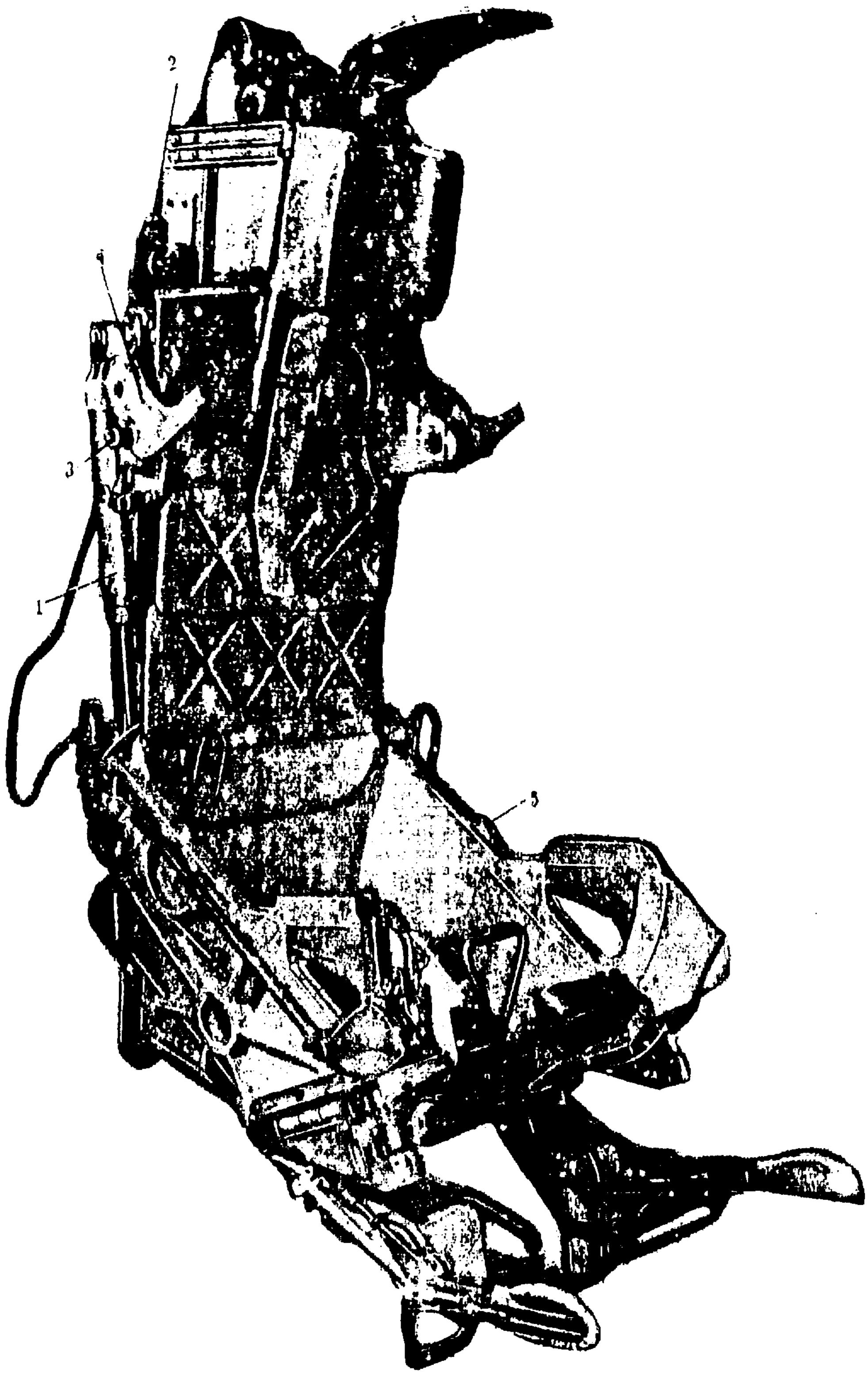


FIG. 104. EJECTION SEAT (FRONT RIGHT-SIDE VIEW, ASPECT ANGLE 3/4)
1 – 215Ф firing mechanism; 2 – АД-3 time lock; 3 – trunnion; 4 – double-arm lever; 5 – clamp for cord of КАП-3 parachute controller.

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[redacted]

1. The pilot presses the armrests, thus actuating the firing mechanism for the shoulder restraint and main firing mechanism for seat ejection.

2. After the seat has travelled 40 mm, the drogue parachute firing mechanism gets engaged, drives out the canopy plug and pushes the parachute in the airstream.

3. The seat engages the canopy. The pilot is covered with the canopy, his feet being held by catch locks.

The АД-3 time lock switches on.

4. The drogue parachute turns the whole system so that the seat pan back faces the onrushing air stream.

5. The АД-3 time lock switches on the 215Ф firing mechanisms. The firing mechanisms open the front locks which connect the canopy with the seat and the lock for the 215П firing mechanism seat.

The seat with the drogue parachute gets disengaged from the seat.

6. The 215Ф firing mechanisms turn the canopy about the trunnions, as a result of which the canopy becomes disconnected from the seat.

At this moment the restraint locks and pilot's feet catch-locks open.

7. Upon reaching the altitude of 4000 m. the main parachute opens automatically, and the pilot descends by parachute.

The canopy may be also jettisoned by the pilot previous to ejection, which is allowed at airspeeds not in excess of 700 km/hr.

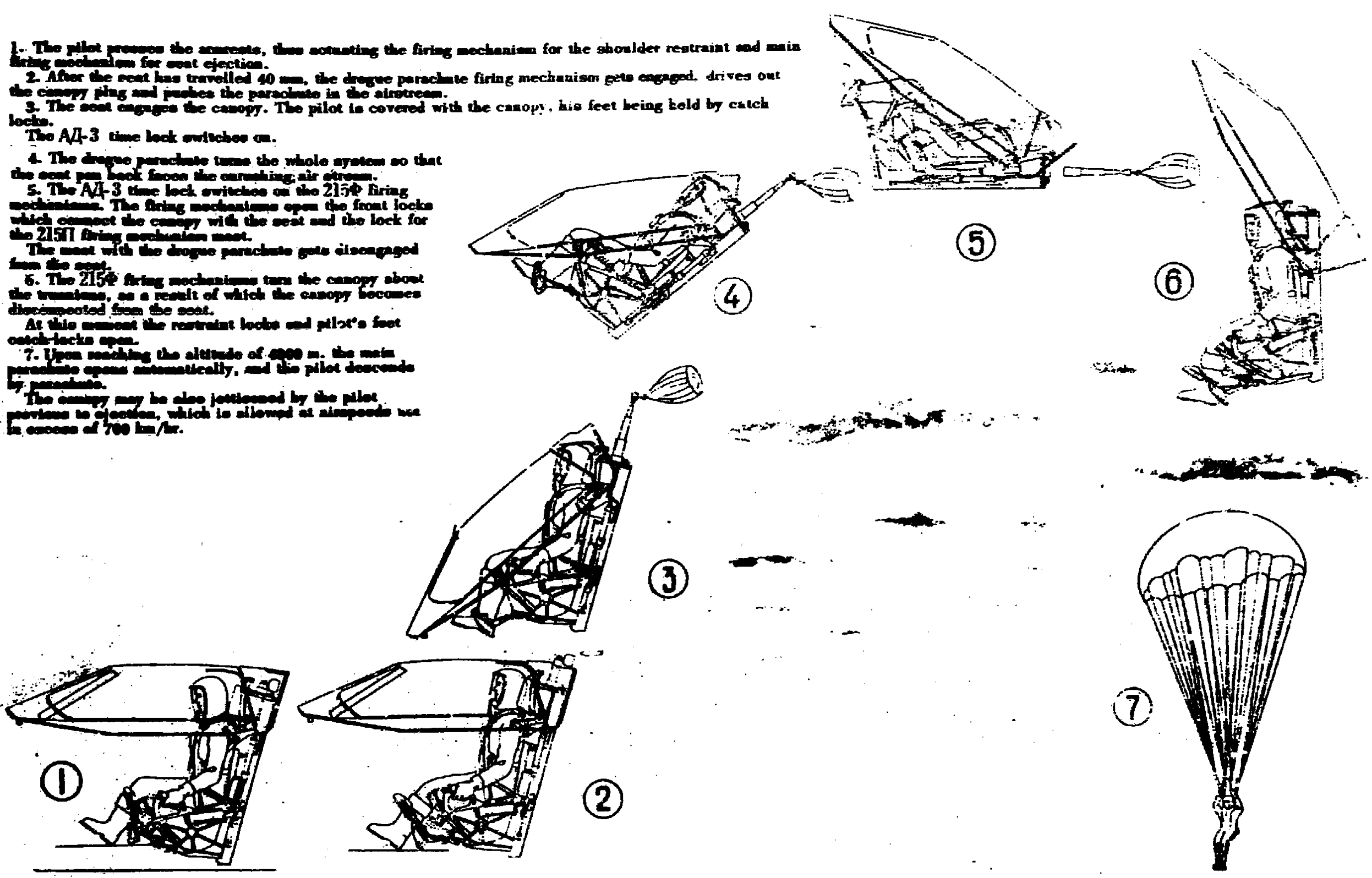

FIG. 105. EJECTION PROCEDURE

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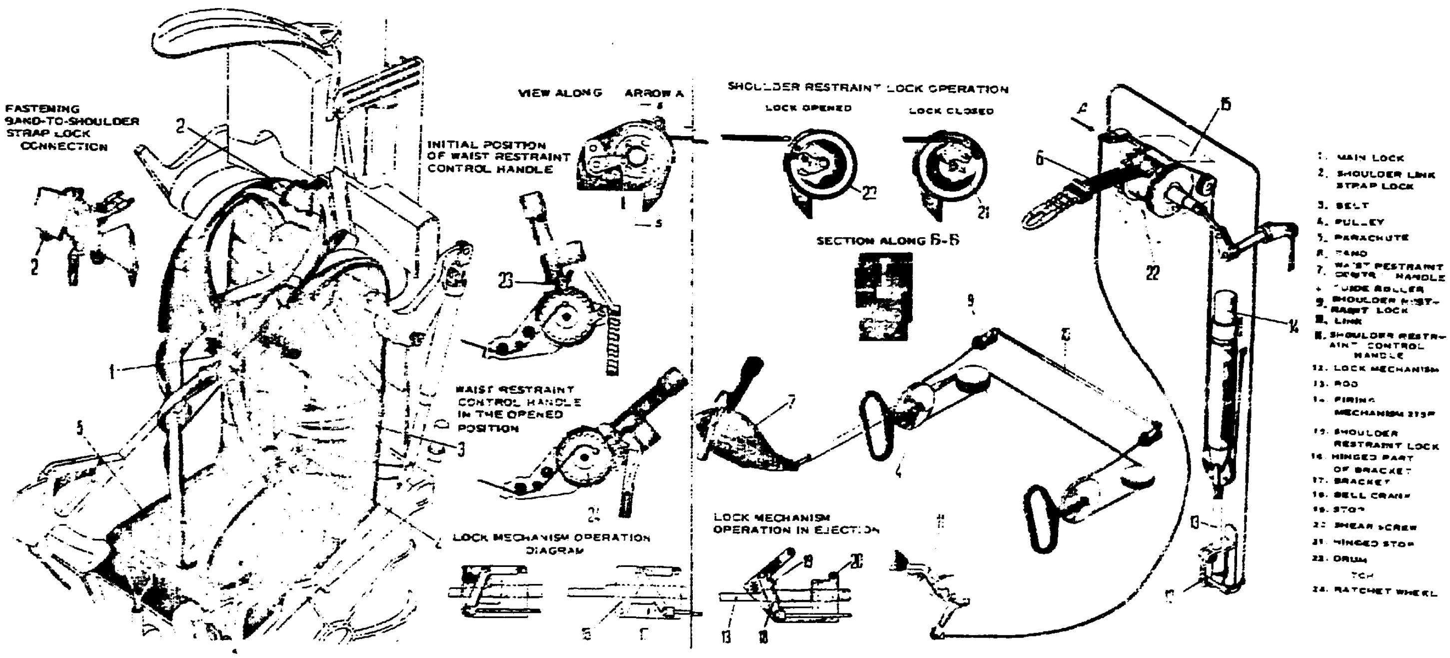

FIG. 166. PILOT'S HARNESS

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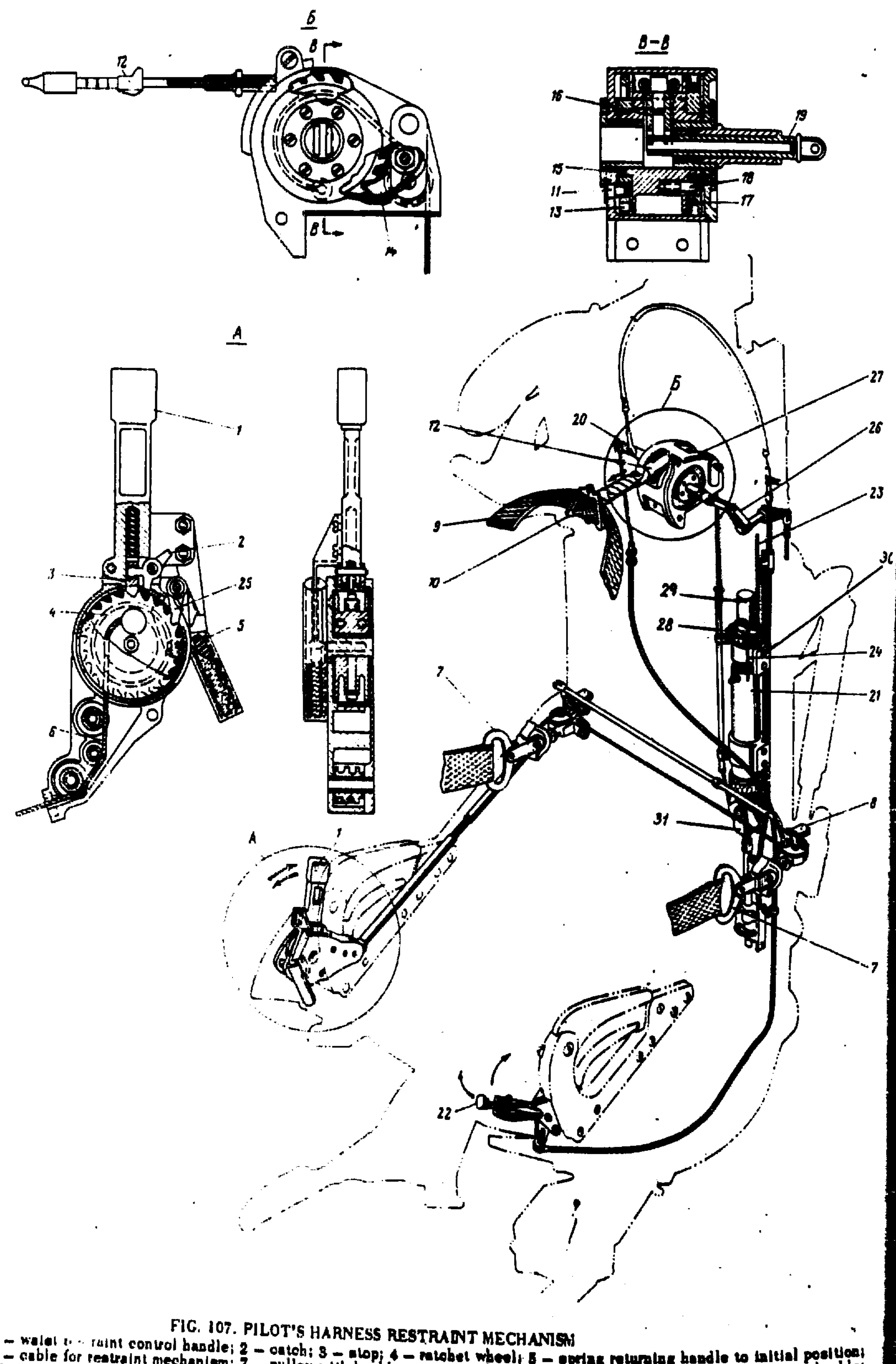


FIG. 107. PILOT'S HARNESS RESTRAINT MECHANISM

1 – waist restraint control handle; 2 – catch; 3 – stop; 4 – ratchet wheel; 5 – spring returning handle to initial position; 6 – cable for restraint mechanism; 7 – pulley with buckle; 8 – waist belt lock; 9 – shoulder restraint strap; 10 – buckle; 11 – screw; 12 – lock strap; 13 – ratchet; 14 – locking catch; 15 – lock drum; 16 – closing lever of lock strap; 17 – roller for restraint cable; 18 – retainer of shoulder restraint lock; 19 – closing rod; 20 – bell crank for restraint system; 21 – closing rod; 22 – restraint control handle; 23 – rod for firing mechanism TCM 2500-38; 24 – rod for seat ejection system control handle; 25 – catch; 26 – shoulder restraint lock emergency opening mechanism; 27 – shoulder strap lock; 28 – cable pipe; 29 – firing gun; 30 – upper yoke; 31 – lower cover.

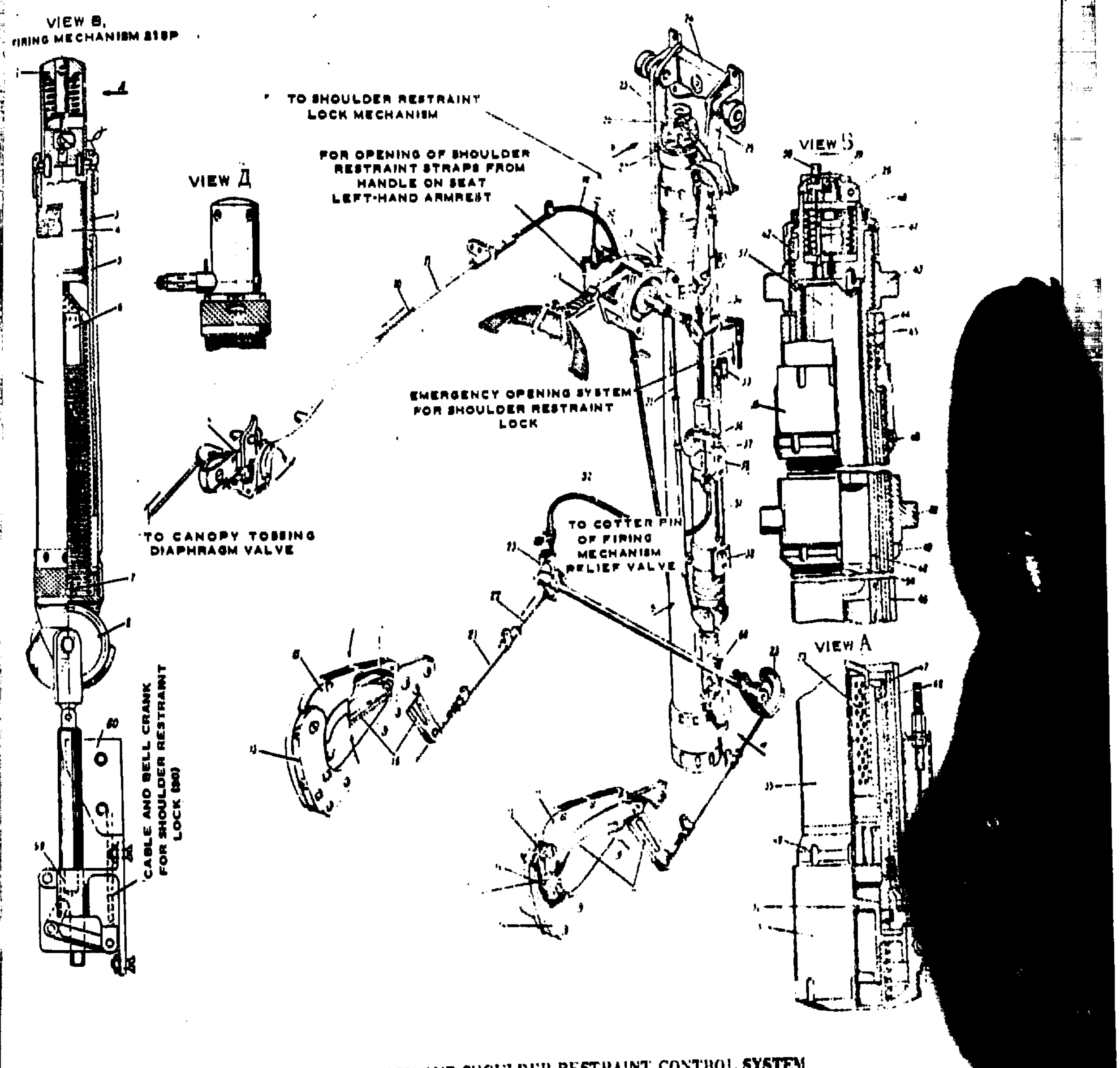


FIG. 108. SEAT EJECTION AND SHOULDER RESTRAINT CONTROL SYSTEM

1 – 215P firing mechanism for pilot's restraint system; 2 – bolt; 3 – inner cylinder; 4 – explosive cartridge
ПК-3М-1; 5 – outer cylinder; 6 – stop; 7 – nozzle; 8 – roller; 9 – bracket; 10 – cable; 11 – pipe; 12 – bowden
sheathing; 13 – right armrest; 14 – left armrest; 15 – ejection seat control handle; 16 – bell crank; 17 – spring;
18 – spring; 19 – spring; 20 – catch; 21 – pipe; 22 – cable; 23 – sector; 24 – bracket for firing mechanism
attachment; 25 – brace struts; 26 – pin for TCM-2500-38 firing mechanism; 27 – cable; 28 – lower yoke of firing
mechanism; 29 – attachment link for shoulder restraint lock; 30 – shoulder restraint lock; 31 – cable; 32 – bowden
casing; 33 – bracket; 34 – rod; 35 – TCM-2500-38 telescopic firing mechanism; 36 – bell crank; 37 – shackle;
38 – attachment yoke for 215P firing mechanism; 40 – firing spring; 41 – bolt body; 42 – union nut; 43 – upper
yoke; 44 – sleeve; 45 – middle cylinder I; 46 – outer cylinder; 47 – middle cylinder II; 48 – inner cylinder;
49 – locking nut; 50 – blade; 51 – lock for TCM-2500-30 firing mechanism; 52 – piston; 53 – fire grate; 54 –
bracket; 55 – pin for TCM-2500-30 firing mechanism; 56 – explosive cartridge indicator; 57 – explosive cartridge
ПК7-3М; 58 – lug; 59 – bell crank; 60 – rest.

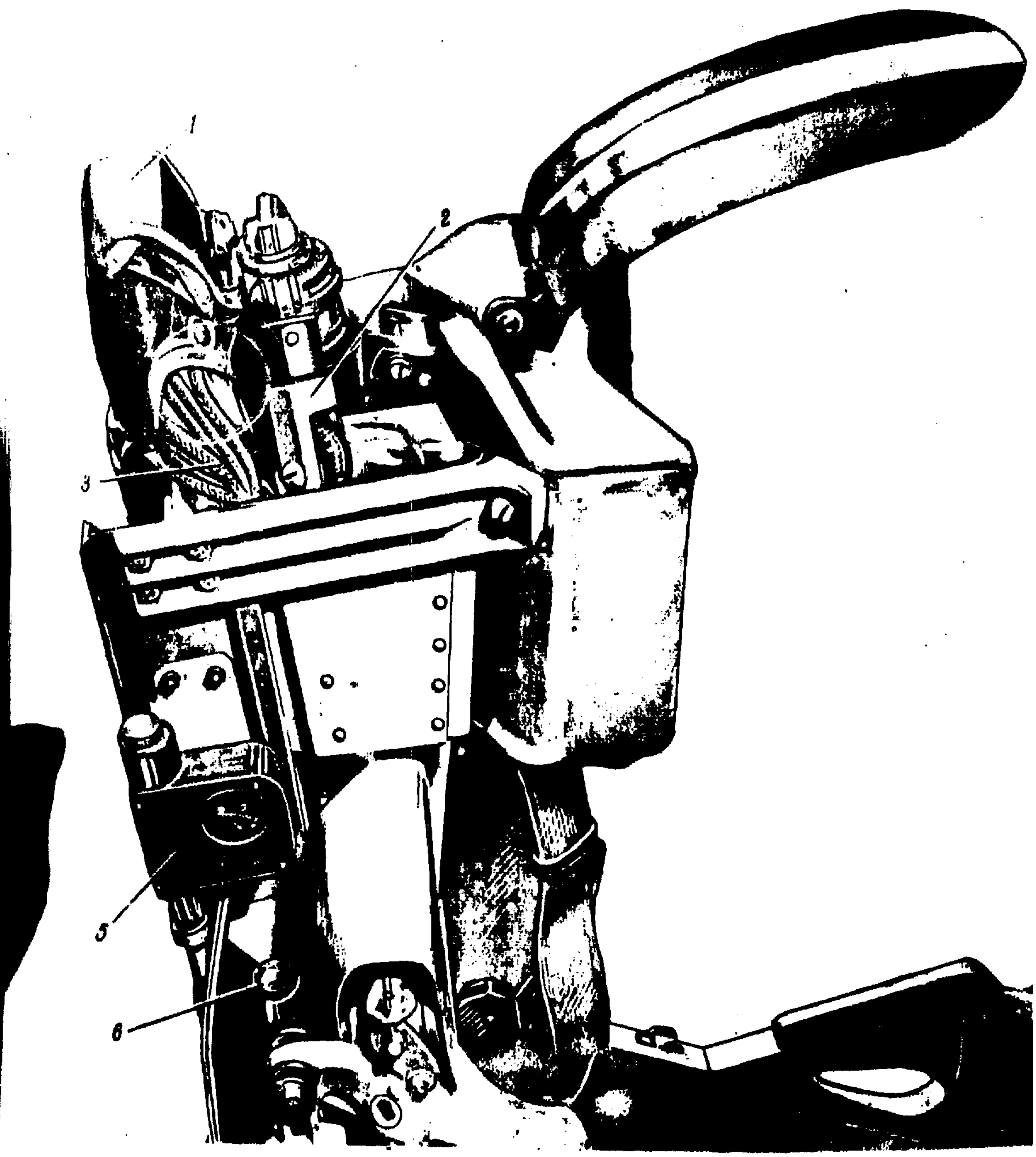


FIG. 109. EJECTION SEAT HEADREST

1 — container with parachute; 2 — swivel; 3 — parachute shroud lines; 4 — 215П firing mechanism; 5 — АД-3 automatic time mechanism; 6 — spring mechanism.

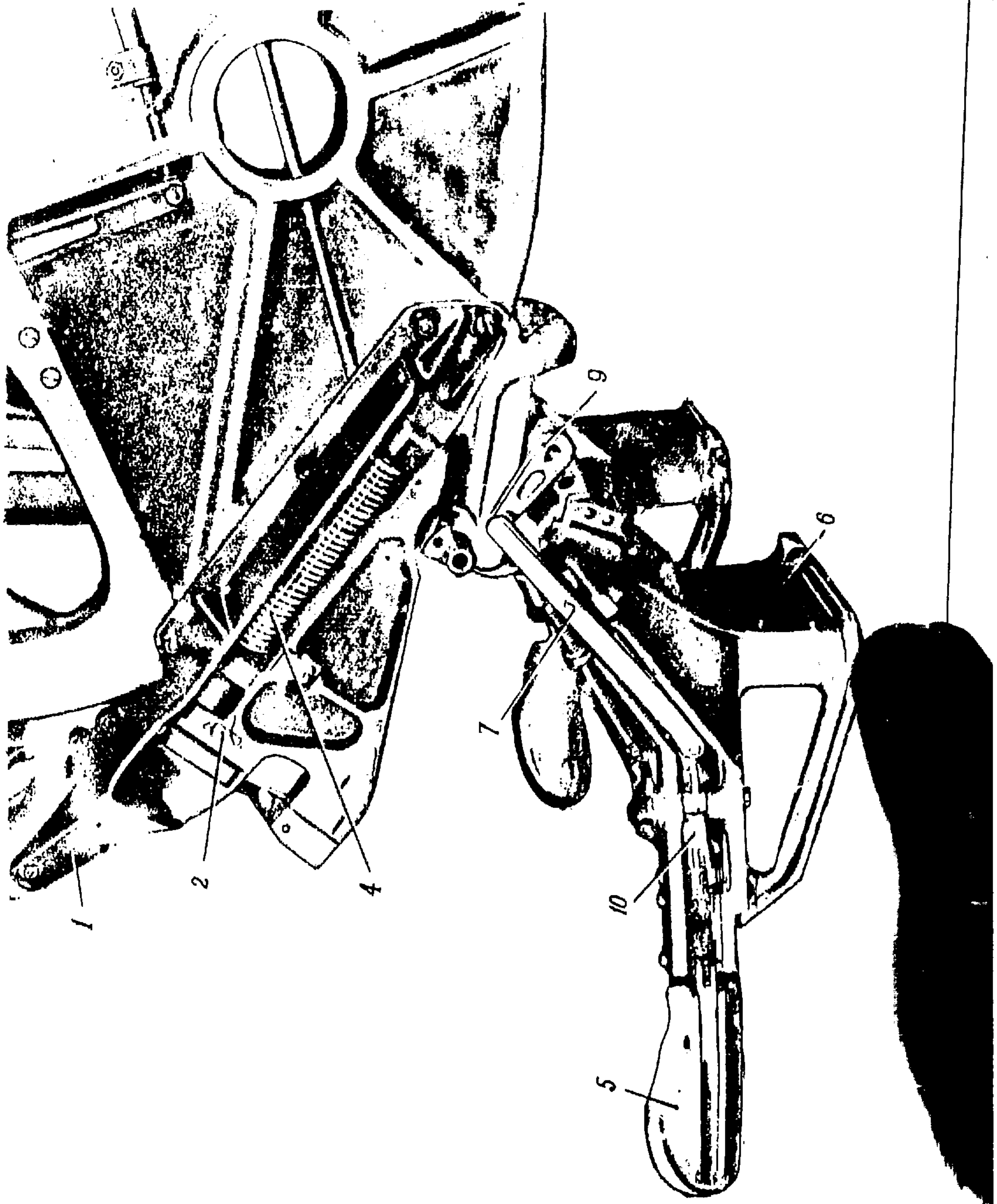


FIG. 110. LEFT SIDE OF SEAT PAN

1 – bracket for collapsible support; 2 – collapsible support; 3 – rod stop; 4 – spring; 5 – foot catch lock; 6 – foot support; 7 – bell crank; 8 – collapsible support control shaft; 9 – lever; 10 – ratchet sector; 11 – shear locking screw.

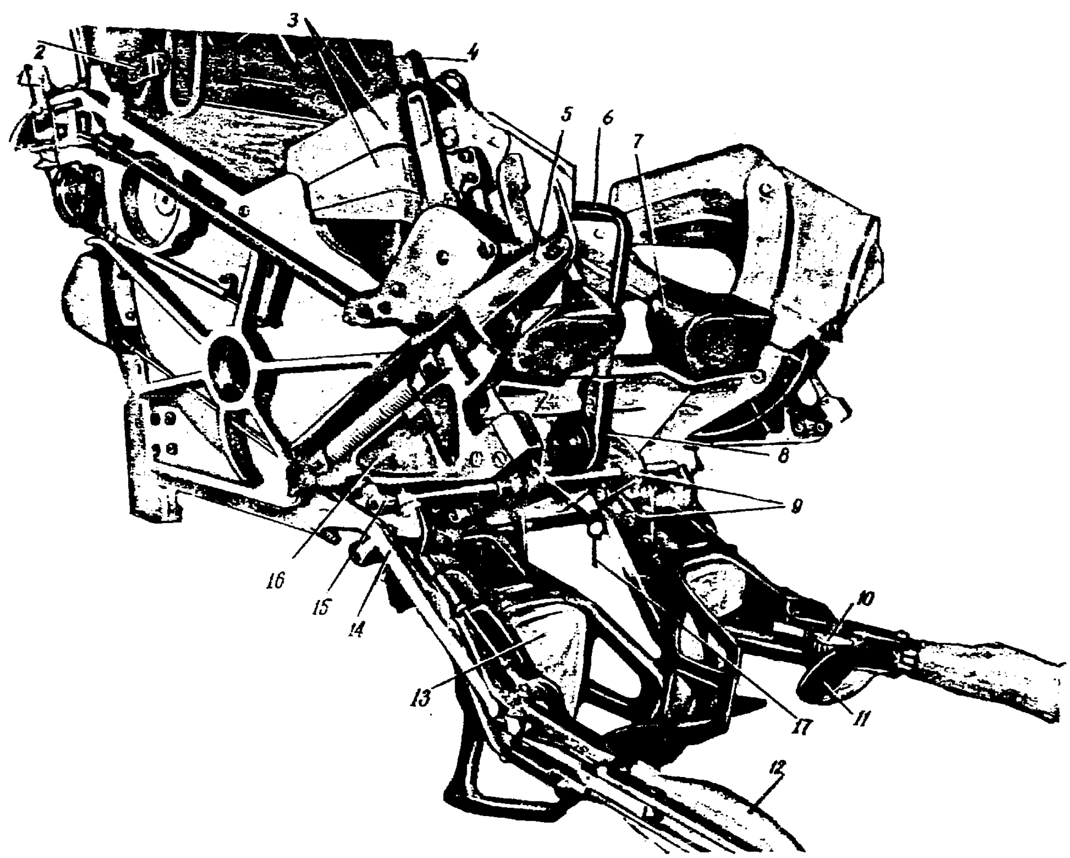


FIG. 111. RIGHT SIDE OF SEAT PAN

1 – bolt for 215Φ firing mechanism; 2 – roller with waist restraint buckle; 3 – firing mechanism lever; 4 – waist restraint control handle; 5 – bracket for collapsible support; 6 – hand grip; 7 – foot pad; 8 – transmission roller; 9 – lever for locking foot support with ground safety pin; 10 – ratchet sector; 11 – lever for closing catch-locks; 12 – catch-locks; 13 – foot supports; 14 – bell crank; 15 – collapsible support control shaft; 16 – collapsible support; 17 – pin for connecting cable of collapsible support control shaft.

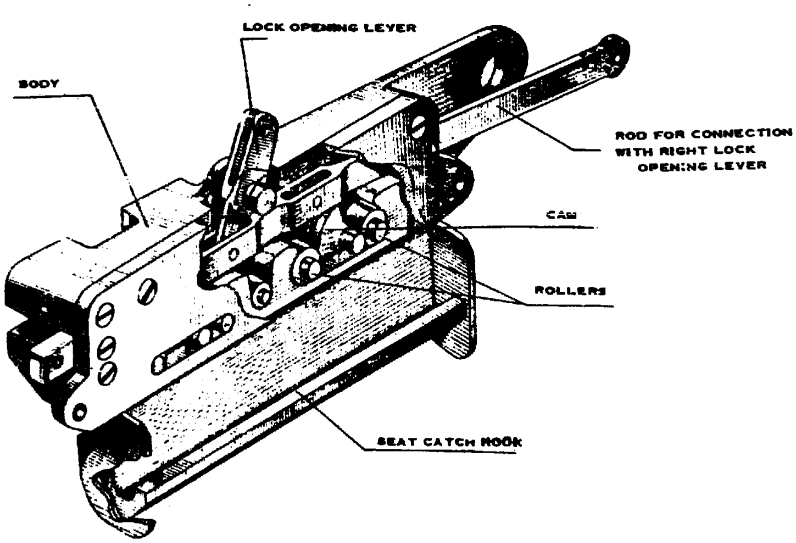
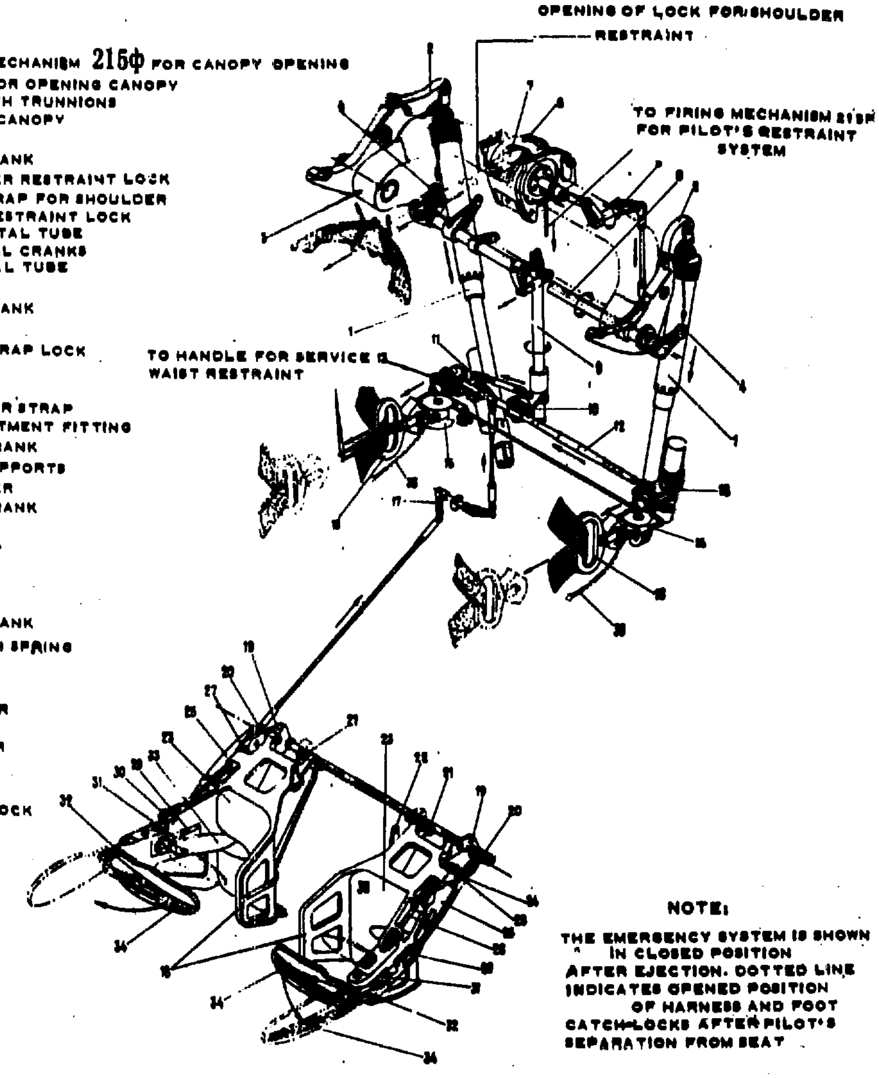


FIG. 112. EJECTION SEAT FRONT LEFT-SIDE CATCH-LOCK

1. FIRING MECHANISM 215Ф FOR CANOPY OPENING
2. LEVER FOR OPENING CANOPY
3. BEAM WITH TRUNNIONS FOR CANOPY
4. LEVER
5. BELL CRANK
6. SHOULDER RESTRAINT LOCK
7. LINK STRAP FOR SHOULDER RESTRAINT LOCK
8. HORIZONTAL TUBE WITH BELL CRANKS
9. VERTICAL TUBE
10. LEVER
11. BELL CRANK
12. ROD
13. WAIST STRAP LOCK
14. ROLLER
15. ROLLER
16. SHOULDER STRAP ADJUSTMENT FITTING
17. BELL CRANK
18. FOOT SUPPORTS
19. RETAINER
20. BELL CRANK
21. SPRING
22. BRACKET
23. ROD
24. REST
25. BELL CRANK
26. ROD WITH SPRING
27. PIN
28. PIN
29. RETAINER
30. REST
31. RATCHET
32. ROD
33. LEVER
34. CATCH LOCK
35. CABLE



NOTE:
THE EMERGENCY SYSTEM IS SHOWN IN CLOSED POSITION AFTER EJECTION. DOTTED LINE INDICATES OPENED POSITION OF HARNESS AND FOOT CATCH-LOCKS AFTER PILOT'S SEPARATION FROM SEAT

FIG. 118. EMERGENCY OPENING OF LOCKS FOR HARNESS AND FOOT CATCH-LOCKS.

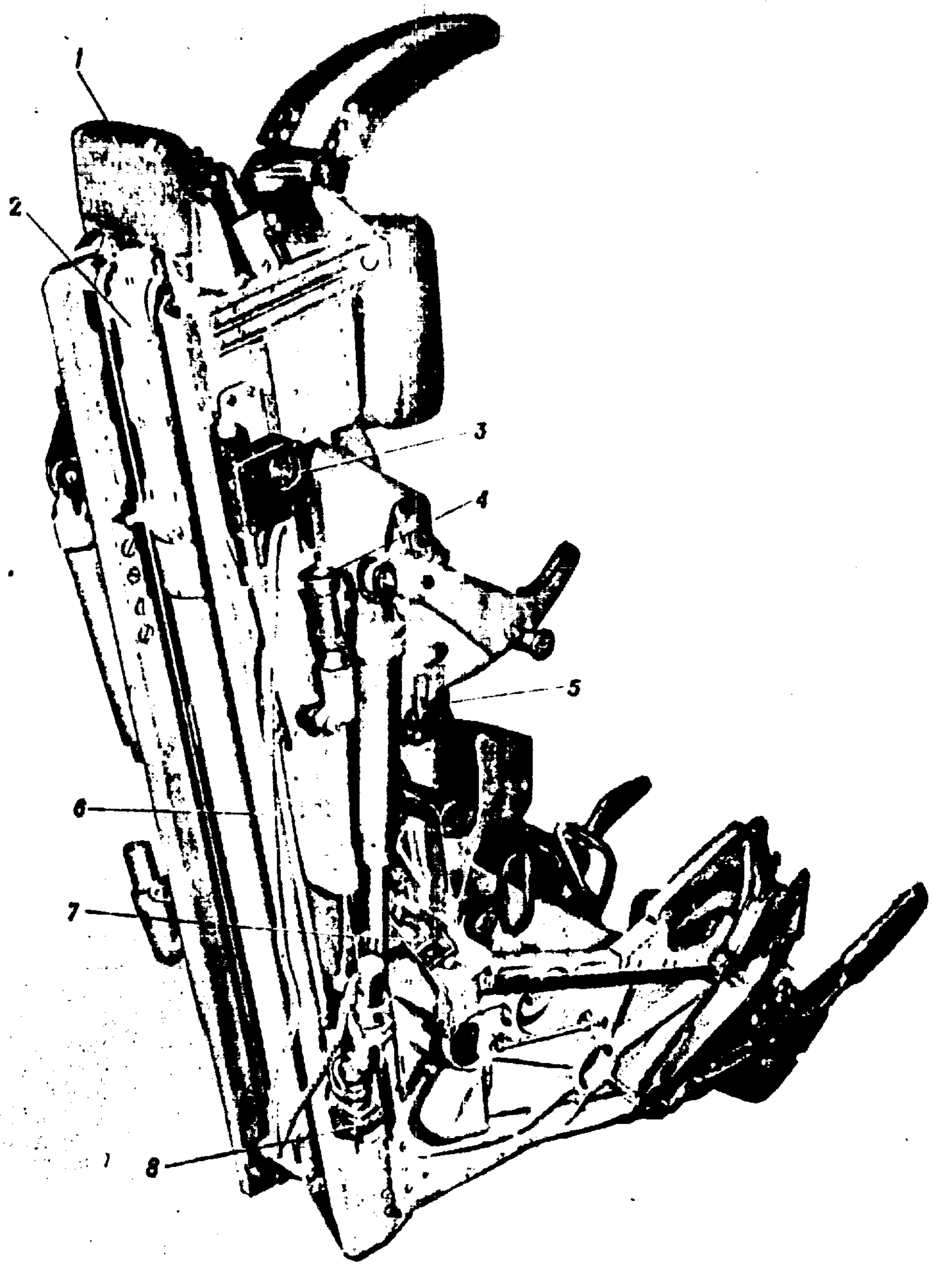


FIG.114. EJECTION SEAT.3/4 RIGHT-SIDE REAR VIEW
1 – drogue parachute; 2 – TCM-2500-38 firing mechanism; 3 – automatic time mechanism АД-3; 4 – spring mechanism; 5 – locking of upper cross shaft bell crank; 6 – cord for АД-3 time mechanism; 7 – waist restraint lock; 8 – bracket with plug connector.

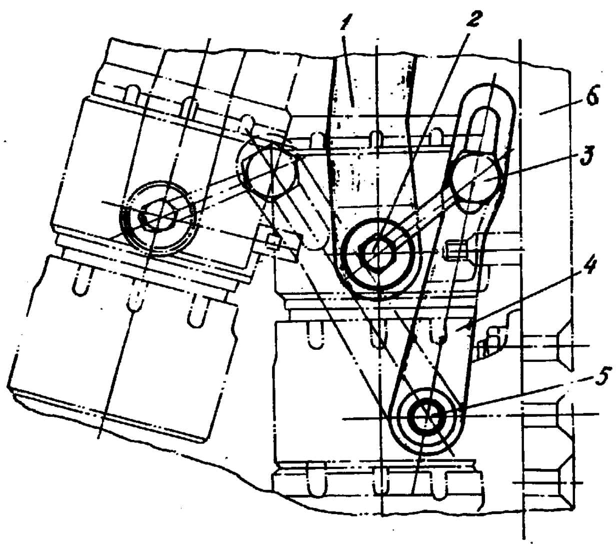


FIG. 115. TCM-2500-30 FIRING MECHANISM LOWER ATTACHMENT FITTING
1 – rod; 2 – bolt for rod fastening; 3 – bell crank fastening bolt; 4 – bell crank; 5 – hinged bolt for fastening bell crank; 6 – special plate.

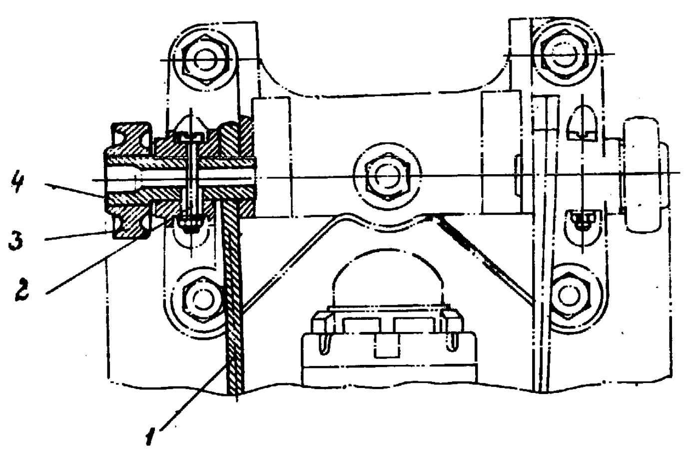


FIG. 116. TCM-2500-30 FIRING MECHANISM UPPER ATTACHMENT FITTING
1 – rod; 2 – attachment bolt for roller pin; 3 – roller; 4 – bushing.

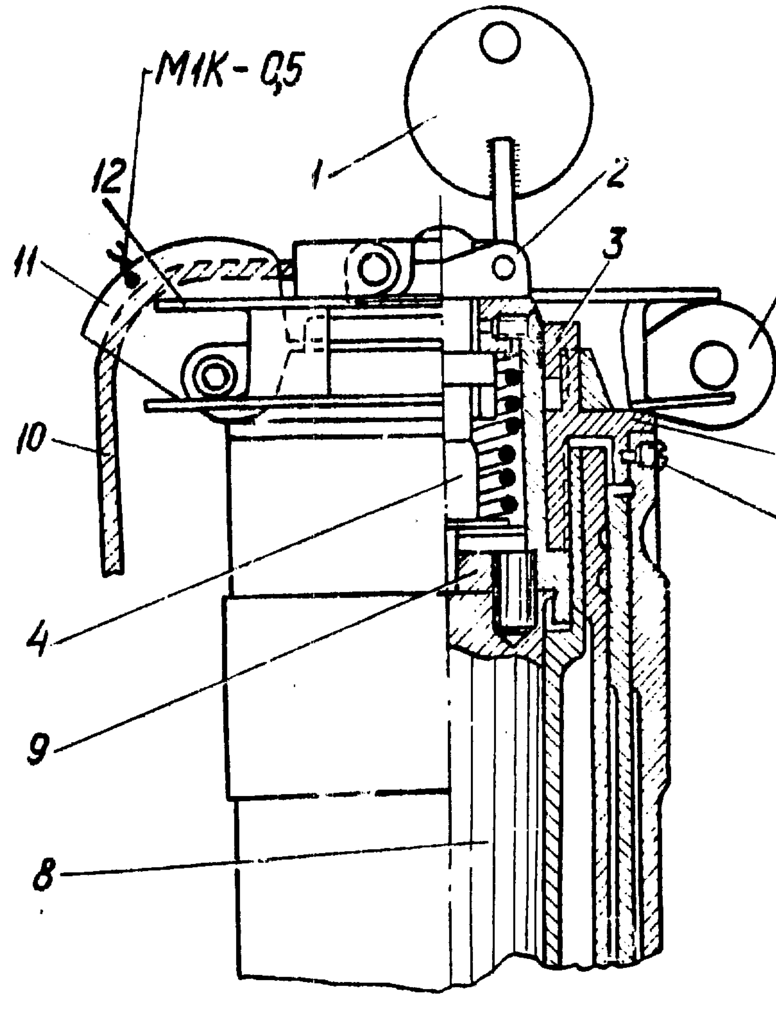


FIG. 117. HEAD OF FIRING MECHANISM 215П

1 – ground safety lock pin; 2 – pin; 3 – bolt lock nut; 4 – striker; 5 – shaped ring with lugs; 6 – lock screw; 7 – union nut; 8 – ПКЗ-МЛ explosive cartridge; 9 – bolt of firing mechanism; 10 – cable for cotter pin; 11 – sector; 12 – shaped piece.

1. MECHANISM FOR BK-2-141 LIMIT SWITCHES
2. UPPER ROD FOR ADJUSTING LIMIT SWITCHES MECHANISM CUT-OUT
3. LOWER ROD FOR SEAT ADJUSTMENT SYSTEM
4. LOWER ROD ATTACHMENT BRACKET
5. ШР-20 ПКЧНШ8 PLUG CONNECTOR
6. BUSH ON SEAT PAN
7. МУ100-АП ELECTRIC MOTOR
8. WORM WHEEL
9. LIFTING SCREW

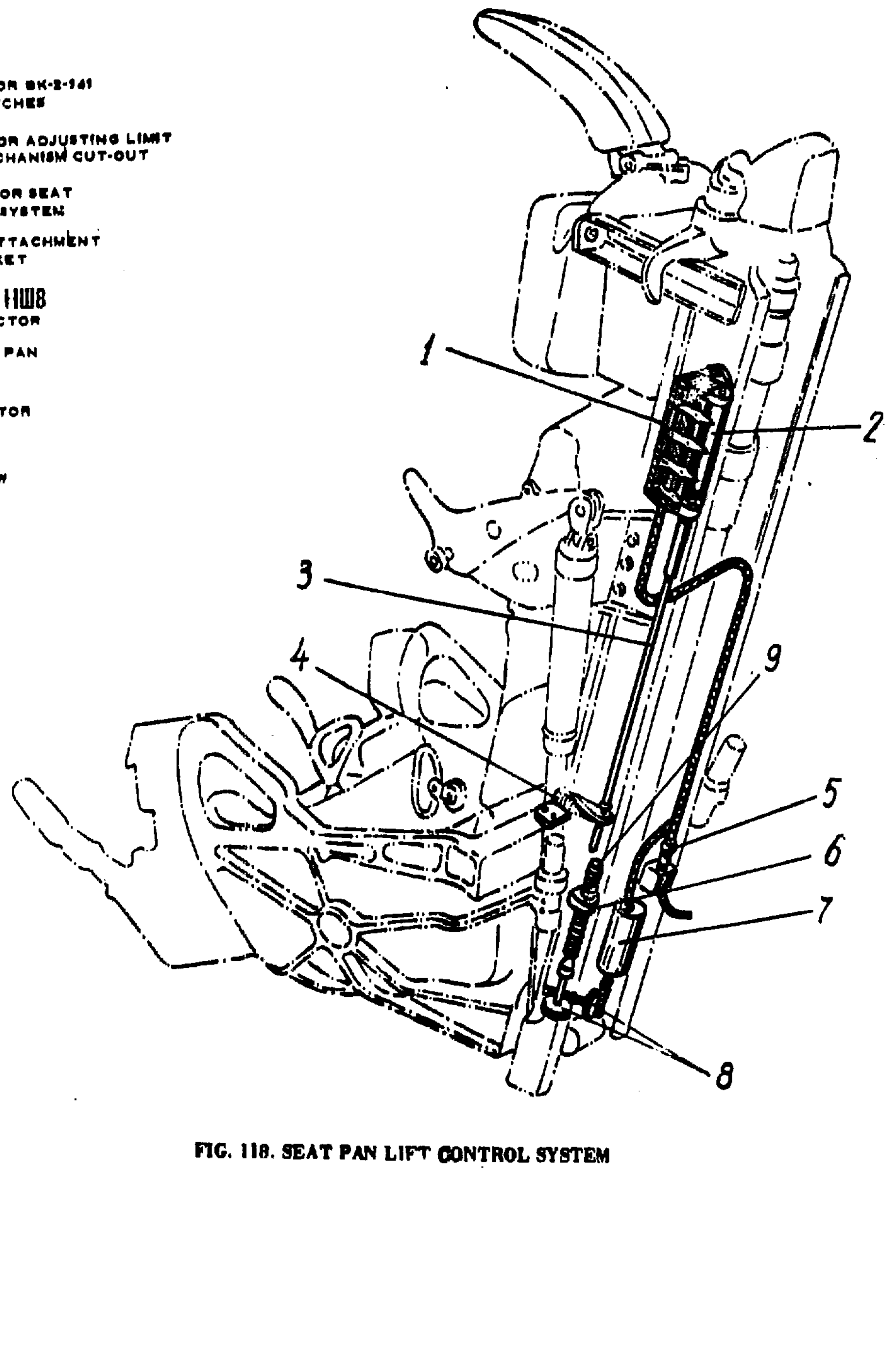


FIG. 118. SEAT PAN LIFT CONTROL SYSTEM

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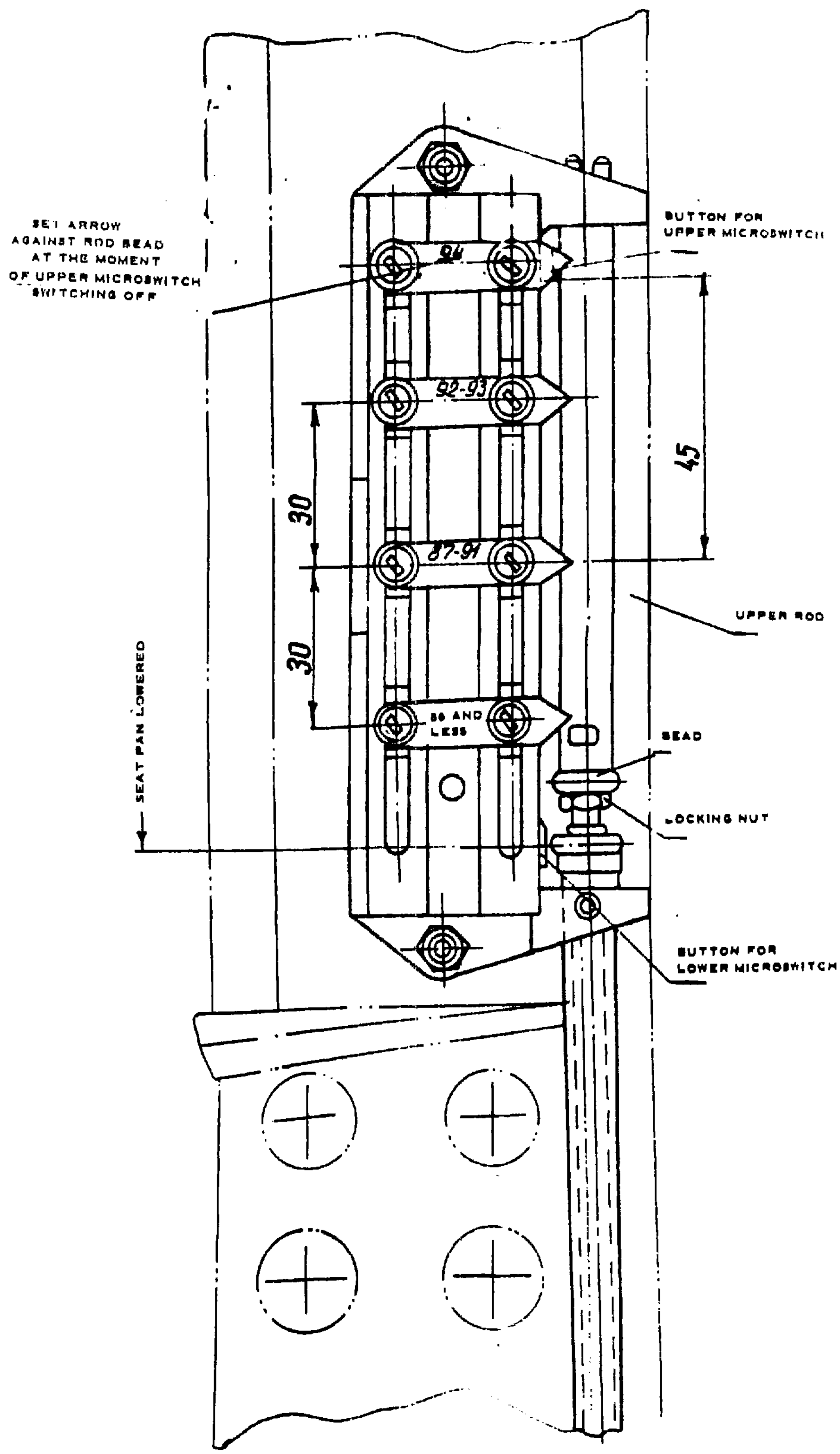

FIG. 119. SEAT ADJUSTING MECHANISM

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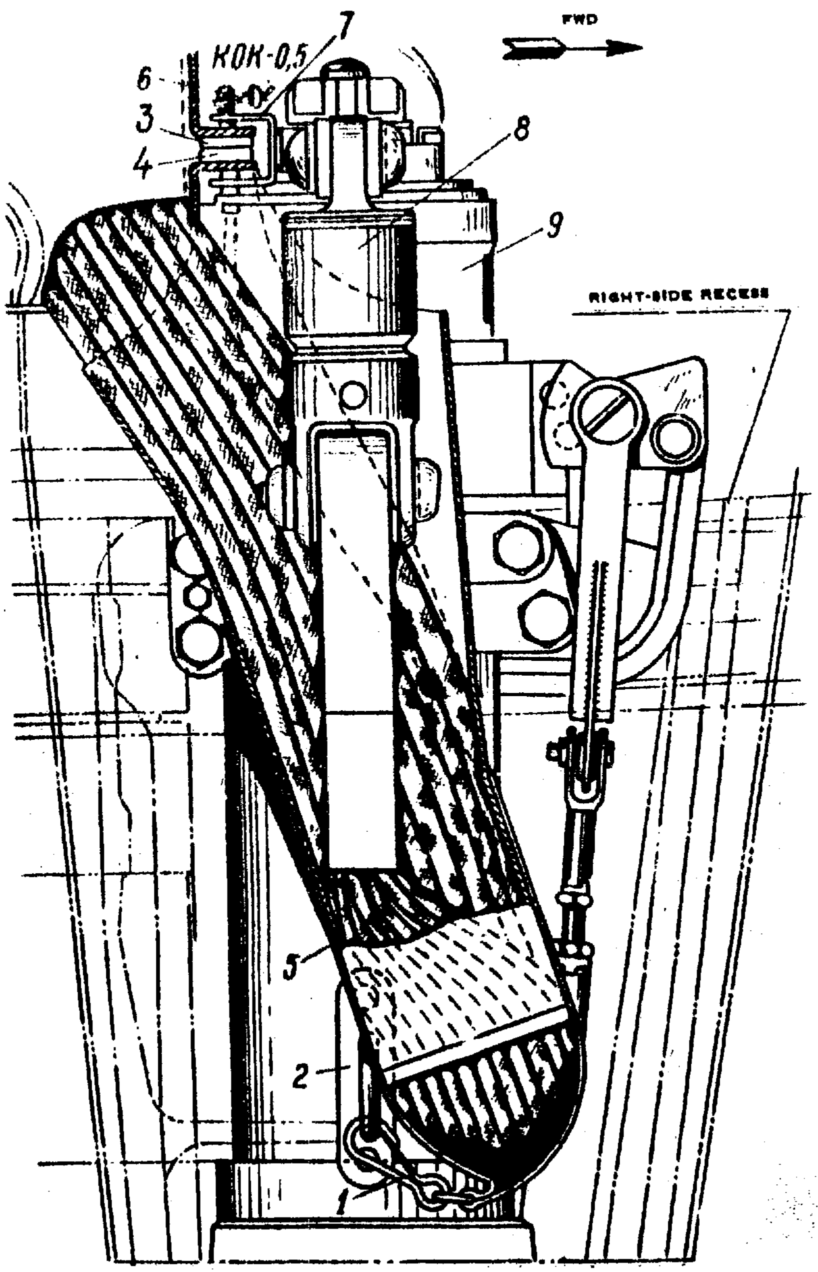

FIG. 120. DROGUE PARACHUTE

1 – snap hook for connection of shroud line cover; 2 – clamp; 3, 4 – plates; 5 – cover for parachute shroud lines; 6 – cotter pin (cable tip); 7 – firing mechanism bolt shaped member; 8 – parachute swivel; 9 – 215П firing mechanism.

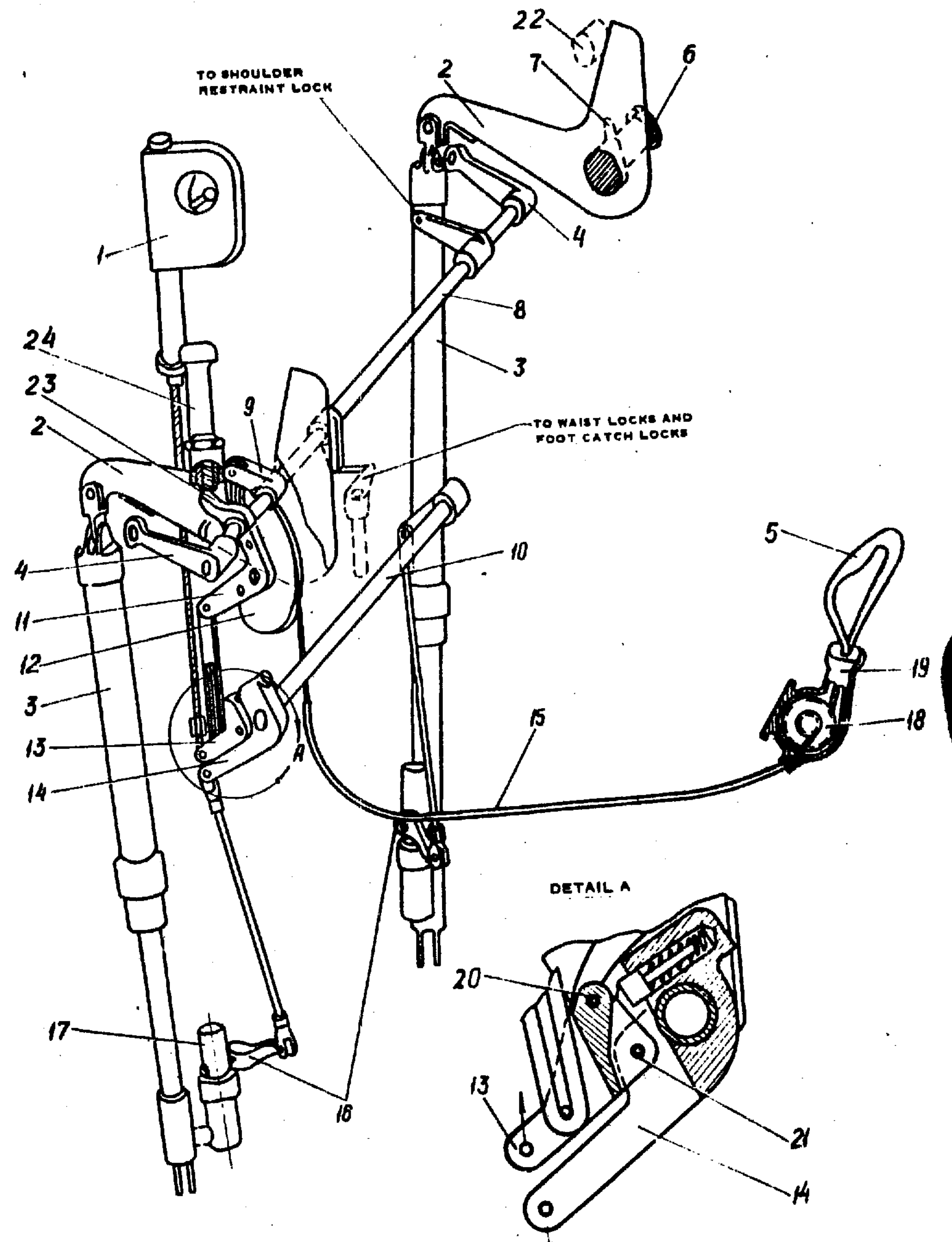

FIG. 121. GEAR TRAIN DIAGRAM FOR CANOPY SEPARATION AND OPENING OF PILOT'S RESTRAINT LOCKS

1 – АД-3 automatic time mechanism; 2 – double arm lever for canopy tossing; 3 – 215Ф firing mechanism; 4 – lever for cross shaft; 5 – hand grip; 6 – cross beam trunnions; 7 – trunnion cam; 8 – upper cross shaft; 9 – lever for actuating cross shaft from hand grip; 10 – cross shaft for 215Ф firing mechanisms; 11 – transmission lever from hand grip; 12 – roller; 13 – intermediate lever; 14 – lever for control of 215Ф firing mechanisms; 15 – cable from hand grip; 16 – lever; 17 – bolt of 215Ф firing mechanism; 18 – transmission roller; 19 – roller body; 20 – cotter pin locking lever 14; 21 – intermediate lever rotation axle; 22 – rest on canopy; 23 – bell crank; 24 – spring mechanism.

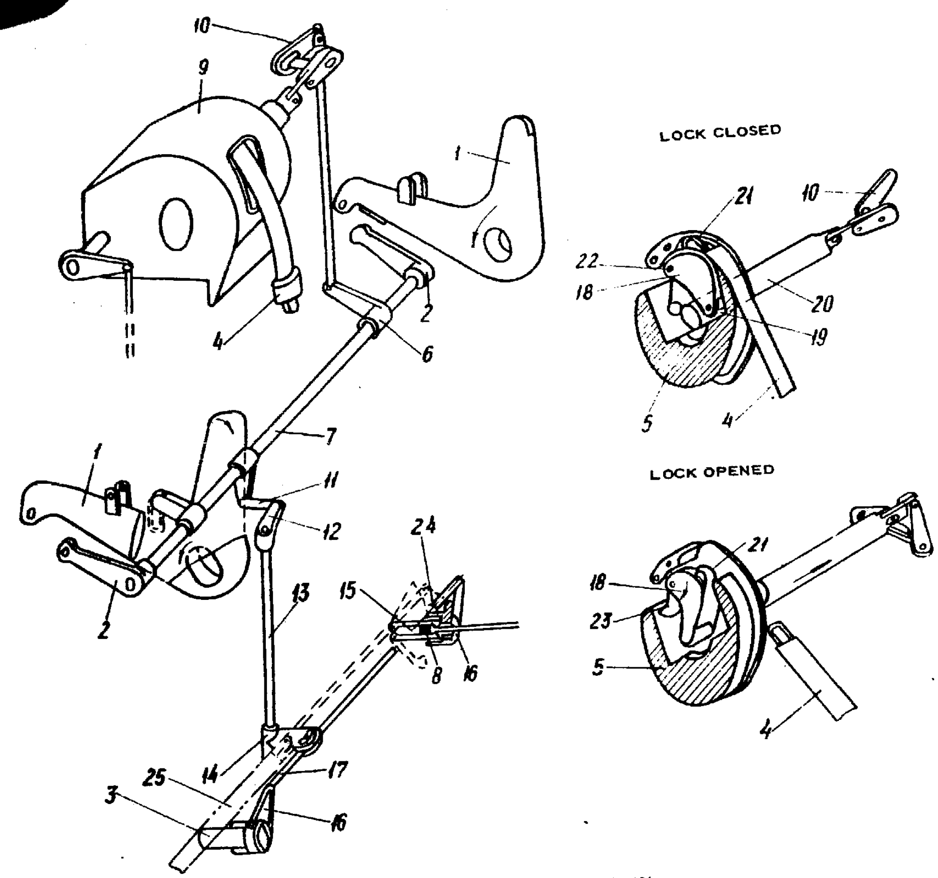

FIG. 122. SHOULDER RESTRAINT LOCK OPERATION
1 — lever for canopy opening; 2 — cross shaft lever; 3 — waist restraint lock; 4 — link strap for shoulder lock;
5 — lock drum; 6 — lever; 7 — upper cross shaft; 8 — waist restraint cable attachment piece; 9 — shoulder
restraint lock; 10 — lever for lock opening; 11 — link; 12 — vertical shaft lever; 13 — vertical shaft; 14 —
vertical shaft lower lever; 15 — waist lock catches; 16 — waist lock lever; 17 — rod for waist lock levers;
18 — catch with roller; 19 — roller; 20 — rod for closing lock; 21 — catch lug for guiding cable; 22 — catch
rotation axle; 23 — catch tang for screw-driver; 24 — lugs on lock lever
for closing catches; 25 — link; 26 — rod.

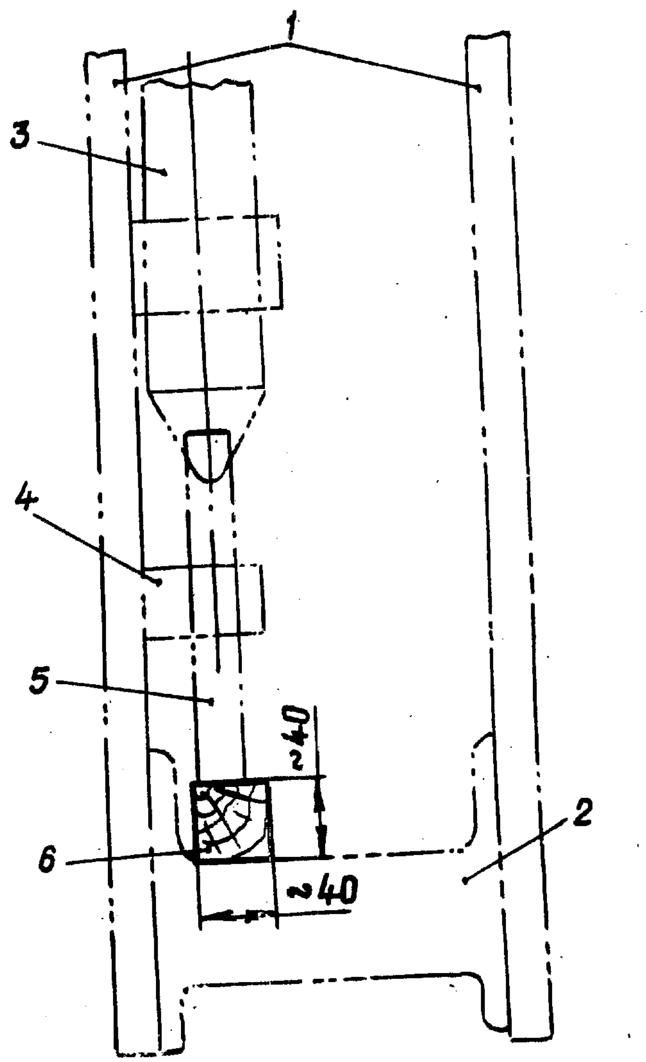

FIG. 123. INSTALLING WOODEN BLOCK UNDER 215 P FIRING MECHANISM

1 — seat rails; 2 — seat lower beam; 3 — 215 P firing mechanism; 4 — rod guide; 5 — rod; 6 — wooden block.

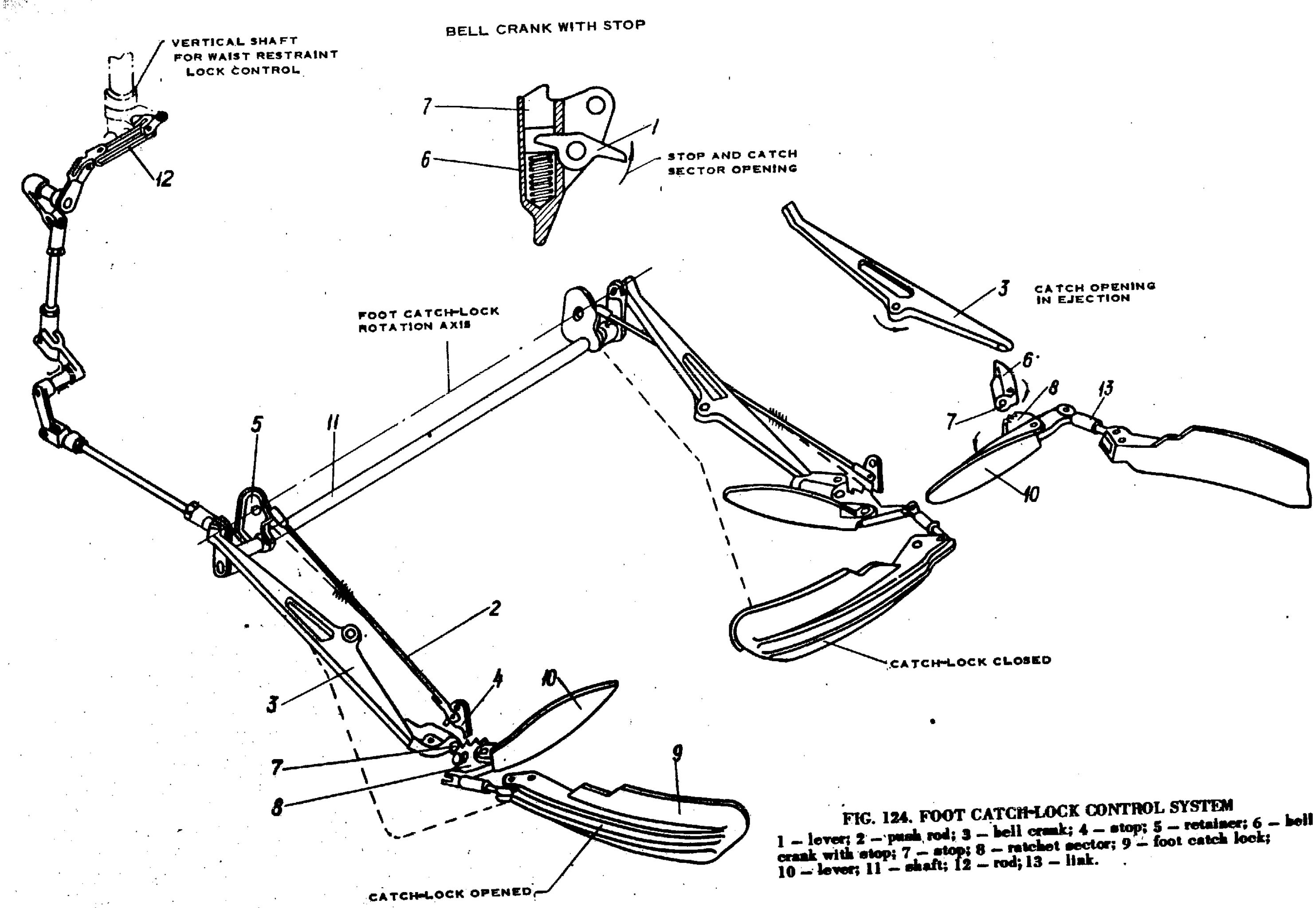

FIG. 124. FOOT CATCH-LOCK CONTROL SYSTEM
1 – lever; 2 – push rod; 3 – bell crank; 4 – stop; 5 – retainer; 6 – bell crank with stop; 7 – stop; 8 – ratchet sector; 9 – foot catch lock; 10 – lever; 11 – shaft; 12 – rod; 13 – link.

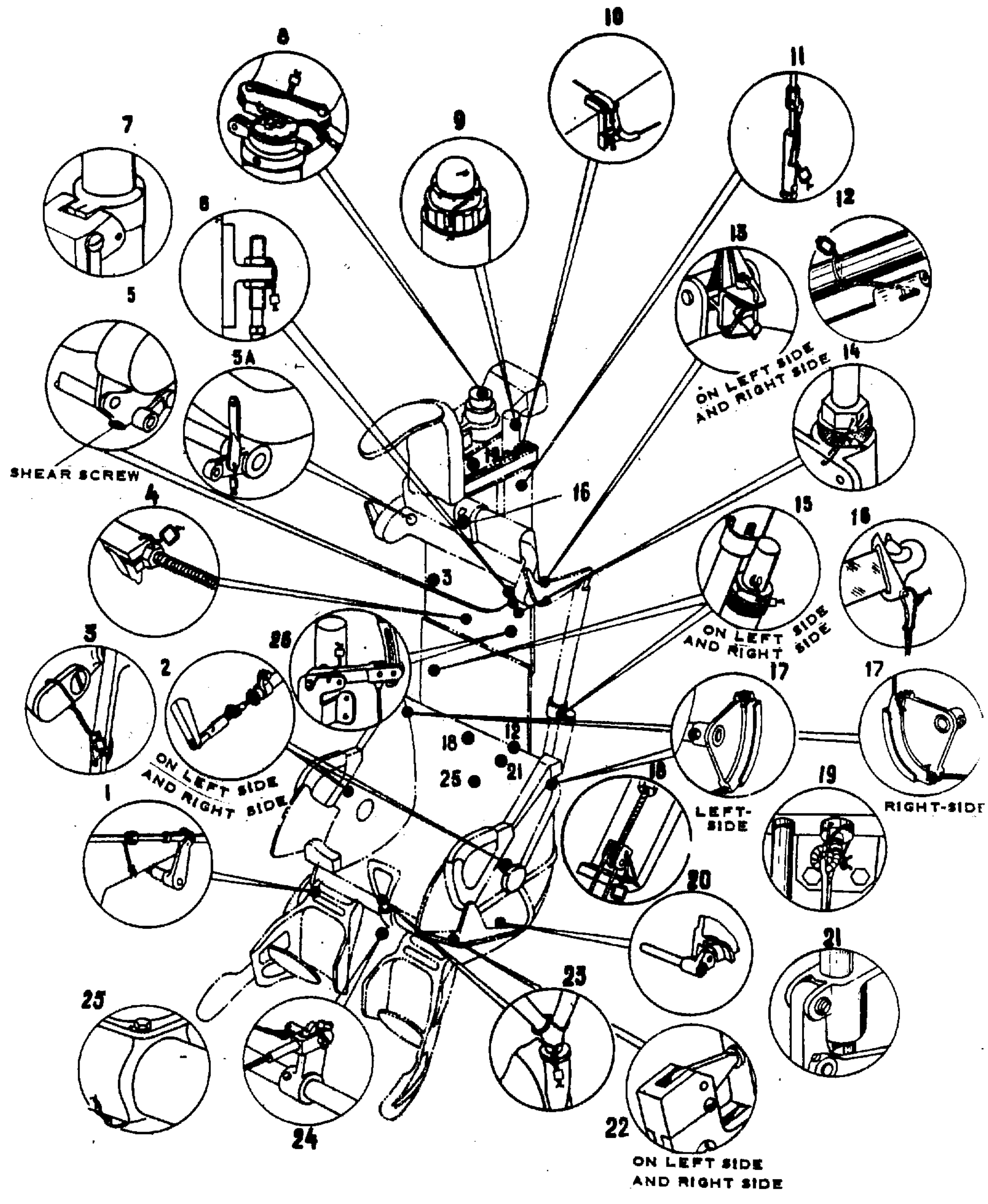

FIG. 125. EJECTION SEAT LOCKING DIAGRAM

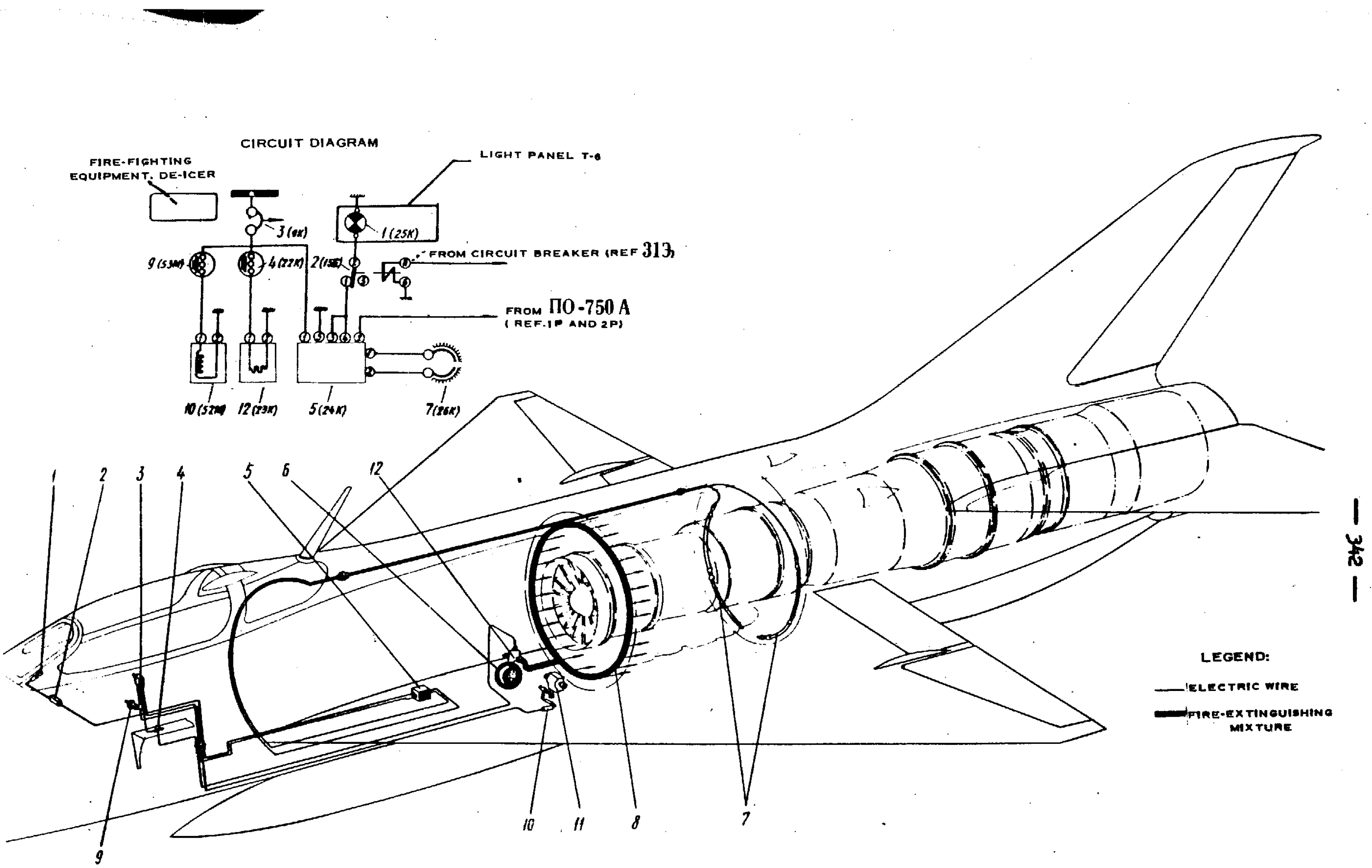

FIG. 126. FIRE-FIGHTING EQUIPMENT

[illegible] light; 2 — relay ТКЕ-56ПД for checking lights on light panel; 3 — circuit breaker A3C-5; 4 — 205 KC fire-extinguishing button; 5 — ИС-2МС electronic amplifier; 6 — [illegible] 11 — fuel system shut-off valve; 12 — explosive cartridge for fire-extinguishing bottle 20C-2-1C.

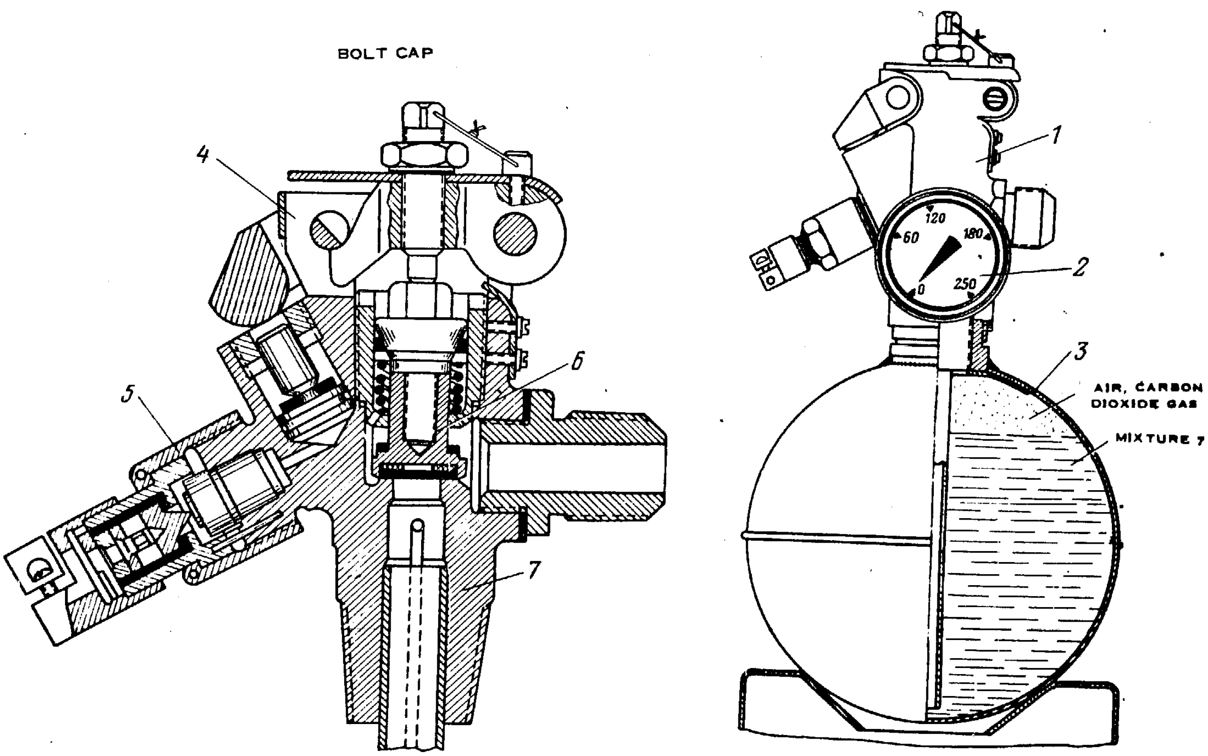

FIG. 127. FIRE-EXTINGUISHING BOTTLE WITH BOLT CAP
1 – bolt cap; 2 – pressure gauge; 3 – bottle; 4 – closing device; 5 – firing mechanism; 6 – valve; 7 – body

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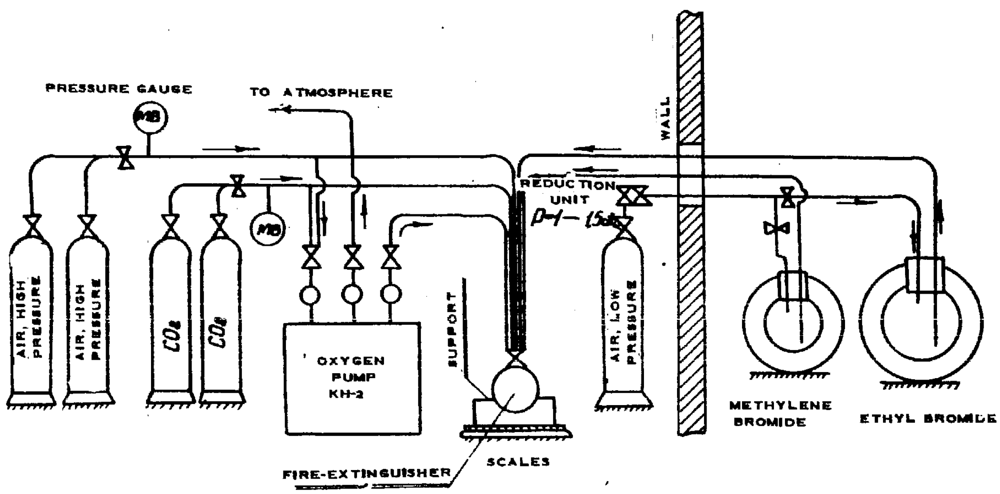

FIG. 128. DIAGRAM FOR FIRE-EXTINGUISHER FILLING WITH MIXTURE 7

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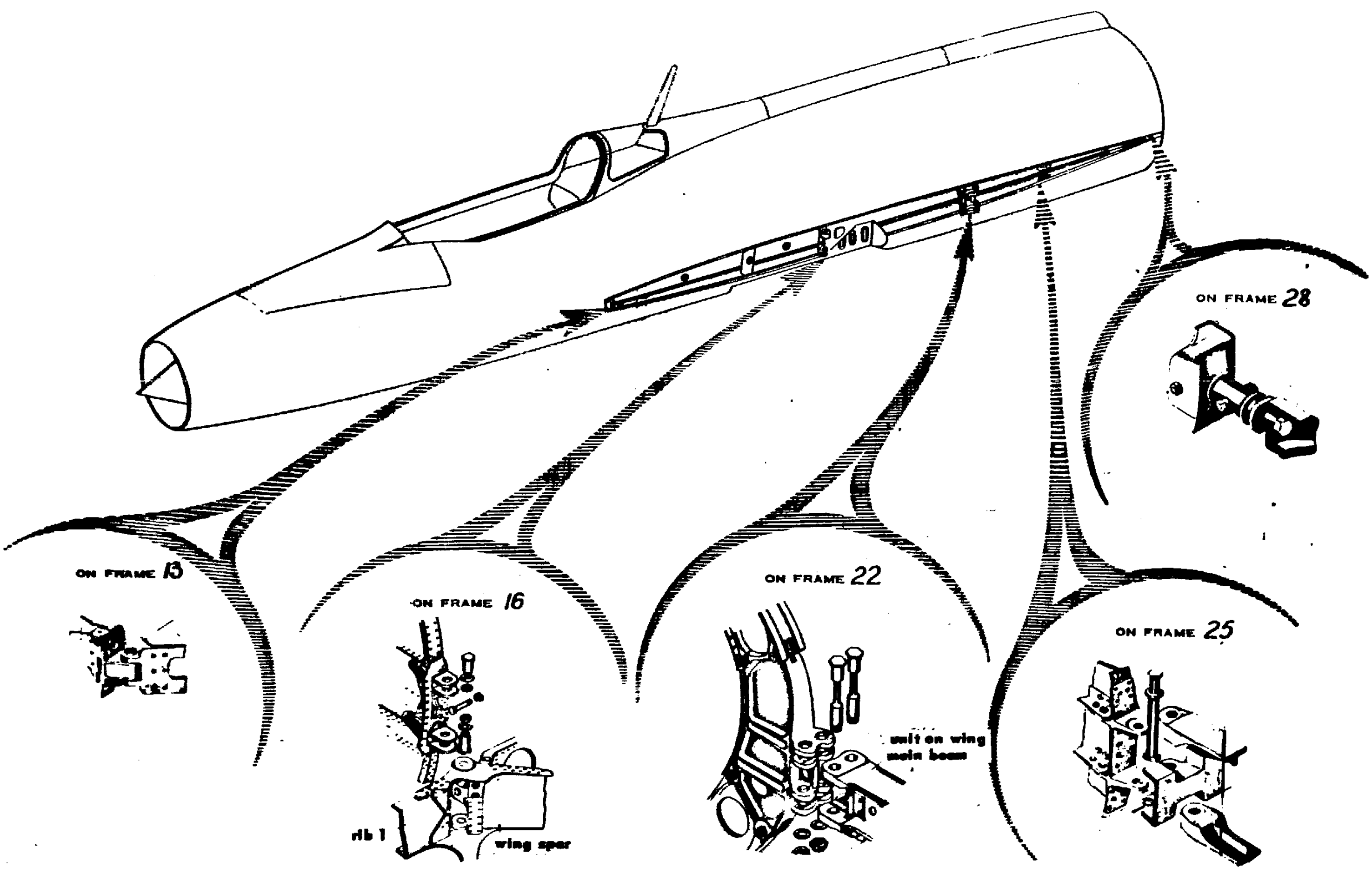

FIG. 129. WING ATTACHMENT FITTINGS

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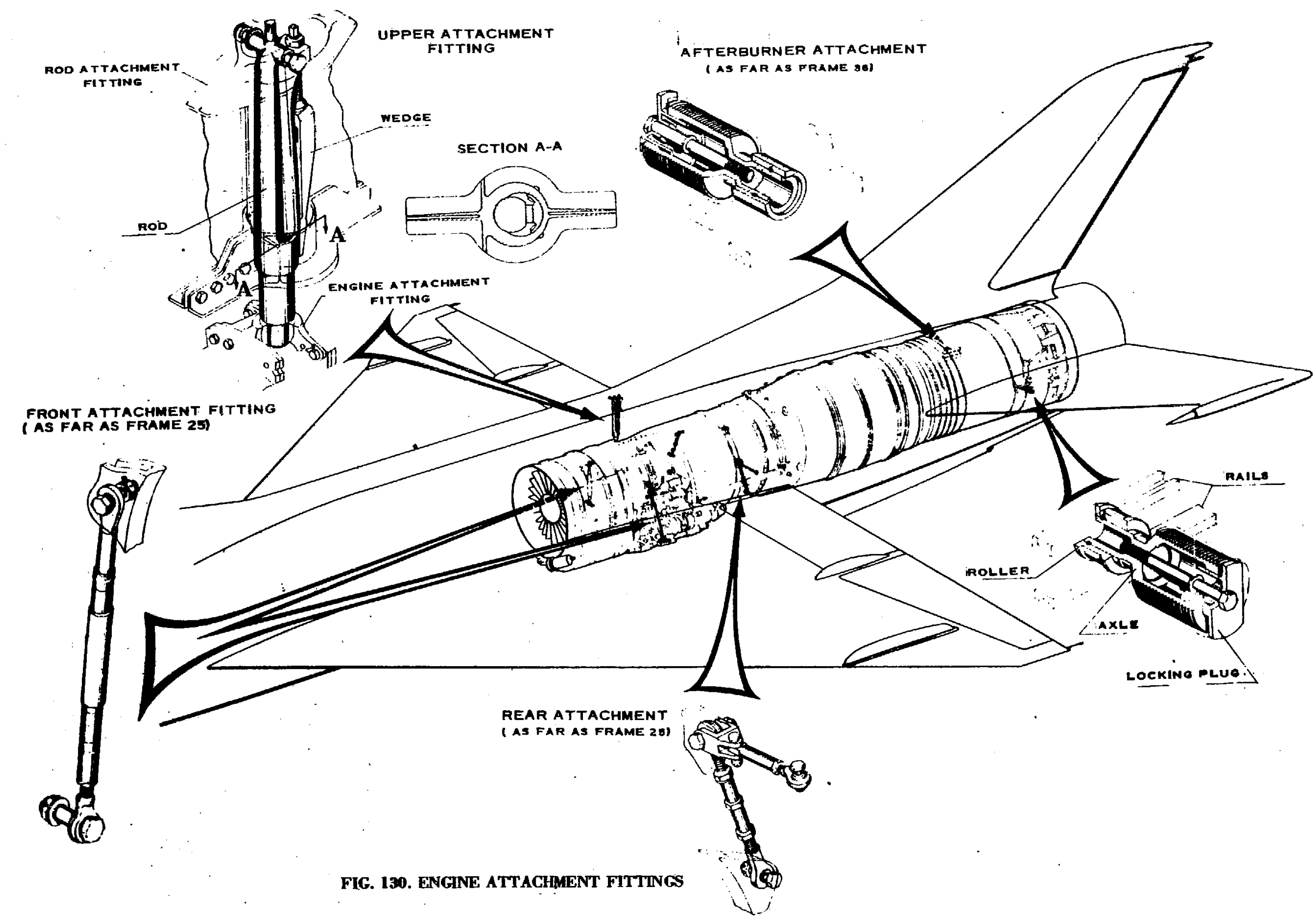

FIG. 130. ENGINE ATTACHMENT FITTINGS

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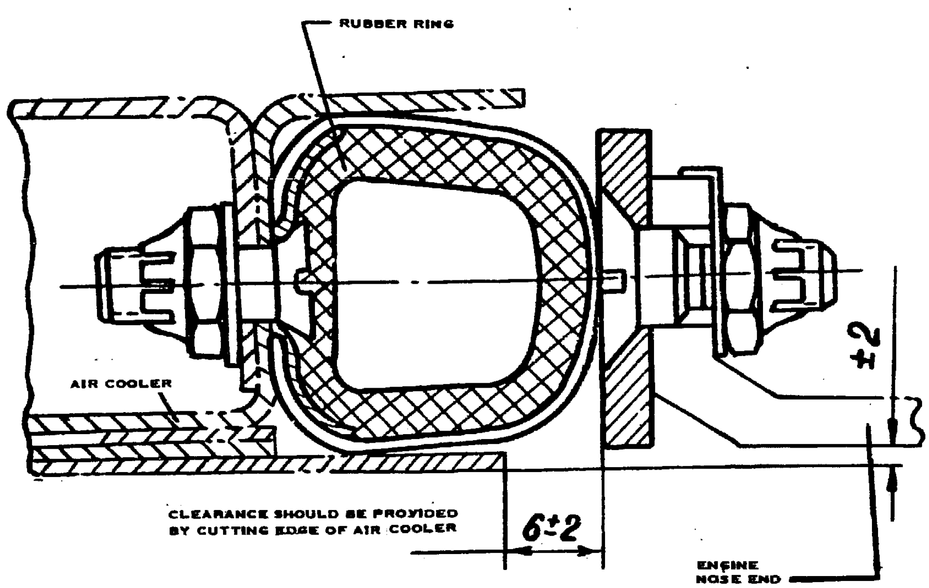

FIG. 131. INSTALLATION OF SHAPED SEAL

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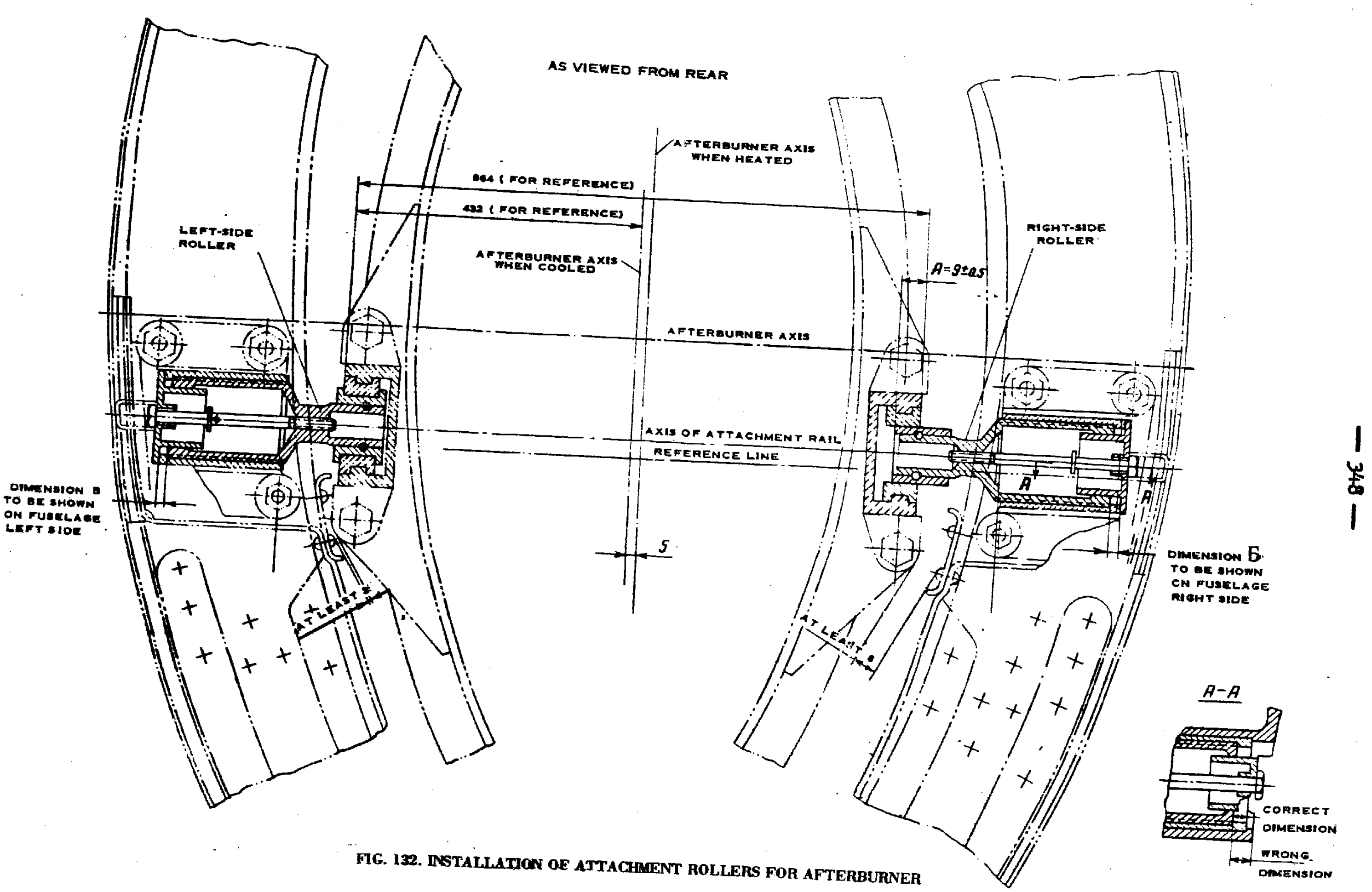


FIG. 132. INSTALLATION OF ATTACHMENT ROLLERS FOR AFTERBURNER

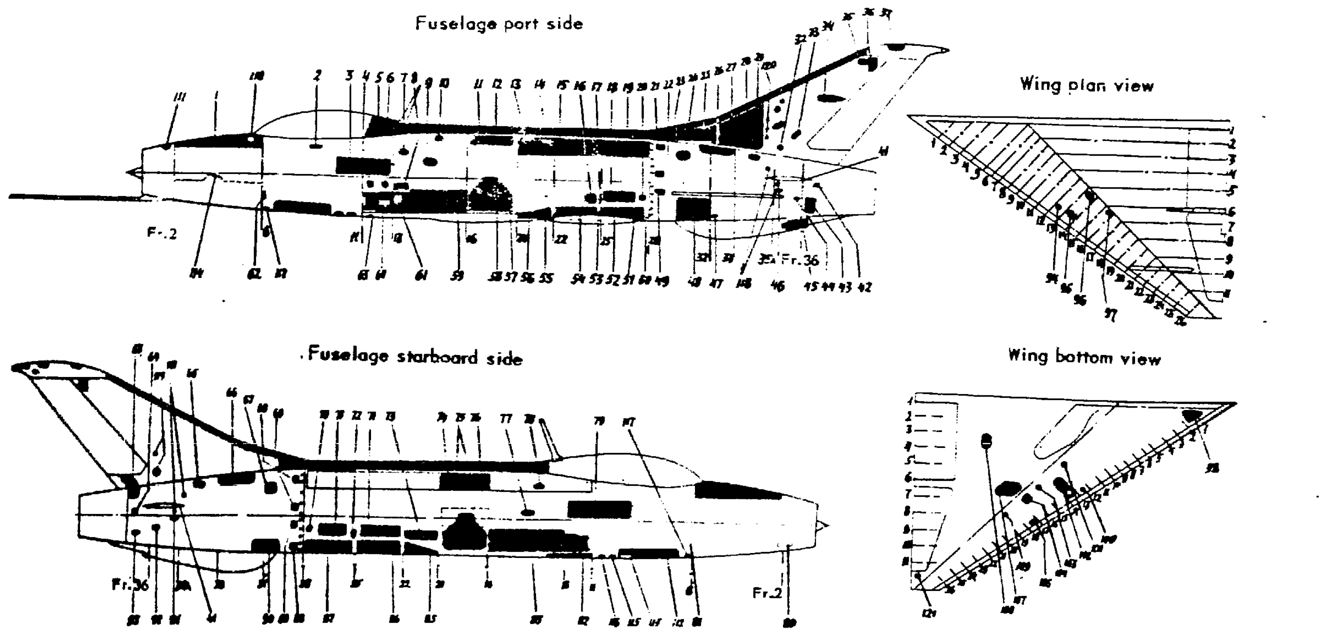
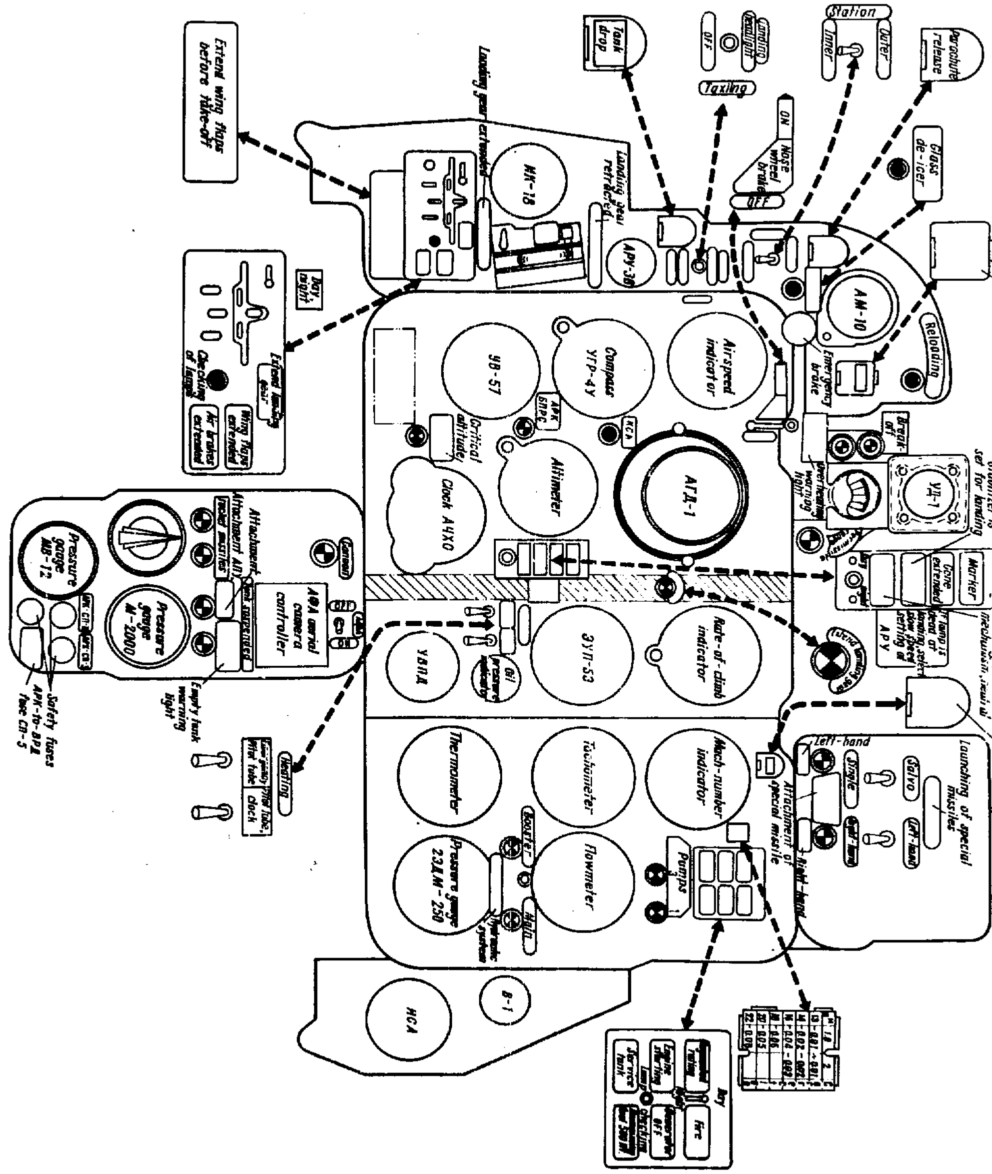


Fig. 133. Location of Service Hatches in Aircraft

1 – radio equipment; 2 – "Having opened canopy insert ground safety pin into canopy emergency handle"; 3,79 – electrical equipment; 4 – hatch for assembly; 5 – fuel system units; 6 – reduction valve for oxygen supply; 7 – inspection of cartridge belt; 8 – aileron bell-crank; 9 – wing tank connection; 10 – tank filler; 11 – float valve and low level warning unit; 12,93 – fuel tanks venting and aircraft control; 13 – gasoline filler; 14 – tank filler; 15 – fuel tanks 4,5 and 6;16,52,86,87 – engine accessories; 17, 72 – engine attachment fittings; 18 – engine and hydraulic system accessories; 19 – fuel tanks venting and control elements; 20 – connecting servo system pump; 21 – hydraulic reservoir filler; 22 – fuel line connection; 23 – automatic transmission ratio controller АРУ-3В; 24 – thermocouple; 25 – artificial feel mechanism АРУ-3В; 26 – hydraulic accumulator of servo system; 27 – pumping unit НП-27; hydraulic booster and marker-beacon receiver МРП-56П; 28, 35, 36, 37 – attachment fittings of radio wiring; 29 41, 65 – stabilizer control; 30, 31, 32, 33 – rudder control bell-cranks; 34 – induction transmitter ИД-2; 42, 64 – jet nozzle actuating cylinder; 43 – hydraulic pipes of jet nozzle; 44, 92 – attachment fittings of afterburner; 45 – brake chute lock; 46, 91 – lubrication of bearings; 47 – drainage of telescopic joint; 48 – brake chute; 49, 89 – hydraulic line disconnect valves; 50 – fuselage attachment fittings; 51 – kerosene drain; [illegible] – engine and hydraulic system accessories; 54 – kerosene rair.; 55 – [illegible] and hydraulic system accessories; 57 – pump of fuel tank No.3;control; 58,74 – fuel tank No.3; 59 – fuel system accessories; 60 – fuel line and pipe line of cockpit defroster system; 61,82 – air brake attachment fitting; 62, 81 – L.G. strut axle; 63 – rudder bell crank; 66 – main hydraulic system accumulator; 67 – thermocouple; 68 – hydraulic reservoir filler; 69 – safety valve of fuel tank pressurization system; 70 – connection of ground pump to main hydraulic system; 73 – hydraulic units; 75 – fuel tank No.3 attachment screws; 76 – charging of oxygen supply system; 77 – wing tank joint; 78 – inspection of cartridge link belt; 80 – hook for towing aircraft; 83 – voltage regulator; turbo-cooler; КАФ-13А; connector with latch; 85 – fire extinguishing bottle; 88 – fire detector; 90-ЭК-48 valve; marker-beacon receiver МРП-56П; 94, 97, 100, 103 – attachment of special missile; 95 – ПУС-36 launching control unit; connector; 96 – L.G. strut axle; 98 - non-linear mechanism; 101 – kerosene drain; 102 – rack connector; 104 – aileron bell-crank; 105 – access to wing navigation lights БАНО; 107 – hydraulic booster; 108 – flap cylinder; 109 – place for jack; 110 – destruction button; 111 – alcohol filler; 112 – storage battery hatch; 113 – checking E.M.F. of battery cells; 114 – access to radio-altimeter units РВУ; 115 – ground supply; 116 – access to electric units; 117 – access hole for inspection of L.G. nose strut attachment fittings; 118, 119 – inspection holes of control bell-cranks bolts; 120 – access holes for inspection of bolts securing booster; 121 – access to aileron axle; 99 – air bottles.

INSTRUMENT PANEL



INSET No.4

[redacted]

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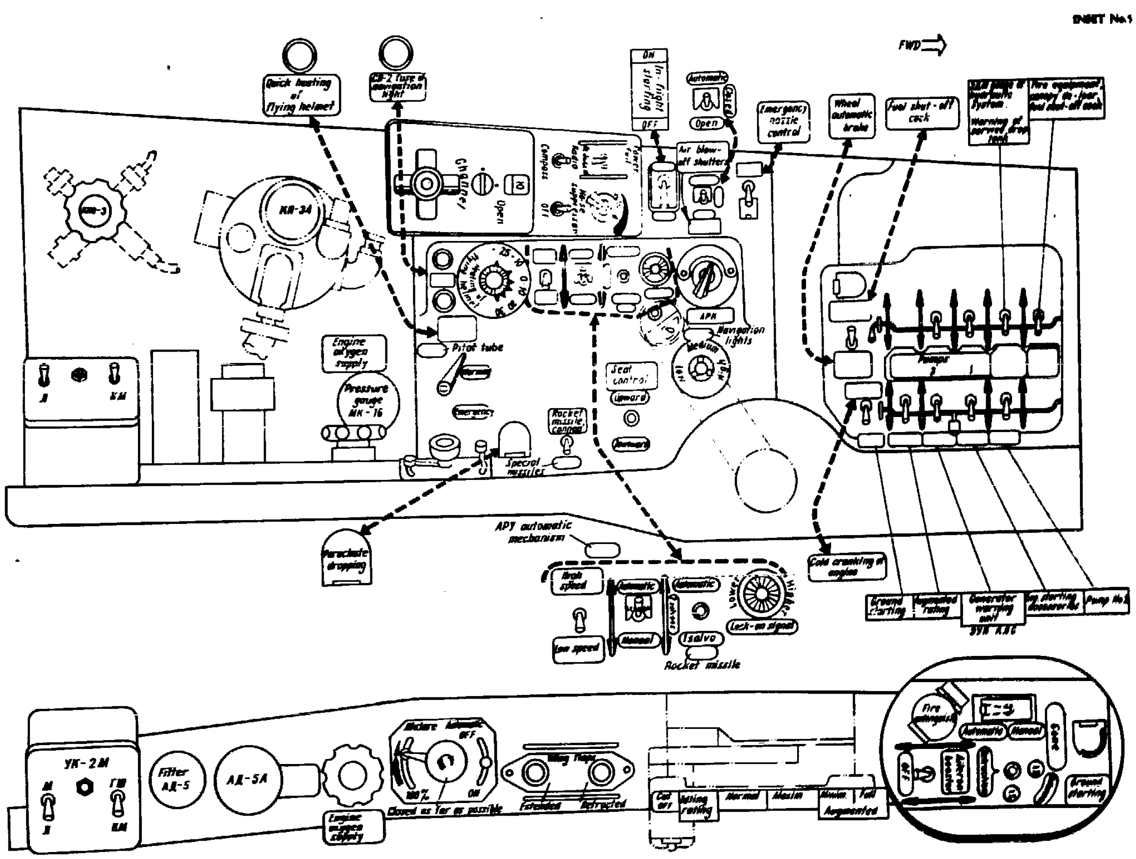
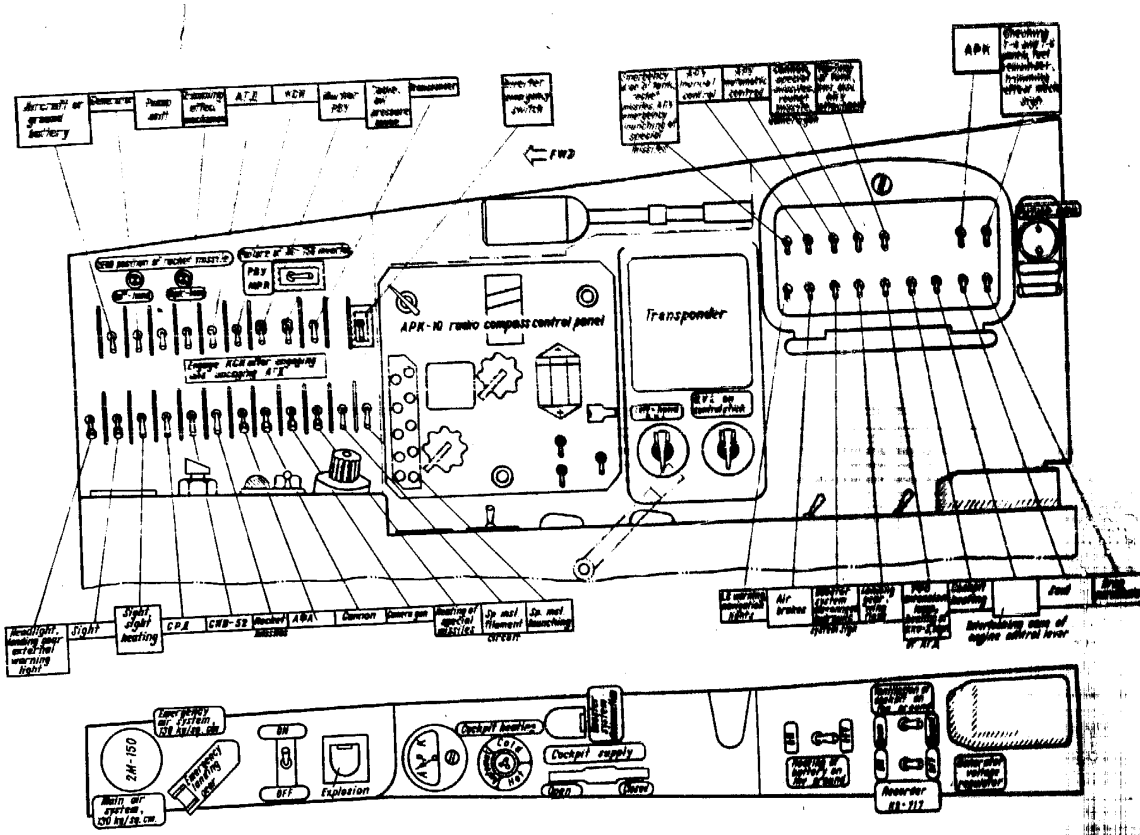


LEFT-HAND PANEL

INSET No.5



RIGHT-HAND PANEL.