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AIRCRAFT МиГ-19с

Service Manual

This Manual provides information concerning servicing and maintenance of the aircraft units and systems, as well as armament, radio and radar equipment, instruments and oxygen equipment.

Wiring diagrams and Specifications of these units, systems and equipment are given in a separate Album.

Technical Specifications and other data for the units, armament and special equipment are based on the information of the Manufacturing plants.

The data contained in the present Manual conform to the results of the Manufacturer's and official tests.

INTRODUCTION

The МиГ-19С aircraft (Fig.1) is a single-seater supersonic jet fighter with a power plant consisting of two РД-9Б engines with afterburners.

The МиГ-19С is a cantilever midwing aircraft with a sweptback wing and sweptback empennage with a controlled stabilizer. The fighter has no elevator.

The fighter is equipped with a tricycle landing gear, the main wheels being retracted into the wings while the nose one - into the fuselage. The landing gear is furnished with an automatic wheel braking system.

The fuselage is composed of two parts (nose and tail) connected by means of an easily detachable joint at frame No.20 which ensures a convenient removal and installation of the engines.

Two speed (air) brakes are located on the fuselage tail portion front, whereas the lower speed brake is positioned on the fuselage nose portion in the vicinity of frames Nos 11 and 14. The total area of the three speed brakes is 1.49 sq.m.

The rear bottom part of the fuselage tail has a special bay for the container with the drag parachute.

The pilot's cockpit is of the pressurized ventilated type equipped with an ejection seat with a face curtain to protect the pilot's face, as well as with a set of the KKO-1 oxygen equipment.

The single-glass cockpit canopy is composed of the windshield and sliding part. The latter can be jettisoned from the closed position only.

Entry of dust, water or snow into the cockpit with the aircraft parked is prevented by pressurizing the cockpit from the outside with the aid of the pressurizing cock handle ar-

ranged outside the port side of the canopy sliding part.

Mounted on the outside of the cockpit windshield is the de-icer pipe.

The aircraft has a sweptback wing, the sweepback angle being 55° along 25% of the chord line; the wing area is 25 sq.m. and its span is 9 m. The wing carries wing flaps with a sliding shaft of rotation and balanced ailerons; the port side aileron carries a trim tab. Attached to the wing top are aerodynamic fences.

To increase stability of aircraft lateral control at great M-numbers, interceptors (plates) are arranged parallel to the rear stringer on the wing bottom connected mechanically with the ailerons(deflecting the aileron downward causes the respective interceptor to come out).

To improve the aircraft flying properties at all altitudes and flying speeds, the longitudinal control of the aircraft is accomplished by a stabilizer with the АРУ-2А variable-ratio boost control unit system.

The longitudinal control system (stabilizer control) is of a rigid type including the БУ-14МС hydraulic booster, which is cut into a non-reversible circuit and fed from the booster hydraulic system, with its duplicating supply line running from the main hydraulic system. The booster is changed over to the main hydraulic system automatically as the pressure in the booster line drops below 65^{+5} kg/sq.cm.

It is also possible to switch the duplicated control from the main hydraulic system. The aircraft is equipped with an emergency control of the stabilizer by means of the АПС-4 electric [illegible] operated by the pilot with the aid of a control [illegible] electric follow-up system. The lateral control is automatically switched over from the hydraulic system to the electrical one [illegible] when the pressure in the line before the booster drops below 50^{+2} kg/sq.cm.

When control is effected from the АПС-4 emergency line mechanism, the pilot feels the same efforts on the control handle as when operating the stabilizer from the booster, but the handle travel speed is reduced and corresponds to the rate of shifting the stabilizer through 4 degr. per second (when checked on the ground).

Aircraft endurance is ensured by the employment of separate hydraulic systems with variable-displacement pumps (the pump driven by the left-hand engine supplies the booster line, whereas the pump servicing the landing gear, wing flaps, air brakes and engine jet nozzle shutters is actuated by the right-hand engine). Each system has its own hydraulic tank and pump. The pressure in the systems is equal.

The aircraft air system feeds compressed air for actuating the main and emergency landing gear wheel braking systems, for the emergency lowering of the landing gear and wing flaps, for re-loading the cannon, for releasing and disconnecting the drag parachute, for removing the sliding part of the canopy, for pressurizing the cockpit, for closing the shut-off fuel valves, and also for operating the de-icing system.

The aircraft fuel system comprises four tanks located in the fuselage. Their total capacity is 2170 litres.

Besides, two additional tanks of 400 or 760 litres each may be suspended from the wings. In flight the tanks may be dropped.

Fuel consumption is checked by the ТРЗ-52 fuel flow-meter that serves to indicate constantly the remaining amount of fuel in the aircraft system.

Engine starting is facilitated by a gasoline system comprising a gasoline tank and a booster pump.

The aircraft armament consists of three 30-mm НР-30 cannon. Two cannon are located in the wings at the root ribs, while the third one is arranged at the starboard bottom of the fuselage nose part. The wing cannon are furnished with 73 cartridges each and the fuselage cannon is supplied with 55 cartridges.

Each cannon has a link bag, the cartridge cases are ejected outside.

The aircraft rocket weapon comprises two ОРО-57К rocket pods with eight АРС-57 (С-5) rockets.

The ОРО-57К cluster rocket launchers may be suspended in two ways:

(a) with drop fuel tanks installed;

(b) with drop fuel tanks removed (mounted instead of the tanks).

The bombing equipment of the aircraft consists of bombs weighing from 50 to 250 kg and attached to universal

bomb carriers instead of drop tanks.

The aircraft armour consists of armoured glass for the canopy windshield, armoured plate arranged in front of the cockpit, armoured head and back plates of the pilot's seat.

The radio and radar equipment comprises a transmitter-receiver station, type РСИУ-4П , airborne responder, type СРО, tail warning radar, radio range finder, type СРД-1М, combined with sight, type АСП-5Н , and also a ОСП-48 system consisting of an automatic radio compass, type АРК-5, radio altimeter for low altitudes, type РВ-2, and a marker receiver, type МРП-48П.

Chapter I

PREPARATION OF AIRCRAFT AND ENGINES FOR FLIGHT

1. GENERAL

1. In carrying out inspections and routine maintenance work, follow the order set forth in the present Manual and observe the Instructions delivered along with the units and instruments.

2. Periodically, depending on the operating conditions, drain the condensate from the entire fuel system through the drain cocks (plugs). This is usually done before the flight.

3. Routine maintenance operations on the aircraft, engines and other units should be carried out at regular intervals determined by the number of aircraft flying hours, i.e. every 10 ± 1, 25 ± 5, 50 ± 5, and 100 ± 5 flying hours. In carrying out the 50-hour operations, perform simultaneously the 10-hour and 25-hour maintenance operations, and in fulfilling the 100-hour operations, perform the 10-hour, 25-hour and 50-hour routine maintenance operations.

4. In case of replacement of an engine or some other unit, routine maintenance operations on them should be performed at intervals determined by the number of aircraft flying hours, i.e. every 10 ± 1, 25 ± 5, 50 ± 5 and 100 ± 5 flying hours.

Routine maintenance operations on a newly installed engine or unit may be carried out ahead of the schedule.

5. To ensure trouble-free operation of aircraft equipment under different climatic conditions of the airfields (humidity, dust, etc.), in case of intensive use of separate units when carrying out special missions (increased number of take-offs and landings, intensive firing, etc.), during engine replacement or prolonged intervals between the flights it is recommended to perform unscheduled operations on all or separate aircraft

(units) in compliance with the present instructions on routine maintenance operations.

6. The tools and fixtures employed for any operations on the aircraft must be in good condition.

After work is over, check to see that no tools or fixtures remain in the aircraft.

7. Before turning over the aircraft for 25, 50 and 100-hour maintenance operations, it is recommended to carry out the following checks during one of the last startings of the engine:

(a) check the pressurization value in the fuel drop tanks and in tank No.1 and make sure that there is no fuel leakage in the fuel system (See Chapter X, Section 2 "Checking Fuel System for Leakage");

(b) check the oil pressure at the engine inlet.

Then examine the aircraft as prescribed for the post-flight inspection.

8. Coat all friction parts of the aircraft except the bearings of the wheels, of the АПС-4 stabilizer emergency control system, and of the turbo-cooler with ЦИАТИМ-202 lubricant; the wheel bearings should be treated with НК-50 grease, the turbo-cooler bearings with ОКБ-122-14 oil and those of the АПС-4 stabilizer control system with ОКБ-122-12 oil.

9. It is not allowed to pressure-lubricate or wash closed-type ball bearings. They must be only wiped and their external surface coated with a film of grease.

10. In performing inspections and routine maintenance operations, clean the external surfaces of the aircraft units, armament, special equipment and their linkage of dirt and dust. Never should dirt be washed off with a kerosene-air mixture.

11. With the aircraft parked close the cockpit with a cover to protect rubber parts in the cockpit and the canopy glass against sun rays.

12. The hydraulic accumulators and landing gear shock absorbers must be charged with compressed nitrogen. If compressed nitrogen is not available, it is allowed to charge them provisionally with compressed air.

13. During ground tests do not employ external power sources with a voltage below 24.5 V.

2. SAFETY PRECAUTIONS

1. Before starting an inspection or any maintenance operations on the aircraft, take precautions to exclude inadvertent firing of the cannon or the ejection seat, retraction of the landing gear or switching on of electrical mechanisms as this may involve accidents and cause damage to aircraft equipment.

To this end open the cockpit canopy and without entering the cockpit make sure that:

(a) the cockpit canopy emergency autonomous removal handle is in the CLOSED position and locked;

(b) the seat ejection gun and its triggers on the handrails are safetied while the face curtain handle and triggers on the seat handrails are locked;

(c) the tactical and emergency bomb drop buttons are closed with caps;

(d) the landing gear control switch is in the neutral position and held by its lock;

(e) the storage battery and all electrical switches are cut off;

(f) the CPO responder destruction circuit is cut out (the safety cotter pin is inserted).

2. To avoid failure of the engines due to a possible entry of foreign objects through the open blow-off bands, the following rules must be observed when working in the engine bay:

(a) use tools only after they have been attached to a cord;

(b) take measures to prevent the removed units and parts from dropping into the bay;

(c) perform operations on installation and removal of equipment only with the blow-off bands closed.

3. Reduce pressure in the hydraulic systems to zero and cut off the accumulator before starting operations on the stabilizer, ailerons, landing gear wells, wing flaps and air brakes to avoid any accident. To ensure safety during operations in the air brake wells, lower the speed brakes, reduce pressure in the hydraulic system to zero, disconnect the accumulator and then set the slide for retraction to make sure that the air brakes do not retract.

4. To avoid inadvertent firing of the seat ejection gun,

never remove the cockpit canopy along with the interlocking cable of the seat ejection gun.

5. When working in the cockpit with the canopy removed or opened, see to it that the protective caps are screwed onto the canopy pneumatic remover guns; prior to closing or installing the canopy, remove the caps.

6. With the engines running, it is not allowed to pass or stand in front of the air intake ducts at a distance less than 15 m.

7. It is prohibited to switch on the АРУ-2А variable-ratio boost control unit without switching on the БУ-14МС hydraulic or АПС-4 electrical drives to avoid failure of the АРУ-2А control unit.

8. When handling the aircraft armament, place a red warning flag at a distance of 3 to 5 m. in front of the aircraft to warn against standing or walking in front of the aircraft.

At night do not fail to place a red warning light.

9. All holes of the units and pipes opened during dismantling should be immediately closed by special plugs or caps.

10. In order to retain the fuel in the inner chambers of the engine pumps before draining the fuel from tank No.1, open the filler neck of tank No.1 and create pressure in the fuel system by engaging the pump of tank No.1. This done, close the fuel shut-off cocks and drain the fuel, with the tank filler neck open.

11. If the engine oil system has been emptied, top up the oil tank prior to starting the engine and turn the cold engine 2 or 3 times, after which refill the oil system.

3. PRE-FLIGHT INSPECTION

Uncover the aircraft and remove the covers from the cannon, air-speed tubes ПВД and ТП-156; remove the plugs from the air intake ducts and jet nozzles, as well as from the pipe union of the РД-2МА pressure regulator and from the air blow-off shutters; then remove the screw clamps from the rudder.

Arrange the wing service ladders, prepare the ground equipment and tools.

Inspect and check the aircraft as shown in Fig.2.

I. Air Intake Ducts

1. See that there are no foreign objects in the ducts and check the screws for proper tightening (by the red marks).

II. Fuselage Nose Part

2. Check the ПВД air-speed tube rod and the ТП-156 emergency tube for condition and attachment.

3. Check the de-icer system for alcohol leakage and see that the tank is full. Check the storage battery for leakage of electrolyte.

4. See that the armament and radio equipment access doors and plates are closed.

III. Upper Nose Bay

5. Open the cover of the nose bay and check the latter for foreign objects. Inspect the condition of the landing gear strut mechanical position indicator.

With the bay door closed make sure the strut position indicator freely extends when pushed.

IV. Nose Landing Gear Strut

6. Check the wheel tyre for proper inflation by tyre deflection which should be 10 to 15 mm.

7. Check earthing cable for proper fit and attachment in its special socket.

8. Check for АМТ-10 fluid leakage from the wheel shimmy damper.

9. Check the pressure of nitrogen in the shock absorber by the compression of the latter.

10. See that there is no leakage of АМТ-10 fluid from the shock absorber.

11. See that there is no leakage of АМТ-10 fluid from the hydraulic cylinder, units, pipes and hoses in the wheel strut well.

12. Check opening and attachment of the landing gear doors.

13. Check the attachment of pipe lines and electrical wire bundles.

14. Check the attachment of oxygen bottles.

V. Right-Hand Main Landing Gear Strut

15. Check the wheel tyre for proper inflation; tyre deflection should be 30 to 40 mm.

16. Check the pressure of nitrogen in the shock absorber (by the shock absorber compression) and see that there is no AMT-10 fluid leakage.

17. Make sure there is no leakage of AMT-10 fluid from the strut hydraulic cylinder.

18. See whether the wheel door and strut up locks are closed.

Inspect the condition and attachment of the landing gear doors (wing, strut and wheel doors).

19. Check the L.G. strut well for oil leakage from the units, hoses and pipes.

20. Check the attachment of pipes and electric wire bundles.

VI. Right-Hand Wing

21. Check the wing access panels for proper closing and see that there is no leakage of AMT-10 fluid from the aileron booster access hatch.

22. Check the condition of the mechanical position indicator of the main landing gear strut and the attachment of the aerodynamic fence.

23. See that there is no fuel leakage from the fuel drop tank.

VII. Right-Hand Side of Fuselage

24. Check the access door covers for reliable closing.

25. Check the position of the air blow-off shutters on the panel of the right-hand engine access hatch. See whether the fuel system shut-off cocks and the air blow-off bands on the engines are open.

26. Make sure there is no oil or fluid leakage.

27. Inspect the ends of the vent tubes and clean them if necessary.

VIII. Empennage

28. Examine the outside of the adjustable stabilizer. Make sure there is no foreign matter in the space between the fairing and the stabilizer.

29. Check the condition of the bent tab or the position of the trim tab on the rudder (on aircraft of later design).

30. Check the access panels on the empennage for reliable closing.

IX. Jet Nozzles

31. Make certain there are no foreign objects in the nozzles and no leakage of AMT-10 fluid; check also the nozzle shutters for free opening and for proper position. The shutters should be completely open, i.e. be in the starting-augmented rating position.

X. Left-Hand Side of Fuselage

32. Perform the inspection in the same way as on the right-hand side of the fuselage (See Points 24 to 27).

33. In addition, check the drag parachute doors for reliable closing; check also the front and rear locks of the doors and the parachute cable lock for proper safetying and reliable closing. The cable should not be slack and should be reliably secured in the clamps, whereas the retainers of the door open position locks should stand against the notches.

XI. Left-Hand Wing

34. Perform the inspection in the same way as on the right-hand wing (See Points 21 to 23).

35. In addition, check the balanced position of the aileron trim tab in accordance with the inscription on the trim tab.

XII. Main L.G. Left-Hand Strut

36. Perform the inspection in the same way as on the main L.G. right-hand strut as prescribed in Points 15 to 20.

XIII. Filling of Aircraft Systems

Open the access panels and do as follows:

37. Check the aircraft for filling with fuel by the fuel level in tank No.1

In doing so do not fail to check the readings of the fuel flow meter.

The fuel level in the fuselage and drop tanks should be below the lower edge of the filler neck by 20 to 30 mm in summer and by 10 to 20 mm in winter.

Drain the fuel sediment from tank No.1 and make certain it contains no water or foreign particles.

38. Check the fuel level in the starting system. The fuel level in the system tank should be 40 mm below the lower edge of the filler neck both in summer and in winter.

39. Check the oil level in the engine tanks. It should be at the mark 10.5 - 11 litres on the dipsticks marked " Л " and " П " (which stand for the left- and right-hand engines, respectively). With the engines running on the ground, the amount of oil in the tanks must not be less than 7 litres.

40. Check filling of hydraulic systems. With zero pressure in the systems and retracted wing flaps and air brakes, the level of АМГ-10 fluid in the tanks should be at the marks made on the dipsticks.

CAUTION: It should be borne in mind that a proper fluid level in the hydraulic tanks is of utmost importance for normal operation of the systems. Lack of АМГ-10 fluid in the tanks may cause failure of the hydraulic systems in flight.

41. Check the alcohol level in the de-icer system tank. The tank should contain 6 litres of alcohol.

42. Add fuel, oil, fluid and alcohol, if necessary, and close the access panels.

XIV. Aircraft Cockpit

Make sure there are no foreign objects or water in the cockpit. In winter check the cockpit for ice, especially under the pilot's seat, through the ports made in the seat. Remove the cover from the wing flap control panel, after which inspect the cockpit as follows:

43. Check the canopy organic glass for cracks, formation of "silver" or worsening of glass transparency. Check also the de-icing system spraying manifold for cleanliness. Check the condition of the pressurizing rubber tube and its coating.

44. Check to see that the pressure reads 50_{-3} kg/sq.cm. in the air bottle of the cockpit pressurizing system, from 110 to 130 kg/sq.cm. in the canopy remover gun bottle, from 110 to 130 kg/sq.cm. in the main air system, 50 kg/sq.cm. in the landing gear emergency system and from 110 to 130 kg/sq.cm. in the wing flap control system.

45. Check the safety belts and their locking mechanism for proper operation, and smooth down the belts. Check the locking pieces on the seat face curtain, on the handrails, on the diaphragm valve, on the ring of the ejection gun interlocking cable, and also on the flexible pin of the АД-3 automatic unit; make sure the spring hook of the АД-3 unit rope is reliably secured to frame No.7 and that the ОРК-1М cable is attached to the seat rail.

46. Get seated in the cockpit and check the canopy sliding part for easy closing and opening, and see also that it is reliably fixed in the extreme positions.

Check the canopy locks for reliable closing and for presence of the locking pieces on the control levers of the canopy locks and on the canopy emergency jettison handle.

47. Check the engine control levers for easy travel, reliability of locking and fixing on the stops.

48. Make sure the brake system is in good order by pressing the brake lever and exercising the pedals. Clogging of the release hole may be one of the reasons for improper air release from the УП-30 valve. The hole must be cleaned.

Note: Under zero temperature conditions check, simultaneously with depressing the brake lever, whether the brake shoes displace.

49. Check the operation of the main and booster hydraulic systems as prescribed in Chapter VIII, Section 2 "Checking Operation of Hydraulic Systems".

50. Check the stabilizer control system for proper operation as instructed in Chapter IV, Section 2 "Care of Stabilizer Control".

51. Check the ailerons for deflection with the booster engaged and disengaged, make sure the handle and ailerons move smoothly and that a certain effort from the spring-feel mechanism is perceptible on the handle.

52. Deflect the pedals to make certain that the rudder deflects fully and freely, without knocks and binding, in the desired direction.

53. Check the aileron trim tab and the rudder trim tab (if it has been installed) for deflection, then place them in neutral position in accordance with the inscriptions on the trim tabs.

54. Check to see whether the emergency extension valves of the landing gear and wing flaps are closed and safetied with KOK-0.5 wire.

55. Check to see whether the caps of the fuel shut-off cocks closing buttons are safetied with Л62 brass wire, 0.25 mm in diameter.

56. Check operation of the АД-5 button; after being pressed, the button should return to its initial position. See that the rubber cover is in good condition.

57. Under conditions favourable for the ice formation during the flight, do not fail to check operation of the de-icing system.

58. Check whether the circuit breakers necessary for the given flight are switched on. The circuit breakers are located on the right-hand panel under the transparent cover.

After the equipment has been checked by all the experts, check whether the access plates opened during the inspection are reliably closed and switch off the circuit breakers that have been switched on during the pre-flight inspection.

Before the pilot takes his seat in the cockpit, remove the cable with the ground locks and set the air-speed tube rod in the horizontal (flight) position.

4. CHECKING OPERATION OF ENGINES

Check the operation of the engines on a specially equipped ground provided with a deflecting plate in the rear and special stops (concrete-enveloped rails) for the blocks.

CAUTION: The engines may be raced only with the fuselage attached. If it is necessary to race the engines with the tail part detached, use a special appliance to hold up the tail pipes during engine racing.

To ensure better cooling conditions for the units located in the engine bay, it is necessary to open the engine access panels when the engines run on the ground.

Note: Check the engines for acceleration and starting with the access panels closed.

When preparing the engines for starting, do as follows:

1. In windy weather position the aircraft air intake ducts into the wind.

2. Make sure that all ground equipment in front of the aircraft and behind it has been removed; see that the ground in front of the air intake ducts is clean.

3. Make certain the parking place is equipped with fire-fighting means.

4. Remove the plugs from the air intake ducts, jet nozzles and ports of the shutters serving to pass the air from the engine bay, examine the air intake ducts and make sure that there are no foreign objects in them.

5. Make sure that the remote controlled shut-off cock of the engine is in the ON position.

6. Place the air-speed tube rod in the flight position and remove the cover from it.

As the aircraft is provided with two hydraulic systems and the pump of the main system is attached to the right-hand engine, whereas the pump of the booster hydraulic line which is mounted on the left-hand engine does not operate the jet nozzle shutters, it is well to bear in mind the following:

1. Start and stop the engines in the following sequence:

Engine Starting

Start first the right-hand engine and then the left-hand one.

Engine Stopping

Stop first the left-hand engine and then the right-hand

one to ensure proper control of jet nozzle shutters.

2. If it is necessary to check operation only of the left-hand engine at various ratings, then prior to starting the engine connect a ground hydraulic pump to the main system or start the right-hand engine.

3. If it is absolutely necessary to stop first the right-hand engine, bear in mind that it will be impossible to control the shutters of the left-hand engine and they may remain in the position NORMAL or MAXIMUM after the engine has been stopped.

Note: After the right-hand engine has been stopped, the shutters of the left-hand engine may be displaced only once immediately after stopping the engine utilizing the pressure in the hydraulic accumulator for this purpose.

Start the engine in the following sequence:

1. Cut in the switches bearing the inscriptions AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ.БОРТОВОЙ, АЭРОДРОМ.)and GENERATOR (ГЕНЕРАТОР) of the engine to be started.

Note: When starting the engine from the ground storage battery, do not switch on the generator.

2. Switch on the circuit breakers bearing the inscriptions STARTING UNITS (АГРЕГАТЫ ЗАПУСКА), PUMP OF FUEL TANK No.1 (НАСОС БАКА 1), INSTRUMENTS OF ENGINES, FIRE-FIGHTING EQUIPMENT, PUMP WARNING UNITS OF TANKS NOS 1, 3 and 4 (ПРИБОРЫ ДВИГ., ПРОТИВОПОЖАРН.ОБОРУД., СИГНАЛ ПОМП 1, 3,4 БАКОВ) and OIL PRESSURE SHUT-OFF VALVE (ПЕРЕКР.КРАН ДАВЛЕН. МАСЛА) of both engines.

Note: After the circuit breaker OIL PRESSURE SHUT-OFF VALVE has been switched on, the respective warning lamp NO OIL should light up on the T-6 lamp register.

3. Set the control lever of the engine to be started to the position IDLING SPEED (МАЛЫЙ ГАЗ).

4. Depress, on the left panel, the button STARTING (ЗАПУСК) of the engine to be started for 1 or 2 sec.

The engine must start.

The STARTING button must be depressed 1 or 2 sec. (but not later than 10 sec.) after the lever has been set to the position IDLING SPEED.

Check operation of the engine in compliance with the Engine Maintenance Instructions.

Notes: 1. If the engine fails to start, scavenge it, for which purpose set the engine control lever in the position STOP (СТОП). Then press the button STARTING to rotate the engine shaft.

2. Proceed to starting the left-hand engine only when the right-hand one is running at idling rating.

3. Check operation of the engines at maximum rating and at augmented rating separately. When trying the engine, see that the three wheels are always braked and thrust blocks are placed under the wheels. The blocks should rest against special stops (a concrete-enveloped rail). The wheels should be braked only after they have come to stop against the blocks. When no concrete-enveloped rails are available, the aircraft may be secured by special cables attached to the landing gear struts.

4. A partial drain of fuel from the vent line when changing the engine ratings is no defect. Fuel is drained from the control cylinder of the air blow-off band.

In case faults have been detected in operation of the engines, it is recommended to try the engines and measure all the engine characteristics. To this end, connect the ground instruments mounted on a special panel contained in the set of ground equipment.

CAUTION. To maintain the required temperature in the aircraft fuselage, the duration of engine running on the ground at speeds below the rating at which the air blow-off bands close the ports, should not exceed 5 min. If this time period is not sufficient, set the engine to 9800 – 10000 r.p.m., after 5 min. have elapsed and run it at this speed for about 1 min. or switch off the engine if it is impossible to raise its speed, after which the trying may be continued.

With the fuselage joined together continuous operation of the engines running on the ground at the augmented rating

must not exceed 10 sec. to avoid overheating of the structural elements of the fuselage tail and nozzle shutter control cylinders.

It is not allowed to run both engines simultaneously at speeds exceeding 10,000 r.p.m.

In trying the engines it is recommended to observe the following sequence (See Fig.3):

0 - 1 - start the engine; time required for the engine to gain a speed 100 r.p.m. below the idling rating must not exceed 80 sec., and the short-time gas temperature surge should not exceed $t_g = 850^{\circ}C$.

1 - 2 - run the engine at idling rating for 1 min., $n = 4100^{+200}$ r.p.m., gas temperature $t_g \leqslant 650^{\circ}C$; the oil pressure warning lamp does not burn.

3 - 4 (3' - 4') - check the cockpit air feed and pressurizing system.

5 - 6 - raise the engine speed to $n = 10,400 \pm 50$ r.p.m. and maintain it for 0.5 to 1.5 min. During this time period check operation of the hydraulic system, aircraft control and generators. As the engine speed is being raised to $10,400 \pm 50$ r.p.m. the jet nozzle shutters should switch over from STARTING (AUGMENTED) rating to NORMAL rating at a speed of n = 4500 to 6500 r.p.m.

7 - 8 - run the engine at NORMAL rating, $n = 11,150 \pm 50$ r.p.m.; $t_g \leqslant 550^{\circ}C$; the oil pressure warning lamp is out.

8 - 9 - run the engine at MAXIMUM rating, but for not more than 10 sec.; $n = 11,150 \pm 50$ r.p.m., $t_g \leqslant 650^{\circ}C$; the oil pressure warning lamp is out.

CAUTION. The engine may be run at maximum speed not earlier than one minute after the idling rating has been obtained.

9 - 10 - run the engine at AUGMENTED (ФОРСАЖ) rating, but for not more than 10 sec. The warning lamp AUGMENTED RATING (ФОРСАЖ) is on; $n = 11,150 \pm 50$ r.p.m., $t_g \leqslant 650^{\circ}C$ at ambient air temperature $t \leqslant 15^{\circ}C$, and $t_g \leqslant 680^{\circ}C$ at ambient air temperature $t > 15^{\circ}C$; the oil pressure warning lamp does not burn; short-time surge of engine speed up to n = 11,600 is permissible for a period not exceeding 3 or 5 sec.; the augmented rating may be switched on only after the lever has been kept at MAXIMUM rating for at least 3 sec.

Note: In case the MAXIMUM and AUGMENTED ratings are adjusted with the aircraft fuselage detached and the tail pipe secured on a special truss, a continuous running of the engines must not exceed 6 min.

10 - 11 - reduce the speed to idling rating. In doing so check to see that the blow-off bands open the ports at 9700_{-100} r.p.m.

11 - 12 - check idling speed on warmed up engine ($n = 4100^{+200}$ r.p.m.; $t \leqslant 650^{\circ}C$; the oil pressure warning lamp is out).

13 - 23 - check the engine for acceleration ability:

at speeds from beginning of automatic control to normal rating	- from 9 to 12 sec.;
from idling rating to normal	- from 9 to 12 sec.;
from idling rating to maximum	- from 9 to 13 sec.;
from idling to augmented rating	- from 10 to 15 sec.

Check the engine for acceleration ability when the engine control lever is moved consecutively from the idling rating stop to the positions NORMAL (НОМИНАЛ), MAXIMUM (МАКСИМАЛ) and AUGMENTED (ФОРСАЖ) for 1.5 to 2 sec.

In checking the engine for acceleration ability, a short-time speed surge up to n = 11,600 r.p.m. during 3 to 5 sec. is permissible, the gas temperature being $t_g \leqslant 750^{\circ}C$ (a short-time stop in further speed acceleration at a speed of n = 10,000 to 11,600 r.p.m. is permissible as the speed is being raised from idling to maximum rating).

24 - 25 - cool the engine for at least 1 min. at n = 9800 - 10,000 r.p.m. In doing so, check the aircraft controls (with the boosters disengaged) and also operation of the generators.

25 - 26 - 27 - stop the engine.

When stopping the engine make sure that the fuel is not burning inside the jet nozzle.

After the engine has been stopped, the fuel accumulated due to failures in the engine starting or due to an improper setting of the lever into position STOP (СТОП) may inflame. If this happens, rotate the cold engine once or twice. If this fails to stop fuel burning, which testifies to a large amount of fuel accumulated in the engine, start the engine and let it run for 1 min. at 10,000 r.p.m. Then stop the engine.

When stopping the engine check it by listening for smooth running and for absence of abnormal noises. The time required for stopping the engine after the idling rating must be not less than 60 sec.

The engine may be stopped from any rating, except MAXIMUM and AUGMENTED, without cooling.

In trying the engines it is recommended to check the operation of the hydraulic system, wing flaps, air brakes and their warning systems, as well as the aircraft control system with the boosters engaged and also operation of the generators, engine and hydraulic system instruments.

With the engines running, make certain that a normal working pressure is created in the hydraulic system, the pressure being checked by the pressure gauges on the right-hand panel and on the lower portion of the instrument board.

Check the wing flaps and air brakes for proper extension and retraction. Make sure that after the flaps and brakes have been extended or retracted, the pressure in the system is duly restored to its normal value.

Notes: 1. Before the first start and also after each time the pipes of the engine oil or fuel systems have been disconnected, or after some units of the systems have been replaced or if air pockets have been detected in the system, prime the whole system. Then start the engine with the engine compartment hatch doors open. After checking the system for pressure-tightness, close the hatches.

2. If starting (spinning) the engine was stopped before the warning lamp ENGINE IS STARTED IN THE AIR, CUT OFF IGNITION (ЗАПУСК В ВОЗДУХЕ ПРОИЗВЕД, ЗАЖИГАНИЕ ВЫКЛЮЧИ) went out, switch on the circuit breaker STARTING UNITS (АГРЕГАТЫ ЗАПУСКА) for 30 to 40 sec. to accomplish the starting automatic cycle.

Cold spinning of the engine should be accomplished as follows:

1. Cut in the switch AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ.БОРТОВОЙ, АЭРОДРОМ.) and circuit breakers STARTING UNITS (АГРЕГАТЫ ЗАПУСКА), EMERGENCY DISENGAGEMENT OF AUGMENTED RATING, MAXIMUM (АВАРИЙНОЕ ОТКЛЮЧЕН.ФОРСАЖА, МАКСИМАЛ) of the respective engine and PUMP OF TANK No.1 (НАСОС БАКА 1).

2. Set the engine control lever to the position STOP (СТОП).

3. Press the button STARTING (ЗАПУСК) for 1 or 2 sec. The speed should be from 800 to 1100 r.p.m. and the oil pressure warning lamp should burn or blink at least.

Note. To prevent the starter-generator from overheating, it is not allowed to perform more than four cold spinnings in a close succession. After the fifth spinning of the engine or several unsuccessful attempts to start the engine, it is necessary to check the level in the oil tank. If the oil level in the tank has dropped by more than 2 litres, drain the oil from the front housing and add oil into the tank.

5. AIRCRAFT TOWING

The aircraft is towed about the airfield by a truck-tractor or automobile with the aid of a special towing gear (See Fig.4).

The towing gear fork is connected with the nose wheel axle by a locking pin, whereas the hooks of the towing cables engage towing links of the main landing gear struts. The towing lug of the towing gear is attached to the vehicle.

The aircraft may be towed only with the mechanic or pilot in the cockpit. During towing the cockpit canopy should be shifted backward and held in the rear position by the rear lock. The air speed tube rod should be raised.

Before towing the aircraft, do as follows:

1. Check the pressure in the brake system against the double-pointer pressure gauge. It should be equal to $10^{+0.5}$ kg/sq.cm.

2. Set the sight selector switch knob to the position FIXED (НЕПОД.).

The aircraft may be towed at a speed from 10 to 15 km/hr on concrete run-ways and from 5 to 6 km/hr on natural run-ways and in the vicinity of the parking place.

Note: Prior to towing an aircraft under conditions of poor visibility (at night, in fog, etc.). do not fail to switch on the aircraft navigation lights. Towing speed should not exceed 5 km/hr.

It is recommended to avoid abrupt starting or abrupt braking of the vehicle.

6. INSPECTION ON STARTING LINE AND PREPARATION FOR REPEATED FLIGHT

Prior to the inspection obtain information from the pilot on operation of the aircraft and of its systems in flight. Then inspect and check the following:

1. Make sure the skin of the airframe, air intake ducts, wing flaps, air brakes, jet nozzles is not damaged and that all access hatches are closed.

2. Inspecting the engines through the access holes make certain there is no leakage of fuel or AMT-10 fluid.

3. Check the L.G. struts for cracks along the welded seams. See that there is no leakage of AMT-10 fluid through the packings of the shock absorbers and hydraulic cylinders or through the joints of the units, pipes and hoses in the landing gear well. Visually inspect the wheels for condition of the rims and tyre tubes; see also that the tyres and nose wheel axle do not slip.

Check to see that the air pressure in tyres and shock absorbers is normal.

4. See whether the jet nozzle shutters are set in the maximum open position (augmented rating). Make sure the turbine blades are in good order.

5. At ambient air temperatures below zero check the leading edges of the air intake duct horizontal partitions for ice formation.

6. If the de-icing system has been used in the flight, top up the alcohol tank. There should be not less than 3 litres of alcohol.

7. Check, in the cockpit, the voltage of the storage battery, availability of fuel for the flight, the readings of the fuel flow meter. Check also the air system, cockpit canopy pressurization system and oxygen system for proper charging. Check the pressure in the oxygen system by the ИК-18 indicator.

Check whether the engines are primed with oil; the tank should contain 10.5 - 11 litres. If necessary, service the systems with fuel, oil and compressed gases.

8. Check the level of AMT-10 fluid in the hydraulic reservoirs. Not more than 300 cu.cm. of fluid may overflow from one reservoir into the other during one flight.

9. If the drag parachute was made use of during the landing, remove the parachute container, inspect the compartment and install a spare container with a drag parachute. If the parachute was not used, check the doors for reliable closing, for correct setting of the locks according to their marks and for proper locking.

10. Make certain that the canopy and camera gun glass panels are in good order and clean.

Note. After each rough landing or if the fuselage tail struck the ground during the landing, the aircraft should be taken away from the starting line and carefully examined.

Chapter II

AIRCRAFT SERVICING

1. FUEL SERVICING

In servicing the aircraft with fuel observe the following rules:

1. Use the following grades of fuel: fuel T-1 or TC-1 for the main fuel system and pure aviation gasoline for the starting system.

2. The aircraft systems may be filled only after the unit engineer has checked the condition of the fuel servicing truck, correspondence of the fuel and oil qualities to those stated in the certificates, and has given a written permission to service the aircraft.

3. Before servicing the aircraft, disconnect the switch AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ. БОРТОВОЙ, АЭРОДРОМНЫЙ) located on the right-hand wall, earth the aircraft (the earthing cable is on the nose wheel fork, see Fig.5) and the fuel servicing truck, connect the fuel supply gun with the aircraft body by a special bonding strip attached to the filler necks.

4. The aircraft should be serviced from a truck equipped with a combined filter (silk-felt-silk in the fuel servicing truck and a screen filter in the gun).

The filters of the fuel servicing truck should be in good order and clean. In servicing the aircraft, take steps to prevent dust, dirt and foreign objects from getting into the tanks.

Fuel servicing is done in the following sequence:

First fill rear tanks Nos 3 and 4, then tank No.1 (Fig.6). Tank No.2 is filled by gravity from tank No.1.

The fuel level in the tanks should be below the inner edge of the filler neck by 20 to 30 mm in summer and by 10 to 20 mm in winter.

The starting tank is filled with 5 litres of gasoline.

After the aircraft has been serviced with fuel, close the filler necks tightly, lock them and close the access plates.

The fuel drop tanks are filled through their filler necks (Fig.7). The drop tank capacity is 760 litres. The tank has a front and rear compartments (chambers), each being provided with its own filler neck. The tank chambers are filled separately:

(a) each tank is filled with 600 litres of T-1 fuel (its specific weight is 0.82 - 0.83); the rear compartment being filled to capacity with approximately 500 - 515 litres, while the remaining amount is poured into the front compartment;

(b) fuel TC-1 (its specific weight is 0.775) is used to fill the tanks to capacity.

Standard 400-litre drop tanks are filled to capacity.

CAUTION. 1. With the engines running, it is not allowed to open the filler necks of the fuselage tanks, because this may involve damage to the tanks since the pressure in the engine compartment (i.e. on the tanks outside) is greater than that inside the tanks.

2. In filling the tanks it is strictly prohibited to take the screen filters out of the tank filler necks since the strong jet from the fuel servicing truck gun may damage the float-type fuel quantity gauge in tank No.1. In addition, when the filters are removed, dirt and foreign matter may get inside the tanks.

After filling the tanks is over, set the fuel flow meter pointer to the value corresponding to the filled amount of fuel:

(a) on the indicator with a spur rack for setting the pointer, push the spur rack and set the required flow meter scale division against the dial mark in the centre of the scale port;

(b) on the indicator having no spur rack, unlock the locking screw of the safety plate that closes the access to the pinion setting screw and give the locking screw several turns

back. Then do as follows:

- turn the plate about the backed out screw to open the port giving access to the setting pinion;
- insert the screw driver into the slit, push and turn the setting pinion to set the required scale division against the dial mark in the centre of the scale port;
- close the hole with the plate, drive the locking screw home and safety it.

2. FUEL DRAINING

Fuel from the fuselage tanks of the fuel system may be drained through the drain cock located behind the pump of tank No.1 by engaging the respective transfer and booster pumps.

To drain the fuel, do as follows:

1. Earth the aircraft and the fuel container into which the fuel is to be drained.
2. Open the access hatch to the drain cock (on the fuselage nose part belly at the air brake).
3. Put the fuel drain hose on the drain cock.
4. Open the filler neck of tank No.1.
5. Engage the pump of tank No.1 and the pump of that tank, from which fuel is to be drained (prior to this close the shut-off cocks). In this case, fuel will be drained through the drain cock of tank No.1.

Notes: 1. If it is necessary to drain the fuel from the entire system, it is recommended to engage the pumps of all tanks simultaneously and to drain the fuel through the cock located behind the pump of tank No.1 Fuel draining in this case will take minimum time.
2. If the pump of a tank fails in operation, drain the fuel from that tank by gravity.

The hose serving to drain the fuel from the fuselage tanks permits draining the fuel drop tanks directly into the fuel servicing truck through the suction pump. To this end, connect the hose end union nut to the suction stage of the fuel servicing truck and put the hose free end into the tanks through the filler necks, having removed the filler neck filters.

Do not fail to previously check the hose for cleanliness.

Gasoline is drained through the drain cock by engaging the ПНР-10-9М pump (Fig.8). Before draining the gasoline, set the selector WORKING POSITION – SLUSHED POSITION (РАБОЧЕЕ ПОЛОЖЕНИЕ – КОНСЕРВАЦИЯ) on the control panel of one of the engines into the position SLUSHED (КОНСЕРВАЦИЯ), switch on the storage battery and the switch IN-FLIGHT IGNITION (ЗАЖИГАНИЕ В ВОЗДУХЕ) of the same engine and open the drain cock.

CAUTION. Uninterrupted operation of the ПНР-10-9М pump is permissible for not more than 30 sec.

After the gasoline is drained, disengage the pump and set the selector on the engine to WORKING POSITION.

3. OIL SERVICING

The engine oil system is filled with МК-8 oil and transformer oil.

The engine oil tanks are filled by a servicing truck through a filter. If no oil servicing truck is available, oil may be poured from a specially adapted container through a funnel equipped with a screen filter and silk fabric.

The oil to be used should have a certificate, containing oil analysis results. The analysis data should meet the requirements of the State Standards. The oil containers should be sealed by the respective persons in charge.

Oil is filled as follows:

1. Open the filler neck access hatches and remove the filler neck caps.
2. Fill the tanks will oil checking its level in the left-hand tank by means of the measuring rod bearing the letter "Л" and in the right-hand tank by means of the measuring rod with the letter "П".

A tank filled to capacity (with the engine oil system primed) should contain from 10.5 to 11 litres of oil.

3. Close and lock the filler neck caps of the oil tanks and close the access panels.

If the engine oil system was drained, fill the oil tank to capacity before starting the engines, then spin the engine 2 or 3 times from cold to fill the system with oil (capacity of the system less the oil tank is 2.5 litres). At this the oil pressure warning lamp should burn or blink.

Note. The oil tanks are topped up after trying the engines. Topping up before trying the engines may result in overfilling the tanks during the subsequent starting of the engines.

Then start the engine, stop it, check the oil level in the tank and top it up.

During cold spinning prime the oil system in accordance with the engine operating instructions.

CAUTION. 1. With the engines running it is prohibited to open the oil tank filler necks or to add oil.

2. If it is necessary to open the filler necks of the oil tanks immediately after the flight or after prolonged operation of the engines on the ground, protect the hands against burns since the caps become very hot.

4. OIL DRAINING

The oil from the oil tank and settler of the engine front housing is drained through special cocks located under the engine. Each engine has two cocks. One cock is intended for oil draining from the tank and the other for draining the settler of the engine front housing. The cocks are accessible through the access hatches of the lower starting unit (Fig.9). When the cock is opened, oil is drained through the engine common vent line, the outlet pipe of which is mounted on frame No.20.

5. CHARGING MAIN AND EMERGENCY SYSTEMS WITH AIR

Air is charged in the following sequence (Fig.10).

1. Open the panel located on the left wing bottom surface and giving access to the charging connection, connect the charging hose of the airfield bottle to the aircraft charging connection, having previously blown the bottle and the charging hose with compressed air.

2. Open the cock of the supply line, the cock serving to fill the emergency system of the wing flaps and the cock serving to fill the emergency system of the landing gear. All these cocks are arranged in the well of the left-hand strut of the main landing gear (Fig.11).

3. Open the valve of the airfield bottle and charge:

(a) the emergency bottle of the landing gear to a pressure of 50 kg/sq.cm.; then close the cock;

(b) the main system bottles and the emergency bottle of the wing flaps to a pressure of 110 - 130 kg/sq.cm.; then close the cock.

The pressure values are to be checked by the pressure gauges on the right-hand panel in the cockpit.

4. Make sure that the pressure gauge of the cockpit canopy remover gun (on the cockpit right-hand wall) shows an air pressure not below that of the main system pressure gauge (from 110 to 130 kg/sq.cm.).

5. Close the valve of the airfield bottle. After charging with air, make sure there is no air leakage through the bottle filling cocks.

CAUTION. In winter prior to charging the system, the bottles should be kept two or three days in the frost to prevent moisture from getting into the air system.

6. CHARGING CANOPY PRESSURIZING BOTTLE

The bottle of the canopy pressurizing system is charged to a pressure of 50_{-3} kg/sq.cm. During operation the pressure in the bottle may vary from 35 to 50 kg/sq.cm. If the pressure in the bottle drops below this level, recharge the bottle.

The bottle should be charged in the following sequence.

1. Open the bottle charging hatch in the rear port of the canopy.

2. Remove the plug from the charging connection of the pressurizing system to connect the hose of the airfield bottle, having previously inclined the bottle and blown the hose through with compressed air.

3. Open the valve of the airfield bottle and charge the canopy bottle to a pressure of 50_{-3} kg/sq.cm., checking the pressure value by a pressure gauge.

4. Close the valve of the airfield bottle.

5. Disconnect the hose from the charging connection and screw the cap in place.

6. Close the canopy access hatch.

CAUTION. 1. It is well to remember that if the airfield bottle valve is opened abruptly to full capacity, the safety valve of the canopy pressurizing system will not be able to fully release the excessive air, and the pressure in the bottle may rise above 50 kg/sq.cm.

2. In winter prior to charging the system, the bottles should be kept two or three days in the frost to prevent moisture from getting into the air system.

7. FILLING HYDRAULIC SYSTEM WITH FLUID

The hydraulic system is filled from an airfield servicing truck, and when the latter is not available, this is to be done from a container through a clean funnel with a No.40 screen (1600 cells per sq.cm.).

The system is to be filled with AMT-10 fluid, the total capacity of the main and booster hydraulic systems being about 40 litres.

The hydraulic system is charged in the following sequence:

1. Jack up the aircraft.

2. Charge the hydraulic accumulators with nitrogen to a pressure of 40^{+5} kg/sq.cm. using a special device for this purpose.

3. Charge the main hydraulic system as follows:

(a) open the filler neck of the main system hydraulic reservoir and fill it with AMT-10 fluid to capacity.

Note. In filling the tank with AMT-10 fluid it is well to remember that the reservoir is divided by a partition equipped with inverted flight valves. The fluid from the filler neck flows first into the upper part of the tank and then through the valve it passes into the lower one and into the system. The time required for the fluid to pass through the valve is 3 - 5 min.

(b) connect the airfield power supply source and cut in the switches AIRCRAFT OR GROUND STORAGE BATTERY and circuit breakers LANDING GEAR, WING FLAPS, PARACHUTE (ШАССИ, ЗАКРЫЛК., ПАРАШЮТ), STABILIZER AND AILERON BOOSTER (СТАБИЛ., ЭЛЕРОН БУ), STABILIZER BOOSTER, FLARES (БУ СТАБИЛ., РАКЕТЫ), LANDING GEAR WARNING LIGHT , AIR BRAKE (СИГН.ШАССИ, ТОРМ. ЩИТКИ);

(c) engage the airfield hydraulic pump (right-hand aircraft wall) and build up working pressure of 135 kg/sq.cm. in the system.

Note. To prevent formation of air pockets in the hydraulic system when connecting the airfield hydraulic pump, fill the pump hoses previously with operating fluid.

(d) set the landing gear selector valve in the position EXTENDED and press the push-button LANDING of the wing flaps;

(e) top up the hydraulic reservoir with AMT-10 fluid and prime the system, making at least six retraction and extension cycles of the landing gear, wing flaps and air brakes.

Check the fluid level in the hydraulic reservoir after every two cycles and add fluid, if necessary.

The AMT-10 fluid level in the reservoir should be between the extreme notches on the measuring rod with no pressure in the system, landing gear extended, air brakes and wing flaps retracted.

If the fluid level is above the upper notch on the measuring rod, drain the excessive fluid through the suction valve to which the airfield pump is connected.

After checking the fluid level in the reservoir, close the filler neck cap.

Note. Proper retraction and extension of the landing gear are of great importance for correct charging of the hydraulic system with fluid and for prevention of air pockets since the landing gear hydraulic cylinders have a considerable capacity.

Add AMT-10 fluid into the hydraulic tank, if necessary.

4. Charge the booster system as follows:

(a) open the filler neck of the booster system hydraulic reservoir, top the latter up with AMT-10 fluid and wait 3 or 5 min.

Note. In filling the reservoir with AMT-10 fluid it is well to remember, that the booster system hydraulic reservoir is divided by a partition with inverted flight valves. The AMT-10 fluid from the filler neck flows first into the upper chamber of the reservoir and then through the valve it passes into the lower one and into the system.

The time required for the fluid to pass through the valve is 3 or 5 minutes.

(b) connect the airfield hydraulic pump to the aircraft (portside) and build up working pressure in the system (135 kg/sq.cm);

(c) connect the airfield power supply source, switch on the storage battery and both boosters;

(d) top up the hydraulic reservoir with AMT-10 fluid and prime the system making 20 complete deflections of the aircraft control stick to either side and in the longitudinal direction.

After every 5 deflections of the control stick check the level of AMT-10 fluid in the hydraulic reservoir at zero pressure in the system.

Add AMT-10 fluid, if necessary.

5. After both hydraulic systems have been filled, turn the caps off the fittings of the hoses that serve to feed fluid from the hydraulic reservoirs to the pumps, release air from the hoses and pumps and use an oil gun to fill the hoses and pumps with AMT-10 fluid.

6. Lower the aircraft, start both engines and pump through both hydraulic systems with the aid of the aircraft pumps by lowering and retracting the wing flaps, air brakes and jet nozzle shutters two or three times and also by making 10 complete deflections of the control stick to either side, towards the pilot and away from the pilot.

After stopping the engines check the fluid level in both hydraulic reservoirs.

The system may be considered fully primed if the performance of any operation does not influence the fluid level in the reservoir and the pressure in the system rises to its maximum value.

After the system is filled up, cut out all the switches and circuit breakers switched on for the filling operation, close the filler necks of the reservoirs and put in place the access hatch panels.

8. FLUID DRAINING

The fluid is drained from the main hydraulic system in the following sequence:

1. Jack up the aircraft;
2. Connect the airfield power supply source.
3. Cut in the switch AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ. БОРТОВОЙ,АЭРОДРОМ.), and the circuit breakers LANDING GEAR, WING FLAPS, PARACHUTE (ШАССИ, ЗАКРЫЛК.,ПАРАШЮТ), STABILIZER AND AILERON CONTROL BOOSTERS(БУ СТАБИЛ.,ЭЛЕРОНОВ).
4. Connect an airfield hydraulic pump.
5. Retract the landing gear and lower the air brakes.
6. Reduce pressure in the hydraulic system to zero by operating the aircraft control stick.
7. Make an emergency lowering of the landing gear and wing flaps.
8. Release the air from the hydraulic cylinders of the landing gear and wing flaps.
9. Disconnect the delivery hose of the airfield hydraulic pump and lower it into a container for draining the AMT-10 fluid.
10. Open the hydraulic reservoir filler neck.
11. Engage the airfield hydraulic pump and drain (pump out) the AMT-10 fluid from the hydraulic system and the hydraulic reservoir.
12. Drain the AMT-10 fluid from the hydraulic cylinders of the air brakes, setting the control valve to retraction and closing both side air brakes simultaneously by hand, after which close the belly brake. As this is done, the AMT-10 fluid will be forced out of the hydraulic cylinder into the reservoir. Repeat Point 11.
13. Cut out all the switches and circuit breakers employed for draining the AMT-10 fluid.

Fluid from the booster system is drained in the same way as described in Points 2, 3, 4, 6, 9, 10,11 and 13.

9. FILLING DE-ICER SYSTEM WITH ALCOHOL

The de-icer system is filled with pure 96% rectified alcohol.

The alcohol is filled through the reservoir filler neck located on the left-hand side of the fuselage nose (Fig.12).

The reservoir must be filled with 6 litres of alcohol as checked by the measuring rod.

After filling the reservoir with alcohol, close the filler neck tightly. Alcohol from the reservoir is drained through the

cock in the reservoir bottom, for which purpose it is required to turn off the plug.

The cock is made accessible through the hatch in the bottom of the fuselage left-hand nose part (Fig.13).

10. CHARGING OXYGEN SYSTEM

The aircraft oxygen system is charged with medicine oxygen only. Charging is accomplished as follows:

1. Open the hatch panel giving access to the aircraft charging connection and turn the cap off the latter (Fig.14).

2. Connect the pipe from the airfield oxygen charging station (AKЗС) to the aircraft charging connection.

3. Check to see whether the KB-2 valve in the cockpit is closed.

4. Open the valve of the AKЗС station and fill the aircraft bottles with oxygen.

At an ambient air temperature of +15°C fill the aircraft bottles to 150 kg/sq.cm. At other temperatures of the ambient air, fill the aircraft bottles in accordance with the following Table:

Table

Charging Pressure in Oxygen Bottle Depending on Ambient Air Temperature

Temperature, °C	Oxygen pressure in bottle, kg/sq.cm.	Temperature, °C	Oxygen pressure in bottle, kg/sq.cm.
+35	160	-10	138
+30	157	-15	136
+25	155	-20	134
+20	152	-25	131
+15	150	-30	128
+10	148	-35	126
+ 5	145	-40	124
0	143	-45	121
- 5	140	-50	118

Note. The pressure values are to be checked by the AKЗС station pressure gauges as well as by the pressure gauges located in the aircraft cockpit.

5. After filling the aircraft bottles, close the AKЗС station valve and disconnect the pipe from the aircraft charging connection.

6. Check the pressure in the system by the MK-18 indicator.

7. Put the cap onto the aircraft charging connection and close the hatch panel.

Chapter III

AFTER-FLIGHT INSPECTION

After the aircraft was taxied to the parking place, in the process of engine stopping, make sure that no smoke is coming from the jet nozzles. The presence of smoke testifies to a trouble in the drain valve or to the penetration of oil and fuel into the tail pipe. In stopping the engines make sure that the turbine rotates easily and no foreign noises are heard. The turbine rotation is considered easy if its time period beginning from the moment corresponding to the idling speed to the moment of a complete engine stop is not below 1 min. Prior to stopping the engines, release the air brakes (actuating the switch on the engine control lever). Lower also the wing flaps. After stopping the engines, check the hydraulic accumulators for correct charging; with the accumulators normally charged the pressure in the hydraulic systems should sharply drop from 40 kg/sq.cm. to zero as checked by the pressure gauge.

Before the pilot leaves the cockpit, the ground safety pin should be inserted into the head of the seat ejection gun. After the pilot has left the cockpit, put the cable with ground safety pins in place in the cockpit and insert the safety pin of the CPO airborne responder destruction circuit.

Raise the ПВД air-speed tube and put the aircraft in the parking line.

Obtain information from the pilot on operation of individual units and systems. Fill the aircraft with fuel and oil and also with compressed gases. Clean the landing gear and airframe of dust, dirt or snow, lower the air brakes and wing flaps, open all the inspection hatches, after which examine and check the following (See Fig.15):

I. Air Intake Ducts

1. Check for holes, dents, loose rivets, skin bulging and foreign objects, as well as for proper tightening of the screws (by the red marks).

Check the condition of the compressor blades visually.

II. Fuselage Nose Part

2. Check the condition and attachment of the ТП-156 and ПВД air-speed tubes to make sure that the lock of the ПВД air-speed tube is in good condition when the tube is raised for flight.

3. See whether there is any alcohol leakage from the de-icing system.

4. Check the attachment of the lower hatch panels.

5. See that there are no holes, dents or loose rivets on the skin.

III. Upper Nose Compartment

6. Check to see that the mechanical indicator of the nose L.G. strut is in good condition.

7. Make sure the nose hatch panel locks are reliable.

IV. Nose L.G. Strut

8. Inspect the wheel for condition and the wheel tyre for proper inflation by the deflection of the wheel which should be from 10 to 15 mm; recharge the tyre, if necessary, to a pressure of $7^{+0.5}$ kg/sq.cm.

Check the marks on the wheel rim and tyre to make sure the tyre has not changed its position. When worn down to cord fabric, the tyre casing must be replaced.

Check the wheel for easy rotation in the fork (with the aircraft jacked up), see that the wheel axle nuts are not overtightened and that there is no wheel play.

9. Make sure the earthing cable is in good condition and is reliably secured.

10. Check the condition and attachment of the brake inertia transmitter; check also the condition of the pipes running to the brakes.

11. Examine the shimmy damper and its attachment. Replenish the lubricant on the friction parts.

12. Check the landing gear strut for cracks especially along the welding seams and for condition of the unit and part joints locking.

13. Check the pressure in the shock absorbers according to the tyre deflection at parking and see that there is no leakage of AMT-10 fluid. Recharge the shock absorber with air to a pressure of $30^{\pm}1$ kg/sq.cm., if necessary.

14. Check the strut hydraulic cylinder for leakage of AMT-10 fluid and for good condition of the joints.

15. Examine the nose strut well, lower part of frame No.4, pipes and hoses of the hydraulic and compressed air systems, all parts and joints for leakage of AMT-10 fluid. See that the pipes and units do not rub against each other, are not damaged or chafed.

16. Check the condition of the cable and see whether the wheel position indicator arm operates properly, for which purpose pull and then release the cable.

17. Examine the nose wheel well doors and their attachment fittings. If necessary, wash and lubricate the hinges. Check the operation of the door opening and closing mechanism. If you force the door opening mechanism to close until the doors rest against the stops and gradually release the doors, they should energetically return to the fully open position. Check the lateral play at the end of the door in the open position. This play must not exceed 5 mm.

V. Main L.G. Right-Hand Strut

18. Examine the wheel, locking of the nut securing the wheel to the half-axle, condition and degree of wheel tyre inflation which is to be checked by the wheel deflection (normal deflection is 30 to 40 mm).

When required, inflate the tyre to a pressure of $10^{+0.5}$ kg/sq.cm. Check the marks on the wheel rim and tyre to make sure that the wheel tyre has not changed its position. The wheel tyre may wear down to the upper layer of cord fabric. Check the wheel for free rotation (See Point 8).

19. Check the condition and attachment of the inertia transmitter and also the condition of the pipes running to the brakes.

20. Examine the strut, shock absorber and half-axle for cracks, especially along the welding seams and for leakage of hydraulic fluid around the shock absorber inner tube.

21. Check the pressure in the shock absorber by the tyre deflection at parking. If required, charge the shock absorber with air to a pressure of $70^{\pm}1$ kg/sq.cm.

22. Check the condition of the wheel position indicator arm and see to it that the locking nut is not loose.

23. Check the condition of the strut hydraulic cylinder and tightening of the rod locking nut. Make sure there is no leakage of hydraulic fluid around the rod and from the ends of the hydraulic hoses. Examine the upper attachment fitting of the hydraulic cylinder.

24. Examine the condition of the wheel door hydraulic cylinder.

25. Inspect the strut and wheel door UP locks as well as their cable linkage; see that there is no binding in the movable joints of the lock or of its cable linkage. The locks should be in the open position. Replenish the lubricant if required.

26. Check the condition and attachment of the units and pipes in the strut well and see that the units, pipes or their attachments are not damaged. See that there is no leakage of hydraulic fluid, examine the condition, attachment and play of the strut doors. The following plays as measured at the ends of the doors are permissible: up to 10 mm for the wheel door and up to 5 mm for the wing door. No play is allowed for the strut door.

27. Clean the hinged connection units of dust, dirt or snow and lubricate them.

Note. It is not recommended to remove dirt with kerosene to avoid damage to the electric wiring insulation.

VI. Right-Hand Wing

28. See whether the skin, aerodynamic fence and rivets are damaged, whether all the access panels and their attachment screws are in place and whether the screw heads are flush with the surf-

29. Make sure there is no leakage of the fluid from the aileron booster access hatch.

30. Check the condition of the wing fillet and cannon fairings, as well as tightening of their attachment screws.

31. Check the condition of the hole edges in the wing skin intended for the landing gear strut position indicator arm.

32. Examine the wing tip and check the presence and tightening of the attachment screws.

33. Examine the aileron and the interceptor, their hinged connections and attachment fittings.

With the aileron in the neutral position, the interceptor should be sunk relative to the wing skin surface by 1.5 - 2.5 mm. The jutting out of the interceptor beyond the wing contour, with the aileron in the neutral position, is not permissible.

Deflect the ailerons to check for binding, knocks or play exceeding the permissible values for ailerons and interceptors.

34. Examine the wing flaps, their attachment fittings, guides, slides, locks and carriages; if required, wash them and coat with a thin layer of ЦИАТИМ-201 lubricant. Check to see that there is no fluid leakage around the rod of the hydraulic cylinder; examine the rod locking and check for cracks on the under-flap panel of the wing.

The lowered wing flaps should have the following play: up to 15 mm at an angle of 15° and up to 20 mm at an angle of 25°.

35. Check the condition of the drop fuel tank, its attachment, and see that there is no fuel leakage. The tank filler necks should be closed tightly and locked. The fuel tank brace struts should have no freedom of rotation.

VII. Right-Hand Side of Fuselage

Open the engine inspection panels, examine and check the following:

36. Check the condition of the air blow-off shutter mechanism on the hatch panel.

37. See whether the air blow-off band is open.

38. Examine the condition of the inside skin and of the fuselage framework in the engine compartment; make sure the locks and the rubber sealing of the engine inspection hatch panels are in good condition; see that there are no foreign objects.

39. Examine the units, pipes and hoses of the fuel and oil systems and their attachment to see that they are not damaged, properly locked and sealed.

40. Make certain that there is no leakage of fuel and oil along the unit flanges and igniters, through the joints in the piping and manifolds, and along the parting lines of the bodies for which purpose engage the pumps of tanks Nos 1, 2, 3 and 4 for a short time with the engine control levers in the STOP position.

41. Check the units and pipes of the hydraulic system and their attachments for damage and for leakage of the fluid.

42. Examine the quick-detachable joints of the tail unit control rods, the rods and hinge joints of the airoraft and engine controls, as well as their condition and locking.

43. Check the attachment of the АРУ-2А variable-ratio boost control unit (the rod should be in the longer arm position, the limit switch should be cut out); check also the condition of the spring feel mechanism, ДР-5 mismatch transmitter rod, and see whether the БУ-14МС booster and the АПС-4 electric mechanism are properly attached. Pay special attention to the attachment and condition of the ДР-5 mismatch transmitter wiring.

44. Check the turbo-cooler unit fan for easy rotation.

45. Examine the right-hand and belly air brakes, their attachment fittings and hydraulic cylinders. Make sure the fluid does not leak through the sealing parts.

46. Clean the outlets of the vent line pipes of dirt and snow. Ice is to be removed by heating the pipes with hot air.

47. Examine the fuselage ventral fin and tail shock absorber for condition and attachment; see that there is no fuel leakage.

VIII. Empennage

48. Examine the stabilizer, fin, rudder and their attachment fittings; check them for play.

Check to see that there is no play in the stabilizer control (with the БУ-14МС booster disengaged, play in the stabilizer

control when a load of 10 kg is applied to the stabilizer trailing edge must not exceed 3 mm as measured at the edge).

49. Deflect the rudder to check for binding, knocks or play.

50. Examine the empennage inspection panels for proper closing.

IX. Jet Nozzles

51. Inspect the inner surfaces of the tail pipes, shutters and taper rings of the jet nozzles for burnt through places, warpage, cracks, metal deposit, scores and also for leakage of hydraulic fluid from the shutter control system. Make sure that the nozzle shutters are in the starting (augmented) position.

Notes. 1. The shutters should move under hand-applied effort without binding.

2. Metal deposits on the inner surface of the tail pipe testifies to deterioration inside the engine.

52. Examine the turbine blades for damage, burnt places and overheating.

53. Inspect the fuel manifold. See that there are no cracks, burnt through places, warpage or fuel leakage.

54. Check for minimum clearance between the jet nozzle ejectors and sliding rings. The clearance must be not less than 6 mm. Check the clearance between the jet nozzle ejectors and the fuselage fairing. It must not be less than 12 mm.

X. Left-Hand Side of Fuselage

55. The inspection is to be carried out in the same way as prescribed for the right-hand side (See Points 36 - 47).

56. Check the condition of caps of the fuel tank filler necks and see that there is no fuel leakage.

57. In addition, check the drag parachute hatch doors, security of their locking arrangements, and the parachute cable lock, for reliable operation.

Notes: 1. If during landing use was made of the drag parachute, recove the container, clean the compartment of dirt or snow, inspect it and install another container set with a parachute.

2. Should kerosene get inside the drag parachute compartment, take out the parachute and dry it.

XI. Left-Hand Wing

58. The inspection is to be carried out in the same way as that on the right-hand wing (See Points 28 to 35).

59. In addition, check the condition and position of the aileron trim tab. The trim tab should be in a position corresponding to the inscription it bears.

XII. Main L.G. Left-Hand Strut

60. Carry out the inspection as prescribed in Points 18 to 27 for the right-hand strut.

XIII. Aircraft Cockpit

61. Check the organic glass for cracks, silver formation, poor transparency, especially in places of attachment. See that the framework and rubber sealing pieces are not damaged.

62. Check the condition and attachment of the canopy deicer pipe.

63. Check the condition of the seat and belts and the attachment of the telescopic mechanism. Check the locking of the seat blind, seat handrails and of the ring of the seat ejection gun interlooking cable, as well as of the flexible pin of the АД-3 unit. Check the shoulder harness locking mechanism for proper operation. Check also the rope spring hook of the АД-3 unit for proper attachment to frame No.7.

64. Check the attachment of the armoured head plate and of the armoured plate. Take the pilot's seat in the cockpit and check the canopy sliding part for easy closing and opening and for reliable fixing in the extreme positions.

65. Check the canopy locks for reliable closing, check rails, locks and hinges for cleanliness and condition. Check also the locking of the canopy locks control levers, slide rail and canopy autonomous jettison lever.

66. Check the pressure in the canopy pressurizing bottle. It should be within 35 - 50 kg/sq.cm. Check the inflation of the pressurizing rubber tubes with the canopy closed.

CAUTION. Never inflate the canopy pressurizing rubber tube with the canopy open to avoid damage to the tube.

67. Shift the engine control levers to make sure that they move easily and smoothly, that there is no binding or play exceeding the permissible limits, that they are reliably stopped and fixed on the rests. Check the rests for reliability of attachment and for proper condition of their locking.

68. Make certain that the brakes are properly and simultaneously released at both stages. The first stage pressure should be 5 kg/sq.cm., while that of the second stage must be $10^{+0.5}$ kg/sq.cm.

69. Check the stabilizer control, make sure the АРУ-2А automatic system functions reliably, check the change-over from the stabilizer hydraulic control to the stabilizer emergency electric control system.

Note: If the pilot informs you about a certain trouble in the operation of the stabilizer control, check the latter in the scope of the 25-hour scheduled operations.

70. Check the aileron control with the БУ-13М booster engaged and disengaged. With the booster disengaged, make sure that the ailerons deflect easily (without knocks or binding) and fully.

Make sure the effort is felt on the control stick (from the aileron spring feel mechanism).

71. Check the deflection of the aileron trim tab, then set the trim tab to a position corresponding to the inscription that it bears.

72. Check the rudder control to make sure that with the rudder pedals deflected, the rudder turns easily (without knocks or binding) and fully.

If the rudder is equipped with a trim tab (on aircraft of latest make), check the deflection of the tab and set it into a position corresponding to the inscription on the trim tab.

If the rudder has no trimmer, check the condition of the rudder bend tab.

73. Check the landing gear and wing flap emergency lowering cocks for tight closing and for proper locking with КОК-0.5 safety wire.

74. Check to see that the caps of the fuel shut-off cock closing buttons are safetied with Л62 brass wire, 0.25 mm in diameter.

75. See that there are no foreign oojects or water in the cockpit. In winter make sure there is no ice in the cockpit especially under the pilot's seat which is to be examined through the inspection holes made in the seat.

76. Check the condition of the aircraft and engine control rods and bell cranks, paying special attention to the condition of the control rods under the pilot's seat. This is done through the inspection holes made in the seat.

77. Cut out all the circuit breakers which have been switched on for the post-flight preparation of the aircraft.

78. After the aircraft has been inspected by all the responsible experts and the faults have been eliminated, make sure that no tools, bolts, nuts or other foreign objects have been left in the air intake ducts, tail pipes, aircraft cockpit, etc.

79. Close the cover of the wing flap control panel and close the connection of the РД-2МА regulator.

80. Put a screw clamp on the rudder, plug the holes of the air blow-off shutters, the air intake ducts and jet nozzles, check the access hatch panels that were removed during the inspection for proper closing, pressurize the canopy and put covers on the aircraft if it is not intended for immediate flying missions.

Chapter IV

AIRCRAFT AND ENGINE CONTROLS

1. GENERAL

The aircraft control system includes the stabilizer, aileron, interceptor, and rudder controls (Fig.16).

Stabilizer Control

Stabilizer control is characterized by the following peculiarities:

1. Hydraulic control of the stabilizer is accomplished with the aid of the БУ-14МС booster connected into the system according to the irreversible diagram. Efforts on the control stick are created by the spring feel mechanism (Fig.17).

The operating fluid is supplied to the БУ-14МС booster from the booster hydraulic system. Should a pressure drop occur in the booster hydraulic system, the БУ-14МС unit is automatically connected to the main hydraulic system.

The control stick is relieved of efforts by the trimming effect mechanism which is controlled by manipulating the button located on the control stick.

2. To improve the aircraft manoeuvreability and to make full use of the stabilizer when flying at high altitudes and great M numbers, as well as to limit stabilizer operation when flying at high indicated speeds and medium altitudes, the stabilizer control system incorporates the АРУ-2А variable-ratio boost control unit.

The АРУ-2А unit automatically changes the gear ratio between the control stick, the stabilizer and the spring feel mechanism (depending on the flight speed and altitude), thus providing for a natural change of efforts on the control stick during flight (Fig.18).

3. In emergency, the stabilizer is controlled electrically by means of the АПС-4 stabilizer emergency drive, which is cut in automatically as soon as pressure in both hydraulic systems drops below 50^{+2} kg/sq.cm. It enables the pilot to control the aircraft by applying a normal effort to the control stick, but at a lower speed of the control stick travel, the rate of stabilizer shifting at zero hinging moment amounting to 4° per sec. Manipulating the control stick the pilot cuts in the microswitches of the ДР-5 transmitter, connected to the stabilizer control, thereby feeding energy to the reversing and brake electromagnetic couplings of the АПС-4 stabilizer emergency drive which shifts the stabilizer up or down. The stabilizer emergency drive may also be switched on manually, by manipulating the change-over switch mounted on the left-hand panel of the cockpit (Fig.19).

To shift from the electric control back to the normal hydraulic control of the stabilizer, the change-over switch on the left-hand panel should be again operated manually.

No provision has been made for the manual control of the stabilizer in view of great aerodynamic forces involved.

4. The automatic adjustment of stabilizer control, that is changing of the gear ratio between the control stick and the spring feel mechanism, takes place when flight conditions vary within the following range (Fig.20):

A. The adjustment of flight speed is carried out within the indicated speed range from $V_{ind} = 480 \pm 25$ km/hr to $V_{ind} = 900^{+30}_{-20}$ km/hr. With flight speed increasing within the above range, one and the same deflection of the aircraft control stick will be associated with an increase of efforts on the stick and a decrease of the stabilizer shifting angle; with the speed reducing, the adjustment procedure is reversed.

B. When flying at altitudes from H = 5000 m. to H = 10000 m., the stabilizer control adjustment with regard to the speed of flight is corrected in compliance with the altitude of flight, that is, with an increase of flight altitude at constant indicated speed, one and the same control stick travel will be associated with reduced efforts on the

stick and an increased angle of the stabilizer deflection; with the flight altitude decreasing, the adjustment procedure will be reversed.

C. At altitudes below 5000 m., the adjustment depends on flight speed variations only; in this case, at indicated speeds of less than 480 ± 25 km/hr, or over 900^{+30}_{-20} km/hr, constant gear ratioes are maintained between the control stick, the stabilizer and the spring feel mechanism (these ratioes corresponding to minimum or maximum efforts on the control stick and to maximum or minimum deflection angles of the stabilizer).

At altitudes of over 10,000 m., irrespective of the aircraft speed, and also at indicated speed of less than 480±25 km/hr, irrespective of the altitude, constant gear ratio values are retained between the control stick, the stabilizer and the spring-feel mechanism (these gear ratio values corresponding to minimum efforts on the control stick and to maximum deflection angles of the stabilizer).

D. Operation of the APU-2A variable-ratio boost control unit is checked against the indicator mounted on the instrument panel left. Within the adjustment range referred to above the indicator pointer registers the indicated speed and altitude corresponding to the position of the APU-2A rod at the given moment. Figures on the outer scale of the indicator designate speed values (increasing in the clockwise direction) whereas the inner scale shows altitude values (decreasing in the clockwise direction). In this case:

(a) at altitudes below 5000 m. the position of the indicator pointer on the speed scale should correspond to the indicated speed of flight;

(b) at altitudes from 5000 m. to 10,000 m. the indicator pointer position corresponds approximately to the speed or altitude of flight.

Examples: 1. H = 8000 m., V_{ind} = 600 km/hr; the indicator pointer will be in the "a" position (Fig.21) thereby registering the indicated speed of flight which approximates 600 km/hr.

2. H = 8000 m., V_{ind} = 800 km/hr; the indicator pointer will be in the "б" position thereby showing the flight altitude which approximates 8000 m.

3. H = 8000 m., V_{ind} = 680 km/hr; in this case the indicator pointer will be in the "c" position thereby registering the flight altitude which approximates 8000 m. and the indicated speed which is approximately 680 km/hr.

Thus, with the flight altitude increasing, the speed adjustment range becomes narrower; at these altitudes the extreme right-hand position of the pointer is limited by the altitude of flight;

(c) at flight conditions lying beyond the adjustment range, the indicator pointer will be in one of the extreme positions;

(d) when flying at an indicated speed of 480±25 km/hr or lower (at any altitude), and at an altitude of 10,000 m. or over (at any speed), as well as during landing, the rod of the APU-2A variable-ratio boost control unit is set at the longer arm; in this case the pilot lamp located on the instrument panel and marked with LAMP IS OUT AT LANDING, CONTROL APU MANUALLY (НА ПОСАДКЕ ЛАМПА НЕ ГОРИТ - ПЕРЕХОДИ НА РУЧНОЕ УПРАВЛЕНИЕ АРУ) must light up.

Notes: 1. It should be borne in mind that at an altitude of 10,000 m. or over and at an indicated speed of over 480±25 km/hr, the pilot lamp indicating the take-off-landing position of the APU-2A unit may remain unburning.

This depends on electric characteristics of individual components of the APU-2A control unit and is considered to be normal.

2. When flying at altitudes of up to 10,000 m., the pilot lamp will light up with the speed reduced to V_{ind} = 440±30 km/hr.

5. Normally the APU-2A variable-ratio boost control unit operates automatically.

In case the control unit fails, the pilot can control

the variable-ratio boost control unit manually by switching on the МУ-100АП electric motor.

The electric equipment controlling stabilizer operation functions as follows (Fig.22):

(a) the control unit of the variable-ratio boost control unit is normally energized throughout the flight (Fig.23);

(b) manual control of the АРУ-2А unit is effected by the pilot operating the change-over switch АРУ AUTOMATIC, MANUAL (АРУ, АВТОМАТ, РУЧН.) located on the left-hand panel;

(c) the electric emergency follow-up system controlling stabilizer operation is switched on automatically, when pressure in the pressure line of the БУ-14МС booster drops below 50^{+2} kg/sq.cm.;

(d) the trimming effect mechanism, type МП-100М, is normally energized throughout the flight, the mechanism being switched on with the push-button on the stick.

Aileron Control

The following features are characteristic of aileron control:

1. All aerodynamic loads imposed on the aileron are taken up by the БУ-13М booster connected into the control system according to the irreversible diagram.

2. Efforts from the ailerons are created on the aircraft control stick by the spring feel mechanism incorporated in the aileron control system. The spring feel mechanism provides for changing the efforts on the control stick depending on the angle of aileron deflection.

3. To render the ailerons more effective at high M numbers, the wings are fitted with interceptors (plates) whose control system is connected with the aileron control by means of a special link mechanism (Fig.24).

With the aileron (left-hand, or right-hand) deflected all the way down, the respective interceptor extends by 57 ± 5 mm downward from the wing skin, the interceptor of the other aileron remaining in the initial position.

The interceptor starts extending as soon as the aileron gets deflected downward through $3 \pm 0.5^{\circ}$, and comes all the way out when the aileron is deflected by $10^{\circ}30' \pm 2^{\circ}$.

4. The trim tab should be employed for relieving the control stick of efforts only when the БУ-13М booster is cut off. For reasons of safety, use of the trim tab is strictly prohibited when the booster is cut in.

Rudder Control

The rudder is controlled in the usual manner. All aerodynamic forces acting on the rudder are taken by the pilot. To relieve the pedals of excess efforts, the rudder on the latest aircraft models is fitted with a trim tab controlled by manipulating a push-button switch located on the left-hand panel; the neutral position of the trim tab is indicated by the respective pilot lamp.

Engine Control

The right-hand and left-hand engines may be controlled separately or together. To control both engines simultaneously, their levers should be brought together, and the retainer of the right-hand lever should be fitted into a special recess machined on the left-hand lever (Fig.25).

The engine control levers can be set in the positions, corresponding to the following ratings: CUT-OFF (СТОП), LOW SPEED (МАЛЫЙ ГАЗ), NORMAL (НОМИНАЛ), MAXIMUM (МАКСИМАЛ), and AFTERBURNER (ФОРСАЖ). In all these positions, except NORMAL, the control levers are retained by stops. In the NORMAL position the levers are retained by ball retainers.

To shift the engine control levers from MAXIMUM to the AFTERBURNER position, it is necessary to press the latches and to release them at the end of the lever travel in order to retain the levers in the AFTERBURNER position. When shifting the levers from LOW SPEED to the CUT-OFF position, press the rear latches mounted on the sector bracket. To shift the levers from the CUT-OFF or AFTERBURNER positions, the latches provided on the levers[x] should be pressed.

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x) The aircraft of the latest series are furnished with a push-button control lever sector (See Fig.149). For checking and adjustment procedures see Appendix 11.

To safeguard the engine compartment against an excessive pressure rise resulting from high-indicated speeds or engine operation at a rating at which the air blow-off bands are released, provision is made for special outlet ports. The ports are located on the engine access panels, four on each side. When the blow-off bands are closed, the ports are covered with shutters (Fig.26) which are actuated by the cylinders (one cylinder for each side) and springs. Kerosene is delivered under pressure into the cylinders from the blow-off band control system.

When the blow-off band is closed, the fuel pressure is transmitted simultaneously into the shutter control cylinder, as a result of which the cylinder rod overcomes the tension of the spring thereby closing the shutters.

Connected to the control system of the left-hand engine blow-off band is the cylinder actuating the shutters arranged on the left-hand access panel. The cylinder controlling the shutters on the right-hand access panel is connected to the control system of the right-hand engine blow-off band (Fig.27). When the blow-off band is open, the fuel system of the band cylinder and, consequently, of the shutter cylinder is connected to the return line, and the shutters are forced by the springs and by the excess pressure in the fuselage to open.

2. MAINTENANCE OF STABILIZER CONTROLS

Following below is the procedure for checking and adjustment of the stabilizer control system during pre-flight inspection, scheduled maintenance operations as well as during replacement and repair of the stabilizer control units.

Checking Stabilizer Control System
(during pre-flight inspection)

Carry out the check, using an external power source rated for 27 V ±10 per cent.

1. Check operation of the stabilizer emergency follow-up control system with no pressure in the hydraulic system, proceeding as follows:

(a) operate the switch marked with AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ. БОРТОВОЙ, АЭРОДРОМ) on the right-hand panel;

(b) see that the circuit breaker АРУ-2А CONTROL (УПРАВЛ. АРУ-2А), located on the right-hand panel, is switched on; this should cause the green pilot lamp mounted on the instrument panel and marked with LAMP IS OUT AT LANDING, CONTROL АРУ MANUALLY (НА ПОСАДКЕ ЛАМПА НЕ ГОРИТ, ПЕРЕХОДИ НА РУЧНОЕ УПРАВЛЕНИЕ АРУ) to light up, which corresponds to the take-off-landing position of the АРУ-2А unit;

(c) make certain the circuit breaker STABILIZER CONTROL MECHANISM МУС-2 (УПРАВЛ. МУС-2 СТАБИЛ.) is turned on, whereas the change-over switch on the left-hand panel, marked with STABILIZER CONTROL (УПР. СТАБИЛИЗАТОРОМ) is set in the ELECTRIC CONTROL ON (ВКЛ. ЭЛЕКТРОУПРАВЛ.) position; ascertain by listening that the stabilizer control mechanism, type МУС-2, functions properly;

(d) shift the aircraft control stick forward and rearward to see that it travels smoothly and causes a smooth deflection of the stabilizer; check the control stick for easy travel and proper effort created by the spring feel mechanism; when released, the control stick should return approximately to the neutral position.

Note: The free travel of the control stick on the longer arm of the АРУ-2А unit due to the travel of the slide valve incorporated in the БУ-14МС booster, and of the ДР-5 transmitter amounts to 11±2 mm (according to point T, See Fig.99).

2. Check the АРУ-2А unit for proper operation when carrying out adjustment with regard to speed (perform the check during the pre-flight inspection of the aircraft instruments).

Carry out the check with the control stick released, using the following procedure:

CAUTION. 1. To avoid damage to the electric motor of the АРУ-2А unit, carry out the check with the stabilizer control mechanism МУС-2 functioning, or the booster БУ-14МС turned on.

2. To safeguard the МРД-6 transmitter of the АРУ-2А control unit against damage when checking it for proper operation, do not allow dynamic pressure to rise in excess of 1000-1100 km/hr.

(a) set the АРУ-2А change-over switch on the left-hand panel in the AUTOMATIC (АВТОМАТ) position;

(b) connect the КПУ-3 instrument to the dynamic orifice of the ПВД air speed tube;

(c) build up an excess pressure in the dynamic piping (МРД-6 transmitter); gradually increase pressure, and watch the readings of the АРУ-2А indicator on the speed scale; the readings should correspond to these of the КПУ-3 instrument and of the air speed indicator within the indicated speed range from $480^{\pm}25$ to 900^{+30}_{-20} km/hr.

When the indicated speed is increased to $480^{\pm}25$ km/hr, the green pilot lamp on the instrument panel carrying the inscription LAMP IS OUT AT LANDING, CONTROL АРУ MANUALLY (НА ПОСАДКЕ ЛАМПА НЕ ГОРИТ, ПЕРЕХОДИ НА РУЧНОЕ УПРАВЛЕНИЕ АРУ) should go out.

With a further increase in the indicated speed up to 900^{+30}_{-20} km/hr, the arm of the АРУ-2А unit becomes shorter, which causes the stabilizer leading edge and, consequently, the control stick to go downward;

(d) while gradually reducing dynamic pressure, make sure the stabilizer and the control stick travel in the reverse direction ; with the indicated speed reaching $440^{\pm}30$ km/hr, the pilot lamp marked with LAMP IS OUT AT LANDING, CONTROL АРУ MANUALLY should light up. Disconnect the КПУ-3 instrument from the air speed tube.

Notes: 1. To preserve the useful life of the stabilizer emergency drive, type АПС-4, and of the rod of the ДР-5 transmitter, perform the check on the stabilizer controls in accordance with Point 1 with the control stick shifted only once all the way forward and rearward.

The checking procedure outlined in Point 2 should be carried out with the БУ-14МС stabilizer booster turned on.

2. In case the АРУ-2А unit is checked for proper

operation in compliance with Point 2 at an ambient air temperatures below - 30°C, the cockpit and the АРУ-2А unit should be first heated, with the engine running.

3. Check the operation of the stabilizer controls with the booster, type БУ-14МС, turned on and the engines running, or using a ground pump connected to the booster hydraulic system (port side) proceeding as follows (Fig.28):

(a) make certain that circuit breaker STABILIZER OR AILERON BOOSTER (БУ СТАБИЛ., ЭЛЕРОНОВ) arranged on the right-hand panel is turned on;

(b) set the change-over switch, located on the left-hand panel and marked with STABILIZER CONTROL (УПРАВЛЕНИЕ СТАБИЛИЗАТОРОМ), in the HYDRAULIC CONTROL (ВКЛ.ГИДРОУПРАВЛ.) position, and ascertain that pressure in the system, as indicated by the pressure gauge, amounts to $135^{\pm}7$ kg/sq.cm.;

(c) while shifting the control stick all the way forward and rearward, see that the stabilizer moves smoothly and that the control stick travels with some difficulty (Fig.29).

CAUTION. When the port side engine is switched out before the turbine comes to a standstill or when it is started (before the speed of 4100^{+200} r.p.m. is reached), the control stick must not be shifted in any direction , for at these r.p.m. values the hydraulic pump output is not sufficient, and this will result in a sharp pressure drop leading to repeated operation of the slide valve switch, which in its turn, will cause the hydraulic fluid to flow from the main hydraulic line to the booster system or vice versa.

(d) shift the control stick forward or rearward to see that the main slide valve of the БУ-14МС booster is not jammed.

The signs of jamming are as follows:

if the slide valve gets jammed in the neutral position, an additional effort is imposed on the control stick resulting from the action of the duplicating slide valve spring, and amounting to 4 - 5 kg;

if the slide valve gets jammed in a position other than neutral the control stick will be deflected from the neutral position, or the maximum speed of the control stick travel

will be changed (reduced approximately 3 times in one direction, and increased two times in the other).

Note: When performing a ground check on the control system with the БУ-14МС booster turned on, the stabilizer may experience some fluttering due to the absence of loads on it. This fluttering is not transmitted to the control stick and is not felt during flight. The phenomenon does not interfere with the normal operation of the aircraft.

4. Check the operation of the stabilizer controls with the БУ-14МС booster turned on and the АРУ-2А selector switch set in the MANUAL (РУЧНОЕ) position, for which purpose:

(a) set the change-over switch on the left-hand panel in the MANUAL (РУЧН.) position, and shift the АРУ-2А control unit servo-rod to the shorter arm by pressing the change-over switch set in the SHORTER ARM (МАЛОЕ ПЛЕЧО) position; this will cause the pilot lamp marked with LAMP IS OUT AT LANDING, CONTROL АРУ MANUALLY (НА ПОСАДКЕ ЛАМПА НЕ ГОРИТ - ПЕРЕХОДИ НА РУЧНОЕ УПРАВЛЕНИЕ АРУ) to go out;

(b) by shifting the control stick all the way forward and rearward, ascertain that it is heavily loaded and that the stabilizer deflection angles have been reduced.

After the stabilizer controls have been checked, operate the push-button switch to set the АРУ-2А rod at the longer arm; set the АРУ-2А selector switch in the AUTOMATIC (АВТОМАТ) position.

5. Check the operation of the trimming effect mechanism, with the БУ-14МС booster turned on, proceeding as follows:

(a) make sure the circuit breaker located on the right-hand panel and marked with AILERON TRIM TAB, TRIMMING EFFECT (ТРИММЕР ЭЛЕРОНА, ТРИММЕРН.ЭФФЕКТ) is turned on and the pilot lamp on the instrument panel TRIMMING EFFECT NEUTRAL (ТРИММЕРН.ЭФФЕКТ НЕЙТРАЛЬНО) is burning;

(b) push the change-over switch of the trimming effect mechanism on the control stick forward (diving), and then rearward (pitching); the control stick should deflect correspondingly, while the pilot lamp should go out; the stabilizer leading edge will also go up and down;

(c) the check over, set the trimming effect mechanism in the neutral position, watching the indications of the respective pilot lamp.

The neutral position of the trimming effect mechanism is determined by the pilot lamp lighting up, when the change-over switch (button) is being reset from the forward position to the rearward one.

Note: The useful life of the stabilizer emergency drive, type АПС-4, and of the tie-rod of the ДР-5 transmitter being of a limited duration, it is recommended to roughly estimate the total time of their actual operation in flight.

Checking Automatic Engagement of МУС-2 Stabilizer Control Mechanism, Hydraulic Coupling of АПС-4 Stabilizer Emergency Drive as well as Disconnection of БУ-14МС Booster by КВЭМ Valve and by Change-Over Cylinders

(when performing 25-hour scheduled maintenance operations)

Perform the check, with the aid of a ground hydraulic pump connected to the main hydraulic system (starboard), proceeding in the following manner:

Note: As the selector valve incorporated in the line running to the БУ-14МС booster connects the latter to the main hydraulic system as soon as the pressure in the booster system becomes equal to, or drops below, 65^{+5} kg/sq.cm., the above check may be performed only with the use of the main hydraulic system.

1. Make sure the circuit breakers, located on the right-hand panel and carrying inscriptions STABILIZER CONTROL MECHANISM МУС-2 (УПРАВЛ.МУС-2 СТАБИЛ.) and STABILIZER AND AILERON BOOSTERS (БУ СТАБИЛ., ЭЛЕРОНОВ) are turned on; set the selector switch located on the left-hand panel and marked with STABILIZER CONTROL (УПР. СТАБИЛИЗАТОРОМ) in the HYDRAULIC CONTROL (ВКЛ.ГИДРОУПРАВ.) position to cut in the БУ-14МС booster.

2. Switch on the ground hydraulic pump and build up a pressure of 135±7 kg/sq.cm., after which stop the pump.

3. While shifting the control stick forward and rearward, watch for a pressure reduction in the hydraulic system. When pressure, as indicated by the pressure gauge, drops to 50^{+2} kg/sq.cm., the КЗЭМ valve will cut off the pressure line and disconnect the БУ-14МС booster, while the change-over cylinders will cut in the МУС-2 stabilizer control mechanism (Fig.30); as pressure downstream of the valve drops to zero, the hydraulic coupling of the АПС-4 stabilizer emergency drive will be engaged, hence the stabilizer will be controlled electrically.

The changing-over of the stabilizer control will be evidenced by a reduction in the speed of the control stick travel and by the noise produced by the МУС-2 stabilizer control mechanism.

Checking АРУ-2А Unit for Proper Operation when Adjusting it in Relation to Speed and Altitude

(when performing 25-hour scheduled maintenance operations)

Check the АРУ-2А unit for proper operation by employing an external power source rated at 27 V ±10 per cent, and a ground hydraulic pump connected to the main hydraulic system or to the booster hydraulic line (port side), proceeding as follows:

Note: In case the ambient air temperature is below -30°C, start the engine to heat the cockpit and the АРУ-2А unit prior to performing the check.

(a) see that the circuit breakers located on the right-hand panel and bearing inscriptions АРУ-2А CONTROL (УПРАВЛ. АРУ-2А) and STABILIZER OR AILERON BOOSTER (БУ СТАБИЛ.,ЭЛЕРОНОВ) are switched on, while the selector switch on the left-hand panel controlling operation of the АРУ-2А unit is set in the AUTOMATIC (АВТОМАТ) position;

(b) disconnect the static pressure line from the МРД-6 transmitter, for which purpose detach the hose from the tee-piece connecting the МРД-6 transmitter to the МРД-26 transmitter arranged behind the instrument panel; stop the tee-piece pipe union;

(c) connect the КПУ-3 instrument to the dynamic orifice of the ПВД air speed tube; connect another КПУ-3 instrument to the static orifices of the ПВД air speed tube;

(d) make certain the dynamic pressure line change-over switch (on the left-hand panel) is set in the AIR SPEED TUBE OPERATING (ПВД РАБОЧ.) position;

(e) turn on switch AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ.БОРТОВОЙ, АЭРОДРОМ) mounted on the right-hand panel; this should cause the pilot lamp on the instrument panel marked with LAMP IS OUT AT LANDING, CONTROL АРУ MANUALLY (НА ПОСАДКЕ ЛАМПА НЕ ГОРИТ - ПЕРЕХОДИ НА РУЧНОЕ УПРАВЛЕНИЕ АРУ) to light up;

(f) start the ground hydraulic pump and the БУ-14МС booster by setting the switch mounted on the left-hand panel and carrying the inscription STABILIZER CONTROL (УПР.СТАБИЛИЗАТОРОМ) in the HYDRAULIC CONTROL (ВКЛ.ГИДРОУПРАВЛ.) position;

(g) build up an excess pressure in the dynamic air pressure line (the МРД-6 transmitter); gradually increase the pressure to the value corresponding to an indicated speed of 900^{+30}_{-20} km/hr. This will cause the rod of the АРУ-2А unit to shift to the shorter arm position (the pilot lamp should go out as soon as the indicated speed reaches 480±25 km/hr);

(h) reduce pressure in the dynamic line to the value corresponding to an indicated speed of 440±30 km/hr; the rod of the АРУ-2А unit will move to the longer arm position; check to see that the indicator of the АРУ-2А unit reads the proper value on the speed scale, and that the signalling system operates properly (the pilot lamp should light up);

(i) increase the excess pressure in the dynamic line to the value corresponding to an indicated speed of 900^{+30}_{-20} km/hr, and create a rarefaction in the static line (the МРД-26 transmitter); gradually increase the rarefaction to the value corresponding to an altitude of 10,000±350 m.

The rod of the АРУ-2А unit should move to the

longer arm position (the pilot lamp may remain unburning). With the rarefaction brought to the value corresponding to an altitude of 5000±300 m., the rod of the APU-2A unit should shift to the shorter arm position. Make certain that the indicator of the APU-2A unit reads the proper value on the altitude scale.

The check completed, remove the cap from the tee-piece and connect the static line to the MPД-6 transmitter.

Notes: 1. Carry out the check, with the control stick released.

2. With the rod of the APU-2A unit shifted from the longer arm to the shorter arm, and vice versa, the stabilizer leading edge and the control stick will experience minor deflections.

3. It should be borne in mind that the calibration of the automatic control system is performed under standard atmospheric conditions. Under any other conditions, the readings of the indicator of the APU-2A unit on the altitude scale will differ from the readings of the aircraft altimeter, the difference growing with the altitude and amounting to about 1000 m. at an altitude of 10,000 m.

3. ADJUSTMENT OF STABILIZER CONTROL SYSTEM

The adjustment of the stabilizer control system is carried out in case it has been disturbed in the course of aircraft operation, repair of the control equipment or replacement of the stabilizer or of the APU-2A variable-ratio boost control unit (Fig.31).

Note: If the stabilizer replacement has been carried out, level the aircraft prior to performing the necessary adjustment.

The adjustment of the control system includes the following operations:

1. Checking stabilizer and control stick deflection angles.

2. Adjusting stabilizer drift, when the APU-2A unit is shifted from the longer to the shorter arm.

3. Adjusting the neutral position of the trimming effect mechanism.

4. A final adjustment of the trimming effect mechanism after the balancing flight.

Checking and adjustment procedures are carried out according to the stabilizer port side (Figs 32 and 33) with the ground hydraulic pump connected to the booster hydraulic system and with the use of an external power source.

1. Adjustment of the stabilizer and control stick deflection angles must be carried out as follows:

(a) make sure that the circuit breakers arranged on the right hand panel and carrying inscriptions STABILIZER OR AILERON BOOSTER (БУ СТАБИЛ., ЭЛЕРОНОВ) and APU-2A CONTROL (УПРАВЛ. АРУ-2А) are switched on, and ascertain that the rod of the APU-2A unit is in the longer arm position by the light of the pilot lamp;

(b) shift the control stick forward and rearward to see that its adjusting bolts come up against the stops, and that all hinged joints, bell cranks and control units have clearances providing for an additional travel of the control stick;

(c) by shifting the control stick rearward from the extreme forward position, set the stabilizer in the zero position, that is bring the stabilizer tip downward by Д = 13±3 mm (from the notch on the fairing to the notch on the stabilizer leading edge; see Levelling Diagram, Fig.99).

Lock the control stick in this position and measure distance K from the instrument panel to point T on the control stick. To measure the distance, use a special clamp, mounted on the control stick at a distance of 510 mm from its rotation axis. Distance K should be equal to 225±3 mm. In this position an effort of approximately 1.5 kg will be felt on the control stick (with the trimming effect mechanism in the neutral position).

In case distance K is in excess of, or less than, the

specified value, adjust it with the help of an oblique tie-rod arranged behind the seat;

(d) shift the control stick all the way forward and rearward, checking stabilizer deflection; check distance Д against the levelling diagram of the given aircraft.

In case some discrepancy has been noted, readjust the stabilizer angles with the aid of the tie-rod running to the selector valve of the БУ-14МС booster, or the tie-rod of the ДР-5 transmitter.

2. Adjustment of the stabilizer drift due to shifting the АРУ-2А unit from the longer arm to the shorter arm should be carried out as follows:

Note: Adjustment of the drift affects the longitudinal balancing of the aircraft, therefore the adjustment procedure must be carried out with due care.

(a) shift the control stick rearward from the extreme forward position to set the stabilizer in a position in which its leading edge would go downward by Д = 8 ± 3 mm, as is shown in the levelling diagram of the given aircraft; lock the control stick in this position, by employing a special device.

Note: No efforts will be required to shift the control stick; the trimming effect mechanism is in the neutral position.

(b) shift the rod of the АРУ-2А unit to the shorter arm. The pointer of the respective indicator should occupy the extreme right-hand position, while the stabilizer tip should go down;

(c) measure distance Д = 30±3 mm (drift) between the notches on the fairing and the stabilizer leading edge; this distance should be within the limits presented in the levelling diagram.

If the drift value is in excess of, or less than, the specified value, ensure the required size by changing the inclination of the АРУ-2А unit housing in the following manner:

(a) shift the rod of the АРУ-2А unit to the longer arm;

(b) bring the stabilizer leading edge down to obtain size Д = 8 ± 3 mm, shown in the levelling diagram, and lock the control stick and the stabilizer by disconnecting the БУ-14МС booster and МУС-2 stabilizer control mechanism;

(c) use the hatch on the starboard to detach the tie-rod (See Fig.16) from the upper arm of the bell crank with a weight, and the tie-rod of the ДР-5 transmitter from the rod of the АРУ-2А unit.

If the stabilizer drift is less than is specified in the Levelling Diagram, the housing of the АРУ-2А unit should be inclined in the clockwise direction, if viewed from the port side. In this case the tie-rod tip should be somewhat turned out, while the tip of the tie-rod of the ДР-5 transmitter should be turned in. In the event the stabilizer deflection is in excess of the specified value, the housing of the АРУ-2А unit must be turned in the reverse direction, with the tie-rods adjusted accordingly.

Note: If necessary, ensure the required inclination of the АРУ-2А housing in the experimental way.

After the tie-rods are attached, switch on the БУ-14МС booster and check the stabilizer drift again. Having ascertained that the drift is within the specified value, shift the rod of the АРУ-2А unit to the longer arm.

3. Adjustment of the neutral position of the trimming effect mechanism must be performed in the following manner:

(a) make certain that the rod of the АРУ-2А unit is set at the longer arm, and shift the control stick to bring the stabilizer leading edge down by Д = 8 ± 3 mm from the notch on the fairing; this size corresponds to the neutral position of the trimming effect mechanism, and is presented in the trimming chart of the given aircraft;

(b) lock the stabilizer in this position by switching off the БУ-14МС booster and the МУС-2 stabilizer control mechanism;

(c) detach the spring feel mechanism body (in the front point) from the bell crank;

(d) set the trimming effect mechanism in the neutral position; the pilot lamp should light up when the button on the control stick is shifted towards the pilot;

(e) turn the spring feel mechanism relative to its adjusting tip to adjust the length of the mechanism so that

the holes in the bell crank align with the holes in the front portion of the spring feel mechanism. The final adjustment of the spring feel mechanism length is effected by turning the bush provided with flats and entering the spring feel mechanism body in the vicinity of the adjusting tip. The adjustment procedure completed, couple the spring feel mechanism to the bell crank with a bolt.

Note: The neutral position of the trimming effect mechanism may also be adjusted by changing the length of the MT-100M electric mechanism with the help of the adjusting tip.

(f) switch on the БУ-14МС booster and check the trimming effect mechanism for proper adjustment of the neutral position. For this, shift the control stick rearward and then allow it to slowly travel to the neutral position, at a rate of not more than 100 mm per 10 sec.; while proceeding in this way, slightly retain the stick so that it could stop in a position provided for by the friction in the control system.

Measure the deflection of the stabilizer left-hand half from the notch on the fairing to the notch on the leading edge.

Shift the control stick forward and slowly return it to the neutral position, proceeding in the above manner, after which check the stabilizer deflection in this position. Take the measurements two times. The mean value obtained should amount to size $\Delta = 8 \pm 3$ mm, presented in the trimming chart of the given aircraft.

Note: To minimize the influence of friction on the measurement accuracy, it is recommended to carry out the check with the ambient air temperature amounting to not less than $+10^{\circ}$C.

After the operations relating to the adjustment of the stabilizer control system have been completed, check the stabilizer control system for proper functioning, taking care to run over all points involved.

With the stabilizer in the extreme positions and the rod of the АРУ-2А unit in the longer arm position, ascertain that the shackles connecting the central bell crank to the levers on the stabilizer shafts are properly aligned. The shackles should be capable of a free rotation about their axes in the hinged bearings when turned manually.

4. Final adjustment of the trimming effect mechanism after the balancing flight is carried out in case the pilot used the trimming effect mechanism during the flight.

Carry out the final adjustment as follows:

(a) build up pressure in the booster hydraulic system and switch on the БУ-14МС booster;

(b) without changing the position of the trimming effect mechanism, set by the pilot, with the rod of the АРУ-2А unit set at the longer arm, and the control stick released, detach the spring feel mechanism from the bell crank. Being released of the friction forces arising in the control system, the spring feel mechanism will somewhat change its length;

(c) shift the control stick to line up the holes provided in the spring feel mechanism tip and in the bell crank (do not insert the bolt).

Lock the control system in this position by switching off the БУ-14МС booster and the МУС-2 stabilizer control mechanism;

(d) measure the deflection of the stabilizer left-hand half from the notch on the fairing to the notch on the stabilizer leading edge (the size measured should amount to $\Delta = 8 \pm 6$ mm);

(e) set the trimming effect mechanism in the neutral position, for this push the change-over switch on the control stick forward and then pull it until the pilot lamp lights up;

(f) adjust the spring feel mechanism to line up the hole in the tip with the hole in the bell crank; insert the bolt into the lined-up holes;

(g) check the adjustment results.

Shift the control stick rearward and then allow it to slowly travel to the neutral position at a rate of not more than 100 mm per 10 sec.; while proceeding in this manner, slightly retain the stick so that it could stop in a position provided for by the friction in the control system.

Measure the deflection of the stabilizer left-hand half from the notch on the fairing to the notch on the stabilizer leading edge.

Shift the control stick forward and slowly return it to the neutral position, proceeding in the above manner, after which check the stabilizer deflection in this position. Take the measurements two times. The mean value obtained should amount to size $\Delta = 8 \pm 7.5$ mm.

Adjustment of the trimming effect mechanism completed, perform a test flight with the purpose of checking the longitudinal balancing; the results obtained should be entered into the trimming chart.

4. ADJUSTING CLEARANCES IN STABILIZER JOINTS

When play is detected in the stabilizer joints which exceeds the specified value and causes the aircraft to flutter when in level flight at a speed approximating the maximum value, the stabilizer joints should be checked for play values.

The following should be taken into consideration:

1. The bending play of the stabilizer beam should not exceed 90 μ, as measured in the vicinity of the fourth stabilizer attachment bolt (as numbered from the aircraft centre plane).

2. No axial play should be allowed.

3. No torsional play should be observed in the stabilizer control system up to the central control bell crank on frame No.30 (inclusive).

Checking Stabilizer Beam for Bending Play

The bending play of the stabilizer beams (of left-hand and right-hand parts), with the stabilizer installed on the aircraft, is carried out as follows:

1. Set the stabilizer in the neutral position.

Note: With the stabilizer in the neutral position, its leading edge points downward. The notch on the stabilizer leading edge should be lower than the notch on the fairing by size $D_o = 13 \pm 3$ mm. To obtain this value, refer to the Levelling Diagram of the given aircraft.

2. Mount the fixture with the dial gauge onto the fuselage; bring the dial gauge leg against the fourth bolt securing the stabilizer to the beam (Figs 34, 35 and 36).

3. Build up pressure in the booster hydraulic system, using a ground pump for the purpose, and switch on the EV-14MC booster.

CAUTION! When carrying out the above procedure do not manipulate the aircraft control stick.

4. Hang the clamp to apply a specified load on the stabilizer tip (where the beam axis crosses the edge).

5. Set the dial gauge pointer at zero by turning the scale.

6. Apply a load amounting to 12 - 13 kg and directed upward to the stabilizer set in the neutral position as shown in Fig.34, using a fixture with a calibrated spring.

Register the dial gauge readings.

When applying the load, with the stabilizer in the neutral position, take care to see that the beam is not affected by torsional forces. In case the stabilizer beam has a play of about 50 μ, slight knocking of the beam in the supports may be heard, with the load applied as recommended in Point 6.

Note: It should be borne in mind that the forces should be directed only upwards, the play in the reverse direction being taken up by the weight of the stabilizer proper.

The above method of checking the stabilizer beam play provides for estimation of the total beam play as compared to the permissible value.

In case the stabilizer beam play exceeds the permissible value (90 μ), perform a more accurate measurement of the total beam play, with the respective half of the stabilizer removed; only after this should the decision be taken as to the necessity of eliminating the play.

Determine the beam play with the stabilizer removed, using the following procedure:

1. Remove the stabilizer half whose beam is to be checked for play. Dismantling of the stabilizer should be performed in compliance with the procedure outlined elsewhere in this book. The stabilizer dismantled, lock the control stick, making use of the ground retainer to retain the stabilizer beam in the neutral position.

2. Fit the dynamometer-type appliance into the fourth bolt hole in the beam, so that no torsional forces should affect the beam, when the load is applied.

3. Mount the fixture with the dial gauge onto the fuselage, bringing the dial gauge leg against the axis of the special bolt installed as is laid down in Point 2 (See Fig.35).

4. Set the dial gauge pointer against zero.

5. Employ a dynamometer to apply to the beam a load amounting to 25 kg and directed downward (See Fig.34); register the dial gauge readings. Remove the load.

6. Apply a load of 25 kg directed upward. Register the dial gauge readings again.

Note: With the load directed upward indications of the pointer should be read starting from the initial zero position.

The total readings as registered according to Points 5 and 6 will give the total bending play of the stabilizer beam. The permissible total play of the stabilizer beam on aircraft in actual operation should not exceed 90 μ.

Eliminating Bending Play of Stabilizer Beam

To eliminate the bending play of the stabilizer beam and to bring it to the required value, not exceeding 90 μ, remove the stabilizer and proceed in the following manner:

1. Tighten taper bush 3 (See Fig.35) in the beam support on frame No.33.

This is done with the help of nut 4 and a special socket wrench. Prior to tightening the bush, unlock the nut by unbending the washer tabs (Fig.37).

Tightening of the bush in the ШКБ-210К bearing should provide for a complete elimination of the play between the beam and the taper bush as well as between the taper bush and the inner race of the ШКБ-210К bearing (See Fig.35).

Notes: 1. Use the above method of bending play elimination only in case the play is not in excess of 100 to 150 μ.

2. If the bending play is equal to or in excess of 200 μ, do not tighten the bearings to eliminate it, for such an excessive play is due to a breakdown of the bearings. In this case the bearings should be replaced by new ones.

Nut 5 (Fig.37) is made accessible through the clearance between the beam and the end rib of the fairing. After tightening nut 5, lock it in the new position by bending the tabs of the locking washer accessible through the hatch on the stabilizer fairing.

When tightening the taper bush, see that the stabilizer beam turns along with the bearing inner race over the bearing needles. This should be checked additionally, with the stabilizer fitted in place and the shackles connecting the stabilizer beam lever to the central assembly bell crank detached. In this case the stabilizer leading edge should go down thereby turning the beam.

2. If the bending play of the stabilizer beam is not eliminated by tightening the taper bush, check the stabilizer beam shank for proper tightness in the bearing of the support on frame No.30.

When carrying out the above check, first disjoint the aircraft fuselage and remove the inner casings of the fuselage tail portion, then tighten nut 1 (See Fig.35).

The beam shank is tightened in the bearing by a torque-indicating wrench, the tightening torque not exceeding 380 kg-cm, with taper bush 3 on frame No.33 released. After the tightening procedure is completed, lock nut 1 in the new position by means of cotter pin 3x50; then tighten up taper bush 3 as is recommended in Point 1 of this Para.

3. Check the joint between beam shank 6 (See Fig.35) and beam 7 for bending play. The play may be detected visually, while rocking the stabilizer beam. Should the shank and

beam move relative to each other, replace the stabilizer bea

4. If the above methods of eliminating the stabilizer beam play prove to be of no use, the centre elements of the ШКБ-210К bearing or of bearing 2 (See Fig.35) should be replaced by new ones, that is the inner parts of the bearings together with the spherical centre rings should be replaced. When mounting new spherical rings complete with the needles and inner races into the outer races located on frames Nos 3 and 33, the efforts applied to turn the bearing spheres shoul be within the following permissible values:

(a) the effort required to move the spheres over the outer race of bearing 2 (See Fig.35) on frame No.30 should amount to 4 - 25 kg, when using lever L = 250 mm;

(b) the effort required for moving the spheres over the outer race of the ШКБ-210К bearing on frame No.33 should n exceed 4 - 25 kg, when employing lever L = 600 mm.

Notes: 1. When replacing the bearing, make an access hole in the end rib of the stabilizer fairing as shown in Fig.38.

2. During regular inspection of the removed bearing rings cracks may escape detection. Therefore, it is recommended to check the bearing rings for cracks using pigmented kerosene or a magnetic flaw detector, with the ring expanded to set up stresses.

When installing new bearings, use ЦИАТИМ-201 lubricant.

Bending play on aircraft of the first series not furnished with taper distance bushes in the stabilizer beam support on frame No.33 should be eliminated as is detailed in Points 2,3 and 4. To ensure a more precise fit for the new bearing, the diameter of the beam portion receiving the inner bush of the bearing must be measured with due accuracy. In exceptional cases, the play may be eliminated by replacing the support beam.

Determining and Eliminating Torsional Play

Any torsional play in the stabilizer control system is to be excluded.

The stabilizer control system is checked for torsional play manually by slightly swinging the stabilizer trailing edge up and down; no audible knocks should be produced in the joints of the stabilizer control system. This check is carried out with the stabilizer set in the neutral position and the БУ-14МС booster switched on (with the БУ-14МС booster switched off torsional play, as checked at the trailing edge of the stabilizer, may be experienced due to play in the АПС-4 stabilizer emergency drive; this play is accompanied by slight knocking and cannot be considered as an evidence of torsional play in the stabilizer control system up to the БУ-14МС booster).

Should any torsional play be detected, with the БУ-14МС booster switched on, all joints of the control system, from the stabilizer up to the booster, must be checked, special attention being paid to proper tightening of the bolt and hinge joints.

When inspecting the bell crank of the stabilizer central control unit mounted on frame No.30 (Fig.39) tighten up right-hand (looking forward) nut 1 of the bell crank shaft, by employing a standard wrench, and check whether right-hand side splines of the hub of bell crank 2 fit properly into the recess of the collar provided on shaft 3 (See Б-Б Section). Tighten bell crank shaft left-hand nut 4 applying an effort of not more than 130 - 160 kg-cm.

Check the shackles connecting the central unit bell crank to the stabilizer beams for play. Should some play be detected, shackles 5 must be replaced. When carrying out the replacement procedure, measure the distance between the centres of the holes drilled in the old shackle to choose a new shackle of the same dimensions. The shackle replaced, check to see that there is no torsional play, and check the stabilizer deflection angles, which should conform to those given in the aircraft Rigging Chart.

Determining and Eliminating Axial Play

No axial play should be allowed in the stabilizer suspension system.

Axial play is determined by applying an axially directed effort of 25 to 30 kg to the stabilizer tip, where the stabilizer beam, if continued, will cross the stabilizer edge, that is the stabilizer should be pushed and pulled in the axial direction.

Axial play is considered to be absent, if no relative movement or knock can be noticed or heard in the following joints:

1. The joints of the supporting bearing on frame No.30.

2. The bolt joint of the beam and its shank, and of beam lever 8 (See Fig.35).

If axial play occurs in the joint of the supporting bearing on frame No.30, disjoint the aircraft, remove the casings of the fuselage tail portion and tighten up nut 1 (See Fig.35).

If the tightening of the bolt joints of the beam, its shank and of the lever does not result in the elimination of the play, the stabilizer beam should be replaced.

Any operation pertaining to the elimination of excessive play and associated with replacement and choosing of the stabilizer beam bearings located on frames Nos 30 and 33 can be performed by the Manufacturer's representatives only.

5. REPLACEMENT OF STABILIZER CONTROL SYSTEM UNITS

General

When replacing any units, tie-rods and bell cranks of the stabilizer control system, ensure the following (Fig.40):

(a) free rotation of bell cranks under their own weight, with no play along the axis of their attachment or suspension;

(b) clearances between the control system assemblies and the aircraft structural components;

(c) proper fitting of the adjusted tip threads into the tie-rod sleeves (check by making use of the check holes provided in the sleeves).

(d) free travel of the tie-rods where seals are fitted;

(e) proper installation of the tie-rods and units (without any tension).

Replacement of АПС-4 Stabilizer Emergency Drive

When effecting the replacement of the stabilizer emergency drive (Fig.41), check the reserve travel of the rod at the stabilizer maximum deflection angles with the АРУ-2А variable-ratio boost control unit set at the longer arm. To accomplish the above check after a new АПС-4 stabilizer emergency drive has been mounted on the respective bracket, build up operating pressure in the hydraulic system (without connecting the АПС-4 unit to the bell crank), switch on the БУ-14МС booster and shift the control stick all the way rearward and forward; rotate the rod of the АПС-4 unit to extend and retract it to the extreme positions; measure the reserve travel of the rod in the mentioned positions (Figs 42 and 43). This should amount to not less than 5 mm . The rod of the АПС-4 unit should be freely attached to the bell crank; no misalignment of the rod should be allowed in any of the bell crank positions.

After the installation of the АПС-4 stabilizer emergency drive has been completed, check its operation, making use of the emergency electric follow-up system.

Replacement of БУ-14МС Booster

When replacing the booster check the reserve travel of its servo-rod at the stabilizer maximum deflection angles, with the АРУ-2А variable-ratio boost control unit set at the longer arm. To accomplish the above check after the new booster has been mounted on the respective bracket, shift the control stick all the way rearward and forward, without connecting the booster to the tie-rods; set the servo-rod manually in the extreme front and rear positions, and measure the reserve travel of the rod taking into account the travel of the selector valve in both positions. The reserve travel of the rod should not be less than 1 mm.

Make sure the booster rod can be easily attached to the bell crank; without misalignment in any of the bell crank positions.

The bolts securing the БУ-14МС booster should be properly tightened and locked.

Note: Should the clearances between the shanks of the servo-rod of the БУ-14МС booster and the АПС-4 unit turn to be less than the specified values (Fig.44), the booster rod shank may be refitted.

Having finally installed the booster, detach the rod of the АПС-4 stabilizer emergency drive from the control bell crank (to avoid damage to the АПС-4 unit) and employ a ground hydraulic pump to check the booster operation and the stabilizer maximum deflection angles, with the АРУ-2А unit set at the longer arm. The deflection angles should be within the limits set in the aircraft Levelling Diagram. Having ascertained that the stabilizer deflection angles and the reserve travel of the АПС-4 unit rod are within the specified values, connect the rod of the АПС-4 unit to the bell crank.

Replacement of Control Rod Complete with ДР-5 Mismatch Transmitter

When the control rod complete with the ДР-5 transmitter is replaced (Fig.45), the length of the new control rod should be the same as the length of the control rod removed from the aircraft.

The replacement procedure should be carried out as follows:

1. Remove the control rod from the aircraft and adjust the length of the new rod according to the old one. For this, connect the non-adjustable ends of both the rods with a long bolt, and manipulate the adjustable shank of the new control rod to make it equal in length to the old rod; make certain the bolt fits smugly into the holes provided in the adjustable shanks of both tie-rods, then lock the shank of the new rod. The holes in the shanks should line up, the permissible error not exceeding half of the shank thread pitch.

CAUTION! It is strictly prohibited to strain the wire bundle of the Д-5 transmitter either during mounting or operation. Do not pull at the wire bundle to extract the plug from the socket, never use it as a handle when carrying the transmitter.

2. Install the new rod in the aircraft and lock the joints. To avoid breaking the wire bundle where it is soldered secure it to the tie-rod.

3. Use the emergency electric follow-up system to check the drift of the stabilizer in compliance with the Levelling Diagram of the given aircraft when the АРУ-2А unit is shifted from the longer to the smaller arm and vice versa. Check also the maximum angles of the stabilizer deflection, when the АРУ-2А unit is set at the longer arm; check the emergency electric follow-up system for proper operation.

4. Check operation of the ДР-5 mismatch transmitter (with the АРУ-2А unit set at the longer arm) to preclude possible jamming of the piston square tip in the guiding hole, when the adjustable shank of the tie-rod is turned through some angle. For this:

(a) turn the tie-rod shank in the direction shown by arrow Г to set it in the position illustrated in Section АА; turn the body of the ДР-5 transmitter in the direction shown by arrow Д to set it in the position illustrated in Section ББ (Fig.46).

This done, check operation of the microswitches of the ДР-5 transmitter by listening to its noises while swinging the bell crank with weight on frame No.25. With the weight swung in both directions, four clicks should be produced by the microswitches;

(b) turn the tie-rod shank as shown by arrow В, and the ДР-5 mismatch transmitter as shown by arrow Е; check the transmitter for proper operation as recommended in item (a).

Having checked the stabilizer control system and the new mismatch transmitter for proper operation, use red

paint to mark the position of the tie-rod adjustable shank; secure the wire bundle of the ДР-5 transmitter; make sure it does not brush against or catch some nearby projecting parts when the stabilizer is deflected, and is loose enough to allow the stabilizer deflection to the extreme positions. Check whether the wire bundle is securely fastened to the connector by the clamp (Fig.47).

Replacement of Control Rods

The length of the new control rods should be equal to the length of the rods replaced (perform the necessary adjustment by manipulating the control rod tips). New tie-rods being installed, check the maximum deflection angles of the stabilizer with the АРУ-2А unit set at the longer arm.

Replacement of МП-100М Trimming Effect Mechanism

When replacing the МП-100М mechanism, it is essential to adjust the length of the new unit within the length of the old one by manipulating the rod tip. After the МП-100М mechanism has been replaced, check it for proper operation and correct setting in the neutral position, giving special attention to the proper fastening of the wires.

Replacement of Spring Feel Mechanism

The length of the newly installed mechanism should be equal to the length of the spring feel mechanism removed from the aircraft. The mechanism length is adjusted with the help of the rod tip. The final adjustment of the length is effected by turning the mechanism flange (provided with flats) and located at the adjusting tip.

When installing the mechanism, care should be taken to see that the adjusting tip is connected to the control bell crank strictly in accordance with the notches provided on the serrated plate of the bell crank.

Having installed the spring feel mechanism, check its operation by shifting the control stick to the extreme positions; check the trimming effect mechanism for proper setting in the neutral position.

Replacement of Units of АРУ-2А Automatic System

The АРУ-2А automatic system includes:

(a) the servo-mechanism (АРУ-2А unit proper);
(b) the control unit;
(c) the АРУ-2А position indicator;
(d) the pilot lamp;
(e) the selector switch;
(f) the manual control push-button switch. The servo-mechanism and the control unit are interconnected as to their output characteristics. The replacement of one of these units may be performed only at the specialized repair shop after the characteristics of the new unit have been so adjusted as to conform to those of the unit installed in the aircraft.

The servo-mechanism and the control unit constitute an integral assembly; when one of the units fails, both should be replaced.

Replacement Procedure for АРУ-2А Boost Control Unit

The replacement of the АРУ-2А variable-ratio boost control unit should not affect the adjustment of the stabilizer control system.

To remove the unit, proceed as follows (Fig.49):

1. Lock the control stick with the help of a special fixture; power supply to the units of the stabilizer control system should be cut off, and there should be no pressure in the hydraulic system.

2. Detach the rod with the ДР-5 mismatch transmitter from the rod of the АРУ-2А unit.

3. Uncouple the АРУ-2А variable-ratio boost control unit from the rod running to the bell crank with weight.

4. Detach the rod from the bell crank coupled to the spring feel mechanism.

5. Remove the clamps securing the control rod sealing boots at frames Nos 25 and 26.

6. Detach the АРУ-2А boost control unit from the bracket.

7. Displace the unit in the direction of flight to provide access to the threaded tip of the rod running to the spring feel mechanism.

8. Screw off the rod locking nut, and turn the rod to detach it from the tip. When turning off the rod, count the number of turns made, or measure the distance from the rod end face to the tip rim.

9. Dismantle the APY-2A unit from the aircraft.

Install the new APY-2A variable-ratio boost control unit on the aircraft in the reverse order of dismantling. When installing the unit take care not to change the length of the control rod connected to the unit.

After the installation of the unit has been completed, check and, if necessary, adjust the stabilizer control system; check the APY-2A automatic system for proper operation in relation to speed and altitude.

Additional Instructions on Mounting APY-2A Automatic System Units

To prevent failures in the operation of the automatic system installed on the aircraft in actual service, the following rules should be strictly adhered to:

1. When checking the system operation, the supply voltage must not exceed 27 V ±10 per cent.

Higher voltages may result in damage to the control units.

2. Do not actuate the APY-2A automatic system, should any component be missing (the position indicator, for instance).

Energizing of the automatic system, with the position indicator missing (its leads being connected to each other or to the aircraft frame), will result in burning out of the position indicating potentiometer.

3. When installing the automatic system units, see that the negative contact is reliably connected to the frame to ensure proper operation of the system under vibration stresses.

4. Check to see that plug connectors ШР, the control

unit and the servo-mechanism are properly connected to the mains.

When mounting the APY-2A rod position indicator on the instrument panel, see that the indicator terminals are not connected to the frame.

5. It is strictly prohibited to adjust the stops of the servo-mechanism limit switches to avoid damage to the mechanism rod.

6. When installing the APY-2A mechanism on the aircraft, exercise utmost care to ensure that the rotation axes of the servo-mechanism are parallel to those of the bell crank serving for attachment of the spring feel mechanism. See that their axes are in the same plane.

Misalignment of the rod running from the spring feel mechanism to the servo-mechanism will cause damage to the race of the ball bearing fitted in the rod of the servo-mechanism.

7. When installing the servo-mechanism, exercise care to ensure that in the extreme positions of the mechanism, its wire bundle is not tightened, its sag being not less than 10 to 20 mm; the wire bundle should be properly secured and should not brush against the protruding structural components of the aircraft, when the servo-mechanism is deflected. Tightening may result in wire bundle breakage.

8. Before connecting the static and dynamic lines to the control unit, check to see that the lines are free of dirt and are properly sealed. Take care not to misplace the dynamic and static lines.

9. Whenever the APY-2A automatic system is subjected to any checks, making use of the automatic control circuits, great care should be taken to ensure that the maximum value of dynamic pressure does not exceed 1000 to 1100 km/hr near the ground.

At an altitude of 10,000 m., the dynamic pressure value, as read by the speed indicator wide pointer should not exceed 930 to 950 km/hr. Otherwise the sensitive elements of the МРД-6 impact pressure transmitter may experience residual deformation causing failure to the automatic system.

10. With the aircraft in actual service, the readings of the indicator and of the navigating instruments indicating speed and altitude of flight do not necessarily coincide due to atmospheric conditions differing from the standard values,

and also because of variations in the 27 V ± 10 per cent supply.

6. AILERON AND INTERCEPTOR CONTROL

Check the operation of the aileron controls as follows:

1. With the БУ-13М booster switched on, shift the control stick all the way to the right and to the left, and see that it moves smoothly. Make sure some effort is imposed on the control stick due to the action of the spring feel mechanism and to the friction of the booster piston. Ascertain that the control stick and the ailerons deflect to the very end of their travel, and that the free travel of the control stick is within the permissible value. The control stick and the ailerons are checked for full deflection by forcing the ailerons up and down; in each of the aileron extreme positions the control stick should come up against the stop. The free travel of the control stick is checked with the ailerons locked in the neutral position. The total free travel of the control stick, as measured at the stick end, should not exceed 18 mm. The play of the aileron halves relative to each other should not exceed 1 mm, when a load of 5 kg is applied to the trailing edge of the aileron.

2. Switch on the storage battery and the circuit breaker marked with AILERON TRIM TAB, TRIMMING EFFECT (ТРИММЕР ЭЛЕРОНА, ТРИММЕРН. ЭФФЕКТ). Then push the switch AILERON TRIM TAB (ТРИММЕР ЭЛЕРОНА) mounted on the left-hand panel to the right and to the left, and check to see that the aileron trim tab is deflected up and down, respectively. Set the trim tab in the neutral position.

3. Check the control system, with the БУ-13М booster switched on; carry out the check when the engines are running, or employing a ground hydraulic pump and an external source of power.

For this:

(a) make sure the circuit breaker STABILIZER OR AILERON BOOSTER (БУ СТАБИЛ., ЭЛЕРОНОВ) mounted on the right-hand panel is switched on; turn on the ПН-45 selector switch located on the left-hand panel and marked with AILERON HYDRAULIC BOOSTER (ГИДРОУСИЛ.ЭЛЕРОНА);

(b) shift the control stick all the way to the right and to the left to see that it moves freely, without jamming or jerking. Make sure an effort is felt on the control stick due to the action of the spring feel mechanism, while the aileron and the stick (when released) return to the neutral position. The maximum angles of aileron deflection should not differ by more than 1.5°, as compared to aileron deflection with the booster switched off.

Shift the control stick to the right and to the left to see the main slide valve of the booster is not jamming.

The signs of jamming are as follows:

(a) if the slide valve is jammed in the neutral position, an additional load of 3 or 4 kg comes to be imposed on the stick by the spring of the duplicating slide valve;

(b) in case the slide valve is caught in a position other than neutral, the control stick will be displaced from the neutral position; the maximum rate of the control stick travel may also be affected (it may be reduced approximately three times in one direction, and increased two times in the other);

(c) check the control system for play in the hinged joints of the rods and bell cranks. To accomplish this, jerk the trailing edge of the ailerons and listen to knocks in the joints from the aileron to the booster.

Check the interceptors for proper installation and adjustment, for which purpose set the ailerons in the neutral position. With the ailerons deflected down from 0° to 3±0.5°, the interceptors should not extend beyond the wing profile.

With the ailerons shifted, one after another, down by 10°30'±2°, the respective interceptors should fully extend beyond the wing, that is by 57±5 mm. The further movement of the ailerons down to 20° should not cause any displacement of the interceptors. The difference between the interceptors fully extended on the right-hand and left-hand wings must not exceed 2 mm.

With the ailerons set in the neutral position, the interceptors should not hide into the wing by more than 2.5 mm.

The extension of the interceptors beyond the wing profile, when the ailerons are set in the neutral position, is not allowed.

The mechanisms controlling interceptor operation are adjusted in such a manner that the interceptor starts its outward movement when the aileron is deflected down by $3\pm0.5^{\circ}$. The adjustment of the interceptors on the right-hand and left-hand wings is carried out in a similar manner.

To accomplish the adjustment proceed as follows:

1. Remove the access panel in the wing at rib No.19.

2. Extract the bolt, coupling interceptor control rod 11 (See Fig.24) to the aileron bell crank.

3. Loosen the locking nut of interceptor control rod 11 and turn in (or out) the threaded tip.

4. Couple rod 11 to the aileron bell crank and check to see whether the interceptor starts to extend out of the wing at the proper moment.

The interceptor should start extending when the aileron is deflected down by $3\pm0.5^{\circ}$.

Note: A clearance of not less than 3.5 mm should be ensured between the roller of rod 11 and the end face of the guide plate provided on bracket 12. This clearance should be adjusted by reducing the aileron deflection up and down by 1°.

Should it be necessary, turn the threaded tip in or out again, bearing it in mind that when the tip is turned in, the aileron deflection angle, at which the interceptor starts to extend, is increased, and vice versa.

The adjustment of the interceptor control mechanism completed, tighten the rod locking nut, lock the bolt coupling the interceptor rod to the aileron bell crank, and fit the panel in place.

Clearances between the moving parts of the interceptor and the edges of the wing flap cutouts should amount to 2.5 ± 1 mm, while clearances between the interceptor and the edge of the wing rear stringer lower edge must be equal to 2 ± 1 mm.

The interceptor play in the direction, perpendicular to the wing chord, as measured in the fully extended position of the interceptor, with the aileron deflected all the way down and at an alternating load of 1.5 kg should not exceed 3 mm.

7. RUDDER CONTROL

In service, it is necessary to check the rudder for easiness of control. The bell cranks and tie-rods must be checked for jamming, while the hinged joints of the tie-rods and bell cranks are to be checked for play. The hinged joints of the tie-rods and bell cranks are considered to be free of play, if no knocks are heard in the rudder control system, when the trailing edge of the rudder is sharply jerked by hand.

The aircraft of the later models must be checked for proper operation of the rudder trim tab by making use of the push-button switch located on the left-hand panel. After the checking procedure is completed, the trim tab must be set in the neutral position.

8. ENGINE CONTROL

The engine control systems should be checked, using the following procedure:

1. Check, in turn, the right-hand and left-hand engines for easy control; see that the control levers are properly retained by the respective stops.

The engine control system is checked by smoothly shifting the engine control levers from the CUT-OFF (СТОП) stop to the AFTERBURNER (ФОРСАЖ) stop and backward.

The lever should move without any jamming.

2. When setting the control lever at the CUT-OFF (СТОП) stop, see that: "0" notch of the ПУ-3 dial located on the engine is set against notch "С" provided on the control panel housing, the lever of the НР-10А pump is in the CUT-OFF (СТОП) position, while the control lever in the cockpit has a reserve travel of 1 to 2 mm.

Check to see that the engine controls are put out of operation in the CUT-OFF (СТОП) position when the lever in the cockpit is shifted forward.

3. Press the lever latch and shift the lever to the LOW SPEED (МАЛЫЙ ГАЗ) position; see that the lever of the НР-10А pump on the engine is set between the extreme notches provided on the pump dial; make sure the

control lever in the cockpit is retained by a special latch on the control sector, when it is moved rearward, and is not hindered in its movement when pushed forward.

4. Shift the control lever in the NORMAL (НОМИНАЛ) position and see that: the lever of the НР-10А pump on the engine is set against the stop, the lever of the ПУ-3 control panel is turned through 70° from the CUT-OFF (СТОП) position, as indicated on the control panel dial, while the control lever in the cockpit is held by the ball retainer; if some additional effort is applied the control lever may be shifted from this position both forward and rearward.

5. Shift the control lever to the MAXIMUM (МАКСИМАЛ) position and see that the control lever in the cockpit is retained by the stop only when the lever is pushed forward; a click should be heard on the engine, when the control lever is 3 or 4° short of this stop (as indicated on the dial of the ПУ-3 control panel); this click is produced by operation of the respective limit switch of the control panel; see that the control panel lever is turned through 75° from the CUT-OFF (СТОП) position (as indicated on the panel dial) when the engine control lever is set in the MAXIMUM (МАКСИМАЛ) position.

6. Press the latch, shift the engine control lever in the cockpit to the AFTERBURNER position (the extreme forward position) and see that the control lever in the cockpit is 1 or 2 mm short of the stop, and that it is held by the stop when pulled back; make sure a click is heard on the engine, when the control lever is still 3 or 4° before this stop (as indicated on the dial of the ПУ-3 control panel; this click is produced by operation of the respective limit switch of the control panel; check to see that the control panel lever is turned through 85° from the CUT-OFF (СТОП) position (as indicated on the panel dial) when the engine control lever is set in the AFTERBURNER (ФОРСАЖ) position.

7. Check the engines for proper control; make sure the engine control levers are simultaneously and properly retained by the sector stops in the cockpit, when both control levers are operated at the same time. For this, connect the control levers with a clamp and repeat the checking procedure outlined above.

Notes: 1. The engine control system is adjusted by changing the length of the aircraft control rods, as well as by changing the length of lever arms of the engine control panel and of the aircraft bell crank located between frames Nos 17 and 18; the lever arms may be adjusted with the help of the serrated plates.

2. When adjusting the control system with the purpose of ensuring synchronous operation of the engines, neither change the length of the rod connecting the pump lever to the control panel lever, nor the length of the НР-10А pump lever arm with the help of the serrated plate.

3. When checking the engine control system for proper adjustment, with the engines running, proceed as recommended in the РД-9Б engine operating instructions.

4. Check the position of the НР-10А pump lever within the sector two times:

(a) when smoothly shifting the engine control lever in the cockpit to the low throttle stop (after this the lever is released);

(b) when abruptly shifting the engine control lever to the low throttle stop and pressing the lever against this stop by hand.

9. AIR BLOW-OFF SHUTTER CONTROL

When starting the engines during the pre-flight preparation, check both engines, in turn, for proper operation of the blow-off shutters. With the engine speed increasing, the shutters should close at 9700_{-100} r.p.m., when the air blow-off bands operate. With the engine speed decreasing, the shutters should open at the blow-off band opening r.p.m. The shutters must close smoothly without jamming. The opening of

the shutters should be performed at a higher rate, but also without any jamming or jerks (See Figs 26 and 27).

The shutter cylinder control system is checked for leakage with the access panels removed and the engines running at the maximum rating (at the maximum pressure of kerosene in the system). No leakage of kerosene through the joints is allowed.

During normal operation of the engine, see that the shutters, when closed, do not project above the fuselage skin. No kerosene drip should be allowed through the cylinder vent pipe union.

If this does occur, the cylinder should be replaced.

When the aircraft is parked, the ports should be closed with a special fixture.

CAUTION. Prior to flight or starting the engines, ascertain the fixture is removed from the shutters.

10. ADJUSTMENT OF ENGINE CONTROL SYSTEM

The engine control system is checked using the following procedure (for each individual engine):

1. Shift the engine control lever to the CUT-OFF (СТОП) position and ascertain that it is 1 or 2 mm short of the rear stop on the sector; make sure that the lever of the HP-10 pump throttle cock is set at the lower stop, whereas the ПУ-3 control unit lever is in the 0° position, as indicated on the dial.

If there is some discrepancy in the positions of the engine control lever, ПУ-3 control unit lever, and the pump throttle cock lever, proceed as follows:

(a) detach the rod located between the ПУ-3 control unit lever and the bell crank, in the vicinity of frame No.16;

(b) set the ПУ-3 control unit lever against 0°, as indicated on the dial; the HP-10 pump throttle cock lever should come up against the stop. This done, bring the control rod to the bell crank and secure it with a bolt at the proper groove.

Notes: 1. After the above adjustment is carried out, the springing of the tie-rod between the ПУ-3 control unit and the HP-10 pump throttle cock should be within 2 mm.

2. If the adjustment is disturbed only with regard to one rating, do not detach the control rod and carry out the necessary adjustment by displacing the respective stop on the control sector.

3. The engine control may be adjusted with the help of the control rod behind the control sector in the cockpit; when proceeding in this way, mind the variations in effort applied to the control levers.

2. Shift the engine control lever to the LOW SPEED (МАЛЫЙ ГАЗ) stop making sure the lever is not springing. The ПУ-3 control unit lever should be set approximately at 13°, as indicated on the dial, while the lever of the HP-10A pump throttle cock should stop on the low speed sector somewhere between the extreme notches. For the engine to be normally brought to the low speed, the position of the HP-10A pump lever should be higher than the middle notch. To perform the required adjustment, make use of the low speed stop in the cockpit. With the engine control lever moved from the CUT-OFF (СТОП) position to the LOW SPEED (МАЛЫЙ ГАЗ) position, a click will be produced by the microswitch located in the ПУ-3 control unit housing and marked "К.П." When microswitch "К.П." operates, energy is supplied to the starting system.

3. Having checked the LOW SPEED position, slowly shift the lever to the NORMAL (НОМИНАЛ) position until it comes up against the stop. Make sure there is a click produced by the ПУ-3 control unit microswitch supplying energy for shifting the jet nozzle shutters to the normal rating position. With the engine running, the above events will take place at 4500 - 5700 r.p.m.

With the control lever shifted to the NORMAL (НОМИНАЛ) stop, make certain the position of the ПУ-3 control unit lever corresponds to $70 \pm 1^{\circ}$ (on the dial), while the lever of

the HP-10A pump throttle cock is set against the MAXIMUM SPEED (МАКС.ОБОР.) stop.

To ensure more reliable operation the control rod running from the ПУ-3 control unit to the HP-10A pump may be extended by 2 mm, when the throttle cock lever is set against the MAXIMUM SPEED stop.

4. Set the engine control lever in the MAXIMUM (МАКСИМАЛ) position, making sure the ball retainer functions properly. Microswitch "М" in the ПУ-3 control unit should produce a click when the dial reads $75^{\circ}_{-1}{}^{\circ}$.

5. With the engine control lever set in the AFTERBURNER (ФОРСАЖ) position ($85^{\circ}_{-1}{}^{\circ}$ on the dial) a click should be produced by microswitch Ф.

The control lever must be reliably locked in the AFTERBURNER position, 2 mm before the front stop.

When the engine control lever is set in the AFTERBURNER or MAXIMUM position the lever of the HP-10A pump must rest on the MAXIMUM SPEED (МАКС.ОБОР.) stop, while the lever locking must occur when the dial reads 3 or 4° after the click of the respective microswitch.

The total play of each engine control lever should not exceed 2 mm, when an effort of 5 kg is applied, and the lever of the HP-10A pump is pressed against the MAXIMUM SPEED (МАКС. ОБОР.) stop.

CAUTION! Excessive play in the engine control system may result in the following troubles:

1. With the engine control lever set in the CUT-OFF (СТОП) position, the throttle cock of the HP-10A pump will be partially open, which will cause fuel burning and local overheating when the engine is being shut down.

2. With the engine control lever set in the AFTERBURNER or MAXIMUM position, the microswitches of the ПУ-3 control unit will not operate.

3. The engine will not be brought to idling speed at starting, due to an insufficient temperature increase.

Not more than a 10-kg effort must be enough to move the engine control levers from the CUT-OFF (СТОП) position to the NORMAL (НОМИНАЛ) position; while an effort of not more than 17 kg will shift the levers from the NORMAL position to the AFTERBURNER position. To ensure synchronous operation of the engines, when the control levers are coupled, their positions at the stops in the cockpit should fully correspond to the ПУ-3 control unit dial indications on both engines.

Note: Adjustment procedure on the aircraft which are powered by the engines allowing regulation of thrust at the augmented and maximum ratings (furnished with push-button control of these ratings) should be carried out as is laid down in Appendix 11.

11. ADJUSTMENT OF AILERON CONTROLS AFTER LATERAL BALANCING FLIGHT

Lateral balancing of the aircraft is carried out in case the pilot during the trimming flight, with the booster, type БУ-13М, switched off, employed the aileron trim tab, or if the pilot (when performing balancing, with the БУ-13М booster switched on) shifted the control stick by more than 1/4 of its complete travel to eliminate the banking.

Carry out the necessary adjustment proceeding as follows:

1. When trimming the aircraft with the booster switched off, measure the deflection of the aileron trim tab trailing edge from the zero position, without changing the position of the trim tab. A permissible deflection of the aileron trim tab from the zero position must not exceed ±6 mm. If the balanced position of the trim tab, as obtained by the pilot during flight, happens to be within the specified value, the new position of the trim tab should be marked as its neutral position.

In case the aileron trim tab deflects by more than 6 mm, the new position of the aileron should be adjusted by using the adjustable tie-rods (located immediately aft of the aileron). The adjustment should be carried out within the limits of 1° up and down, with the control stick in the neutral position. The stops of the control stick in the cockpit must be adjusted in the new (neutral) position of the ailerons

so as to provide for a complete deflection of the ailerons up and down in compliance with the Levelling Diagram and the clearances between the wing and the aileron leading edge in positions other than neutral. After checking the aileron controls in flight, mark the new balanced (neutral) position of the trim tab.

2. When trimming the aircraft in flight with the BU-13M booster switched on, the aircraft unbalance is corrected by changing the value and the sign of "scissors" for the left-hand and right-hand ailerons within $\pm 1^{\circ}$ ("scissors" according to points 38 - 14, See Levelling Diagram; for the right-hand aileron ± 6 mm, with the left-hand aileron points lined up). It is strictly prohibited to adjust the aileron position by means of changing the length of the hydraulic booster rod. In this case, as when the booster is switched off, the adjustment should be carried out with the help of the adjustable tie-rods.

When adjusting the lateral control system, with the booster switched on, make certain the neutral position of the aileron spring feel mechanism has been adjusted properly.

In exceptional cases, when the adjustement cannot be carried out within $\pm 1^{\circ}$ of the aileron deflection, or when replacing the wing, the aircraft lateral balancing may be adjusted by changing the angle of attack of the wing with the aid of the wing flap.

To accomplish this, proceed as follows:

(a) extend the wing flaps;

(b) detach the hydraulic cylinder rod from the wing flap;

(c) remove the carriage bolt fairings;

(d) unlock and turn off the nuts, and remove the bolts attaching the carriages to the wing flap;

(e) extract the slide pins from the brace strut bushes;

(f) turn the eccentric bushings in the brace strut bushes;

(g) drill a new hole in the eccentric bushing, and lock it in the new position.

After the above adjustment the wing flap must not project or sink by more than 2 mm (in respect to the wing upper surface).

The adjustment procedure completed, perform a test flight.

Note: When disjointing and jointing or replacing the wings, and during subsequent test flights, it should be borne in mind that some of the aircraft are provided with eccentric bushings having an eccentricity of 1.75 and 2.5 mm in the front attachment units of the wings to eliminate banking.

The positions of the eccentric bushings are shown in the chart presenting the aircraft adjustment data pertaining to balancing. It should also be taken into consideration that changes in the eccentricity value greatly affect the lateral balance of the aircraft throughout the entire speed range.

12. ADJUSTMENT OF AIRCRAFT DIRECTIONAL STABILITY

To ensure aircraft stability in flight, unbend the rudder bend tab: the lower part of the tab - at low speeds; the upper part of the tab - at high speeds.

The rudder bend tab should not be bent by more than 2 mm. Unbend the rudder tab only after having ascertained that the balanced position of the rudder is properly adjusted in the neutral position of the pedals.

Chapter V

LANDING GEAR

In maintenance and care of the aircraft landing gear apply to the following Specifications:

Description	Main L.G.	Nose L.G.
1	2	3
1. Type of wheels	KT-37	KT-38
2. Size	660x200 B	500x180 A
3. Pressure in tyres	$11^{+0.5}$ kg/sq. cm.	$7^{+0.5}$ kg/sq. cm.
4. Wheel brakes	Double-chamber with automatic braking system	Double-chamber with automatic braking system
5. Type of shock absorbers	Pneudraulic shock struts	Pneudraulic shock struts
6. Complete stroke of shock absorber	120 ± 2 mm	122.5 ± 1 mm
7. Amount of fluid used	550 cu.cm.	750 cu.cm.
8. Operating fluid	AMT-10	AMT-10
9 Initial pressure of nitrogen in shock absorber	70±1 kg/sq. cm.	30±1 kg/sq. cm.
10 Pressure in brakes: first rating	5 kg/sq. cm.	5 kg/sq. cm.
second rating	$10^{+0.5}$ kg/sq. cm.	$10^{+0.5}$ kg/sq. cm.
11 Tail shock absorber: (a) type	Hydraulic-spring design	
(b) amount of fluid	90 cu. cm.	
(c) stroke	30±0.8 mm	

The design of the main and nose struts is presented in Figs 50 to 53.

1. CARE OF LANDING GEAR

As, with the aircraft parked, the nose and main struts occupy different positions with respect to the vertical line, the refilling of their shock absorbers must be performed separately.

Errors in the shock absorber fluid level can be avoided by trying to ensure that each shock absorber of the landing gear of a raised aircraft is close to the vertical position.

Re-Filling Nose L.G. Shock Absorbers

1. Jack up the fuselage nose part so as to clear the wheel of the ground.

2. Connect the appliance for nitrogen charging to the charging connection of the shock absorber, and reduce nitrogen pressure in the shock absorber to zero. Prior to filling the shock absorber with AMT-10 fluid, close the charging connection and keep the strut motionless for 1.5 to 2 hours to allow AMT-10 fluid to settle down and to remove nitrogen from the fluid.

3. Use an injector to feed about 100 cu. cm. of AMT-10 fluid into the shock absorber through the upper pipe union.

4. Lower gradually the aircraft nose until the shock absorber is completely compressed. When doing so, the excess of AMT-10 fluid will pour out of the shock absorber through the upper pipe union. The charging connection which is located below the pipe union should be previously closed.

Keep the shock absorber in the fully compressed position for 20 min. to let the excessive fluid flow out of the upper pipe union.

NOTE: If no fluid appears through the upper pipe union, add some fluid and compress the shock absorber as is described above.

5. Turn in the drain hole plug.

6. Raise the aircraft nose and charge the shock absorber with nitrogen compressed to 30±1 kg/sq. cm.

Charging Nose Wheel Shimmy Damper

The shimmy damper is charged with АМГ-10 fluid through the upper hole that is closed with a plug. In filling the shimmy damper with АМГ-10 fluid, it is necessary to turn the wheel fork slowly from side to side.

The wheel is turned by means of a drawbar.

Pour АМГ-10 fluid until it reaches the upper edge of the hole for the plug, and then use a pipette and measuring glass to suck off about 2 cu. cm. of АМГ-10 fluid from the shimmy damper to provide for temperature expansions, then put the plug in place.

Wheel Steering Mechanism

Wash out the nose wheel steering mechanism as follows:

1. Jack up the aircraft nose until the nose wheel is clear of the ground.
2. Remove the cover from the steering mechanism.
3. Wash the old grease off the steering mechanism by means of kerosene forced into the mechanism with the aid of an injector.
4. Coat the steering mechanism with ЦИАТИМ-201 lubricant.
5. Put the cover of the mechanism in place and secure it with wire.

Recharging Main Wheel Shock Absorber

1. Raise the aircraft until the wheels clear the ground by placing jacks under the wings.
2. Connect the nitrogen charging device to the shock absorber charging connection and reduce the nitrogen pressure in the shock absorber to zero. Prior to pouring the fluid into the shock absorber, keep the strut motionless for 1.5 to 2 hours to let the fluid settle down and to remove nitrogen from the fluid.
3. Turn out the charging connection and use an injector to add about 100 cu.cm. of АМГ-10 fluid into the shock absorber through the hole for the charging connection.
4. Lower the aircraft gradually until the shock absorbers are completely compressed. The excess of АМГ-10 fluid will come out of the shock absorber through the charging connection hole.

Keep the shock absorber in this position for 20 minutes to ensure a complete drain of the excessive fluid.

5. Screw in the charging connection, jack up the aircraft and charge the shock absorber with compressed nitrogen until a pressure of 70 ±1 kg/sq.cm. is obtained.

Note: In winter when charging the shock absorber in a warm room, bear in mind that when placed on the aircraft the pressure in the shock absorbers will drop due to cooling. To avoid this, it is necessary, during charging, to additionally compress the nitrogen by 4 per cent per every 10°C of the difference between the temperature in the room where the shock absorbers are charged and the outdoor ambient air temperature. It is well to remember that after charging the shock absorber with fluid and nitrogen, the pressure will drop after 1 or 2 flights due to the solution of the nitrogen in АМГ-10 fluid. Therefore, the shock absorber should be recharged with nitrogen to obtain the required pressure.

Recharging Tail Shock Absorber

The tail shock absorber (Fig.54) is charged with fluid by means of an injector through the charging connection hole, the latter being closed with a bolt after the charging is over.

The charging is accomplished with the non-compressed shock absorber in the vertical position and is continued until the delivery fluid begins to flow out of the charging connection.

The total amount of fluid to be charged is approximately 90 cu.cm.

2. CHECKING RETRACTION OF LANDING GEAR

The check retraction and extension of the landing gear is as a rule accomplished by means of a ground hydraulic pump and a ground source of power. The minimum pressure in the hydraulic system at which the landing gear is retracted should be 100 kg/sq.cm.

In retracting and extending the landing gear do as follows:

1. Check the landing gear for proper retraction and extension.

2. Check the L.G. wheel position indicator arms and electric warning system for proper operation.

After the warning lights flash on, shift the landing gear selector switch to the neutral position. The following warning lamps should light up: three green lamps indicating that the landing gear is extended; or three red lamps indicating that the landing gear is retracted. Besides, with the landing gear retracted and the wing flaps extended, the warning lamp EXTEND LANDING GEAR (ВЫПУСТИ ШАССИ) should light up.

With the landing gear retracted, the wheel position indicator arms should be flush with the skin (without interference between the position indicator rings and the skin); the position indicator arms are adjusted with the landing gear retracted.

In extending the landing gear, the wheel tyres may touch the inner skin of the wheel door.

3. Check the units and pipes for leakage of the fluid.

4. Check the units and pipes for cracks, corrosion, etc.

5. Check operation of the locks of the landing gear struts and doors.

With the landing gear control valve in the neutral position, the struts and wheel doors should not drop out or open.

6. Check operation of the sequence valves in compliance with the instructions given in Para. 5 of this Chapter.

3. CARE OF WING FLAPS

The wing flaps have two extension positions: take-off position when extended by 15° and landing position when extended by 25°.

The wing flaps (Fig.55) are controlled by means of three buttons: TAKE OFF (ВЗЛЕТ), LANDING (ПОСАДКА) and RETRACTED (УБРАНЫ) that are located on a special desk on the aircraft port side. With the aircraft parked, the button desk is closed with a cover.

In service, it is necessary to check the operation of the limit switches of the wing flap retracted position and of the microswitches of the wing flap extended positions.

During service do the following:

1. Check whether the limit switch mechanisms and the wing flap extended position warning system are reliably secured to the channel side wall.

2. Check the mechanism rod-to-hinge link joint for condition of locking.

3. Check the attachment of the flat and rest on the wing flap carriage.

4. Coat the friction surface of the hinge bell crank and rest, as well as the hinge pivot pin with ЦИАТИМ-201 lubricant.

5. If it is required, adjust operation of the microswitches at 15 and 25° by displacing the flat with the rest fore or back, or by changing the length of the mechanism rod.

The first microswitch should be cut in for 15° when the rod travels $5^{\pm 1}$ mm from the neutral position.

The second microswitch should be actuated for 25° when the rod travels 12^{+5} mm from the neutral position and the wing flaps deflect by 25°.

The maximum permissible jutting-out of the rod from the mechanism body is 45 mm.

6. Check the rod retaining screws of the wing flap retracted position limit switches for condition of the locking.

7. The retraction of the wing flaps is checked by the going-out of the warning light and by a pressure rise in the hydraulic system.

During service it is also necessary to take care of the wing flap carriages and guides. They should be free of cracks and nicks. Do not fail to coat the guides and carriages with ЦИАТИМ-201 lubricant.

4. CARE OF DRAG PARACHUTE

After use was made of the drag parachute (Fig.56) during landing of the aircraft, do as follows:

1. Remove the container from the aircraft.

2. Clean the bay and mechanisms of the parachute of dust, dirt and moisture.

3. Check the doors for dents, torn edges of the skin and for other damage that may cause the parachute to seize when it is being let out.

4. Check operation of the door opening and closing mechanism, parachute container attachment lock and parachute control cable securing lock; make also sure that the cores for arranging the control cable as well as the container proper are in good condition.

5. Coat the hinges of the paracnute mechanism with grease.

6. Check the rods and bolt joints for proper locking.

Installation of Container

1. Place a spare container with a parachute into the bay (Fig.57).

2. Arrange the control cable in the groove of the clamp located on the tail support.

3. Insert the lug-shaped end fitting of the cable into the cable securing lock; the cable end fitting should be caught by the lock.

4. Close the doors and pull out the cable that closes the container doors.

5. Close the door front retainer pin and safety it with KOK-08 wire.

In the closed position the pins of the front and rear retainers should come to stand against the notches made on the fuselage.

CAUTION: It is recommended to check before each flight the retainer of the front lock for presence of safety wire and the rear retainer of the doors for position of the pin.

For the arrangement of the parachute in the container, its care and storage see respective instructions on employment of parachutes.

5. ADJUSTMENT OF LANDING GEAR

In aircraft service, as well as in case of replacement or repair of the landing gear, perform the following checking and adjustment operations:

Main Landing Gear

1. Check to see whether the surfaces of the landing gear doors coincide with the contour of the wing.

2. See whether the clearances between the doors and the wing (Fig.58) are within the required limits.

If the clearances are less than required, file the doors to obtain the required sizes.

3. Check the struts for play, for which purpose:

(a) jack up the aircraft until the wheels clear the ground. Before checking for play, retract the landing gear, open the strut locks (by actuating the clamp in the cockpit) and lock manually the landing gear struts in the locks of the extended position;

(b) apply an effort of 15 kg gradually to the wheel axle of the main landing gear and measure the play of the wheel axle. Play should be not more than 6 mm in the longitudinal direction and not more than 10 mm in the lateral direction.

Note: In checking the joints for play, it is well to remember that the summary lateral play of the struts includes the permissible play of the ball lock of the main landing gear actuating cylinder.

If it has been found that the summary play, as measured on the wheel axles, exceeds permissible limits, determine which joint has maximum play before eliminating the defect.

Taking up play by replacing parts must be first accomplished in joints with maximum play.

4. Check adjustment of the sequence valve whose operation must ensure the closing of the landing gear doors after the strut has engaged the up lock.

Under a hand-applied effort directed against retraction, the wheel door should not retract during the time period from setting the landing gear control valve for retraction to the moment the strut presses against the sequence valve; should the wheel door retract, the sequence valve is out of order or clogged.

The adjustment of the sequence valve is accomplished by changing the length of its rod (by screwing the end-piece in or out). If the wheel door retracts too early, screw in the sequence valve end-piece.

After the strut presses against the sequence valve rod, the latter should have a travel margin from 2 to 5 mm.

The sequence valve adjustment is correct when the wheel door begins to close after the strut has been retracted.

5. Check operation of the strut up locks and of the wheel door locks.

With the strut retracted, the suspension shackle lug axis should engage the hook by not less than 6 mm, as measured from the hook nose, whereas with the lock open the minimum clearance between the hook nose and suspension shackle lug is 2 mm (Fig.59) at the moment the shackle passes by. The lock hook should turn easily.

In extending the strut, the wheel door locks should open before the up locks, so as to prevent the strut from damaging the door.

The moment of door lock opening is adjusted by tightening the turnbuckle on the cable linkage running from the main landing gear lock lever to the door lock lever.

In adjusting the lug serving to secure the strut in the lock it is allowed to place a washer up to 4 mm thick. In doing so, see that the retracted doors form a continuation of the wing bottom skin.

A correct position of the strut in the lock may be obtained by adjusting the length of the hydraulic cylinder rod which is achieved by screwing the eye-bolt in or out.

After the adjustment is over, perform a trial retraction of the landing gear.

Should the size of the landing gear track be disturbed, adjust the latter by screwing the eye-bolt of the main landing gear hydraulic cylinder in or out. Screwing in the end-piece reduces the landing gear track.

Nose Landing Gear

Check the strut link clearances and play as follows:

1. Take up the play in the joints by applying an effort of 15 kg for retracting the strut.

2. Measure the clearance between the nose link and the retainer; it should be 0.1 - 0.15 mm with the ball lock play taken up. When there is no clearance, the hydraulic cylinder rod may fail to engage the ball lock.

In case the clearance exceeds 0.15 mm, replace the retainer plate on frame No.4 by a thicker one.

If the clearance is less than 0.1 mm, adjust the hydraulic cylinder rod.

Note: Check the play after disconnecting the extension line pipe from the hydraulic cylinder. Otherwise, the hydraulic cylinder piston will not be able to displace due to the hydraulic lock and it will be impossible to determine the play.

3. With the strut retracted, the clearance between the nose strut link and the bracket gasket should be from 0.5 to 1.0 mm (Fig.60).

To ensure the required clearance, it is allowed to file the gasket and pin by not more than 2 mm.

4. With the landing gear nose strut retracted and the lock closed, the cam should completely and symmetrically enter the slit in the strut link. The sinking of the cam in the link slit up to 2.5 mm is permissible. The entry of the cam into the link slit is ensured by filing the cam retainer.

5. With the lock cocked, the pin part protruding over the gasket should not exceed 7.5 mm, whereas the minimum clearance between the pin side surface and the cam should be 4 mm.

6. With the doors open, the permissible play is 5 mm.

7. The clearances between the doors leading and trailing edges and the fuselage skin equal 1.5 ± 0.5 mm with the strut retracted.

8. The clearance between the wheel and doors must be at least 15 mm with the strut retracted.

9. The clearances between the doors and fuselage are presented in Fig.61.

10. Axial play of the strut on the suspension shaft is permissible it if does not exceedd 0.25 mm. Excessive play is taken up by placing a washer, from 0.5 to 1.0 mm thick, on one side, between the bearings. The resultant parallel displacement of the strut axis up to 2 mm from the aircraft axis is permissible.

11. Summary longitudinal and lateral play, as measured on the wheel axle, is permissible if it does not exceed 5 mm when an effort of 15 kg is applied to the wheel axle.

Wing Flaps

It is allowed to straighten the wing trailing edge up to 1 mm to make the wing flap flush with the wing.

If the wing flap contour protrudes along the upper arc it is allowed to chamfer the wing flap to 0.5x2.5 mm.

The slots along the wing flap contour should be within the sizes given in Fig.62.

It is allowed to chamfer the skin and the interseptor.

Play of the wing flap in the guide channels up to 1.5 mm (Fig.63) is permissible in the plane of the aircraft base line.

The clearances between the wing flap and the wing must be equal to values indicated in Fig. 64.

In case the clearances and play are other than those indicated in Figs 63 and 64, do as follows:

(a) check the wing flap hydraulic cylinder rod for protrusion corresponding to the locked position of the ball lock. The protruding portion should be equal to 94.5 mm from the rod locking nut to the cylinder body (to be checked with the hydraulic cylinder removed);

(b) build up a hydraulic pressure of 25 to 100 kg/sq.cm. for retracting the wing flaps. Without removing the pressure, check the hydraulic cylinder rod for protrusion and connect the rod to the wing flap. Use the adjusting fork bolt to set up a clearance from 0.5 to 1.0 mm between the face of the wing top skin and the wing flap.

Retract and extend the wing flaps three times by means of the airfield hydraulic pump, and make sure that the clearance equals a value from 0.5 to 1.0 mm when pressure for retracting the wing flaps is built up in the hydraulic system.

If the clearance is less than required, adjust it by means of the adjusting shank.

Chapter VI

PRESSURIZED CABIN

1. GENERAL

The aircraft cabin is a pressurized ventilated cabin in which the required temperature can be maintained automatically throughout the flight.

The pressure difference in the cabin is created from an altitude of 1500 to 2000 m. and smoothly increases as the aircraft climbs. At an altitude of 10000 m. the pressure difference reaches 220^{+15}_{-20} mm Hg (that is about 0.3 kg/sq. cm). This pressure difference is maintained up to the service ceiling without any change. The cabin pressure is regulated by means of the regulator, type РД-2МА. The valve, type ПК (Fig.65), calibrated for a pressure of 0.35 kg/sq. cm., protects the cabin from excessive pressures.

The difference between the cabin and atmospheric pressures and the cabin altitude are checked by means of the УВПД-15 cabin altitude and pressure indicator.

2. CARE AND MAINTENANCE

With the cabin air feed cock open, hot or cold air is delivered into the cabin by setting the switch to the corresponding position (with the engines operating). The complete change-over of the distributing electric valve from one extreme position to the other takes up 30 seconds.

During parking the cabin air feed cock should be closed.

NOTE: When the aircraft is issued from the manufacturing plant the thermostat, type ТРТВК-45М, is set to the temperature of +16°C. In service the thermostat can be reset to any temperature within the range of +15 to +26°C according to the pilot's wish. In summer, if the free air temperature is by 1 to 5° lower than the temperature the ТРТВК-45М thermostat scale is set to, it is recommended, prior to

opening the cabin air feed cock, to manually change over the electric air distributing valve to the COLD (ХОЛОДНЫЙ) position so as to prevent the delivery of hot air to the cabin at the first moment.

The rubber cups sealing the control system shafts should always seal (compress) the shafts properly. During service see that all boots (sealing cases) are intact. Cracked boots (cases) or boots compressing the shafts poorly must be replaced by new ones.

To improve the conditions for sealing boots operation, see that the lubricant, grade ГОИ-54, is applied to the shafts where they are compressed by cups.

The rubber sealing parts (especially the cups and the canopy sealing hose) should be protected from the effect of fuel, oil, alcohol, etc. To protect these parts and the canopy glazing from the sun light, the canopy should be closed while the cabin should be pressurized from the outside and closed with a cover.

In the event the rubber surfaces are damaged, or have deep cracks or the rubber is not sufficiently elastic, it is necessary to replace the sealing elements.

Care of the air distributing electric valve in service consists in periodically scavenging the electric motor brushes with compressed air. For this purpose loosen the yoke mounted on the valve body and shift it aside. After scavenging fit the yoke in position.

The air turbocooler should be checked for absence of corrosion and for intactness of the blower vanes. The bearings of the turbocooler should be lubricated with oil, grade ОКБ-122-14.

The non-return valves, type ОКН-30, installed in the hot and cold air lines do not require special care but in case the cabin pressure drops due to a leakage in the pressurization system, it is necessary to determine which valve is leaky and to replace or to grind it in.

The pressurization system pipe lines are connected by means of nipple connections. To prevent the nuts from sticking to the nipples, apply the lubricant, grade СТР-4223, to the thread. If the lubricant is not available, it is permissible to make it up.

The composition of the lubricant (in weight parts) is:

Talc 10

Oil "Vapor" 1

Remove the old lubricant from the disjoined connection, wash the thread with gasoline and then apply fresh lubricant bearing in mind that excessive lubricant must not get inside the pipe line when the pipe is connected.

3. CHECKING CABIN FOR LEAKAGE

The cabin is checked for leakage:

(a) prior to each altitude flight;

(b) after a certain number of flying hours according to the routine maintenance schedule;

(c) after any operations in the cabin envolving elements of the cabin pressurization system.

Checking Cabin for Leakage prior to Altitude Flight

Checking the cabin for leakage prior to altitude flights is performed with the engines operating in the following manner:

1. Plug the branch pipe of the РД-2МА regulator (See Fig.65) and get into the cabin.

2. With the engines operating at low r.p.m., close the canopy and seal it.

3. Advance the engines to 5000 or 6000 r.p.m.; if only one engine is operating, advance it to 7000 r.p.m.

4. By gradually opening the cabin air feed cock (installed on the starboard side) increase the air delivery to the cabin.

Watching the increase of pressure difference in the cabin by the cabin altitude and pressure indicator, type УВИД-15, and the effect of pressure upon the ear drums increase pressure in the cabin up to 0.32 kg/sq. cm.

If the cabin pressure increases to 0.32 kg/sq. cm. this testifies to the gastightness of the cabin. The test over, close the cabin air feed cock, depressurize the canopy and remove the plug from the branch pipe of the РД-2МА regulator.

If the pressure does not increase at all or increases but slightly (in this case the pressure of 0.32 kg/sq. cm. cannot be reached) find the leaky place and eliminate the fault.

First of all check the gastightness of the joint between the canopy sliding part and the fixed parts (windshield and canopy-carrying panel).

Leakage may be also caused by the ПК valve, especially if it is fouled with dust or foreign matter.

Checking Cabin for Leakage during Routine Maintenance or after Operations Influencing Cabin Gas-Tightness

The cabin is checked for intensity of leakage as follows:

1. Connect the hoses from the ground test installation to the pipe unions located in the hatch of the oxygen charging connection. The ground test installation ensures charging the cabin via one hose and checking the cabin pressure difference via the other hose.

2. Plug the outlet pipe of the regulator, type РД-2МА.

3. Close the canopy and pressurize it from the outside.

4. By opening the ground test installation valve charge the cabin to a pressure of 0.3 to 0.32 kg/sq. cm. (220-230 mm Hg); the rate of pressure increase should not exceed 0.1 kg/sq.cm per minute.

5. Stop the delivery by shutting off the installation valve and note the time during which pressure in the cabin drops from 0.3 kg/sq. cm. to 0.1 kg/sq. cm. (75 mm Hg).

The cabin is considered gastight if the time of the pressure drop is equal to 90 seconds at least.

If the time taken by the pressure drop is less than 90 seconds, the cabin is leaky. Detect the leaky places and eliminate the fault.

6. The test over, disconnect the test installation, plug the pipe unions and remove the plug from the РД-2МА regulator pipe.

The cabin leakage intensity may be checked without the test installation. In this case the cabin should be charged from a ground air bottle. The test procedure should be as follows:

1. Connect the ground bottle to the inboard filler adapter of the aircraft air system and open the air bottle valve.

2. Plug the pipe of the РД-2МА regulator.

3. Get into the cabin, close the canopy and seal it.

4. Slowly opening the cabin air feed cock (installed on the starboard of the cabin) watch the pressure increase by the УВПД-15 cabin altitude and pressure drop indicator and by the effect of pressure on the ear drums.

Increase the pressure up to 0.3 or 0.32 kg/sq. cm. and close the cock.

5. Determine the time during which the cabin pressure drops from 0.3 kg/sq. cm. to 0.1 kg/sq. cm. It must be not less than 90 seconds.

Checking Operation of Air Distributing Valve

Operation of the air distributing electric valve should be checked as follows:

1. Switch on the storage battery and the circuit breaker bearing the inscription CABIN SUPPLY, ЗУП-53 TURN INDICATOR, DE-ICER, CABIN LAMP, PORT REAR УФО ULTRA-VIOLET ILLUMINATION LAMP (ПИТАНИЕ КАБИНЫ, ЗУП-53, ПРОТИВООБЛ., КАБ. ЛАМПА, ЛЕВ. ЗАДН.УФО).

2. Set the control switch of the air distributing electric valve to the НОТ (ГОРЯЧИЙ) position. The noise of the operating electric motor in the distributor and the visible movement of the lever mechanism (if the panel of the right-hand engine access hatch is open) testify to the serviceability of the valve.

In the extreme position the distributor electric motor must be spontaneously cut out.

Note: If on setting the switch to the НОТ (ГОРЯЧИЙ) position the electric mechanism fails to be cut in (which may be caused by the fact that the electric distributor is already in this position), first set the switch to the COLD (ХОЛОДНЫЙ) position, wait until the mechanism is changed over to this position and then reset the switch to the НОТ (ГОРЯЧИЙ) position.

3. Set the switch CABIN HEATER (ОБОГРЕВ КАБИНЫ) to the COLD (ХОЛОДНЫЙ) position; the visible movement of the lever mechanism will be reverse to that which was observed with the switch set to the НОТ (ГОРЯЧИЙ) position.

In the extreme position a spontaneous cut-out should take place.

4. The time required for a complete travel of the distributor from one extreme position to the other is about 30 seconds.

5. Switch off the circuit breaker and the storage battery.

Check operation of the automatic control of the cabin air temperature regulating system in the following manner:

1. Switch on the storage battery and the circuit breaker CABIN SUPPLY, ЗУП-53 TURN INDICATOR, DE-ICER, CABIN LAMP, PORT REAR УФО ULTRA-VIOLET ILLUMINATION LAMP (ПИТАНИЕ КАБИНЫ, ЗУП-53, ПРОТИВООБЛ., ЛЕВ. ЗАДН. УФО).

2. Set the temperature of +16° C on the thermostat, type TPTBK-45M.

3. With the air temperature in the cabin below +10°C, switch over the cabin supply system to the cold air delivery after which set the switch to the AUTOMATIC (АВТОМАТ) position.

If the temperature regulator is serviceable, the cabin air supply system should be changed over to the hot air delivery.

4. At an air temperature in the cabin over +20°C switch over the cabin supply system to the hot air delivery. This done, set the switch to the AUTOMATIC (АВТОМАТ) position.

If the temperature regulator is in good repair, the cabin air supply system must be changed over to the hot air delivery.

5. At a cabin air temperature of 16±5°C set the temperature on the TPTBK-45M thermostat by 5 or 6°C higher or lower than the air temperature in the cabin and carry out the check as prescribed in Items 4 and 5.

The check over, set the TPTBK-45M thermostat to 16°C and switch off the circuit breakers and switches turned on for the period of checking.

Checking Gas-Tightness of Non-Return Valves

The non-return valves unit is checked for leakage during the cabin leakage test with the air pressure supplied by the operating engines. If one engine (any engine in turn) is set to low throttle and the other engine is set to 7000 r.p.m., the cabin must be charged normally. Then the engine settings should be changed. Weak air supply to the cabin in any case testifies to the loss of gastightness by the valve which serves both the cabin and the engine operating at the low throttle r.p.m.

The leakage should be eliminated by grinding in the valve and pipe union surfaces or by replacing the valve and the pipe union.

4. CANOPY AND ITS EMERGENCY JETTISON

The cabin canopy has a single-sheet glazing. The canopy (See Fig.66) consists of a fixed windshield and a sliding part which may be jettisoned in flight if necessary. The canopy is jettisoned by means of the lock emergency system and the canopy remover guns actuated by the compressed air from the special purpose (emergency) cylinder.

To ensure effective removal of the canopy (by the remover guns) the canopy emergency removal system is provided with a diaphragm valve which starts to supply air to the remover guns before the canopy locks get opened by the spring-loaded mechanism.

The canopy sliding part is secured to the fuselage by two front and one rear locks. When the canopy is opened or closed the lock rollers move along the channel bars. The backward movement of the canopy is limited by hinged stops mounted on the left- and right-hand channel bars. In the front position the canopy is locked by the left- and right-hand front locks, their hooks 8 (Fig.67) engaging locking shackles 7 mounted on the fuselage.

The locks and canopy are opened from the inside of the cabin by turning handle 6 of the left-hand front lock backward as far as it will go. The handle movement is transmitted to lifting levers 10 of the left- and right-hand locks disengaging shackles 7 from hooks 8.

With a further application of force to the left- and right-hand locks handle the canopy slides backward until it is fixed by the the rear locks in the extreme rear position.

The canopy is opened from the outside of the aircraft by means of the external handle (Fig.68). For this it is necessary to shift the latch on the handle forward (along the arrow) and to turn the handle counter-clockwise through 150° after which it becomes engaged with the axle mounting the internal handle.

The further turning of the external handle clockwise will open the locks and shift the canopy as it takes place when using the internal handle.

The canopy is removed from the rear position stop by means of the handle mounted in the upper part of the front arc (on the right-hand side) of the canopy frame.

The canopy locks are locked automatically by locking shackles under the action of the springs as soon as the canopy is set in the closed position.

With the canopy closed and locked in the front position the arrows with the inscription CANOPY LOCKED (ФОНАРЬ ЗАПЕРТ) on the cases of the left- and right-hand front locks must get aligned with the red line on the looking shackle.

The pressurization (depressurization) of the cabin from the inside is performed by turning the handle of the cock installed on the canopy left-hand lock. The pressurization (depressurization) of the cabin from the outside is performed automatically when the canopy locks are closed or opened by the external handle on the left-hand lock.

Canopy Removal and Installation

The canopy is removed from the aircraft in the following manner:

1. Shift the canopy to the open position.
2. Make sure that the ground lock is fitted in the ejection gun and disconnect the ejection interlock cable from the canopy.
3. Mount protective caps on the canopy remover guns so as to avoid accidents when working in the cabin.
4. Remove the locking pins from the hinged stops of the right- and left-hand channel bars. Actuated by the spring the stops will be turned to the rear position.
5. Shift the canopy backward and remove it from the aircraft.
6. Install the protective stop on the canopy remover system diaphragm valve.
7. Mount the ground lock on the canopy spring-loaded mechanism. The ground lock may be removed only after the canopy has been installed on the aircraft. It is prohibited to move the canopy with the ground stop to the front position.

The installation of the canopy (Fig.69) is the reverse of dismantling; see that the canopy guide gets into the moving channel bar.

CAUTION. 1. It is prohibited to remove the ejection interlock cable together with the canopy.

2. When removing the canopy, take care not to press accidentally upon tongue 14 (See Fig.70), which may actuate the spring-loaded mechanism and remove the canopy lock hooks.

3. After the canopy has been opened and shifted to the rear position as well as when removing the canopy from the aircraft, return the canopy external handle to the initial position so as to avoid damage.

4. After the canopy has been removed, it is necessary to fit the stop in position on the diaphragm valve to prevent it from tripping.

Canopy Emergency Jettison System

The canopy emergency jettison can be performed with the canopy closed, with the cabin both pressurized and unpressurized (Fig.70).

During the ejection of the seat the canopy jettison is effected by the seat blind (face curtain). If necessary, the canopy can be jettisoned with the help of the autonomous jettison handle on the starboard side.

On turning the canopy autonomous jettison handle the seat ejection gun interlocking gets removed, the striker is released, the diaphragm of the canopy remover valve (See Fig.73), through which air comes into the canopy remover guns, becomes torn and the canopy locks open. The canopy remover guns operate before the canopy locks open.

To ensure reliable operation of the canopy emergency jettison system, it is necessary to systematically carry out the routine maintenance operations.

Checking Canopy Emergency Jettison System

Check the canopy emergency jettison system actuating it by:

(a) the canopy autonomous emergency jettison handle at excessive pressure of 0.1 kg/sq. cm. in the cabin.

(b) the ejection seat blind.

Note: Combine this check with checking the seat ejection gun (See end of Chapter VII).

Perform the check as follows:

1. Remove the canopy.
2. Unload the seat ejection gun.
3. Make sure that the canopy emergency jettison lever on the seat is connected to the clevis control rod.
4. Make sure that the air pressure in the canopy pressurization cylinder is equal to 35 or 50 kg/sq. cm. While that in the canopy remover gun cylinder is equal to 120 or 130 kg/sq.cm.
5. Examine the diaphragm valve (See Fig.73) for:
- correct position of the safety pin;
- correct locking of the lever with wire, type KOK-0.5;
- absence of slack in the cables connected with the safety pin and the lever.
6. Install the canopy on the aircraft.
7. Get into the cabin, close the canopy and pressurize it.
8. Create excessive pressure of 0.1 kg/sq. cm. in the cabin (as prescribed in "Checking Cabin for Leakage").
9. Use the canopy emergency jettison system to remove the canopy, for which purpose pull the autonomous jettison handle with an energetic movement of the hand. This should result in the puncture of the diaphragm valve, opening of the canopy locks, emerging of the rods from the canopy remover guns and separation of the sliding part from the aircraft.

The diaphragm valve must be punctured during the initial travel (not more than 15 mm) of the cable (when actuated by the autonomous jettison handle or by the seat blind).

Simultaneously with the operation of the diaphragm valve the interlocking ball with the cable should disengage from the ejection gun safety lever.

CAUTION. To protect the canopy when jettisoning it, take measures to prevent the canopy from falling to the ground.

After the canopy has been jettisoned, close the pressurization cock to prevent the hose from being damaged.

10. Remove the canopy from the aircraft and cock the spring-loaded mechanism. For this purpose insert the bar of the device through the hole in the canopy frame (on the right-hand side) and screw it into the rod of the spring-loaded mechanism. By pulling the device handle compress the spring and fix the spring in this position by turning lever 21 (Fig.71). At the same time cock the rear lock for which purpose set hook 18 (Fig.72), locking lever 5 and control guide 17 to the operating position.
11. Cock the left- and right-hand front locks. To do this, set hook 8 (See Fig.67), locking lever 14 and control guide 9 to the operating position on each lock. To prevent a sharp bending of the front lock cable, hold it up with hand at rocker arm 20 (See Fig.70).
12. Check the travel of the rods out of the canopy remover guns. It must be about 65 mm.
13. Insert the safety pin into the diaphragm valve so that the safety pin is between the roller and the washer. The safety pin slot should face the roller.
14. Fit the safety stop in position on the diaphragm valve.
15. Release air from the main air system through the cabin feed cock and by carefully unscrewing the union nut of diaphragm valve pipe union A (Fig.73) let the air out of the autonomous jettison system.
16. Set the rods of the canopy remover guns to the initial position.
17. Unscrew diaphragm valve pipe union A, remove the remains of the diaphragm (at least half of its passage area

must be torn) and examine the valve for damage. For this take out the safety pin, remove the safety stop and carefully pull out the striker.

18. The examination over, cock the spring of the diaphragm valve by means of a special device and insert the safety pin.

When inserting the safety pin, see that the position of the float washer is correct (the safety pin must be between the roller and the washer, its slot facing the roller).

19. Fit a new diaphragm, made of 1X189T-ЛО.1, 12±0.2 mm in diameter (place the diaphragm on the chamfered edges of the bushing and insert it together with the bushing into the body), screw in pipe union A and connect it with the pipe.

Note: When fitting a new diaphragm, see that only one diaphragm is taken (as diaphragms can easily stick to each other).

20. With the spring-loaded mechanism of the canopy emergency jettison cocked, bring the whole of the system to the original condition and install the canopy on the aircraft.

21. Charge the system with air up to 130 kg/sq. cm. and again remove the canopy by pulling out the ejection seat blind as is prescribed above without creating the excessive pressure in the cabin.

22. If the diaphragm of the valve is properly torn and there are no other defects, the check is considered to be completed. After this it is necessary to scavenge the canopy remover pneumatic system to clean it from fragments of the diaphragm that may remain there. For this purpose do as follows:

(a) unscrew the union nuts on the canopy remover guns and take out the rods;

(b) connect the hose from the ground air cylinder to diaphragm valve pipe union A;

(c) scavenge the system with air under a pressure of 10 to 15 kg/sq. cm.

23. After scavenging install the diaphragm into the valve and set the valve and the whole of the system in the operating position.

The spring of the diaphragm valve should be cocked by means of a special device only.

24. On completing the operations lock the valve, the canopy emergency jettison handle, the blind and all the connections which were unlocked during the check.

Notes: 1. If during the check of the canopy emergency jettison effected with the help of the emergency jettison handle or of the seat blind less than half of the valve diaphragm area is found torn, do as follows:

(a) remove the safety stop and take out the safety pin;

(b) check the notches on the body for correct position;

(c) check the thickness of the diaphragm which must be $0.1^{+0.01}$ mm;

(d) scavenge the valve body with air in the zone of the spring (through the slit) to remove dust and dirt;

(e) through the guide slits check the shaft for free movement in the slits.

After the inspection and elimination of troubles release the spring without the diaphragm three or four times. The spring should operate promptly, without jamming.

After the troubles in the valve have been corrected, install the diaphragm in the valve and repeat the checking of the canopy emergency jettison.

If it is impossible to eliminate the fault, replace the valve by a new one and repeat the check.

2. Every 12 months replace the spring in the diaphragm valve by a new one.

After checking the canopy emergency jettison check the canopy locks for simultaneous opening as is prescribed below.

Checking Canopy Locks for Simultaneous Opening

Check the canopy locks for simultaneous opening for which purpose place the canopy on a bench, return the whole of the lock opening emergency system to the initial position, disconnect lever 11 (See Fig.72) from the rod of the spring-

loaded mechanism and suspend 5-kg weights from the lock rollers. Fit a protractor on the canopy beam and the pointer of the device on rocker arm 20 (Fig.74). By slowly rotating rocker arm 20 open the locks. The lock parts which will drop out should be protected from damage.

The locks should open simultaneously. The permissible delay in opening the right-hand lock in relation to the left-hand lock and vice versa must constitute not more than two divisions of the protractor.

The rear lock should open simultaneously with the last front lock. With the front locks opening simultaneously the permissible delay in opening the rear lock is also not over two divisions of the protractor.

In case of necessity adjust the opening of the locks.

The opening of the front locks is adjusted by changing the length of the cables by means of turnbuckles 22 (See Fig.74). The opening of the rear lock is adjusted with the help of rod 15. After the adjustment is over, lock turnbuckles 22 and rod 15 with wire, type KOK-0.5.

Checking Condition of System

To check the canopy emergency jettison system and the locks for simultaneous opening (only in case of some defects) do as follows:

1. Remove the canopy and examine the locks, hinged joints of the emergency jettison mechanism on the canopy and fuselage, the autonomous jettison handle, the attachment of the pipes, cables, and the spring-loaded mechanism.

2. Wash and lubricate all the hinged joints of the lock mechanisms and of the emergency jettison system.

3. Set the emergency jettison system on the canopy to the initial position and lock the front lock control guides with safety wire, type KOK-0.5.

4. Set the emergency jettison system on the fuselage to the initial position. Set the holders of the hinged stops on the rails to the closed position and holding them in this position turn the handle forward. Lock the moving bar and the handle with safety wire, type KOK-0.5.

5. Install the canopy on the aircraft. During the installation see that the guide (Fig.75) gets into the moving bar. Connect the interlocking cable to the canopy and recharge the aircraft air system.

Check the hooks of the canopy front locks for proper engagement with the locking shackles in the following manner:

1. Get into the cabin and smoothly, without shocks, close the canopy pressing it home at the end of its travel.

2. With the canopy closed and the cockpit depressurized, check:

(a) the engagement of the front lock hooks with the locking shackles (measure with a clearance gauge according to Fig.76). The clearance should be within 0.4-0.8 mm;

(b) the amount of compression of the rubber packing washer of the canopy de-icer pipe (Fig.77);

(c) the clearance between the windshield arc and the front edge of the canopy sliding part (Fig.78).

3. Check the locking shackle for easy rotation round the axle and make sure that no jamming takes place during the rotation.

4. Make sure that the canopy is securely locked with the locking shackles by closing and opening the canopy five or eight times.

CAUTION. 1. It is strictly prohibited to file the lock hooks and locking shackles.

2. When closing the canopy see that the locking shackles engage the lock hooks. After each closing of the canopy, press the shackle home with hand to make sure that the canopy is closed.

5. DE-ICER SYSTEM

The de-icer system (Fig.79) ensures the removal of ice from the front and side glass panels of the windshield during flight under the conditions of ice formation. The ice is removed by washing the glazing with alcohol.

The system is brought into operation by pressing the push-button with the inscription DE-ICER (ПРОТИВООБЛЕДЕНИТЕЛЬ). Previously switch on the circuit breaker CABIN SUPPLY, ЭУП-53 TURN INDICATOR, DE-ICER, CABIN LAMP, УФО LEFT REAR ULTRA-VIOLET ILLUMINATION LAMP (ПИТАНИЕ КАБИНЫ, ЭУП-53,

ПРОТИВООБЛ., КАБ. ЛАМПА, ЛЕВ. ЗАДН. УФО). On pressing the push-button the ЭК-48 valve circuit becomes closed to start the compressed air delivery from the aircraft system to the alcohol tank through the reducer, type РВ-3. By the air pressure alcohol is forced out of the tank through the non-return valve and is directed to the de-icer pipe on the canopy windshield.

The system is disconnected immediately the push-button is released.

To make the application of alcohol more efficacious, the system should remain cut in for a period of 2 or 3 seconds. If one switching fails to remove the ice, switch on the system several times at short intervals.

The de-icer system must be checked for serviceability by cutting it in for a period of 1 second at the most. Alcohol must flow out of all the holes of the de-icer pipe in jets parallel to each other and to the surface of the canopy glazing.

If this condition is not observed, clean the outlet holes with copper wire, 0.4 mm in diameter (the diameter of the holes is 0.5 mm).

In service it is necessary to periodically remove the de-icer system tank from the aircraft and to wash it with alcohol, as well as to check the system for leakage, and the consumption of alcohol through the de-icer pipe.

Check the system for leakage with the operating air pressure of 3 kg/sq. cm.

To check the system for leakage, disconnect the de-icer pipe with the non-return valve from the system and plug the free end of the pipe line. By pressing the lever of the valve, type ЭК-48, with hand fill the system with air; no leakage is permissible.

Check the de-icer system for consumption of fluid through the de-icer pipe with the tank filled to capacity (6 lit). To carry out the check, press with hand the lever of the ЭК-48 valve and note the time during which alcohol passes through the de-icer pipe. The system is considered to be serviceable if this time is equal to 80 seconds.

Chapter VII

EJECTION SEAT

1. GENERAL

The ejection seat enables the pilot to abandon the aircraft in an emergency at high speeds of flight (Fig. 80).

To perform the seat ejection, the pilot should take hold of the handle with both hands and pull the blind over his face. The blind protects the pilot's face from the effect of the air stream. During the first half of the handle travel (approx. 30 mm) the diaphragm valve operates and the air passes into the remover guns; next the canopy emergency jettison system is brought into operation. During the second half of the travel (259^{+20}_{-10} mm) after the canopy has been jettisoned, the ejection gun operates and ejects the seat with the pilot out of the cabin.

In case the canopy cannot be jettisoned by means of the blind, release the ejection gun interlocking with the canopy autonomous jettison handle and then eject the seat by pulling the blind again or by pressing the seat triggers on the hand grips.

The canopy jettison by the autonomous jettison handle ensures the release of the ejection gun interlock.

After the ejection the foot rests lower down. Their smooth lowering is ensured by hydraulic dampers which, besides this, hold the foot rests in the lowered position when the soles are acted upon by the air stream after ejection.

When the foot rests are lowered, the legs are held in position by the hand grip vertical plates as well as by special clamps on the foot rests which close after the ejection.

The foot clamps and the safety harness locks are opened by means of the safety harness and foot clamps automatic unlock mechanism, type АД-3, and the spring-loaded mechanism mounted under the seat pan.

If the АД-3 automatic mechanism or the spring-loaded mechanism fails to operate, the safety harness lock is opened manually by means of the ring located on the right-hand strap; when the pilot kicks off from the seat the foot clamps get easily detached from the foot rests to which they are attached by duraluminum rivets.

The stability of the seat in the air after the ejection is ensured by the stabilizing fins opening under the action of springs and the air stream.

The safety harness is locked by means of the handle mounted on the left-hand grip.

2. EJECTION SEAT REMOVAL AND INSTALLATION

Remove the seat from the aircraft in the following manner:

1. Make sure that the ground safety pins have been inserted into the ejection gun head and the triggers on the hand grips.

2. Disconnect the interlocking cable from the canopy and remove the latter. Unload the ejection gun.

3. Disconnect the diaphragm valve safety pin from the cables running to the valve from the seat blind. For this purpose take the shaft out of the fork on the cable.

4. Disconnect the safety lock pin of the ejection gun from the ejection control rod and pull out the cable with the interlocking ball.

5. Unfasten the snap hook of the АД-3 automatic mechanism pull-out cord from the clamp on the frame.

6. On the seat stabilizing fins mount a coupling clamp which will prevent them from opening during the seat removal.

7. Drive out the bushes fixing the seat upper clamp to the ejection gun journals.

8. Remove the seat from the aircraft. At the moment the seat is pulled out disconnect the lower block of the ОРК-1М common connector by pulling at the cable.

The installation of the seat on the aircraft is the reverse of its removal. During the installation see that the canopy emergency jettison lever is engaged with the clevis rod of the emergency jettison system transmission mechanism.

CAUTION. When removing the seat from the aircraft or mounting it in the aircraft see that the guide tube of the cable cutting in the diaphragm valve when actuated by the seat blind does not bend.

3. CHECKING OPERATION OF SEAT MECHANISMS

Safety Harness Lock and Foot Clamp Opening System

Check operation of the system in the following sequence:

1. Remove the seat from the aircraft and place it on a bench with the seat pan upward.

2. Cock the АД-3 automatic mechanism and lock it with a flexible pin.

3. Cock the mid plunger of the spring-loaded mechanism and fix it in this position with a ram rod.

4. Cock the extreme plungers of the spring-loaded mechanism and fix them in position with ram rods.

Mount the locking sleeve connected to the АД-3 automatic mechanism.

NOTE: The extreme plungers and the locking sleeve must be mounted flush with the wall of the spring-loaded mechanism.

6. Remove the ram rods fixing the mechanism plungers in position.

7. Take the seat (fully dressed for the flight and with the parachute attached) and smooth out the straps. This done, close the safety harness lock.

8. Close the foot clamps by pressing the foot rest heel supports.

9. Pull out the flexible pin of the АД-3 automatic mechanism; the foot clamps and the safety harness lock should open promptly without delay.

Checking should be performed twice.

10. The check completed, bring the whole of the system into the operating position by carrying out the operations prescribed in Items 2, 3, 4, 5 and 6.

Note: If the foot clamps become closed accidentally, they should be opened by shifting backward the shafts of the clamp locks protruding from the ports on the inner walls of the foot rests.

11. Lock the flexible pin of the АД-3 automatic mechanism with thread No.00.

12. Install the seat on the aircraft.

Foot Rest Mechanism

Check the operation of the foot rest dampers with the seat removed from the aircraft in the following order:

1. Remove the bolts securing the rods of the left-and right-hand dampers to the hand grips.

2. Lower the foot rests and withdraw the dampers from the cases.

3. Perform outside inspection of the dampers, wash the hinged connections with gasoline and apply lubricant, mark ЦИАТИМ-201, to them.

4. Take out the damper rods and make sure that the rods are neither dented nor scored, nor bent.

5. Place the rods in position, attach the dampers to the hand grips and check their operation by applying pressure to the foot rests.

The movement of the foot rests should be uniform without any misalignment or jamming.

Under a load of 1 kg applied to the foot rests they should lower during 1 or 3 seconds.

Under a load of 40 kg applied to the foot rests they should collapse during 5 or 10 seconds.

Deviations from this rate testify to the shortage of oil in the dampers. In this case check the dampers for proper charging with АМГ-10 oil.

Stabilising Fins Mechanism

To close the fins, press the strut sliding block through the hole in the horizontal fin and lower the fin by an angle of 30 or 40°. This done, turn the vertical fin pressing off the wire latch; the further movement of the fins should be performed simultaneously. Press the fins to the head rest and holding them in this position carry out the same operations

with the fins on the other side of the head rest. To hold the stabilizing fins in the closed position, fit the ground coupling clamp on them.

After the ejection seat has been installed in the aircraft, the coupling clamp should be removed as the fins are prevented from opening by the seat channel rails.

During service it is necessary to check whether the stabilizing fins rotate easily and can be reliably locked in the open position.

If during the installation of the seat in the aircraft the fins open slightly, adjust them to form a close fit with the seat frame.

Ejection Gun Checking

1. Unload the ejection gun and load it with a blank explosive charge, type ПК-7Т (the work must be performed by the armament system technician).

2. Perform canopy emergency jettison from the ejection seat blind with the canopy closed; at the same time check the ejection gun for proper operation and the cartridge percussion caps for correct detonation.

For this slowly pull out the blind as far as it will go and make sure that the sliding part of the canopy has become detached from the aircraft and the ejection gun has operated.

The diaphragm valve should operate when the blind has travelled 30 mm. The canopy locks should open at the blind travel of 122^{+20}_{-10} mm; the ejection gun should operate at the blind travel of 259^{+20}_{-10} mm; the total travel of the blind must amount to 336^{+30}_{-10} mm.

The effort applied to the blind to bring the ejection gun into operation should not exceed 18 to 25 kg.

3. Remove the canopy from the aircraft, unload the ejection gun and make sure that both percussion caps are detonated correctly, that is the percussion caps have not been punctured.

If at least one of the percussion caps fails to be detonated, detach the firing mechanism of the ejection gun, eliminate the fault and recheck the percussion caps.

4. Check the operation of the ejection gun from the triggers on the right-and left-hand grips without checking the percussion caps for proper detonation.

Perform the check with the seat in the upper and lower extreme positions.

After the ejection gun has been checked, remove the seat from the aircraft and check operation of all other mechanisms of the seat.

The ejection gun should be checked by the aircraft mechanic together with the armament system technician.

Safety Harness Locking Mechanism

During service check the safety harness for reliable locking in all positions and the tension mechanism for prompt removal from the stops.

For this:

(a) place the parachute into the seat pan, sit down on the seat and fasten the safety harness;

(b) release the shoulder straps and make sure that the tension mechanism functions properly;

(c) lock the safety harness in all points in succession and make sure that the tension mechanism has been brought into operation thus rendering the movement of leaning forward impossible.

Pay special attention to the safety harness locking in the position corresponding to the seat ejection.

4. ADJUSTMENT OF EJECTION SEAT MECHANISMS

1. The ejection seat is adjusted to fit the pilot's height on the ground by rearranging the locking pins connecting the upper clamp with the seat frame.

2. In the event of deviation from the rate of foot rest lowering and collapsing (the foot rests should lower under a load of 1 kg during 1 or 3 seconds and collapse under a load of 40 kg during 5 to 10 seconds) adjustments should be made as follows:

1. Disconnect in turn the dampers from the hand grips and check separately the time necessary for the foot rests to lower and to collapse under the loads of 0.5 kg and 20 kg.

2. In the event of deviation from the rate mentioned above, recharge the damper with the АМГ-10 oil. For this purpose:

(a) remove the damper from the seat;

(b) compress the damper completely;

(c) unscrew the plug from the filler adapter and fill the damper with the АМГ-10 oil to capacity, after which drain off 1.5 cm^3 of the oil;

(d) screw the plug on the filler adapter, lock it with wire, type КОК-0.5, and seal it;

(e) mount the damper on the seat and recheck its operation.

3. The АД-3 automatic mechanism on the aircraft is set for the operation time of 1.5 seconds. Adjust and check the operation of the АД-3 automatic mechanism in compliance with the Manufacturer's instructions.

4. The operation of the ejection gun within the limits of the blind travel of 259^{+20}_{-10} mm should be adjusted by lengthening or shortening the turnbuckle clevis rod mounted on the right-hand side of the seat head rest.

5. With the seat installed in the cabin the stabilizing fins should be adjusted to make a close fit with the seat frame by unscrewing the limiting bolts (the heads of these bolts should slide along the guides).

Chapter VIII

HYDRAULIC SYSTEM

1. GENERAL

The МиГ-19С aircraft hydraulic system (Fig.81), unlike the hydraulic systems employed on previous issues of type МиГ aircraft, has no automatic relief valve and is fed from two 435BM pumps of variable output which changes depending on the pressure in the system (with the pressure rising, the pump output decreases).

The hydraulic system comprises two independent lines: main line and booster line, each of them being equipped with a pump and a hydraulic reservoir (Figs 82, 83 and 84).

The operation of the system is checked by means of pressure gauges and a warning lamp located on the control instrument board, their pick-up units being arranged both in the main and booster systems.

The lamp PRESSURE DROP IN HYDRAULIC SYSTEM (ПАДЕНИЕ ДАВЛ. В ГИДРОСИСТ.)comes on when the pressure drops to 50 kg/sq.cm. in both lines or in any of the system lines.

The main hydraulic system is designed for actuating the following components:

(a) landing gear;
(b) wing flaps;
(c) air brakes;
(d) jet nozzle shutters of the left- and right-hand engines.

The main hydraulic system serves as a duplicating system for feeding the boosters in case the booster system fails.

The main system is operated by a pump attached to the right-hand engine.

The pump temperature is regulated by a throttle valve which connects the delivery line of the main system with the return line. As the pressure in the system rises to 130 kg/sq.cm. the throttle valve by-passes 1.5 to 2 litres of fluid per minute into the return line. It is, therefore, not required to reduce the pressure in the main system by operating some aircraft unit after stopping the engines.

Normal operation of the boosters when they are fed from the main system is ensured by certain design modifications that prevent the pressure in the main system from dropping to a level at which electric control is switched on.

These modifications are:

1. The hydraulic accumulator and main system pressure gauge are separated from the landing gear and wing flap system by a non-return valve. The energy of the hydraulic accumulator cannot be spent on actuating the landing gear and wing flaps only. The landing gear and wing flap system lines are not provided with a means to check pressure.

2. A sharp pressure drop in the main system when extending the landing gear is excluded by throttle valves mounted in the landing gear strut extension lines and serving to reduce fluid consumption for extending the landing gear and retaining a pressure of at least 60 kg/sq.cm. in the system during the extension of the landing gear.

3. A regulating valve is placed in the air brake extension line. The valve is designed to reduce the fluid feed to the air brakes at pressures reaching 70 kg/sq.cm. and to stop the fluid delivery for the extension of the air brakes when the pressure in the main system drops below 70_{-5} kg/sq.cm.

The booster hydraulic line is designed to feed the stabilizer and aileron control boosters.

The booster hydraulic system is operated by a 435BM pump attached to the left-hand engine. To make operation of the stabilizer and aileron control boosters more reliable, the booster supply and return lines are connected to the main hydraulic system through selector slide valves reacting to the pressure in the hydraulic boosters.

Should the pressure in the booster hydraulic system drop, the boosters are switched over to the supply from the main hydraulic system. When the pressure in the booster hydraulic

system rises, it disconnects the boosters from the main system thus changing them over to the booster hydraulic system supply.

For pressure values at which the boosters are switched over see the Specifications below.

Note. When the pressure drops in the main system the selector slide valves do not switch it over for the supply from the booster hydraulic system.

The pump temperature is regulated by a throttle valve that connects the booster hydraulic system delivery line with the return line and by-passes part of the fluid into the return line. It is, therefore, not required to release the pressure in the booster hydraulic system after stopping the engine. The pressure will be released through the throttle valve.

Hydraulic System Specifications

Description	Main hydraulic system	Booster hydraulic system
1	2	3
1. Operating fluid	AMT-10 oil (State Stds ГОСТ 6794-53)	
2. Capacity of hydraulic system with reservoir(when filled)	30 litres	10 litres
3. Working pressure in system	135 ± 7 kg/sq.cm.	
4. Charging pressure in air chamber of hydraulic accumulator	40^{+5} kg/sq.cm.	
5. Pressure safety valve is rated for	150^{+5} kg/sq.cm.	
6. Pressure safety valve of tank pressurization system is rated for	1.5 ± 0.3 kg/sq.cm.	
7. Air pressure in hydraulic reservoir	0.7 ± 0.1 kg/sq.cm.	
8. Selector slide valve adjustment:		
(a) pressure at which boosters are switched over to main system	—	65^{+5} kg/sq.cm.
(b) pressure at which boosters are switched over to booster hydraulic system	—	above 70^{+15} kg/sq.cm.
Pressure at which change-over cylinders engage АПС-4 mechanism power supply	50^{+5} kg/sq.cm.	
КВЭМ electric mechanism engaging valve adjustment:		
(a) pressure (in both systems) at which valve disengages БУ-14МС booster and engages АПС-4 mechanism	50^{+2} kg/sq.cm.	
(b) pressure at which valve disengages АПС-4 mechanism and engages БУ-14МС booster	80^{+15}_{-5} kg/sq.cm.	

2. CHECKING OPERATION OF HYDRAULIC SYSTEM (within the scope of pre-flight preparation)

The operation of the hydraulic system may be checked with the aid of an airfield variable-capacity pump (type 435BM, with maximum pressure of 135 ± 7 kg/sq.cm.) connected to the ground supply pipe unions of the aircraft hydraulic system, or with the engines running.

CAUTION. In checking the hydraulic system for proper operation with the engines running, do not exercise the aircraft control stick during engine starting (before the engines run at idle speed) or stopping (before their turbines cease rotating).

Never release the pressure in the main booster and systems by exercising the control stick after the engines have been stopped. The pressure in this case will be released through the orifice in the throttle valve located in the pipe line between the delivery and return lines.

During engine starting or stopping, the pump output is small and if the control stick is exercised the pressure in the booster hydraulic system will drop due to large amounts of fluid consumed by the boosters. When this is the case, the selector slide valve operates and switches the boosters over from the booster hydraulic system to the main one, and vice versa. During

the switching-over process the fluid flows through the selector slide valve from one system into the other and, if the valve operates repeatedly, one of the hydraulic reservoirs may get overfilled and the fluid will be thrown out into the vent line which causes the oil level in the other system to go down.

Note. The hydraulic system may be occasionally checked with the aid of a ground installation equipped with a pump (unit 623), but the delivery line safety valves of these installations must be adjusted for a pressure of 130 - 135 kg/sq.cm.; the fluid temperature should not exceed 75°C.

Main Hydraulic System

Operation of the main system is checked with the help of the 435BM ground pump joined to the aircraft main system charging connections (starboard) after a power source has also been connected, or with the starboard engine running.

This is done as follows:

1. Make sure that the circuit breaker bearing the inscription STABILIZER AND AILERON BOOSTER and the switch AIRCRAFT, AIRFIELD STORAGE BATTERY on the starboard are switched on.

2. Set the switches located on the left-hand control desk and bearing the inscriptions AILERON HYDRAULIC BOOSTER and STABILIZER CONTROL in the position HYDRAULIC CONTROL (ВКЛ.ГИДРОУПРАВЛ.).

3. Create working pressure in the hydraulic system.

4. Extend the wing flaps to positions TAKE OFF and LANDING, then retract the flaps and make sure that the warning system operates correctly, that the wing flaps are extended and retracted simultaneously and that they make a tight fit to the wing.

5. Extend and retract the air brakes actuating the push-button on the aircraft control stick as well as the slide on the engine control lever, and make sure that the warning system operates correctly, that the air brakes make a tight fit with the fuselage, and that they operate simultaneously.

6. Deflect the control stick to the right, to the left, backward and forward to make sure the boosters operate normally.

Note. When checking operation of the units, make sure that ... the checking cycle the pressure is restored to 135±7 kg/sq.cm.

7. Check the main hydraulic system accumulator for proper charging for which purpose disengage the ground pump or stop the engines (first the left-hand one and then the right-hand engine) and watch the readings of the pressure gauge of the main system to make sure the hydraulic accumulator is charged correctly.

The hydraulic accumulator is charged correctly if the pressure decreases gradually to 40^{+5} kg/sq.cm. and then drops sharply to zero. If the pressure continues to drop gradually below 40^{+5} kg/sq.cm., the hydraulic accumulator is insufficiently charged with nitrogen. Do not fail to make corrections for the pressure gauge readings.

Recharge the hydraulic accumulator with compressed nitrogen until a pressure of 40^{+5} kg/sq.cm. is obtained.

Booster Hydraulic System

The booster hydraulic system is checked with the aid of a ground pump connected to the booster hydraulic system charging connection (port side) after the source of power has been switched on or with both engines running. The check is carried out as follows:

1. Create pressure in the booster hydraulic system, engage the БУ-13М and БУ-14МС boosters and deflect the control stick several times to make sure that the pressure in the system restores to 135±7 kg/sq.cm. after the stick is stopped.

2. Disengage the ground pump or stop the engines (first the left-hand engine, then the right-hand one) and watch the readings of the booster hydraulic system pressure gauge to check the hydraulic accumulator for proper charging.

The accumulator is charged correctly if the pressure gradually decreases down to 40^{+5} kg/sq.cm. and then drops sharply to zero. Should the pressure continue to drop gradually below 40^{+5} kg/sq.cm., the hydraulic accumulator lacks compressed nitrogen. In this case, charge the accumulator with compressed nitrogen until the required pressure is obtained.

Notes. 1. Reduce pressure without deflecting the control stick, since the delivery line of the system is connected with the return line through a throttle valve.

2. The hydraulic system should be checked simulta-

neously with the aircraft control system.

3. CHECKING BOOSTERS FOR CORRECT SWITCHING-OVER TO MAIN SYSTEM

(To be performed during 25-hour maintenance operations)

Check the boosters for switching over to the main hydraulic system with the aid of ground pumps. In doing so, make sure that the circuit breaker STABILIZER AND AILERON CONTROL BOOSTER and the switch AIRCRAFT OR GROUND STORAGE BATTERY are cut in.

The check is accomplished in the following sequence:

1. Cut in the switch AILERON BOOSTER located on the left-hand control panel.

2. Create a pressure of 135 ± 7 kg/sq.cm. in the main and booster hydraulic system.

3. Disconnect the booster system pump and deflect the control stick to both sides to reduce pressure in the system to 65^{+5} kg/sq.cm.

At a pressure of 65^{+5} kg/sq.cm. the booster should switch over to the main hydraulic system, this being indicated by a change in the readings of the main system pressure gauge.

Note. Aircraft of earlier makes employ slide valves mounted in the delivery line of the БУ-13М booster and serving to switch over the booster as the pressure in its system drops to 65 ± 5 kg/sq.cm.

4. Check the БУ-14МС booster for switching over to the main hydraulic system using the same sequence as in checking the БУ-13М booster. The switching-over should be accomplished at a pressure of 65^{+5} kg/sq.cm. in the booster hydraulic system.

After the check is over, disconnect the ground pumps.

4. RETRACTION AND EXTENSION OF LANDING GEAR, WING FLAPS AND AIR BRAKES

The landing gear is retracted by placing the landing gear control lever in the position RETRACTED (УБРАНО). Wait 10 or 15 sec. after the landing gear warning lamp flashes on, set the control lever to the neutral position and lock it by the latch.

The landing gear is extended by setting the control lever to the position EXTENDED (ВЫПУЩЕНО). The lever may remain in this position until the aircraft taxies to its parking place.

Note. In addition to the warning lights the extreme positions of the landing gear may be also checked by the position indicator arms and by a rise in the pressure up to 135 ± 7 kg/sq.cm.

The wing flaps may occupy one of the following positions:

(a) retracted (position RETRACTED);

(b) extended by 15° (position TAKE-OFF - ВЗЛЕТ);

(c) extended by 25° (position LANDING - ПОСАДКА).

In positions TAKE-OFF and LANDING the wing flaps are held by hydraulic locks, while in the position RETRACTED they are fixed by the ball locks of the hydraulic cylinders.

The wing flaps are extended to the required position by pressing the respective button on the plate WING FLAPS (ЗАКРЫЛКИ). The plate is located on the left control panel and the buttons bear the following inscriptions: ВЗЛЕТ (TAKE-OFF), ПОСАДКА (LANDING) and УБРАНЫ (RETRACTED). Having been pressed, the button remains sunk in its seat. When another button is pushed, the first one returns to its initial position, whereas the newly engaged button remains in the pressed-in position.

After pushing some button and after the wing flaps have been extended or retracted, the respective warning light will flash on. The warning light has the form of a luminous contour of a pointer that serves to indicate that the wing flaps have assumed the required position. If the pilot finds the warning light inconvenient, he may screen it with a curtain.

CAUTION. 1. On a parked aircraft all the buttons should be in their initial position (disengaged); this may be accomplished by pressing the small button on the control plate WING FLAPS. It is strictly prohibited to leave any button switched on when the aircraft is parked.

2. After a flight is over it is recommended to protect the wing flap control plate with a cover to prevent entry of moisture. The cover must be connected with the АД-5 automatic unit by means of a cord.

The air brakes (Fig.85) are extended by placing the slide on the right-hand engine control lever in the middle position or by pressing the knob on the aircraft control stick and keep-

ing it in this position.

The air brakes (Fig.86) are held in the open position by the pressure of the hydraulic fluid. When the air brakes are in the open position, the respective warning lamp flashes on and the pressure in the system goes up to 135^{+7} kg/sq.cm.

The air brakes are closed by setting the slide on the right-hand engine lever to the extreme position or by releasing the push-button on the aircraft control stick. The air brakes are held in the closed position by the pressure in the hydraulic system.

The air brake system employs a regulating valve that is installed in the delivery line with the purpose to disconnect the air brakes when the pressure in the main hydraulic system drops below 70_{-5} kg/sq.cm. When this is done a peculiar noise may be heard (the valve "squeaks"), but this is no defect.

5. EMERGENCY EXTENSION OF LANDING GEAR AND WING FLAPS

Should the hydraulic system fail to operate, the landing gear and wing flap may be extended with the help of the emergency compressed air system.

Emergency extension is accomplished in the following sequence:

1. Set the landing gear control lever to the position EXTENDED.

2. Open the landing gear up-locks and the locks of the main L.G. wing doors for which purpose pull energetically the emergency control handle.

3. Make certain that the landing gear locks are open which is indicated by the following: the red warning lamps go out and the position indicator arms begin to move out.

4. Open the landing gear emergency cock.

CAUTION. It is prohibited to open the landing gear emergency cock before the position indicator arms begin to move out, otherwise the landing gear struts may be wedged in the locks.

5. After the green warning lamps have lit up and the position indicator arms have completely moved out, close the landing gear emergency cock and shift the landing gear control lever to the neutral position.

The emergency extension of the wing flaps is performed as follows:

1. Depress the button LANDING on the wing flap control plate.

2. Open the wing flap emergency cock.

After the wing flaps have assumed the position LANDING, the warning lamp will flash on.

3. Close the wing flap emergency cock.

In case the landing gear and wing flap emergency systems have been used, do as follows:

1. Close and safety the emergency cocks.

2. Charge the landing gear and wing flap emergency bottles with compressed air.

3. Make sure that the landing gear UP-locks are in good condition, examine the cable linkage of the locks emergency opening system and secure the emergency handle.

4. Release the air from the landing gear and wing flap hydraulic cylinders, for which purpose:

(a) disconnect, on the landing gear hydraulic cylinder, the pipe that connects the relief valve with the outlet chamber;

(b) on the wing flap hydraulic cylinders, disconnect the pipe that feeds pressure to the outlet chamber.

After releasing the air, connect the pipes again.

5. After the defect in the hydraulic system that necessitates the application of the emergency system has been eliminated or after a scheduled check of the emergency system, pump the fluid through the hydraulic system to completely release the air from the system.

The system is to be pumped through by means of a ground pump and with the engines running, as is prescribed in the Section "Servicing Hydraulic System with Fluid".

CAUTION. 1. NEVER RETRACT the landing gear or wing flaps after the application of the emergency system until the air has been released from the hydraulic cylinders.

2. NEVER OPEN the emergency cocks unless absolutely necessary and NEVER LEAVE them unlocked.

6. WASHING OF HYDRAULIC SYSTEM

The hydraulic system is washed (flushed) with AMT-10 fluid

in the following sequence:

1. Jack up the aircraft.

2. Drain the hydraulic fluid from the system as is prescribed in Para." Draining of Hydraulic Fluid".

3. Remove the return line filters and the priming filter that are installed in the hydraulic reservoirs, wash them with gasoline and put in place again. Remove and wash the filter mounted in the booster hydraulic system return line, then put it in place again.

4. Disconnect both hoses from the boosters, interconnect the hose ends by means of connection 1004A50-8. Wash the boosters separately.

5. Fill the main and booster systems with fresh fluid as instructed in Para." Servicing Hydraulic System with Fluid".

6. Pump the fluid through the main hydraulic system by means of a ground pump, extending and retracting the landing gear, wing flaps and air brakes 3 or 4 times.

7. Pump the fluid through the booster hydraulic system during 4 or 5 minutes exercising the booster disconnecting cock 5 or 6 times.

8. Drain the washing fluid from the main and booster hydraulic systems (See Para."Draining of Hydraulic Fluid").

9. Remove the filtering elements from the ФГ-11 filters installed in the delivery line, examine the elements and wash them, if required.

10. Put the washed boosters in place and connect the hoses to them.

11. Fill the system with fresh fluid.

Note. In case the system is heavily contaminated, it should be previously washed with kerosene.

Should any unit of the main or booster hydraulic systems be replaced, fill and wash the system as is prescribed in Para."Servicing Hydraulic Sytem with Fluid".

7. CHECKING OPERATION OF HYDRAULIC SYSTEM UNITS

Checking Operation of КВЭМ Automatic Valve

(To be carried out during 25-hour maintenance operations, when preparing for the first flight)

1. Connect the ground pump to the main system connections and build up working pressure in the system.

2. Make sure that the circuit breaker STABILIZER AND AILERON CONTROL BOOSTER , located on the right-hand electric panel is cut in.

3. Cut in the switch AIRCRAFT OR GROUND STORAGE BATTERY and engage the БУ-14МС stabilizer booster actuating the switch STABILIZER CONTROL located on the left-hand panel.

4. SLOWLY deflect the control stick forward or backward to disengage the pump and watch the pressure gauge for a drop of pressure in the system.

As the pressure drops down to 50^{+2} kg/sq.cm., the control stick gets locked. The КВЭМ automatic valve that serves to disconnect the БУ-14МС booster and to connect the electric mechanism will cut off the fluid delivery to the booster.

5. Engage the ground pump, apply an effort to the locked control stick and watch the pressure rise in the system by the readings of the pressure gauge. As the pressure in the system rises to 80^{+15}_{-5} kg/sq.cm., the stick will easily go in the direction of the applied effort.

The КВЭМ valve will cut in the fuel delivery to the booster.

Notes. 1. The КВЭМ valve is calibrated on the stand for a disconnecting pressure of 50^{+2} kg/sq.cm. and for an engaging pressure of 80^{+15}_{-5} kg/sq.cm. The aircraft return line experiences some back pressure due to which these values become somewhat higher. The higher is the pressure in the return line, the higher are the pressure limits. Therefore in air releasing the control stick should be moved as slowly as possible.

2. During the check it is necessary to take into account the corrections for the aircraft pressure gauge readings.

Checking of Hydraulic System Operation after Replacement of КВЭМ Valve or Selector Slide Valve

After the replacement of the selector slide valve or of the КВЭМ valve in the БУ-14МС booster control system, check operation of the system as follows (this check is to be carried out with both engines running):

1. With the engines running at a speed not below n = 5000 r.p.m. check the pressure in the main and booster systems. It should be $135^{\pm 7}$ kg/sq.cm.

2. Engage the БУ-14МС stabilizer booster by actuating the switch on the left-hand panel.

3. Shut off the left-hand engine, move energetically the control stick forward and backward and watch the pressure drop in the booster system. When the pressure drops to 65^{+5} kg/sq.cm., the БУ-14МС booster switches over to the main hydraulic system.

4. Shut off the right-hand engine, move the control stick slowly forward and backward and watch the pressure drop in the main system.

When the pressure drops to 50 - 52 kg/sq.cm. the control stick gets looked. Then the КВЭМ valve will shut off the fluid delivery to the БУ-14МС booster.

Jerks or binding felt on the control stick when performing the check under Point 3 testify to an incorrect calibration of the КВЭМ valve or of the selector slide valve due to which the КВЭМ valve operates for a short time while the slide valve is being changed over. In the latter case it is necessary to check the pressures at which the selector slide valve changes over the fluid supply from the booster system to the main system and to check the КВЭМ valve for a proper disengagement of the booster. Replace that of the two units whose deviation from the calibration data is greater (50^{+2} kg/sq.cm. for the КВЭМ valve and 65^{+5} kg/sq.cm. for the selector slide valve). After the replacement, the difference in the operating pressure for the КВЭМ valve and for the selector slide valve must be at least 10 kg/sq.cm.

Checking Operation of Regulating Valve of Air Brake System

(To be carried out during 25-hour maintenance operations or after the replacement of the valve)

Carry out the check as follows:

1. Connect the ground hydraulic pump to the charging connections of the main system or start the right-hand engine and create a pressure of $135^{\pm 7}$ kg/sq.cm. in the system.

2. Switch on, on the right-hand panel, the circuit-breaker STABILIZER AND AILERON BOOSTER, LANDING GEAR WARNING LIGHTS, AIR BRAKES, NAVIGATION LIGHTS. Cut in the switch AIRCRAFT OR GROUND STORAGE BATTERY.

3. Engage the БУ-13М aileron booster and БУ-14МС stabilizer booster by operating the switches located on the left-hand panel.

4. Retract and extend the air brakes repeatedly and deflect simultaneously the control stick forward and backward as well as to the left and to the right.

Shift the control stick from position to position as quickly as possible. Extend and retract the air brakes continuously making use of the push-button on the stick or of the switch on the throttle control lever.

When this operation is performed the pressure in the main system should not drop below 55 - 60 kg/sq.cm. and the control stick should be free to move.

On the contol stick there should be no abnormal pressure, jerks or binding.

Air brake extension and retraction will take more time since, with a pressure of 70_{-5} kg/sq.cm. and below, the regulating valve will limit the fluid delivery to the air brake system.

Checking Air Brake Interlocking System

(To be carried out during 25-hour maintenance operations)

1. With a pressure of $135^{\pm 7}$ kg/sq.cm. in the system, engage the БУ-14МС stabilizer booster by operating the switch on the left-hand panel.

2. On the right-hand panel switch on the circuit breakers МУС-2 STABILIZER MECHANISM CONTROL (УПРАВ. МУС СТАБИЛ.), LANDING GEAR WARNING LIGHT, AIR BRAKES, NAVIGATION LIGHTS.

3. Shift the control stick fore and aft and simultaneously extend and retract the air brakes.

4. Disengage the stabilizer booster by actuating the switch on the left-hand panel. This will switch over stabilizer control to the emergency electric control system. If the push-button on the control stick or the switch on the throttle control lever are actuated the air brakes should not respond.

5. Engage the БУ-14МС stabilizer booster by operating the

switch on the left-hand panel. The air brakes should extend or retract again.

8. CONTROL SYSTEM OF ENGINE JET NOZZLE SHUTTERS

The nozzle shutters are controlled automatically from the main hydraulic system with the air of four actuating cylinders per each engine.

Depending on the engine duties the cylinder rods shift the restricting ring and the shutters get opened by the pressure of the exhaust gases. Each cylinder has three chambers and three pipe unions corresponding to the three positions of the shutters. The pipe union AUGMENTED RATING (ФОРСАЖ) is mounted first if looking aft, then come pipe unions NORMAL RATING (НОМИНАЛ) and MAXIMUM RATING (МАКСИМАЛ).

Four electromagnet two-position valves ГА-21/9 (two valves per each engine) are employed as the shutter control distributing unit.

In the aircraft papers the valves have the following numbers: No.1 for one pair of valves and No.2 for the other. By various engagement combinations of a pair of valves it is possible to obtain four positions. Shutter control requires only three positions, therefore, only one position of both valves No. 1 is made use of, whereas the pipe unions EXTENDED (ВЫПУСК) are plugged.

Operation of Shutter Control System

Starting Rating (Fig.87)

For starting duty the engine jet nozzle shutters are fully open, all the ГА-21 valves No.2 must be in the position RETRACTED (УБОРКА) connecting the plugged pipe unions EXTENDED (ВЫПУСК) with the return line and the pipe unions RETRACTED with the delivery line. The valve pipe unions RETRACTED connect the pipe unions NORMAL RATING (НОМИНАЛ) of the cylinders with the delivery line. The pair of ГА-21 valves No.2 are in the position EXTENDED connecting pipe unions RETRACTED with the return line and the pipe unions EXTENDED with the delivery line. The valve pipe unions RETRACTED connect the pipe unions

MAXIMUM RATING (МАКСИМАЛ)of the cylinders with the return line whereas pipe unions EXTENDED of the valves connect the pipe unions AUGMENTED RATING (ФОРСАЖ) of the cylinders with the delivery line.

Normal Rating (Fig.88)

For the NORMAL RATING (НОМИНАЛ) the nozzle shutters are half-closed. All the four ГА-21 control valves are in the position RETRACTED (УБОРКА) connecting the pipe unions EXTENDED (ВЫПУСК) with the return line and the pipe unions RETRACTED with the delivery line. The pipe unions RETRACTED of the valves connect the pipe unions NORMAL RATING and MAXIMUM RATING of the cylinders with the delivery line, whereas the pipe unions EXTENDED of the valves connect the pipe unions AUGMENTED RATING (ФОРСАЖ) of the valves with the return line.

Maximum Rating (Fig.89)

For the maximum rating the nozzle shutters are closed as narrow as possible.

Control valves No.1 are in the position EXTENDED (ВЫПУСК) and connect the pipe unions NORMAL RATING (НОМИНАЛ) with the return line through the pipe unions RETRACTED (УБОРКА). Control valves No.2 are in the position RETRACTED and connect the pipe unions AUGMENTED RATING (ФОРСАЖ) of the cylinders with the return line through pipe unions EXTENDED, whereas pipe unions MAXIMUM RATING of the cylinders are connected with the delivery line through pipe unions RETRACTED.

Augmented Rating (Fig.90)

For the augmented rating the nozzle shutters are completely open and all the four control valves are in the position EXTENDED (ВЫПУСК).

The pipe unions EXTENDED of the control valves connect the pipe unions AUGMENTED RATING (ФОРСАЖ) of the cylinders with the delivery line, whereas the pipe unions RETRACTED of the control valves connect the pipe unions NORMAL RATING and MAXIMUM RATING of the cylinders with the return line.

Mounted in the delivery lines of the AUGMENTED RATING after the ГА-21/9 valves are the disengaging cylinders of the augmented

rating interlocking system. The augmented rating may be cut in only in case there is such pressure in the system, as required for setting the shutters in the augmented rating position.

Should the pressure in the system drop below 50^{+10}_{-2} kg/sq.cm. the limit switches of the interlocking cylinders will break the augmented rating cutting-in circuit.

For checking the shutters control system see Chapter XIII, para. 5 "Checking Jet Nozzle Shutters Control System with Engines at Standstill".

9. ELIMINATION OF LEAKAGE THROUGH JOINTS OF HYDRAULIC SYSTEM LINES

(Related to pipes of stainless steel 1X18H9T)

Fluid leakage through the joints may be caused by:

(a) stresses in the joints resulting from overtightening and distortion of the pipes during assembly;

(b) insufficient cleanliness of contacting surfaces in the joints;

(c) distortion of geometric dimensions of the joint members, poor quality of pipe expansion, improper nipple angle, etc.;

(d) damaged joint members, cracks on expanded part or on the nipple;

(e) poor quality of welding;

(f) vibration resulting from poor attachment of pipes.

In the course of service the necessity may arise to eliminate leakage through the nipple joints of the hydraulic system pipes made of stainless steel 1X18H9T.

After a leaky joint has been detected and before it is eliminated, it is imperative to find out the cause of leakage.

Never tighten a joint before finding out the cause of leakage, since this may fail to produce the required result but, on the contrary, will increase fluid leakage.

Fluid leakage should be eliminated as follows:

1. Reduce pressure in the system to zero.

2. Back out the pipe joint nut, examine the condition of the pipe expanded part, nipple and pipe union surface. The pipe expanded surface and the pipe union surface should be clean and have no scores, dents, scratches or cracks.

3. Check the joint between the pipe and the pipe union. The pipe should have no distortion and should not be overtightened in the joint with the pipe union.

4. Join the pipe with the pipe union ensuring absence of distortion or overtightening by bending the pipe accurately if and when necessary.

Apply a thin coat of BV grease to the threaded part of the pipe union and turn manually the union nut of the pipe on the pipe union as far as it will go, then tighten the nut with a wrench.

5. Create a pressure of 135 ± 7 kg/sq.cm. in the system and check the latter for leakage. If this fails to eliminate the leakage through the given joint, disconnect the latter and put a copper gasket.

6. Copper gaskets (standard 925CH) are made to meet various pipe sections used in the system. Select copper gaskets in compliance with the respective pipe sections and mount them as indicated in Fig.91.

7. Copper gaskets are available in each aircraft set of spare parts in the following four sizes:

gasket 925CH-4, for pipes 4x6 . . . . . 10 pcs
gasket 925CH-6, for pipes 6x8 . . . . . 10 pcs
gasket 925CH-8, for pipes 8x10 . . . . . .10 pcs
gasket 925CH-10, for pipes 10x12 . . . . . .10 pcs

8. When a hydraulic pipe is replaced and a new pipe is mounted it is important to see that there is no distortion of the pipe which may create overtension in the joint. Besides, after the pipe has been joined, check the clearance between the pipe union tapered surface and the pipe expanded surface.

There should be no clearance in short pipes (250 - 300 mm long and less). In pipes exceeding 300 mm in length the clearance should not be more than 0.3 - 0.5 mm (See Fig.92).

CAUTION. 1. If pipes are assembled with a clearance in the joint between the expanded pipe surface and the tapered surface of the pipe union, this clearance may be taken up by upsetting the expanded part which, in the course of a repeated pipe tightening, may result in a complete flattening of the expanded part. As the efforts on the wrench during tightening are not felt, it becomes impossible to find out the fault without disconnecting the joint.

2. Never should joints be tightened with the view of eliminating a leakage before the cause of the leakage has been found out.

Chapter IX

AIR SYSTEM

1. GENERAL

The aircraft air system (Fig.93) supplies air to:

(a) brake system;

(b) emergency brake system;

(c) emergency extension system of landing gear and wing flaps;

(d) canopy sliding part pneumatic remover gun during emergency jettisoning;

(e) brake parachute discharge and disconnect system;

(f) fuel shut-off closing system;

(g) de-icing system;

(h) cannon loading system.

Basic Specifications

1. Capacity of main bottles . . . . . 10 litres
2. Pressure in main bottles . . . . . .110 - 130 kg/sq.cm.
3. Capacity of landing gear emergency bottles . . . . . 8.6 litres
4. Pressure in landing gear emergency bottles. . . . . .50 kg/sq.cm.
5. Capacity of wing flap emergency bottle . . . . . .2 litres
6. Pressure in wing flap emergency bottle . . . . . .130 kg/sq.cm.
7. Operating pressure in brake system . . . . . $.10^{+0.5}$ kg/sq.cm.
8. Pressure in emergency wheel braking system . . . . . $.10^{+2}$ kg/sq.cm.

2. BRAKING SYSTEM

The braking system (Fig.94) comprises two systems: main and emergency systems.

The main system may be operated both manually and with the use of the brake automatic control which excludes any skidding when braking the wheels at maximum brake moment. The automatic brake control is actuated with the help of the circuit breaker WHEEL BRAKE AUTOMATIC CONTROL (АВТОМАТ ТОРМОЗОВ [illegible]) with the wheel brake automatic control switched off, the wheels are braked as usually by hand and in stages.

Before taking-off and in the flight the circuit-breaker WHEEL BRAKE AUTOMATIC CONTROL should be switched off.

During the landing run it is allowed to change over from manual to automatic brake control and vice versa. Manual control is changed over to automatic control by switching on the circuit breaker WHEEL BRAKE AUTOMATIC CONTROL without letting go of the brake lever, whereas automatic control is changed over to manual in two steps. First let go of the brake lever, then cut in the circuit breaker WHEEL BRAKE AUTOMATIC CONTROL; as a result the system will be changed over to usual manual control.

To reduce the aircraft landing run it is allowed to apply the nose landing gear brake, for which purpose it is necessary to open the cock bearing the inscription NOSE WHEEL BRAKE (ТОРМОЗ ПЕРЕДНЕГО КОЛЕСА) located in the upper part of the instrument board. This is to be done before taking off. After the aircraft has landed and prior to taxiing, close the cock.

Should the main braking system fail in operation due to damaged pipes, or faults in the ПУ-7 pressure reducing valve or ПУ-8 differential control unit, absence of compressed air in the main bottles or due to some other abnormalities, the aircraft may be braked by means of the emergency brake system, for which purpose open the cock EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ) by pulling the cock handle. This will cause the air from the landing gear emergency bottles to flow through the pressure reducing valve, adjusted for 10^{+2} kg/sq.cm., along the emergency piping directly into the main wheel brakes. The pressure is checked by a pressure gauge connected to one of the main wheel hoses.

Brake release is accomplished by closing the cock EMERGENCY BRAKING, setting the handle into the initial position.

Checking Operation of Brake System

Make sure the system is charged with air. Then carry out the following checks:

1. Check the pressure in the brake system at the first and second braking stages. When the brake lever is actuated, the pressure in the brakes should be 5 kg/sq.cm. at the first stage and $10^{+0.5}$ kg/sq.cm. at the second stage. In the latter case the lever should be pushed as far as it will go.

The difference in the readings of the pressure gauge pointers with the pedals in the neutral position should not exceed 0.5 kg/sq.cm.

When the first braking stage is changed over to the second stage, a sharp increase of efforts on the lever should be felt.

2. Check the wheels for simultaneous application of the brakes and for simultaneous brake release, watching the pressure gauge. To this end, push the brake lever as far as it will go and bring the pressure in the brakes to $10^{+0.5}$ kg/sq.cm.

The time period required for braking and releasing the wheels must not exceed 5 sec.

3. Check for application and release of the brakes on each wheel separately, for which purpose actuate the pedals and push the brake lever.

4. Check operation of the ПУ-7 pressure reducing valve.

To this end, push and release the brake lever, with the pedals in the neutral position. Now, deflect the pedals and listen whether there is any noise of air that is released through the ПУ-8 differential brake control unit. Air noise indicates that the ПУ-7 valve does not completely release the brakes. This may result from binding of the ПУ-7 valve control cable or slide valve.

5. Check operation of the wheel automatic braking cylinder when retracting the landing gear.

This check is to be carried out together with the check on landing gear retraction and extension. With the pressure in the hydraulic system being not less than 80 kg/sq.cm. and the landing gear control valve in the position RETRACTED (УБРАНО),

the pressure in the wheel brake system should be 5 - 10 kg/sq.cm; after the landing gear valve has been placed in the neutral position, the pressure in the brakes should drop to zero during a time period not exceeding 60 sec. After extending the landing gear make sure that the wheel brakes are released by turning the wheels manually. Should the wheel brakes fail to get released, adjust the clearance between the rod of the wheel automatic braking cylinder and the lever of the ПУ-7 valve which should be not less than 2 mm.

Checking Operation of Brake Automatic Control System

To check the УП-30 valve for proper operation do as follows:

1. Jack up the aircraft.

2. Disconnect the plug connector on the УА-23 transmitter (of the right- or left-hand wheel) of the automatic brake control system.

3. Cut in the switch AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ. БОРТОВОЙ, АЭРОДРОМ.) and the circuit breaker WHEEL BRAKE AUTOMATIC CONTROL (АВТОМАТ ТОРМОЗОВ КОЛЕС).

4. Depress the brake lever and create a pressure of 4 - 5 kg/sq.cm. in the brake system.

5. Close the terminals on the УА-23 transmitter half of the plug connector.

As the terminals are closed, the УП-30 valves of the main and nose wheels will operate simultaneously. The air will pass through the УП-30 valves and the wheel brakes will get released; as soon as the terminals are opened the wheels must get braked.

Note. The interlocking system of the wheel brake automatic control on aircraft of latest make has been modified. Skidding of one of the main wheels (left- or right-hand wheel) will result in brake release of the nose wheel only. It is therefore well to remember when checking operation of the wheel automatic control that the closing of the УА-23 transmitter of one of the main wheels will result in air discharge from the УП-30 valve of the nose wheel only and the brake of the latter must get released.

6. Close the terminals of the УП-24 transmitter on the nose wheel. This must result in releasing the nose wheel brake only.

Note. Checks on the air system units of the cockpit canopy pneumatic remover, gun, de-icer, drag parachute and cannon control should be performed as instructed in the respective chapters.

3. CHECKING AIR SYSTEM FOR TIGHTNESS

The system is to be checked in the following sequence:

Checking System from Main Bottles to Consumers

Charge the air system to a pressure of 110 to 130 kg/sq.cm. and close all cocks. A pressure drop in the system not exceeding 5 kg/sq.cm. during a time period of 2 hours is permissible. The check is to be carried out with the aid of the pressure gauge of the main bottles.

Checking Brake System

With the system completely charged up to a pressure of 110 - 130 kg/sq.cm. and the cocks closed, apply the brake lever to bring the pressure in the brake system to $10^{+0.5}$ kg/sq.cm. (to be checked by the double-pointer pressure gauge), the pedals being in either of the extreme positions (both of which are to be checked).

A pressure drop in the system is permissible if it does not exceed 2.5 kg/sq.cm. during 30 min. for each position of the pedals (ПУ-8 differential control unit). The check is to be carried out with the help of the main bottle pressure gauge rated for 250 kg/sq.cm.

Check the readings of the double-pointer pressure gauge.

With the brake lever completely depressed, the double-pointer pressure gauge should indicate a pressure of 10 ± 0.5 kg/sq.cm. in the brakes. The permissible difference in the readings of the pressure gauge pointers is up to 0.5 kg/sq.cm.

Checking Emergency Systems of Landing Gear and Wing Flaps in Piping from Emergency Bottles to Cocks

Charge the landing gear emergency bottles to a pressure of 50 kg/sq.cm. and the emergency bottle of the wing flaps to a pressure of 110 – 130 kg/sq.cm.

Close the emergency cocks and the landing gear and wing flap system filling cocks. There should be no drop of pressure in the lines from the emergency bottles to the cocks. The check is to be carried out with the aid of the pressure gauge of the landing gear emergency system (rated for 80 kg/sq.cm.) and of the pressure gauge of the wing flap emergency system (rated for 250 kg/sq.cm.). The duration of the check is 1 hour.

Checking Emergency Systems of Landing Gear and Wing Flaps from Emergency Cocks to Hydraulic Cylinders

The check for tightness should be accomplished simultaneously with the check of the landing gear and wing flaps for proper emergency extension.

Charge the landing gear emergency bottles to a pressure of 50 kg/sq.cm. and the wing flap emergency bottle to 110 – 130 kg/sq.cm. The emergency cocks and the charging cocks should be closed.

Extend the landing gear actuating it by means of the emergency system, for which purpose set the landing gear control valve switch to the EXTENDED (ВЫПУСК) position, open the landing gear locks (Fig.95) by using the emergency system and wait for the landing gear warning lights RETRACTED (УБРАНО) to go out and for the wheel position indicator arms to move out, then open the landing gear emergency cock.

Note the pressure in the landing gear emergency system after extending the landing gear from the emergency system. The pressure should not be less than 25 kg/sq.cm. Keep the system under this condition for 30 min. Pressure during this period must not drop by more than 8 kg/sq.cm.

This check should be carried out by the pressure gauge of the landing gear emergency system, rated for 80 kg/sq.cm.

Extend the wing flaps using the emergency system for which purpose push the button LANDING (ПОСАДКА) and open the wing flap emergency extending cock.

Note the pressure in the system after having extended the wing flaps from the emergency system. Air pressure should drop by not more than 60 kg/sq.cm. Keep the system in this position for 30 minutes. During this time period the pressure must not drop by more than 3 kg/sq.cm.

The check is to be carried out by the pressure gauge (rated for 250 kg/per sq. cm.) of the wing flap emergency system.

Checking Emergency Braking System

1. Charge the bottles of the landing gear emergency system. Close all cocks.

2. Open the emergency braking cock and keep it in this position for 30 minutes.

During this period the pressure in the system can drop by not more than 3 kg/sq.cm. The check is to be carried out by the L.G. emergency system pressure gauge rated for 80 kg/sq.cm.

If the system fails to meet the above requirements, find out and eliminate the cause of leakage.

Leaky places of the system are found by hearing.

The pipe joints are checked for tightness by means of soapy water.

4. ADJUSTMENT OF AIR SYSTEM UNITS

The brake control system is to be adjusted if some trouble has been detected in the operation of the system. Adjustment is carried out as follows:

1. Turn the lever that serves to push the ПУ-7 valve rod and push the latter to obtain the pressure of $10^{+0.5}$ kg/sq.cm. in the braking system. Then make sure that the adjustment screw on the lever is turned out as far as the ПУ-7 valve body permits. If this is not the case, back out the screw until it rests against the body of the ПУ-7 valve and safety it with a lock nut.

2. Back out the adjustment screw of the automatic braking cylinder as far as the rod pressing lever permits, after having previously pressed the rod so as to reduce the pressure in the system to zero. The degree to which the rod should be prelimina-

rily pressed is determined by the time required for brake release. To carry out this check, actuate the lever to depress the rod of the ПУ-7 valve until a pressure of $10^{+0.5}$ kg/sq.cm. is obtained in the braking system. Then let go of the lever and determine the time required for the pressure to drop to zero as checked by the braking system pressure gauge. If this time period does not exceed 5 sec., safety the adjusting screw of the automatic braking cylinder.

Chapter X

FUEL SYSTEM

1. GENERAL

The aircraft fuel system includes four fuselage fuel tanks and fuel supply accessories serving two engines. Besides, provision is made for standard drop tanks, 400 or 760 lit. capacity, to be carried under the wings (one tank per wing (Figs 96 and 97).

The fuel vent system is of a half-closed type. The fuel tanks are pressurized with air bled from the compressor ninth stage and with impact pressure.

The fuel tanks are rated for:

No.1 - 1485 lit., No.2 - 330 lit., No.3 - 180 lit., No.4 - 175 lit.

The fuel system consists of starting (gasoline) and main (kerosene) systems.

The starting system comprises the following units (Fig.98):

1. Gasoline tank, 6 lit. capacity, located inside fuel tank No.1.
2. Fuel pump, type ПНР-10-9М.
3. Drain valve.
4. Two electrically-operated valves.
5. Fuel lines.

The gasoline tank is made accessible through an oval hatch located on top of the fuselage between frames Nos 13 and 14. The same hatch provides access to the ПНР-10-9М pump. The drain valve is accessible through a hatch located on the fuselage right side near frame No.18. The hatches of the engine bay give access to the electrically-operated valves.

The main system contains the following:

1. Bag tanks Nos 1 and 2.
2. Metal tanks Nos 3 and 4.
3. Fuel pumps.
4. Shut-off cocks.
5. Fuel lines.

Tank No.1 is located between frames Nos 9 and 15. Tank No.2 is arranged between frames Nos 15 and 20 under the engines. Tank No.3 is located between frames Nos 22 and 25. Tank No.4 is positioned between frames Nos 25 and 30. Incorporated inside tank No.1 is the inverted-flight chamber (Fig.99) to ensure an uninterrupted supply of fuel to the engines under negative - g conditions.

The inverted-flight chamber ensures flying at the above conditions for not over 15 sec. under all ratings, except augmented rating. When flying under negative - g conditions at augmented rating the inverted-flight chamber provides a supply of fuel for not more than 5 sec.

Note: The successive inverted flight (or any other flight under negative - g conditions) may be undertaken not earlier than in 30 sec. to allow fuel to fill the inverted-flight chamber.

Tank No.1 is a service tank. The 495A booster pump is incorporated inside the inverted-flight chamber of this tank. Fuel is transferred from tank No.2 into tank No.1 by means of the ПНВ-2 pump.

A hatch provided under the fuselage near frame No.12 gives access to the 495A pump. The ПНВ-2 pump is made accessible through a hatch located under the fuselage near frame No.16. Access to the ПНР-1 pump of tank No.3 is ensured through a hatch located under the fuselage near frame No.21. The ПНР-1 pump of tank No.4 is made accessible through a hatch provided in the fuselage ventral fin near frame No.29.

From the drop tanks attached to the wings fuel is forced by air bled from the engine compressors and then via a joint line is routed into tank No.1.

The fuel is consumed in the following sequence (Fig.100):

1. When flying without drop tanks:
(a) 490 lit. from tank No.1;
(b) all fuel from tank No.2 and half of fuel amount from tanks Nos 3 and 4;
(c) fuel remainder from tanks Nos 3 and 4;
(d) remaining fuel from tank No.1.
2. When flying with drop tanks:
(a) 100 lit. from tank No.1;
(b) all fuel from drop tanks;
(c) 390 lit. from tank No.1;
(d) all fuel from tank No.2 and half of fuel amount from tanks Nos 3 and 4;
(e) remaining fuel from tanks Nos 3 and 4;
(f) remaining fuel from tank No.1.

Pressurization of fuel tanks facilitates proper functioning of the fuel system at high altitudes and prevents contraction of bag tanks when the engines are being operated with the air blow-off bands open.

The excessive pressure built up in the fuselage tanks amounts to 0.11 - 0.13 kg/sq.cm. (or 0.17 - 0.18 kg/sq.cm. in the tanks on aircraft of latest make). The excessive pressure in the drop tanks should be 0.58 - 0.62 kg/sq.cm. (that in the drop tanks on aircraft of latest make should be from 0.63 - 0.78 kg/sq.cm.). Besides, all the tanks are connected with the atmosphere through a system of vent lines to prevent rarefaction in the tanks when diving at idling rating.

The gasoline tank is pressurized with air taken from the fuselage tanks pressurization system.

The vent system of the fuselage tanks ensures proper flight conditions for aircraft performing aerobatics. The fuel getting into the vent line is drained through a pipe, located at the lower loop of the vent line.

The fuel lines upstream of each engine are fitted with pneumatic and solenoid-operated remote-controlled shut-off valves designed to cut off fuel flow in the main line on emergency and in case the fuel accessories are being replaced. (The valve remote control is of one-way

type, operating only for valve closing). When on the ground the shut-off valves can be closed and opened manually through the engine access hatches. The rate of fuel consumption is controlled by the ТРЗ-52 fuel flow meter which shows:

(a) amount of fuel carried by the aircraft and consumed in flight;

(b) amount of fuel in tank No.1 on the fuel level indicator scale which is provided with a warning light of emergency fuel reserve (550 lit.).

After fuel has been fully consumed from the drop tanks a warning lamp DROP TANKS EMPTY (СИГНАЛИЗ.ПОДВ.БАКОВ) lights up.

The operation of the fuel booster and transfer pumps is controlled with the aid of the СД-3 pressure warning units. After fuel has been consumed from tanks Nos 2, 3 and 4 the corresponding fuel transfer pump (ПНВ-2 , ПЦР-1) should be switched off not later than 5 minutes after the warning lights of the 2nd or 3d and 4th tanks (2-Й БАК) (3 и 4 БАКИ) have come on to a steady burning. When installing fuel lines and tanks apply a smear of БУ sealing compound to every union nut, screw the nuts tight and lock them with КОК-0.8 wire. When doing so be careful to prevent the sealing compound from getting inside the fuel line.

2. CHECKING FUEL SYSTEM FOR TIGHTNESS

The fuel system will be checked for tightness with the aid of a ground installation, the engines being inoperative, drop tanks detached and wing tank fuel line connections plugged.

Check the fuel system for tightness as follows:

1. Fill the fuel tanks to capacity, close the filler neck of the rear tanks with a cover, screw a special plug with two connections for the ground test installation on the filler neck of tank No.1.

2. Attach the test installation hoses to the connections of the plug.

3. Open the gasoline tank access hatch, detach the vent line from the gasoline tank elbow connection and plug the latter.

4. Plug the impact pressure connection (the vent system connection located on the fuselage).

5. Open the hatches of the engine bay, detach the pressurization hose of tank No.1 from the pipe cross and plug the hose.

6. From the connection of the fuel system vent pipe detach the pipe bleeding excessive pressure from the drop tanks and plug the connection.

7. Open the access hatch of the ПНВ-2 pump, turn the pressure relief valves out of the fuel system vent pipe and plug the connections (2 pcs).

8. Blank off the drain connection of the fuel system vent pipe with a rubber plug.

9. Close the fuel shut-off cocks.

10. Using the ground installation, build up an excessive pressure of 0.3 kg/sq.cm in tank No.1 and check the fuel system for tightness during 15 - 20 min. No pressure drop will be tolerated. Fuel leakage through fuel line connections is not permissible.

11. Releave pressure from the system, open the shut-off cocks, set the engine control levers into the STOP (СТОП) position, and switch on all the fuel pumps of the system for 3 - 5 min. No kerosene leakage from the fuel lines and vent system is allowed. Leakage from the vent system testifies to poor tightness of the float valve of the rear tanks.

3. CHECKING FUEL SYSTEM FOR PRESSURIZATION

To do the check:

1. Attach the drop tanks.

Note: The checking of the fuselage tanks for pressurization may be performed with drop tanks detached.

2. Fill the aircraft tanks (including the drop tanks) with fuel.

3. Close the filler neck of tank No.1 with a plug fitted with a connection. Attach a rubberized fabric hose with a pressure gauge (rated for 1 kg/sq.cm.) to the connection.

4. Close the filler neck of the drop tank with a plug fitted with a connection. Attach a rubberized fabric hose provided with a pressure gauge (rated for 1 kg/sq.cm.) to the connection.

5. Start the starboard engine, make it run at 8000 - 9000 r.p.m. for 3 - 5 min. The warning light of the fuel consumption from the drop tanks DROP TANK EMPTY (СИГНАЛИЗ. ПОДВ.БАКОВ) should go out.

Check the pressurization value as read by the pressure gauges.

With the hatches of the engine bay open the pressure in tank No.1 should be from 0.11 to 0.13 kg/sq.cm. (that in the tank on aircraft of latest make from 0.17 to 0.18 kg/sq.cm.). With the hatches closed the pressure must be somewhat higher.

The pressure in the drop tanks should be within 0.58 - 0.62 kg/sq.cm. (that in the drop tanks on aircraft of latest make should be from 0.63 to 0.78 kg/sq.cm.).

In case the pressure in tank No.1 is lower than 0.11 (0.17) kg/sq.cm. check the filler necks of tanks Nos 1 and 4, as well as connections of the vent and pressurization lines for tightness. Check the position of the pipe cross located on the right side of the engine bay (See Fig.96). The arrow of the pipe cross should be pointed downward.

If the position of the pipe cross arrow is correct and all the connections prove to be airtight, replace the pressure relief valves of the fuel system vent pipe, as the low pressure in tank No.1 might be caused by an improper calibration of the relief valves.

However, a sticking of these valves may cause a rise of pressure in the tank pressurization system.

Should the pressure in the drop tanks happen to be less than 0.58 (0.63) kg/sq.cm., check the filler necks, vacuum valves and pressurization pipes of the drop tanks for tightness. Should it prove impossible to trace the cause of the air leakage, replace the sealed box complete with relief valves in the drop tank pressurization system, as the relief valves may be improperly calibrated.

Make sure that the pressure is set within the specified limits, bring the engine r.p.m. down to the idling rating and run the engine at this speed for 1 min. The pressure in tank No.1 should not drop lower than 0.09 kg/sq.cm. during this time.

4. INSTALLING DROP TANKS

Prior to attaching the drop tanks to the wings perform the following (Fig.101):

1. Remove fabric washers from the nests on the wing lower skin designed to accommodate the tank, and inspect the nests.

2. When installing 760-lit. tanks remove the plug and the rubber sealing ring (cup) from the wing nest of the front blind support.

3. Turn the plug out of the fuel supply support located on the wing lower skin, holding up the support through the wing upper hatch. Check the support for cleanliness. Press the support and make certain that it travels as far as 4 mm. Make sure that the connection swings (orientates) inside the support. Check the sealing edge of the support for condition; no nicks on the edge surface are allowed.

4. Check the rod of the tank drop control unit (AOC unit). The rod must be straight and should freely move in its nest. The rod length as measured from the wing skin surface to the screw head must be $23^{\pm 1}$ mm.

5. Open the wing top hatch and check to see that the air pipe is properly attached to the drop tank pressurization connection.

Note: When suspending a 400-lit. standard tank attach the air pipe to the rear connection. In the case with a 760-lit. tank the air pipe should be attached to the front connection.

Make sure the rubber ring of the air supply support in the wing is intact.

6. Remove the plug from the bomb carrier hatch cover.

7. Check the operation of the bomb carrier arms from the emergency and tactical release buttons.

8. Check the bomb carrier interlocking system in the following order:

(a) make certain the A3C circuit breaker BOMB EMERGENCY RELEASE, TANK DROPPING (АВАР.СБРОС БОМБ, СБРОС БАКОВ) located on the right-hand panel is cut off;

(b) cock the locks;

(c) press the AOC unit rods, located on both wings until the KB-6A microswitch operates (a click must be heard) and, holding the rods pressed, turn on the switch AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ.БОРТОВОЙ, АЭРОДРОМ.) and the circuit breaker BOMB EMERGENCY RELEASE, TANK DROPPING ;

(d) release the AOC unit rod on one of the wings; at this moment both locks should operate;

Note: The bomb carrier interlocking circuit will be checked in turn on the right and left wings in the above sequence.

(e) make sure that the bomb carrier interlocking system functions properly, then turn out the circuit breaker and switch turned on for checking purposes.

WARNING. Should the bomb carrier interlocking circuit be found faulty, do not attach the drop tanks unless the fault is eliminated.

Installing standard 400-lit. tanks (Fig.102)

To attach the tanks to the wings:

1. Make sure all parts of the tank are present.

2. Check the fairings of the fuel connection, air supply support strut, blind support strut, and the stabilizer for security of attachment. See that the tank shell is intact.

3. Make certain there is a 4-mm clearance between the check washer surface and the base of the front blind strut.

4. Remove fabric washers from the inlet pipe union of the vacuum-valve and check through it the valve disc for ease of closing and opening with the help of soft wire.

5. Unseal and examine the fuel and air connections of the tank. Make sure the sealings of the fuel and air connections are in good repair. The connection surfaces must be smooth and clean.

6. Unscrew the filler neck cap and examine the tank interior for cleanliness.

7. Check the tank attachment fittings, such as eye-bolt, nuts, locknuts, and washers, for condition.

Examine thoroughly the lug of the eye-bolt; see that the lug spherical surface is clean and free of nicks, dents, burrs and other defects. The side inner surfaces of the eye-bolt lug should be parallel to the side surfaces (flats) located on the bolt lower end.

The thread of the eye-bolt and nut must be clean, without traces of wear, nicks and other injury. Prevent the lubricant from getting on the thread.

The washer surfaces must be clean, dry, free of scores, nicks and rust.

The nut should not seize when screwed on the eye-bolt thread manually; however the nut must not be too loose on the bolt.

8. Make sure there is no washer on the front strut blind support. Remove the washer, if any. To effect this, turn out two bolts and replace them by shorter ones (25 mm long).

9. Make certain the heads of the front supports (air supply and blind ones) are installed as shown in Fig.103, i.e. the supports are shifted and locked in the rear position.

10. Make sure that the rear fuel supply strut is blanked.

11. Check the clearance between the tank fairings and the tank proper. The clearance should measure at least 2.5 mm.

The check done, install the tanks in the following order:

WARNING. Prior to attaching the drop tanks switch off the circuit breaker BOMB EMERGENCY RELEASE, TANK DROPPING, located on the right panel.

1. Cock the bomb carrier arms and attach the tank eye-bolts to the arms. Check to see that the eye-bolt lug is securely engaged by the front support in the arm jaw. After the eye-bolts have been attached to the bomb carriers the warning lamps BOMB SUSPENDED (ЛАМПЫ ПОДВЕСКИ БОМБ) should come on.

2. Bring the tank under the wing and attach the former to the eye-bolt; when doing so see that the tank fuel and air connections enter into the respective nests in the wing and the eye-bolt easily goes through the tank straight tube.

Note: A 3-mm eccentricity of the rear strut support provides for proper alignment of the tank supports with the wing nests. In case the tank supports and the wing nests do not coincide, turn the support in its thread and adjust the support position. Lock the support with a locknut seeing that there is a 8^{+2}-mm clearance between the locknut and the connection (Fig.104).

Fit the protruding end of the eye-bolt with a washer and screw a nut manually. The tank blind support must be tight on the wing skin. The angle piece for the AOC unit on the tank fairing must bear against the unit rod. The latter should project over the wing skin not over 10 mm.

The clearance between the wing skin and the tank fairing must be at least 3 mm.

3. Make certain the tank is properly fitted and tighten the eye-bolt nut. When doing so rock the tank slightly from side to side and press it against the wing surface. Secure the eye-bolt with a locknut.

The tank eye-bolt nuts will be tightened with СД7804-500 wrench (or any other socket wrench available) until the locking washer is pressed against the tank blind supports; perform the tightening evenly, without jerks.

4. Check the tank release mechanism for proper operation on the ground (use empty drop tanks and soft mats laid under the wings for the purpose). The mechanism should operate reliably. In case the mechanism fails to release the tanks (or one tank) trace the trouble to its source, eliminate the trouble, reattach the tanks and repeat the dropping cycle.

After the tanks have been dropped the respective warning lamps should go out.

WARNING. After the attachment of the drop tanks switch on the circuit breaker BOMB EMERGENCY RELEASE, TANK DROPPING.

In case only port side (or starboard) tanks are available instead of the set, re-place the front supports in the following order:

(a) remove the fairings of the front struts to gain access to the air supply and blind supports;

(b) detach the heads of the front (air supply and blind) supports from their bases. To this end unlock and turn out two bolts at each support and remove the latter;

(c) from the strut of the blind support remove the spring complete with washers, unscrew the plug with a special wrench and take out the rubber sealing gasket. Reinstall the supports in the reverse order and test the tank for tightness at a pressure of 0.8 kg/sq.cm.

Note: Prior to the installation coat the support ends with a thin layer of ЦИАТИМ-201 lubricant.

Install the front strut fairings (do not re-place the fairings).

Note: The upper edge of the fairing may be out, if necessary.

The tank should be attached to the wing in the above order.

Fill the tanks with fuel and check them for pressurization and tightness with the engines running.

Installing 760-lit. tanks (Fig.105)

To install 760-lit. tanks under the wings, proceed as follows:

1. Make sure the right and left tanks are fitted with their respective struts and supports. The difference between the tanks lies in the length of the side struts:

the longer strut must be installed on the tank side facing the aircraft axis of symmetry.

2. Check the fairings, side struts and stabilizer for security of attachment to the tanks. Make certain the tanks are intact. See that there are locknuts on the lower ends of the side struts.

3. Unseal and inspect the fuel and air connections. The surfaces of the connections must be smooth and clean. The connection gasket should be intact.

Prior to attaching the tank to the wing coat the front and air supply supports with ШИАТИМ-201 lubricant.

4. Check the rubber sealing gasket fitted in the sleeve for movement along the fuel connection. The gasket should shift without seizure under the action of great effort applied to the gasket and sleeve (Fig.106).

5. Unscrew the filler neck caps and examine the interior of the tank chambers. No moisture and dirt inside the tank will be tolerated.

6. See that there is at least 2.5 mm left between the tank fairing and the tank proper.

7. Open the side hatch on the tank fairing and inspect the suspension eye-bolt; the eye-bolt load bearing surface should be of a round shape and must not have any dents, nicks or burrs. The union nut thread and the tank stud should bear no traces of wear; the nut must be screwed on the tank stud easily, by hand.

8. Working through the vacuum-valve inlet pipe with wire check the valve disc for ease of closing and opening.

9. The side play of the air supply connection should be 1.5 mm; the longitudinal play must be 4 mm.

10. Check to see that there is a 3.7 - 4 mm clearance between the check washer and support on the rear strut. The proper clearance is adjusted with the aid of shims placed over the spring (Fig.107).

The check done, attach the tanks to the wings in the following order:

WARNING: Prior to attaching the tanks to the wings switch off the circuit breaker BOMB EMERGENCY RELEASE, TANK DROPPING.

1. Cock the bomb carrier arms and attach the eye-bolts to them. The respective warning lamps (right and left) BOMB SUSPENDED should flash on. Check the eye-bolts for security of attachment.

2. Attach the tank to the eye-bolt, making sure the connections and the side struts enter into the respective nests in the wings. See that the angle piece for the AOC unit on the tank fairing bears against the AOC unit rod.

3. Working through the hatch in the fairing screw the eye-bolt union nut on the tank stud till the check washer is pressed against the tank rear support.

When tightening the nuts see that the side struts are not gripped in their rests, otherwise the struts will damage the tank. Decrease the strut length by screwing on threaded end piece, if necessary.

4. After tightening the eye-bolt adjust the length of the side struts through rotating the end pieces with a normal wrench by the effort of one hand. The struts must fix the tank without undue stresses.

5. Lock the lower threaded end pieces of the struts with locknuts. Make sure the lower end faces of the struts are overlapped at least 5 mm by the collars which hold the end faces against turning.

6. Check the position of the AOC unit rods on both wings. The rods should project from the wing skin to the screw head sphere not over 10 mm.

7. Lock the eye-bolt union nut with KOK-1 wire and close the hatch in the fairing.

8. Check to see that there is at least a 2-mm clearance between the tank fairing and the wing skin. Cut the fairing, if necessary. The maximum clearance should not exceed 14 mm.

9. Check the tank drop mechanism for operation on the ground (use empty drop tanks and soft mats laid under the wings). The mechanism should operate reliably. In case the mechanism fails to release the tanks (or one tank)

trace the trouble to its source, eliminate the trouble, reattach the tanks and repeat the dropping cycle. The warning lamps must go out.

WARNING: Having attached the tanks switch on the circuit breaker BOMB EMERGENCY RELEASE, TANK DROPPING located on the right panel.

In case there are only port side(or starboard) tanks instead of the set, the starboard tank must be installed on the left wing, and vice versa.

To effect this, replace the struts in the following manner:

(a) back off the locknut securing the strut in the threaded end-piece fitted in the tank;

(b) turning the end-piece by its hexahedral part screw the strut off the end-piece.

When installing the strut reverse the disassembly procedure, screwing in the threaded end-piece right home. Fill the tanks with fuel and check them for pressurization and tightness at the fuel connections with the engines running.

5. POSSIBLE TROUBLES IN FUEL PRESSURIZATION SYSTEM

Fuselage Fuel Tanks

Tank No.1 is pressurized below specified limits. To trace the cause of the trouble, proceed as follows:

1. Check the pressure in tank No.1 with a pressure gauge when the engine is running.
2. Check the pressurization tubing for dents.
3. Check to see that the throttle openings in the pressurization pipe cross of tank No.1 are clean and not clogged.

Remove the pipe cross, wash it in gasoline and blow with compressed air, if necessary. The throttle opening diameter should be 5 mm.

4. Check the pressure relief valves for cleanliness, tightness, foreign matter, damage to the rubber sealing gaskets. See that the valves and the drain pipe are not frozen in cold seasons.

5. Check the vent system valve for ease of travel working through the impact pressure pipe connection located on the fuselage. No sticking of the valve will be tolerated.

6. Check the tubing joints for air leakage. Should the air pressure relief valves prove to be in good repair, with the pressure in the pressurization system remaining lower than the specified value, replace the valves.

Fuel Drop Tanks

When consuming the fuel from the standard drop tanks the following troubles may occur:

1. No fuel is supplied from the tanks.
2. The fuel is consumed from the tanks incompletely.
3. Uneven fuel consumption from the tanks.

If fuel is not supplied from the tanks look for the following possible causes:

(a) the pressurization pipe is improperly connected (air connections of the standard tanks and of the 760-lit. tanks are different);

(b) the vacuum-valves of the tanks stick in the open position;

(c) the drop tank pressure relief valves stick in the open position or the valve springs are broken;

(d) the air supply support-to-wing connection joint is leaky.

If the fuel is consumed incompletely from the tank during flight proceed as follows:

(a) make sure the joints of the wing fuel and air supply pipes are intact;

(b) check the pressure in the tanks while on the ground with the engines running.

The air pressure should be from 0.58 to 0.62 kg/sq.cm. (from 0.63 to 0.78 kg/sq.cm. on the late production aircraft).

The pressure may drop due to clogging of the throttle opening in the air pipe cross.

Note: The throttle opening must measure 2 mm in dia.

Should it prove impossible to trace the cause of low pressure in the tanks, replace the relief valves.

If the fuel is being consumed from the tanks unevenly do the following:

1. Check the pressure in both drop tanks with pressure gauges when trying out the engines. In case the readings vary, check the air supply pipes in the engine compartment for clogging.

2. Check the kerosene lines in the engine compartment for dents.

Should these checks fail to detect the cause of trouble inspect the non-return valves of the drop tank fuel line to see that they open freely, without sticking. Replace the valves, if necessary.

The above troubles may occur also with the 760-lit. tanks. If a tank is faulty, fuel might be consumed simultaneously from both sections of the tank. This trouble may be caused by poor tightness of the tank partition or of the pressurization pipe inside the tank.

To find the trouble:

1. Open the filler neck of the tank rear section.

2. Working through the rear filler neck blank the fuel transfer pipe in the air-tight partition with a rubber plug.

3. Attach the ground installation to the pressurization connection on the tank front portion and build up a pressure of 0.15 kg/sq.cm. No air leakage through the partition is allowed. Replace the tank in case the partition is leaky.

Adjusting AOC Simultaneous Drop Unit

When attached to the wings the support plates of the tanks bear against the rods of the AOC simultaneous drop unit. The rods are adjusted with respect to their length. When extended, the AOC unit rod length should be 23±1 mm (as measured from the wing skin to the screw head sphere). With the tank attached, the rod retracts and measures 10 mm long. In case the AOC unit fails to operate (provided the electric system is in good repair), check the AOC unit rods for extension and adjust the rods length.

The microswitch should cut in (a click must be heard) when the rod travels 6±2 mm from its extreme extended position.

The rod length is adjusted with the aid of a round-head screw located at the end of the rod. The adjustment of the rod length accomplished, lock the screw with a locknut.

Chapter XI

FIRE-FIGHTING EQUIPMENT

1. GENERAL

The aircraft is equipped with three fire-sensitive units (thermocouples), type АД-155А-ЗК , which open the contacts at a temperature of $200^{o}{}_{+50}{}^{o}$C.

All thermocouples are connected to the electric circuit in series. Should the contacts of one of the thermocouples be opened, the current will flow through the relay and light the fire warning lamp FIRE (ПОЖАР) located on the portside panel (Fig.108).

Carbon dioxide, contained in a 3-lit. bottle, is used as the fire extinguishing agent. The bottle is fitted with an electrical discharge bonnet. When the FIRE EXTINGUISHER (ОГНЕТУШИТЕЛЬ) button, located in the cockpit on the portside panel, is pressed, the discharge bonnet charge explodes, and the carbon dioxide flows under a high pressure via the distribution tubing into the engine compartment.

The fire-fighting equipment will be operated as follows:

1. Check to see that the thermocouples are intact. Should even insignificant damage (dents on the caps, traces of impact, etc.) be found, replace the thermocouples.

Note: Never attempt to repair thermocouples in any way.

2. Check periodically the contacts of the thermocouples for reliability of operation.

3. See that the wires running to the thermocouples are properly insulated. The wires should be attached securely without sagging.

4. The bimetallic membrane of the fire sensitive unit must be clean.

In case the red warning light FIRE (ПОЖАР) flashes on the portside panel, proceed as follows:

(a) cut off the engines;

(b) close the remote-controlled fuel shut-off cocks;

(c) close the cockpit pressurization cock;

(d) cut off all fuel pumps;

(e) press the FIRE EXTINGUISHER button, located on the portside panel;

In the event of fire during flight act as set forth in the Pilot's Instructions.

2. THERMOCOUPLE CIRCUIT TEST

To test the thermocouples for operation:

1. Turn on the switch AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ.БОРТОВОЙ, АЭРОДРОМ.) and the АЗС circuit breaker ENGINE INSTRUMENTS, FIRE-FIGHTING EQUIPMENT, TANKS Nos 1,3,4 PUMPS SIGNALLING (ПРИБОРЫ ДВИГ., ПРОТИВОПОЖАРН.ОБОРУД., СИГНАЛ ПОМП 1, 3, 4 БАКОВ).

2. Check the FIRE ALARM warning lamp for operation. The lamp should flash on when the test button is pressed.

3. Cut out the electric connector located at the fuselage tail part-to-nose joint(thus breaking the thermocouple circuit). If the FIRE ALARM warning light comes on, it indicates that the thermocouple circuit is in good repair.

3. CHARGING DISCHARGE BONNET

If the fire-fighting equipment has been used to smother fire, remove and recharge the carbon dioxide bottle.Recharge the discharge bonnet in the following order:

1. Unscrew and remove the discharge bonnet from the bottle.

2. Remove the explosive charge empty case from the bonnet.

3. Clean the plug connector contacts and the bonnet charge nest of carbon deposits.

4. Remove the piston and clean it of carbon deposits and dirt.

5. Clean the piston nest.

6. Reinstall the piston into the bonnet.

7. Screw the bonnet on the charged bottle and lock the former with wire.

Prior to installing the bottle in the aircraft, blow the distribution tubing with compressed air.

Install the bottle in the aircraft, fit the bonnet with a new explosive charge, type ПП-3 , attach the plug connector wire and the tube to the bonnet.

The service life of the discharge bonnet is 3 years (ten operation cycles).

After smothering fire, replace all thermocouples as their adjustment may be disturbed due to overheating.

4. CHARGING BOTTLE WITH CARBON DIOXIDE

The bottle is charged with liquid carbon dioxide (CO_2) at the rating of 0.65 gr per 1 cu.cm. of the bottle volume. For the weight of the carbon dioxide see the corresponding inscription on the bottle.

Note: Prior to charging the bottle make sure that the carbon dioxide to be used meets the Specification requirements and that the transportation cylinder contains enough carbon dioxide for charging the bottle.

To charge the bottle:

1. Using a special wrench unscrew the plug from the bottle connection, take the punctured membrane and the gasket (Fig.109).

2. Install a new membrane (manufactured of grade AIT -Л0.12±0.005 mm material) and a gasket (both to be found in a set of spare parts), punch the gasket in the plug to prevent the gasket from displacement when the bottle is being filled with carbon dioxide.

Note: To facilitate the removal and installation of the plug with a special wrench, screw the latter on the bottle connection so that the wrench shank end gets into the plug recess.

3. Screw the plug fitted with a new membrane into the bottle connection as far as it will go using a special wrench.

4. Immerse the bottle to be charged into a bath of water having a temperature of about +1°C and connect the bottle to the transportation cylinder. To maintain low temperature put ice into the bath.

5. Employing the handle bar of the special wrench back out the plug by 3 or 4 revolutions, open the valve of the transportation cylinder and fill the bottle with carbon dioxide.

6. The charging procedure accomplished, close the transportation cylinder valve.

7. Close the bottle by screwing the plug with the handle bar of the special wrench right home, then disconnect the bottle from the cylinder.

8. Using a weighing—machine accurate within 10 gr weigh the bottle charged with carbon dioxide.

Note: The weight of the carbon dioxide should be equal to the volume of the bottle multiplied by 0.65, the charge weight varying within 50 gr.

9. Immerse the charged bottle into a bath of warm water (from +45° to +50°C) and check the bottle for tightness. Should the bottle prove leaky, bleed the carbon dioxide, remedy the troubles and recharge the bottle.

The charged bottles should be kept in special racks in a vertical position away from direct sun rays and heating appliances. Protect the bottles against mechanical damage.

A charged bottle may be installed in the aircraft not earlier than 5 days after filling and subsequent weighing. The weight of the charge must not decrease by more than 20 gr as compared with its initial weight (directly after filling).

Chapter XII

AIRCRAFT DISJOINTING AND JOINTING. LEVELLING

1. DISJOINTING AND JOINTING

Disjointing and Jointing of Fuselage

The fuselage tail section is joined to the nose section at frames Nos 20 and 20A by means of eighteen studs located on the butt face of frame No. 20.

Correct jointing is ensured by three guiding dowels uniformly spaced on the butt face of frame No. 20. The jointing nuts are reached through special access holes.

To dismantle various communication lines inside the fuselage it is necessary to remove the middle portion of the upper guard plate and to open the access holes leading to the engines, fuel pipe line split connections, control rods, thermocouples (having previously extended the air brakes), engine vent lines, fuel drain system and to the split connections of the hydraulic line. Remove the panel of the access hole leading to the airing branch pipe of the booster line hydraulic reservoir.

The access holes opened, close the engine blow-off bands with the aid of a special wrench.

Zero the pressures in the hydraulic and air systems.

This done, carry out the following dismantling operations:

1. Disconnect the split valves of the vent and delivery lines of fuel tanks Nos 3 and 4 (operate through the access holes from above and below between frames Nos 21 and 22).

2. Dismount the vent line pipes (two at each side) having screwed the unions out of their respective seats in the engine (working through the access holes between frames Nos 22A and 23 under the air brakes).

3. On each engine, disconnect the drain pipe unions of the tailpipe (at frame No. 35) and the drain pipes of the afterburner (at frame No. 25).

4. Disconnect the thermocouple transmitters from the engines.

5. Disconnect the hydraulic line pipes from the valves on the tailpipes.

6. Disassemble the rear attachment fittings of the tailpipes of each engine.

7. Dismantle the fairings of the air bleed pipes of the engine relief chambers, drive out two fastening bolts of each air bleed pipe and remove the pipes from the fuselage.

8. Disconnect the split valves of the return line of the main hydraulic system (one in the right-hand engine inspection hole, and the other – above and to the left at frame No. 20 (See Fig. 110); break up the air line system connection (through the engine inspection holes).

9. Disconnect the split valve of the delivery line of the main hydraulic system (through the access hole to the right of frame No. 21).

10. Disconnect the split valves of the delivery and return lines of the main hydraulic system leading to the belly air brake. Disconnect the jet nozzle shutter control hydraulic line.

11. Disconnect the split valves of the delivery and return lines of the hydraulic booster line (having removed the upper guard plate at frame No. 20).

12. Disconnect the rudder and stabilizer control rods (through the access holes between frames Nos 21 and 22, from above).

13. Disconnect the fire system manifold.

14. Split up electric connections Nos 48, 56, 57 and 58.

CAUTION: The fuselage tail section is wired with heat-resistant conductor. Therefore when breaking up electric connections Nos 48, 56, 57 and 58, never bend sharply or twist the bunched conductors since otherwise the insulation may become damaged which will lead to shorting the wires.

When through with the in-fuselage dismantling operations:

1. Bring a special cart to under the fuselage tail section at frames Nos 24 and 35 and fasten the fuselage tail section to the cart.

Note: If the disjointing is being done on the rolled soil or on a metal strip, place boards under the cart wheels.

2. Open eighteen access holes leading to the jointing studs, unlock and screw off the nuts jointing the two fuselage sections.

3. Separate the fuselage tail and nose sections from each other. To do this, insert drift pins into two access holes located in extreme side points of frame No.20A; pressing the drift pin ends against the end faces of the jointing pins and against special supports provided in the access holes, and operating the drift pins as levers, bring the nose and tail sections of the fuselage apart from each other at frames Nos 20 and 20A.

4. Carefully, seeing to it that the fuselage tail section does not touch the engines and dismantled parts, roll off the fuselage tail section on the cart.

5. Using special plugs, close the ends of the disconnected pipe lines, wrap the electric connections, reinstall the removed access hole panels and the attachment parts.

The fuselage will be jointed in the order reverse to that of disjointing; in jointing, care should be taken to keep the fuselage from touching the engines and the pipes, bunched conductors and hoses, etc. from being seized. Whenever required, the position of the fuselage tail section will be adjusted by the elevating screws provided on the special cart. The cart should be adjusted to provide a position for the guiding dowels on frame No. 20 to enter the holes in frame No. 20A.

The tailpipes will be attached to the rear attachment fittings with the aid of a special fixture (supplied with the equipment set).

Due to the burning of the attachment bolts of the engine tailpipe attachment links, these bolts should be installed on graphite lubricant.

Note: Prior to the fuselage jointing it is absolutely necessary to check easy movement of the attachment units of the tailpipes.

When through with the mounting procedure, examine all places involved through the access holes to make sure that they are clean and free of foreign objects.

The nuts of the eighteen tail-to-nose section attachment studs should be fastened up uniformly (tightened up in turn will be diametrically opposite nuts; operate crosswise).

Upon completion of the mounting procedure, check the locking of all the connections and air-tightness of all the systems.

After jointing the fuselage, as well as after replacement of any hydraulic system unit in the tail section or in the engine compartment, charge and pump through the hydraulic systems from the engines as instructed in "Charging of Hydraulic System with AMT-10 Fluid".

Note: Here it is permissible not to pump the hydraulic system through from the ground servicing cart and not to effect the L.G. extension-retraction cycle.

Disjointing and Jointing of Wing

The wing is attached to the fuselage nose section in two points at frames Nos 9 and 15.

To disjoin the wing from the fuselage:

1. Remove the fillets and the fairings from the wing leading edge section.

2. Open the access holes in the wing leading edge sections, upper and lower access holes of the cannon and the access holes leading to the fuel line of the drop fuel tank.

3. Bring a jack under the nose support block and a support bed with two jacks under frame No. 20.

4. Jack up the aircraft till the wheels clear the ground.

5. Zero the pressures in the main and booster hydraulic systems, and in the air system.

6. Disconnect the air system pipe unions in the wing leading edge section at the wing-to-fuselage joint.

7. Disconnect the hydraulic system pipe unions (4 pipe unions in the port side wing, and 6 unions in the starboard wing).

8. Break up all the electric connections.

9. In the starboard wing through the lower cannon access hole and in the port side wing through the access hole in the leading edge section disconnect the cable leading to the radio altimeter antenna, remove the cable from the attachment locks, pull the cable out and reel it up.

10. Remove the cannon and the air bottle.

11. Disconnect the fuel pipe line leading to the drop fuel tank.

12. Disconnect the aileron control rod in the wing butt joint section.

13. Disconnect the L.G. main leg emergency unlock cable.

14. Place a special cart under the wing and position the support beds of the cart along the spar and stringer at rib No.8 and along rib No.16.

15. Place the jack under the ball-type support of the wing.

16. Uncotterpin the nuts of the bolts fastening the wing to the fuselage in the front and rear attachment points.

17. Push out the front wing-to-fuselage attachment bolts.

18. Using the puller, remove three rear wing-to-fuselage attachment bolts from each side.

IMPORTANT: For removing and re-installing the jointing bolts use should be made of a hammer with a soft tipping.

19. Slightly shaking the wing by its tip, carefully separate the cart with the wing from the fuselage.

20. Close the disconnected ends of the pipe lines with special plugs, and wrap the electric connections.

The wing will be jointed in the order reverse to that of disjointing.

IMPORTANT: Mounting procedure over, check all places involved through the access holes to make sure that they are clear and free of foreign objects.

When through with the mounting procedure, check the locking of all the connections.

After the wing jointing is completed, charge and pump through the hydraulic systems and check the operation of all the wing-mounted units and systems.

2. CHECK-UP OF AIRCRAFT LEVELLING

In the course of service the levelling characteristics of the aircraft undergo changes. Therefore the levelling data obtained during check-up levelling in using units may differ from the data indicated in the Manufacturer's Levelling Diagram supplemented to the aircraft Service Log.

No check-up levelling will be carried out on aircraft which have been delivered to the User from the Manufacturer by air.

Carried out after the assembly of the aircraft which have been delivered to the User disassembled will be the check-up of the deflection angles of the controls (stabilizer, rudder, ailerons, trim tabs, flaps and air brakes). Decrease in the deflection angles, as compared to the data specified in the Manufacturer's Levelling Diagram will not be tolerated. The asymmetry of the deflection angles should be within the tolerance limits specified in the Levelling Diagram.

For the aircraft in active operation the check-up levelling should be done by the points indicated in the Levelling Diagram supplemented to the aircraft Service Log.

In practice the violation of the tolerances indicated in the Levelling Diagram is not limited provided the aircraft flight performances remain adequate (i.e. the pilot reports that the in-flight behaviour of the aircraft is normal) and provided no visible structural deformations decreasing the structure strength have been detected.

The data obtained during the check-up levelling will be entered into the Levelling Diagram with the indication of the check-up date and signature of the persons in charge. Finally the aircraft is authorized for further operation on the basis of the flying test.

After replacement of any unit or after the check-up levelling operations the measurement data should be entered into the Levelling Diagram with the indication of the date and signatures of the persons in charge.

In all cases of replacement or major repair of the aircraft (nose or tail fuselage sections, wing or tail unit) after the check-up levelling the aircraft should be test-flown. After the replacement of one or both wing panels it is necessary to carry out check-up levelling of both wings, of the flaps and ailerons, and then the aircraft should be test-flown.

3. AIRCRAFT LEVELLING

General

In the course of service the aircraft are subjected to levelling for checking up the aircraft units for correct and symmetrical installation (wing, fuselage tail section, controls, etc.) after their replacement or repairs, as well as when the pilot notices that the aircraft's in-flight behaviour is abnormal.

For levelling, use should be made of the Levelling Diagram (Fig.111).

The levelling is carried out with empty fuel tanks, with empty cockpit, without the ammunition and bombs, with the equipment installed and access holes closed.

For levelling, the aircraft is jacked at frames Nos 1 and 20 into the line-of-flight position (the wheels should be raised off the ground). Besides this, safety trestles (or carts for wing jointing) will be installed under the wings at a distance of 3000 mm from the aircraft centre line, and under the fuselage, below frame No.31.

The clearance left between the trestles and the skin should be within 50-70 mm. With the aircraft in this position it is not required to suspend a load from the aircraft nose, and it is possible to apply a load of 100 kg to the horizontal empennage which will not disturb the aircraft position.

The levelling operations should be carried out in a hangar (and in no-wind conditions only, when in the open) with the level set only once. During the levelling it is forbidden to perform any other operations on the aircraft. The level is set up at a distance of 3 to 4 metres from the aircraft so that the measuring tape extended from any levelling point would be seen through the level. When setting up the level, pay attention to the points aligned with the landing gear.

For levelling, the fuselage axis (centre line) is set horizontal by port side reference points 1-2. The superelevation of point 1 over point 2 should be equal to 250 mm. For correct lateral position of the aircraft, two points 8-8 should be matched in height.

Note: In levelling account should be made for local (spot) irregularities of the contours at the levelling points. When recording the levelling data, added to, or subtracted from (depending on the sign), the obtained levelling data should be the correction for the local irregularity of the contour.

The wing wedging angle is $\varphi = 0^{\circ}$; anhedral V $= -4^{\circ}30'$. The actual position of the wing relative to the fuselage centre line is determined according to the Levelling Diagram.

The out-of-symmetry of the anhedral (V) is determined as a difference between the superelevations of point 8 over points 16 of one wing and those of the other wing and should not exceed 8 mm. For each wing point 8 the superelevation should be 177^{+20} mm above point 16.

Check-Up of Fuselage Tail Section Setting and Fin Misalignment

Whether or not the fuselage tail section is set correctly relative to the fuselage nose section is determined by the value of displacement of the fuselage tail section axis from the nose section axis at point 6 in the horizontal plane and at points 3 in the vertical plane.

The fin misalignment in height is determined by the displacement of point 28 relative to point 26 which should be within 18.5 ± 4 mm.

The fin wedging angle is checked relative to points 4-5 by points 25, 26, 27 and 28, 29, 30. The superelevations of these points should be: for points 25-26 within 4±3mm; for points 25 - 27 within 77±5 mm; for points 28 - 29 within 3.5±2mm, and for points 28-30 within 40.5±4 mm.

To check the misalignment of the fuselage tail section in the horizontal plane, install two poles about 5 m. high: one in front of the aircraft and two behind it; stretch a cable between the poles and extend three plumb lines. Align the first plumb line with upper point 4, the second plumb line with upper point 5 and extend the third plumb line against point 6; determine the displacement of point 6 which should be within 200±5 mm.

The displacement of point 3 relative to the centre line of the fuselage nose section should be within 60±2 mm.

Check-Up of Fuselage Twist

The fuselage twist will be determined by the difference of measurements taken from the fuselage reference line at points 1, 2 and 3, port side, and points 1, 2 and 3, starboard side. The difference between the measurement at points 1, starboard side and 1, port side, should not exceed 1 mm; at points 2, starboard side, and point 2, port side, should not exceed 2 mm; at points 3, starboard, and 3, port side - 3 mm.

Levelling of Controls and Landing Gear

Check-Up of Aileron Deflection

With the control stick in the neutral position, the difference between the deflections of the right and left ailerons ("scissors") is allowed to be (with one of the ailerons neutral) not in excess of ±2.5 mm, as measured at points 14 and 38. The amount of the control stick deflection to the left and to the right should be within 16 ± 2^{0}, and the amount of the aileron upward or downward application should be within $20^{+1^{0}}_{-2^{0}}$.

The trim tab of the left aileron should deflect up and down through 15 ± 1^{0}.

Check-Up of Stabilizer Deflections

The stabilizer misalignment is determined by the difference between the superelevations of points 22 over points 1 (for the left and right sections); this difference should not exceed 10 mm.

Whether or not the stabilizer is correctly set in the $\varphi = 0^{0}$ position will be determined by the difference between the superelevations of points B over points A:

$$B - A = 25 \text{ mm}$$

The stabilizer dihedral (V) at $\varphi = 0^{0}$ is determined as the difference between the superelevations of points 20 over points 22; the difference should not be in excess of 75^{+5}_{-3} mm.

The stabilizer "scissors" will be determined by the distance between points 43 and 43 A; this distance should be within 18.5±2.5 mm.

The neutral position of the aircraft control stick will be checked by the distance of point T from the instrument panel; this distance should equal 225 mm.

The stabilizer neutral position is checked by matching points 54 and 55 (with the APY stabilizer variable-ratio boost control unit set at the bigger arm, and the trimming effect mechanism neutral). With points 54 and 55 of the stabilizer left half aligned, difference b-a by points 19 and 20 of the stabilizer left half should amount to 8±3 mm. In this case the stabilizer deflection angle equals $1^{0}30'$ (with the leading edge up).

The maximum amount of the stabilizer deflection will be checked by the distance between points 54 and 55; this distance is specified in the aircraft Service Log.

With the APY stabilizer variable-ratio boost control unit set at the bigger arm, the maximum stabilizer deflection will be $26^{0}30' \pm1^{0}$ DOWN and $11^{0}30' \pm1^{0}$ UP.

Note: For adjustment of stabilizer deflection angles and for their check-up procedure refer to special instruction in the earlier chapters.

Check-Up of Rudder Deflections

The pedals forward and backward travels from the neutral position amount to 66^{+6}_{-3} mm or $30\pm1^{\circ}$, which causes rudder deflections through $25\pm1^{\circ}$ to the right or to the left.

With points 46 and 30A aligned, the "scissors" of the rudder relative to the fin fairing, as measured at points 47-27, should not exceed 3 mm.

The rudder trim tab should be deflected through $8\pm1^{\circ}$.

Check-Up of Air Brakes Extension

The air brakes (right and left) should be extended through 25°, which corresponds to the linear distance of 462 ± 10 mm as measured at points 37.

The third (belly) air brake should extend through 45°, which corresponds to the linear distance of 439 ± 8 mm as measured at points 52.

Check-Up of Flap Deflections

The flaps deflection should be checked by points 33 and 34 (for both flaps).

With the flaps applied 15° DOWN, value N should be within 449^{+13}_{-8} mm.

With the flaps deflected 25° DOWN, value M should be equal to 524 ± 10 mm.

With the flap 25° DOWN, the gap in section 3 should be within 40 ± 3 mm, and in section 13 - within 21 ± 3 mm.

Note: The deflection angles of the stabilizer, ailerons, rudder, control stick and pedals will be measured normal to their respective hinge axes.

Check-Up of Landing Gear Setting

Jack up the aircraft till the wheels clear the ground. Place plywood sheets under frame No. 15 and the landing gear wheels and press them (with a weight) to the ground. Check to see if the struts have come fully out.

To check the landing gear parameters:

1. Attach two plumb bobs to a twine and hang the twine over the wheel tyre tread at its middle (work on the main and nose L.G. wheels); mark the front and rear points of the wheel on plywood sheets inserted under the wheels. Divide the distance between the points obtained on the plywood sheets into two halves, and designate the found projections of the wheel centre points with letters A, B and C (for the nose wheel).

2. Connect points A and B (projections of the L.G. main leg wheel centre points) with a straight line.

3. Extend a plumb line from the middle of the middle wing-to-fuselage jointing bolt on frame No.15 and mark point E on the plywood sheet. Draw perpendicular EF from point E to the AB line.

4. Extend a plumb line from the fuselage bottom point in the aircraft plane of symmetry and mark the projection of this point with letter D.

5. Draw a straight line through points C and D till it meets the AB line. Mark the intersection point with letter G.

The distance between points A and B (wheel track) should be equal to 4156 ± 30 mm; distance AG=BG being equal to 2078 ± 15 mm.

The distance between points E and F (landing gear stagger) should be equal to 1000 ± 10 mm.

The distance between points C and G (L.G. base) should amount to 4398 ± 20 mm.

The camber and toe-in angles of the wheels should be equal to $\pm$ 30'.

Chapter XIII

REPLACEMENT OF ENGINES

1. REMOVING ENGINE FROM AIRCRAFT

Prior to removing (or installing) the engines (Fig.112-114), detach the tail section of the fuselage. Before detaching the tail section of the fuselage make sure the air blow-off bands cover the ports.

Prior to removing the engine slush it with corrosion-preventive compound in compliance with the Engine Operating Instructions, and detach the tailpipe.

To remove the engine:

1. Disconnect the engine control rod from the control panel lever;

2. Disjoin electric wires from the starter-generator;

3. Uncouple the engine main connector;

4. Disconnect the aircraft breather pipe from the engine oil system breather branch pipe; to effect this, release the clamps of the rubberized fabric sleeve and shift the latter complete with the clamps onto the aircraft pipe;

5. Remove the starter-generator vent pipe.

6. Remove the air cooling pipe from the starter generator;

7. From the engine flanges and pipe unions located near frame No.20 in the lower part of the engine disconnect the following pipes:

(a) the pipe for draining fuel from the front portion of the combustion chamber housing;

(b) the pipe for draining oil and fuel from the drain valve housing;

(c) the air intake pipe for tank pressurization;

(d) the pipe for draining fuel from the starting fuel control unit.

8. Close the fuel shut-off cock and disconnect the engine fuel supply line at the quick-disconnect clamp.

WARNING. To prevent fuel (or oil after engine slushing) from getting into the fuselage when disconnecting the fuel line, it is recommended to remove the plug from the engine slushing connection (this connection is located on the aircraft fuel line between the shut-off valve and the engine inlet union) and suck 150 - 200 cu.cm. of fluid from the line using a clean syringe.

9. Disconnect the gasoline hose from the engine electromagnetic valve.

10. Disconnect the cockpit air supply pipes from the non-return valve unit and remove the latter.

11. Drain AMT-10 fluid from the hydraulic reservoir and the hydraulic system when removing the starboard engine, drain the hydraulic system; when removing the port engine, drain the booster hydraulic system.

12. From the hydraulic pump disconnect the suction and delivery lines and the vent pipe; remove the hydraulic pump from the engine having released the clamp of the quick-disconnect fitting which secures the pump to the drive gearbox adapter.

13. Detach the shutter actuating cylinder fuel supply pipe from the pipe connection located at the air blow-off band actuating cylinder inlet. To remove the starboard engine take off the hydraulic reservoir. To this end the starboard engine should be pulled to extend slightly out of the fuselage nose section.

To remove the port engine take off the starting panel. When removing the port engine (with the starboard engine installed), take off the rubberized fabric hose which connects the main hydraulic system reservoir with the pipe leading to the fuselage air intake.

The pipe lines and pipe unions should be blanked with special stoppers immediately after disconnection.

After the engine has been prepared for removal proceed as follows:

1. Roll a special assembly truck under the engine and attach the two rear jacks of the truck to the turbine flange lower openings with the aid of fastening studs (the turbine flange upper openings being intended for a cross-piece to be attached when lifting the engine with a crane).

2. Disconnect the engine side attachment rods from the respective fitting at frame No.20.

3. Dismantle the engine lower attachment fitting (unscrew the retainer, back off the cover attachment nuts and remove the engine fastening pin).

4. While rolling the truck back, shift the engine out of the fuselage so that the assembly pins are 300 mm short of the rail ends.

Note: Shift the engine carefully; see that its accessories and pipe lines do not brush against the fuselage structural elements and equipment.

5. After the engine has been fully shifted out of the fuselage, attach the truck front jack to the combustion chamber front flange and roll the truck away.

6. Inspect the compressor inlet section, the blades of the forward stages, and blank the inlet duct.

To make the aircraft levelling subsequent to the installation of the engine unnecessary, never disturb the adjustment of the engine attachment side struts.

2. INSTALLING NEW ENGINE IN AIRCRAFT

1. Unpack the new engine and remove slushing compound from the engine outer surfaces as set forth in the Operating Instructions.

Note: Remember that the port engines are marked with odd numbers, while the starboard engines bear even numbers.

2. Secure a special cross-piece to the engine, remove the box fittings from the engine, lift it with the ППК-48 crane and place carefully upon the assembly truck.

CAUTION! When lifting and placing the engine on the truck see that the engine pipe lines are not damaged and that the cross-piece ropes do not brush against the engine accessories and units.

3. From the engine to be removed take off the following units and install them in the new engine:

(a) the engine nose piece (lock washers for the nuts securing the nose piece to the engine front flange to be found in the individual set of engine spare parts);

(b) the engine attachment side struts (in compliance with their marks). See that the strut adjustment is not disturbed;

(c) the ДТ-3 tachometer generator;

(d) the relief chamber air outlet pipes complete with attachment clamps;

CAUTION! Prior to installing the pipes make sure the throttle plates fitted on the engine flanges comply with the Service Log specifications.

(e) the starter-generator vent pipe;

(f) the ПН-9 pump inlet flange (with a rubber gasket);

(g) the cockpit air supply pipes;

(h) the drain cock flange branch pipe.

4. Before installing the engine clean the fuselage of dirt and check the aircraft air intake and the engine-to-intake sealing joint for condition (check the rubber for condition and proper fitting).

5. Roll the truck-mounted engine into the fuselage nose section, reversing the procedures outlined under Para. "Removing Engine from Aircraft".

6. Mount the engine attachment fittings. Position the lower pin in accordance with the marks; align the pin and the fitting cover notches.

7. All the pipe lines and wiring should be attached in the order reverse to disassembly (See Para. "Removing Engine from Aircraft") Simultaneously check adjustment of the engine controls making use of the notches made on the

engine and the stops of the throttle in the cockpit.

There should be a 1.5 - 2 mm clearance between the throttle stops and the levers set to the extreme positions. This clearance provides for proper positioning of the levers on the engines.

Note: When installing the starboard engine mount the main hydraulic system reservoir prior to inserting the engine fully into the fuselage.

8. Remove from the defective engine tailpipe and install on the new tailpipe the following parts:

(a) the spring deflectors of the jet nozzle shutter control cylinders;

(b) the guides and pipe for draining fuel from the tailpipe rear section;

(c) the tailpipe attachment shackle; their bolts should be coated with graphite oil prior to installation (Fig.115).

9. Mount the tailpipe on the engine. The tailpipe should be attached to the engine in compliance with the Engine Operating Instructions (align the tailpipe flange notches with those on the engine flange. To mount the flange clamp make use of the notches as well.

The port and starboard engine notches are marked 35Б ЛЕВ. and 35Б ПРАВ. , respectively. When the tailpipe is properly attached to the engine the wider portion of the port engine clamp slot should be positioned horizontally on the right side, that of the starboard engine clamp slot - on the left side.

10. The engine installation over, prime the fuel and oil lines and remove the corrosion-preventive compound from the interior of the fuel system lines proceeding as set forth in the Engine Operating Instructions; check functioning of the air blow-off shutters, fill and prime the hydraulic system in compliance with Para. "Filling Hydraulic System with Fluid", Chapter II, Section One.

11. Having done necessary checks, lock the fuel shut-off cock in the open position with КОК-0.8 wire.

3. CHECKING JET NOZZLE SHUTTERS CONTROL SYSTEM WITH ENGINES INOPERATIVE

The jet nozzle shutters of each engine will be checked for operation in the following order:

1. Make sure all the automatic circuit breakers are OFF and the air blow-off bands are released on both engines.

2. Detach the plug connector from the НР-10А pump hydraulic decelerator of the engine under check and install on the detached part of the connector a dummy connector (with shorting jumpers between terminals "А" and "Г") supplied with the engine tool kit.

3. Detach the connector from the ДСД-2 afterburner fuel low pressure warning mechanism.

4. Connect the ground supply source (24 - 29 V).

5. Turn on the switch bearing the inscription AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ. БОРТОВОЙ, АЭРОДРОМ.).

6. Switch on the following circuit breakers (АЗС) of both engines located on the port panel: AUGMENTED , MAX. (ФОРСАЖ МАКСИМАЛ.) and FUEL SHUT-OFF COCK, OIL PRESSURE (ПЕРЕКР. КРАН, ДАВЛ. МАСЛА).

7. Engage the ground hydraulic pump and build up a pressure of 135±7 kg/sq.cm. on the main hydraulic system.

8. Make sure that when the control lever of the engine subjected to testing is in the STOP (СТОП) position, the jet nozzle shutters are fully open (which corresponds to the idling and augmented ratings).

9. Check operation of the jet nozzle shutters on each engine in turn. To effect this:

(a) move smoothly the engine control lever from the STOP (СТОП) position to the NOMINAL (НОМИНАЛ) position. When the lever covers approximately 23° from the STOP position the nozzle shutters should assume the intermediate position corresponding to the engine nominal rating;

(b) close the air blow-off band and shift smoothly the engine control lever from NOMINAL to MAXIMUM (МАКСИМАЛ). With the engine control lever in the MAXIMUM position the jet nozzle shutters must assume the maximum closed

position which corresponds to the engine maximum rating;

(c) shift smoothly the engine control lever from MAXIMUM to AUGMENTED (ФОРСАЖ) and close simultaneously terminals "1" and "2" on the ДСД-2 pressure warning mechanism connector (a dummy connector with shorting jumpers between terminals "1" and "2" is supplied with the engine tool kit). When shifting from MAXIMUM to AUGMENTED the jet nozzle shutters should move to the respective position within 1.2 - 2.5 sec.

With the control lever in the AUGMENTED position the shutters must occupy the maximum open position, which corresponds to the engine augmented rating.

CAUTION. On the РД-9Б engines featuring the afterburner carburettor ignition, the afterburner ignition coil supply is not interlocked with fuel supply (controlled by the ДСД-2 warning mechanism). Therefore, when operating these engines, prior to setting the control lever to the AUGMENTED position, place a dummy connector into the component part of the ДСД-2 mechanism connector to avoid burning of the КПМ-1А coils.

Notes: 1. The shutters are opened by the pressure of gases emerging from the operating engines. That is why the shutter position should be determined by the position of the rings which control the shutter closing.

2. The engine control lever should be held in the AUGMENTED position for not more than 6 sec., otherwise the КПМ-1А ignition coil and the СП-02 spark plug may be damaged. To switch off the afterburner, move the control lever backward and cut out the dummy connector on the ДСД-2 pressure warning mechanism.

(d) When shifting smoothly the control lever backwards, check the position of the shutters in the MAXIMUM, NOMINAL, and LOW SPEED (МАЛЫЙ ГАЗ) positions. After the lever has passed the MAXIMUM position release the air blow-off band on the engine under testing.

The jet nozzle shutters of the other engine will be checked for operation in the same manner.

10. Couple the two control levers in the STOP (СТОП) position and check the shutters of the jet nozzles for simultaneous shifting in the NOMINAL, MAXIMUM and AUGMENTED positions.

11. Check whether the AUGMENTED position is interlocked with the pressure in the hydraulic system. To this end set the coupled levers to the AUGMENTED position, then completely relieve pressure in the hydraulic system (hold the levers in the AUGMENTED position all the time). Both lamps AUGMENTED on T-6 lamp register must go out and the afterburner ignition coils КПМ-1А must become deenergized.

12. Check to see whether the MAXIMUM and AUGMENTED positions are interlocked with the air blow-off band. To effect this set the coupled levers to the MAXIMUM position in the above manner and release the air blow-off band (with the lever in the MAXIMUM position). The shutters of the jet nozzles should return from the MAXIMUM to the NOMINAL position.

13. Set the coupled levers to the NOMINAL position and close the air blow-off bands on both engines. When the coupled levers are shifted to the LOW SPEED position without releasing the air blow-off bands the jet nozzle shutters should remain in the NOMINAL position. When the air blow-off bands are released the jet nozzle shutters should shift to the LOW SPEED position (the shutters must open fully).

After checking the shutters control, switch off all the energized circuit breakers, cut out the ground supply sources, attach the connectors to the ДСД-2 pressure warning mechanisms and to the hydraulic decelerators of the НР-10А pumps.

The engines fitted with push-buttons for controlling maximum and augmented ratings will be checked as instructed in the Appendix "Control of Engines Featuring Thrust Regulation at Maximum and Augmented Ratings".

4. PREPARING ENGINE FOR FIRST STARTING

Having removed slushing compound from the engine interior and having pumped through the engine pipe lines, inspect thoroughly the installation of the engine on the aircraft, and locking of all fittings. Check the engines and the fuselage bays for foreign objects.

The preparatory procedures for engine starting such as taking safety precautions, cold cranking, starting, warming-up, checking and stopping the engine will be carried out as is outlined in the Engine Operating Instructions.

To facilitate engine inspection and checking of the engine adjustment proceed as follows:

1. Start the newly installed engine for the first time with the engine compartment hatches open and with the fuselage tail section detached. A special device should be provided to support the afterburners.

2. With the engine running check the pipe connections and units of the fuel, oil, vent and hydraulic systems for tightness.

3. After the engine has come to a stop, check and wash the engine oil filter.

4. Attach the tail section of the fuselage, check the attachment fittings, look for any leaks, and release the air blow-off bands that have been closed for attaching the tail section of the fuselage.

Chapter XIV

DISMOUNTING AND MOUNTING AIRCRAFT UNITS

1. STABILIZER

To remove the stabilizer, proceed as follows:

1. Unlock upper and lower portions of the four bolts attaching the stabilizer to the shaft.

2. Turn out the screws and remove the access panel of the bolt securing the stabilizer spar on the shaft.

3. Deflect the stabilizer down for a better access to the nut of the bolt securing the stabilizer spar on the shaft, and unscrew the nut.

4. Unscrew four threaded plugs from below and drift upwards the four bolts fastening the stabilizer to the shaft.

5. Remove the stabilizer from the shaft.

Installation of the stabilizer is the reverse of its removal.

Note: When installing the bolts attaching the stabilizer to the shaft, remember that they bear punch marks corresponding to the place of installation. The bolt with one punch mark is to be installed closer to the aircraft symmetry plane.

2. RUDDER

To dismount the rudder, proceed as follows:

1. Remove the access panel of the rudder bell crank (to the left of the rudder fin).

2. Disconnect the wire connector to the УТ-6Д rudder trim mechanism (in case the mechanism is included in the design).

3. Unlock and remove four bolts attaching the rudder shaft

end to the control lever.

4. Disconnect the bonding links on two rudder attachment units.

5. Detach fabric patches covering access hand holes to the bolts of rudder attachment units.

6. Remove the rudder attachment bolts.

7. Remove the rudder from the fin, by moving the rudder to the left (as viewed in the direction of flight).

Mounting of the rudder is the reverse of its dismounting.

3. AILERON

To remove the aileron, proceed as follows:

1. Release the flap by 25°.

2. Open the balancing hole of the aileron.

3. Remove safety wire and screw out thirty four screws ttaching hermetic fabric to the wing.

4. Disconnect the wire connector to the УТ-6Д rudder trim echanism (only when dismounting the left-hand aileron).

5. Detach the bonding link.

6. Unlock, screw off the nuts and take out the bolts fastning the aileron halves to the control assembly (central).

To gain access to the bolts, detach four fabric patches overing the access holes to the bolts.

WARNING: 1. To save the ball bearings from damage it is forbidden to keep the aileron halves suspended on the dowels of the end units after the removal of attachment bolts from the central units. In exceptional cases the aileron halves may be left on the aircraft after removing central attachment unit bolts, but in such case they should be supported by clamps or supports.

2. A 1-2-mm clearance must be maintained between the beginning of the pin cone and the ball bearing inner ring (Fig.116).

7. Open the inspection panel on the wing-tip fairing, unlock and screw off the aileron end attachment pin.

8. Unlock and screw out the aileron attachment pin on rib No.19 (access from the side of the flap).

Note: The aileron end attachment pins should be screwed out of their seats before the aileron is completely dismounted.

9. Dismount the aileron.

Installation of the aileron is the reverse of its dismounting.

Before installing the aileron inspect and lubricate the attachment pin and the central (cross-member) attachment unit.

4. INTERCEPTOR

Remove the interceptor plate in the following way:

1. Release the flaps by 25° (Fig.118).

2. Deflect the aileron of the wing where the interceptor is dismounted, to a full extent down (Fig.117).

3. Unlock and turn off the nut of the bolt attaching the central unit to the control rod, and take the bolt out.

4. Screw off three nuts from each of the two extreme brackets securing the interceptor.

5. Remove the interceptor.

Mounting of the interceptor is the reverse of its dismounting.

5. FLAPS

To remove the flap, proceed as follows:

1. Release the flaps by 25° (Fig.118).

2. Disengage the hydraulic cylinder rod from the flap.

3. Remove the access panels of the carriage bolts.

4. Unlock, unscrew the nuts and take out two bolts on each side attaching the flap to the carriages.

5. Detach the flap from the wing.

Note: Not to disturb the adjustment, it is advisable to leave the carriages on the wing and to take out only the shaft attaching the flaps to the carriages. To this end remove the access panels of the shafts, turn the bolts out of the brackets and remove the shafts.

Installation of the flaps is the reverse of their dismounting.

6. AIR BRAKES

The air brakes on the aircraft tail part are detached in the following way:

1. Extend the air brakes.
2. Disjoint the tail part of the fuselage from the front one.
3. Disengage the rod of the hydraulic cylinder.
4. Disconnect the bonding link.
5. Open the access panels of the air brake attachment units from the outside and inside.
6. Through the panels unlock and screw out the axle bolts of the air brake attachment units.
7. Dismount the air brake.

Mounting of the air brake is the reverse of its dismounting.

When connecting the hydraulic cylinder rod to the air brakes, pay special attention to the adjustment of the rod eye bolt. The bolt must be adjusted so that the piston rests against the stop in the cylinder when the air brake is pressed against the fuselage skin.

For this purpose the eye bolt must be slightly backed off so that when closed the air brake does not contact the fuselage skin. By gradually screwing the eye bolt in and checking the air brake position relative to the fuselage skin (closing the air brakes by means of the hydraulic system), adjust the air brake closing till it fully contacts the fuselage skin. This done, screw the eye bolt by 1/2 to 1 turn more to obtain slight tension.

WARNING: Excessive tension may entail rupture of the eye bolt, deformation of the air brake or damage of the fuselage skin in the place where it contacts the air brake.

The following must be done to dismount the belly (third) air brake:

1. Extend the air brake.
2. Disconnect the actuating cylinder rod.
3. Disconnect two rods of the drain cock access panel.
4. Open the access panel of the air brake attachment units, unbend lock washers and screw out the bolts attaching the air brake to brackets.
5. Remove the air brake.

Mounting of the air brake is the reverse of its dismounting.

7. BOOSTERS

To dismount the aileron booster, type БУ-13М, proceed as follows:

1. Use the ГА-74/3 control valve to switch off the booster.
2. Reduce the hydraulic pressure to zero and remove the plug from the hydraulic reservoir serving the booster line.
3. Remove the booster access panel on the starboard wing.
4. Disconnect the hydraulic hoses from the booster, install special caps on the booster connections and on hose union nuts.
5. Disconnect two bonding links.
6. Remove cotter pins and screw the nuts off the bolts attaching the actuator rod and the slide valve to the respective control rod and bell crank, and take the bolts out.
7. Screw four nuts off the studs holding the booster journal bearings to the bracket.

Note: Prior to dismounting the БУ-13М booster, note the position of the journals on the bracket. Displacement of journals from the left side of the bracket to the right one, and their turning through 180° are not allowed.

Dismount the booster.

Mounting of the booster is the reverse of its dismounting.

To dismount the stabilizer booster, type БУ-14МС, proceed as follows:

1. Cut the booster off using the ГА-74М/5 valve.
2. Reduce pressure in the hydraulic system to zero and remove the plug of the booster hydraulic reservoir.
3. Remove the booster access panel on the fin.
4. Disconnect the hoses of the hydraulic system from the booster, install special caps on the booster connections and on the hose union nuts.
5. Detach two bonding links.
6. Unlock and screw the nuts off the bolts joining the actuator rod and the slide valve to the respective control rod and bell crank of the stabilizer shaft.
7. Screw four nuts off the studs securing the booster journal bearings to the brackets.
8. Dismount the booster.

Mounting of the booster is the reverse of its dismounting.

When mounting the booster, remember that the БУ-14МС booster is delivered complete with the slide valve rod. In case of replacement the booster must be dismantled alongside with the slide valve rod which may be installed on another booster which will be used on this aircraft.

When installing the slide valve rod, see that the bolt freely enters its hole.

When installing the БУ-13М and БУ-14МС boosters, be sure that:

(a) the longitudinal axis of the booster coincides with those of aircraft bell cranks; the booster shanks freely enter the bell cranks without misalignment. The booster shank should not be jammed in the bell crank fork through the whole range of the actuator rod travel;

(b) erection size from the actuator rod shank axis to the booster head bolt axis is observed. The erection size must be: 390±0.5 mm for the БУ-13М booster, 635.5±1 mm for the БУ-14МС booster;

(c) the bolts of the slide valve rod hinged joint are not excessively tightened. All bolted joints on the booster head must turn along the circumference when actuated with the help of a wrench, whereas the slide valve control rod must easily yield to a hand effort.

After the booster is installed on the aircraft, check the functioning of the duplicating slide valve.

8. LANDING GEAR

Main Leg and Its Wheel

The main leg is removed in the following way:

1. Jack up the aircraft till the wheels are clear of the ground.
2. Detach the hydraulic cylinder rod from the leg.
3. Disconnect the air pipe connections of the brake system from the emergency air bottle (in the shock strut cavity), and remove the pipe attachment unit.

WARNING: While disconnecting the pipes from the emergency air bottle (the shock strut inner cavity) take necessary precautions when letting the air out of the emergency system.

4. Disconnect the electric wiring connector.
5. Detach the landing gear door rod from the shock strut.
6. Disconnect the leg mechanical position indicator.
7. Open the hatch on the lower surface of the wing, unlock and unscrew the nut of the leg suspension axle.

Note: When removing the leg axle, note the position of eccentric bushes in order to preserve the adjustment for installing a new leg.

8. Open the hatch on the wing upper surface and use a special tool to drive the axle out of the bearing.
9. Remove the leg.

Installation of the leg is the reverse of its removal.

To remove the wheel from the main leg, proceed as follows:

1. Jack up the aircraft till the wheel is clear of the ground.
2. Disconnect the brake pipe line at the wheel axle.
3. Unlock and screw the nut off the wheel axle, and slip off the brake drum.

4. Pull the wheel off the axle.

5. Remove the sending unit of the automatic braking mechanism from the brake disk.

6. Detach the pipe from the second brake on its outside.

7. Screw off and drive out three lower bolts securing the brake.

8. Screw off and drive out three upper bolts securing the brake.

When dismounting the brake, disconnect the sending unit of the automatic braking mechanism from the brake disk.

When mounting a new brake, check the coupling of the automatic braking mechanism sending unit for free engagement in the brake disk hole; otherwise, scrape the hole in the disk.

The brake is installed together with the sending unit of the automatic braking mechanism. Therefore, the sending unit is bolted to the brake. After the brake is installed, screw in three upper bolts (without tightening them up), screw in three lower bolts, and then tighten up all the bolts attaching the brake and the sending unit to the disk.

Mounting of the wheel is the reverse of its dismounting.

When installing the wheel, tighten the bearings in the following manner so as to avoid damage:

1. Without tightening the nut (the bearings are not tightened either), turn the wheel by hand to estimate the effort needed to turn the wheel.

2. Proceeding with turning the wheel by hand, screw up the nut finger-tight, and, when tightening the nut by wrench, find the beginning of increasing the effort for turning the wheel; this will be the moment to discontinue the nut tightening.

3. Back off the nut by 1/6 of a turn and lock it.

WARNING: Inadequate estimation of the beginning of wheel turning when tightening the nut may entail excessive tightening of the bearings and render them unserviceable due to heating during braking.

At the same time, make sure that the direction of rotation of the inertia transmitter coincides with that of the wheel.

Nose Leg and Its Wheel

To remove the nose leg, proceed as follows:

1. Jack up the aircraft till the wheel is clear of the ground.

2. Dismount the fuselage cannon.

3. Unfasten the cable of the mechanical position indicator of the leg.

4. Disconnect the air pipe line of the brake system and the electric wiring.

5. Unlock and screw the nut off the leg axle.

6. Drive out the leg axle tapping upon its right-hand side.

7. Detach the leg from the aircraft.

Installation of the leg is the reverse of its removal.

To remove the wheel from the nose leg, do the following:

1. Jack up the aircraft till the wheel is clear of the ground.

2. Disconnect two brake air pipes from the connections.

3. Dismount the sending unit of the automatic braking mechanism.

4. Unlock and screw the nut off the wheel axle.

5. Drive out the wheel axle tapping upon its left side.

6. Remove the wheel.

Mounting of the wheel is the reverse of its removal.

Mounting of the sending unit and tightening of the wheel are performed in the manner prescribed above for the main leg wheel.

9. FUEL TANKS

Tank No.1

To remove fuel tank No.1 from the aircraft, proceed as follows:

1. Drain the tank of fuel.

2. Disconnect all pipe lines from the tank.

3. To gain access to pipe line connections, with the engines mounted on the aircraft, it is necessary to dismount all generator starters, starting panel [redacted] and the hydraulic accumulator of the main system.

The pipe supplying fuel to the engines should be disconnected in the place where the pipe line is connected to the PTC-16 inlet connection. To do this, loosen the clamps and take the pipe line end out of the rubberized fabric sleeve connecting the pipe line to the PTC-16 flow meter.

Dismantling of the pipe connecting tank No.1 with tank No.2 must be done in the place where the clamp of the easily detachable connection is installed.

4. Dismount the sending unit of the float-type fuel level indicator.

5. Dismount float valves of the drop and aft tanks.

6. Remove the gasoline tank out of the fuel tank (this is done after the ПНР-10-9М starting pump has been removed).

7. Strip the units attaching the inverted-flight chamber plate to the panel, and then dismount the lower load-carrying panel between ribs No.9 and No. 15 and the belly air brake.

8. Strip the inverted-flight chamber off the tank. The flexible tube passing inside the tank is disconnected at the outlet pipe connection on the tank wall adjacent to rib No.15. For this purpose, after removing the bolts attaching the inverted-flight chamber plate to the tank and the lower attachment unit of the tank walls, carefully lift the tank lower surface, simultaneously holding the inverted-fligat chamber; work through the port for the inverted-flight chamber.

9. Disconnect pipe lines from the tank vent line connection and remove three bolts securing the connection flange to the tank container.

10. Attach wire KOK-2,25 m. long, to the dowels serving to secure the filler neck plate.

11. Screw lock-nuts and nuts off all dowels fastening the tank to the fuselage.

12. Dismount the tank from the aircraft through the lower hatchway supporting it from above, using the wire fastened to the dowels. When dismounting the tank, take care that the tank connections freely pass through the holes in rib No.15, especially the connection of the fuel pressure pipe line, since the connection is attached to a long portion of the pipe

running from the tank connection to the flow meter.

On dismounting the tank from the aircraft, straighten the tank walls and suspend it in a special container.

Note: Rubber fuel tanks are dismounted and mounted at ambient temperatures not below -10°C. Otherwise, heat the tank during 30 - 40 minutes with warm air (at +60°C) blown into the tank by the МП-44 heater. Before heating the tank, disconnect all pipe lines, remove the fuel level transmitter and float valves.

Mounting of fuel tank No.1 is the reverse of its dismounting. When installing a new tank, check whether the new tank set is complete by comparing it with the replaced tank set.

Before placing the tank into the container, do the following:

1. The outer surface of the tank and the inner surface of the container should be dusted with talc powder after inspecting the glued patches coating the container riveted seams, corners, rubber gasket riveted to the container and covering the container stays and the cover of the lower hatchway. Sharp edges or uncoated rivets are not allowed in the container. Make sure the container plating edges are not bent up.

2. Attach 2.5-m. long wire KOK-2 to all tank dowels. When placing the tank into the container, pass the wire through respective holes in the fuselage. Draw up the tank using the wire till the dowels come out through the holes, then screw the nuts on the dowels without tightening them.

3. Install the inverted-flight chamber into the tank, mount the hatchway cover with the air brake.

WARNING: When attaching the flexible pipe to the connection inside the tank, pull the pipe onto the connection up to the limit collar on the connection (onto the whole length of the fir-tree). Never oil or wet the connection or the inner surface of the pipe. The clamps must be tightened securely.

4. Using a special fixture fill the tank with air up to 0.08 - 0.1 kg/sq.cm. so as to position the tank properly in

the container, with the plugs in all flexible connections of the tank and plates. Then tighten the nuts on the dowels and safety them with locknuts. Fore tightening the nuts make sure that the dowels do not contact the hole edges they pass through; if otherwise, expand the hole.

5. Install all pipe lines to the tank connections and caps on all outlet connections passing through the wall of frame No.15.

Mount all units on the tank in the succession reverse to that indicated for disassembly.

Note: Prior to installing the gasoline tank, use the hole designed for it, and the lower hatchway under the air brake, to make sure the flexible tank walls are not jammed by the lower hatchway cover. Jamming of the tank walls in the fore part is checked through the lower hatchway.

Tank No. 2

To dismount the tank, it is necessary first to dismantle the starter generator of the left-hand engine (to gain access to the place of attaching the filler tube to tank No.1) and starter panel (for access to the tank suspension cable).

Prior to dismounting, drain the fuel, after which tank No.1 must contain not more than 600 lit. of kerosene.

Then proceed as follows:

1. Open the ПНВ-2 pump access panel and dismount the pump with a section of the pipe line from the pump to the tube running in the recess along frame No. 15 upward.

2. From the body of safety valves of the main vent line, remove the safety valve directed backward (the valve hinders the removal of the hatchway cover between frames Nos 15 and 20).

3. Disconnect the filler tube in the place of the clamp of the easy-detachable connection near the pipe union of tank No.1.

4. Disconnect the vent pipe line and wind the wire off the sealing covers of the filler tube and vent line hose.

5. Unfasten the attachment of the lower plate and side dowels.

6. Secure 1.5-m. long wire KOK-2 to the studs and then detach the cable from frame No.18.

7. Remove the cover of the lower hatchway located between frames Nos 15 and 20.

8. Carefully lower the tank through the lower hatchway and take it out of the container, having disconnected tank suspension cables from the dowels on the tank. Cables are to be left on the fuselage.

Notes: 1. When dismounting tank No.2, take care that hermetic covers of the tank connections are not damaged when lowering the tank. For the sake of convenience during the dismounting of the tank, support the covers holding their upper ends, when hoses pass through the covers.

2. While dismounting and mounting the tank, do not break the adjustment of the length of suspension cables.

Mounting of tank No.2 is the reverse of its dismounting.

Before mounting the tank check the condition of the container, riveted seams glued coating, make sure that there are no sharp or bent edges of the container plating.

Check the condition of the rubber gasket serving to seal the container edges contacting the lower hatchway cover. Dust the tank outer surface and the container inner surface with talc powder.

WARNING: 1. The tank is installed without the ПНВ-2 pump.

2. After installing the lower hatchway cover make sure the tank walls are not jammed between the container edges and the cover. Make the check by lifting the tank lower surface and inserting the rounded end of a feeler bar (the feeler bar may be made of a folded pipe, 6x4) between the tank and the container. Be sure the feeler bar touches the container vertical walls all along the hatchway perimeter.

3. Prior to installing the tank, through the holes

for the tank connections, check whether the sealing covers are intact.

Tank No. 3

To dismount tank No.3, proceed as follows:

1. Drain tanks Nos 3 and 4 of fuel.
2. Disjoint the tail unit of the fuselage.
3. Remove the hatchway cover of tank No.3 inside the fuselage tail unit.
4. Disconnect the pipe line connecting tanks Nos 3 and 4. Access is through the hatchway from below.
5. Disconnect the fuel transfer pump from the tank.
6. Disconnect the vent pipe line from the tank.
7. Detach the bonding link.
8. Disconnect two straps attaching the tank.
9. Take the tank out of the tail portion of the fuselage.

Mounting of the tank is the reverse of its dismounting. Having mounted the tank, make sure the clearances between the tank and the fuselage components are not less than 5 mm.

Tank No. 4

Dismount the tank in the following way:

1. Drain fuel out of tanks Nos 3 and 4.
2. Disjoint the tail portion of the fuselage.
3. Remove the cover of the hatchway for tank No.4 in the tail portion of the fuselage.
4. Disconnect the pipe line connecting tanks Nos 3 and 4. Use for the purpose the hatchway from below.
5. Disconnect the filler neck tube from the tank.
6. Disconnect the vent pipe line from the tank.
7. Detach the bonding link.
8. Detach two straps securing the tank to the fuselage.
9. Remove the tank out of the tail portion of the fuselage.

Mounting of the tank into the tail portion of the fuselage is the reverse of its dismounting.

When installing the tanks, the following must be done;

1. Use paste БУ for installing all union nuts and threaded fittings.
2. Use wire КОК-0.8 to safety-wire all threaded connections.
3. All sleeves РМНД used to connect pipe lines must be bonded.

The places on the pipe lines under clamps where bonding links are to be installed, should be cleaned till the metal shines.

On installing the bonding links, coat the excessively cleaned areas with colourless varnish.

After the tanks are replaced and pipe lines are connected, proceed as follows:

(a) drain each tank (separately) of fuel deposit, carefully checking whether it contains impurities or ice crystals in winter time;

(b) test the fuel system for tightness.

Dismounting Sending Unit of PTC-16 Flow Meter

1. Unlock wing nuts on clamps and loosen them so that the clamps may be shifted on the rubberized fabric sleeves.
2. Shift the rubberized fabric sleeve of the PTC-16 sending unit outlet pipe onto the pipe so as to disconnect the outlet branch.
3. Loosen the union nut securing the shut-off valves unit to the pipe, detach the fuel pressure measuring pipe from the connection on the pipe, and turn the latter so that it does not interfere with slipping back the PTC-16 sending unit.
4. Shift the sending unit back freeing its inlet branch of the rubberized fabric sleeve.

Mounting of the sending unit is the reverse of its dismounting.

While installing, never oil or wet connections of the PTC-16 sending unit, pipe ends under rubberized fabric sleeves or inner surfaces of rubberized fabric sleeves.

When tightening clamps with wing nuts, it is necessary after setting the clamps in place to screw the wing nuts finger-tight, then to tighten them by $1\frac{1}{2}$ to 2 turns with flat pliers

and [illegible] them with KOK-0.5 wire. It is the clamp tightening that makes the connection reliable.

Dismounting Sending Unit of Float Fuel Level Indicator

Mounting and dismounting of the sending unit of the fuel level indicator should be done with tank No.1 empty.

The sending unit is dismounted in the following succession:

1. Open the sending unit access panel.
2. Disconnect the electric connector from the body.
3. Turn off the screws securing the flange of the body to the tank plate.
4. Watching through the filler neck, carefully take the float-type sending unit out of the tank.

Mounting of the unit is the reverse of its dismounting.

After the sending unit is installed, use the filler neck to make a visual check for the clearances between the float and the tank wall, and between the float and the walls of the inverted-flight chamber through the whole range of the float travel. In case the float contacts the wall, loosen the screws attaching the sending unit flange to the tank plate, and turn the sending unit, making use of the clearances between the holes in the flange and the screws. Even an insignificant (within a split millimetre) displacement of the flange results in a considerable (up to 15 to 20 mm) displacement of the float.

On mounting the tanks and units of the fuel system, check the fuel system for tightness.

SECTION TWO

ARMAMENT

Chapter 1

GENERAL

1. GENERAL INFORMATION

The MiG-19C carries cannons, rockets and bombs (Fig.119).

It is equipped with three HP-30 cannons: two of them are mounted in the wings at the root ribs and the third one on the right bottom side of the fuselage nose part.

The belt links of all the cannons are collected in the aircraft, while the cartridge cases are extracted outside. The links of the wing cannons are collected in special link collectors and those of the fuselage cannon – in the upper section of a feed box separated from the cartridges by a hinged band.

The cartridges for the wing cannons are placed in the wing nose sections along the wing span.

The cartridges for the fuselage cannon are placed in the feed box and are fed through the feed chute (Fig.120).

Besides, the aircraft carries two rocket pods, type OPO-57K, with eight rockets, type C-5, each.

The rocket pods can be suspended from the aircraft in the following two methods:

(a) with the drop fuel tanks installed;

(b) with the drop fuel tanks removed.

In the first method, i.e. when the fuel tanks are installed, two OPO-57K rocket pods are mounted under the wings (between the undercarriage main strut and the fuselage) on special racks with БД-3-56 locks under the wings.

In the second method, i.e. when the fuel tanks are removed, two OPO-57K rocket pods are secured to the universal racks under the wings instead of the fuel tanks.

At the same time the aircraft can carry two bombs ranging from 50 to 250 kg. These bombs are secured to the universal racks.

To suspend OPO-57K rocket pods (in the second method) use will be made of the same БД-3-56 locks to which drop fuel tanks are suspended, the locks being shifted from the wings to the universal racks.

The АСП-5Н (model В3 or В4) automatic gun sight (Fig.121) operating in conjunction with the СРД-1М radar ranging unit is mounted in the aircraft to deliver aimed fire from cannons and rocket pods as well as to ensure aimed bomb release with the aircraft diving. The АКС-3М (or АКС-5) camera mount and СМ-45 camera controller are designed to check the results of firing and accuracy of sighting.

Fire control from cannons and rocket pods as well as bomb release are exercised by a push-button arranged in the aircraft control stick (Fig.122).

2. SAFETY PRECAUTIONS

The armament should be operated with due care so as to avoid accidents.

When inspecting, testing or preparing the armament for use make sure all circuit breakers and switches are off and the seat ejection gun is locked (both by main and ground safety locks).

Chapter II
PRE-FLIGHT INSPECTION

The pre-flight preparation of the aircraft armament follows the post-flight preparation and includes the following operations:

1. Checking weapon units for proper condition.

Note: If the pre-flight preparation is carried out immediately after the post-flight preparation the condition of weapon units may not be checked.

2. Sorting out cartridges and links, loading cartridge belts before placing them in the aircraft.
3. Preparing bombs, fuzes, mechanical fuzes and bomb fuze control rods.
4. Loading the cannons and charging the ЭКСР-46 electrified signal flare launcher and camera mounts.
5. Suspending and fuzing the bombs.
6. Suspending and loading the OPO-57K rocket pods.
7. Inspecting the aircraft before take-off.

1. INSPECTION OF ARMAMENT UNITS

Before checking the armament units make sure that:

(a) all weapons are unloaded;

(b) seat ejection gun is locked (by main and ground safety locks);

(c) all circuit breakers, switches and push-buttons are off.

With this in view, connect the ground power supply to the aircraft electric mains and check the voltage in the aircraft electric mains which should be within 24 -27 V and the

air pressure in the aircraft air system which should be within 110 - 130 kg/sq.cm. This preliminary work being done, proceed to checking the armament units.

Fuselage Nose Section

1. Open the cover of the upper nose compartment and make sure that the time setting handle of the BM-2 timing mechanism (for the AKC-3M camera mount) is set in the predetermined time position and the changeover switch is in the ON position.

2. Remove the hatch cover and inspect the AKC-3M camera mount for secure fastening and proper condition. Check it for proper functioning with the circuit breakers bearing the inscriptions CAMERA CONTROLLER (ФКП), FIRE CONTROL BUTTON, CAMERA CONTROLLER (КНОПКА ОРУЖИЯ, ФКП) switched on and the fire control button pressed. After this proceed as follows:

(a) wind up the clock of the AKC-3M camera mount;

(b) set the diaphragm in accordance with the weather conditions and film sensitivity and mount an appropriate light filter;

(c) install a loaded film holder in the camera mount. See to it that the cover of the camera mount fits tightly;

(d) examine the protective glass of the camera mount and make sure it is free of damage, dirt and stains.

Note: Operation of the AKC-3M camera mount and the BM-2 timing mechanism should be checked by ear.

Position the hatch cover in place.

3. By external visual inspection make sure that the attachment points of the fuselage cannon, localizer and gas exhaust duct are in proper condition.

Check the localizer openings for proper location with respect to the fuselage skin (Fig.123).

4. Inspect the assemblies of the air system, power supply system, cartridge case and link ejection sleeves, cannon wiring and check them for proper fastening. See to it that the plug connector is tightened up and locked on the electric trigger.

5. Check the feed box for secure fastening by the screw locks.

Right Wing

6. By external visual inspection make sure that the attachment points of the right wing cannon, gas exhaust duct and localizer are in proper condition.

7. Inspect the assemblies of the air system, power supply system, cartridge case and link ejection sleeves and cannon electric wiring for proper condition and secure fastening.

8. Check the cannon feed chute for sound condition.

Tail Unit

9. Inspect the ЭКСР-46 electrified signal flare launcher.

Left Wing

10. Examine the left wing in the order prescribed for the right wing.

Bombs and Rockets

11. Before suspending the bombs and ОРО-57К rocket pods from the aircraft, check the racks for secure fastening, operation of the БД-3-56 bomb racks through the ARMED (ВЗРЫВ) and SAFE (НЕВЗРЫВ) service and emergency circuits; also check the warning lamps for condition.

To check the proper functioning of the bomb racks from the ARMED service release circuit proceed as follows:

(a) Cock the БД-3-56 bomb rack lock with a special wrench. Suspend dummy bombs from the carrying lever and insert the cable ring into the ARMED - SAFE (ВЗРЫВ - НЕВЗРЫВ) position of the lever.

(b) Switch on the storage battery and the two circuit breakers bearing the inscriptions BOMBS (БОМБЫ) and ARMED - SAFE. See to it that two warning lamps (green) with the inscriptions BOMB SUSPENSION LAMPS (ЛАМПЫ ПОДВЕСКИ БОМБ) light up.

double switch with the inscription SERVICE RELEASE, ARMED (ТАКТИЧЕСКИЙ СБРОС, ВКЛЮЧ.НА ВЗРЫВ) engraved on the plate below the instrument panel; as a result a red lamp with the inscription ARMED will light up.

(d) Set the handle of the sight selector switch in the BOMBS position.

(e) Depress the service release button arranged on the aircraft control stick; as a result, the load-carrying lever of the carrier opens, bomb suspension lamps go out and the cable ring remains in the ARMED - SAFE lever. Cut off the circuit breakers and the switch.

To check the proper functioning of the carrier racks from the bomb release emergency circuit in the ARMED position, proceed as follows:

(a) Cock the bomb rack look with a special wrench. Suspend dummy bombs from the carrying lever and bring the cable ring into the ARMED - SAFE lever.

(b) Cut in the circuit breakers bearing the inscriptions EMERGENCY BOMB RELEASE, TANK DROPPING (АВАР.СБРОС БОМБ, СБРОС БАКОВ), BOMBS and ARMED - SAFE; as a result two green pilot bomb suspension lamps will light up.

(c) Cut in the double switch bearing the inscription SERVICE RELEASE, ARMED; as a result the red lamp bearing inscription ARMED lights up.

(d) Depress the button arranged on the left side of the cockpit panel, under the canopy windshield; see to it that the carrying lever of the rack opens, bomb suspension lamps go out and the cable ring remains in the ARMED-SAFE lever, which testifies to the proper operation of the rack.

Cut off the circuit breaker and the switch.

Check the operation of the carrier racks from the emergency circuit in the SAFE position. Proceed as outlined above (except Item c). In this case do not cut in the double switch bearing the inscription SERVICE RELEASE, ARMED. Check to see whether lever ARMED - SAFE of the carrier rack opens and the cable ring falls out of the lever when the button arranged on the panel under the windshield is depressed. Next close the hatches of the rack with a cover and cut off the bomb armament circuit breaker.

12. Inspect the rocket pod release system in the following order:

(a) secure the locks of the БД-3-56 carrier racks;

(b) cut in the circuit breakers bearing the inscription EMERGENCY BOMB RELEASE, TANK DROPPING.

(c) Depress the rocket pod release button and make sure the carrier locks open.

13. Check the rocket pod fire control system for proper operation by means of a control device available in the set of the ПУ-2 control device. For this purpose, proceed as follows:

(a) Suspend the pods from the racks.

CAUTION! In no case it is allowed to check the operation of the pods loaded with rockets.

(b) Cut in the circuit breakers bearing the inscription ROCKETS (РС).

(c) Set the ПП-45 fire selector switch arranged on the left control panel in the required positions: single shot, four-shot salvo or stick firing.

Note: Check the operation of the rocket pods in all three positions of the selector switch.

(d) Set the handle of the sight selector switch in the ROCKETS position.

(e) Insert the jumpers into the rocket pod sockets by connecting the plus and minus leads in each pair of contacts (each pair of contacts being for one barrel).

(f) Depress the landing gear warning light checking button on the ППС-2 panel and keep it pressed all the time until the checking of the rocket pod operation is over.

(g) Depress the firing button arranged on the aircraft control stick; as a result each time when pressing the button the lamps on the rocket pod signal device should go out in turn (during single shots), or almost four lamps together (in case rockets are fired in fours), or all the lamps (during stick firing).

After the fire control system is examined, cut off the circuit breakers, which have been cut in for checking purposes and remove the rocket pods.

14. Make external visual inspection of the sight head and check:

(a) armoured glass of the cockpit, light filter, reflector and objective. Make sure they are free of cracks, dust, dirt and oil spots.

In case dirt is detected wipe out the above parts with a piece of flannel wetted in rectified alcohol;

(b) reflector, light filter and objective for proper condition;

(c) reflector and objective for secure fastening and the light filter for proper locking in operating and travelling positions;

d) illumination rheostat knob for smooth rotation, the mirror and locating surfaces for proper adjustment and locking in any position and the sight cover for tight closing;

(e) silica gel (if any) for proper condition. It should be blue-coloured;

(f) sight head for secure fastening to the bracket.

15. To check the operation of the sight (it should be checked along with the СРД-1М radar ranging unit):

(a) remove the casing from the antenna of the СРД-1М radar ranging unit;

(b) cut in the circuit breaker bearing the inscription SIGHT HEATING, SIGHT (ОБОГРЕВ ПРИЦЕЛА, ПРИЦЕЛ) on the right control panel and after 7 - 15 minutes the circuit breakers with the inscriptions SIGHT and RADAR RANGING UNIT (РАДАЛЬ).

CAUTION! Do not cut in the ratio range finder until the sight circuit breaker is on.

(c) Set the change-over switch RADAR - OPTICAL (РАДИО - ОПТИКА) in the OPTICAL position, and the weapon switch in the CANNON (НР) position.

(d) Set the casing knob in the GYRO (ГИРО) position.

(e) Make sure the potentiometer range hand manual control knob on the control lever of the right engine rotates easily and smoothly within the minimum and maximum range limits; in this case the range finding ring diminishes in size and the sight reticle deflects downwards which indicates that the angle of elevation is being set.

Make sure that the range and time scales of the computer and the pointer of the range indicator should displace; as a result the readings of the range on the indicator and those of the computor are aligned (within tolerance limits).

(f) Make sure that when the illumination rheostat knob is rotated, the brightness of the sight reticle changes from full brightness to complete dim-out.

(g) Make sure that when the locating knob is rotated to increase the locating surfaces, the range finding ring increases too, and vice versa, decreases when the locating knob is rotated so as to decrease the locating surfaces.

(h) Make sure that the sight reticle displaces downward with rotation of the mirror angle setting knob from zero to maximum and returns in its initial position when the knob is released.

(i) Make sure that with the sight switch shifted from НР-30 to the РС position the sight reticle moves down and the time computer scale is displaced.

(j) Make sure that when the damping knob (on the aircraft control stick) is pressed, the sight reticle moves up and when the knob is released, it goes down, with the maximum range value set.

(k) Check the СРД-1М radar ranging unit for proper condition. Set the RADAR - OPTICAL switch in the RADAR position, open and close the antenna with the casing two - three times; as a rule, the radio range finder locks on GROUND (ЗЕМЛЯ) and the green lamp LOCK ON (ЗАХВАТ) on the sight head burns steadily. This may result in a sharp jump of the sight central point and a change in the size of the range finding ring.

(l) Check the target release circuit of the СРД-1М radar ranging unit by pressing the RELEASE knob provided on the sight head. See to it that the green lamp LOCK ON goes out and when the knob is released, lights up.

Cut off the radio range finder and the sight in the order reverse to the cutting-in procedure.

16. Make sure that the cannons, cartridge counter and the warning lamps of "ready-to-fire" system are in proper condition, for which purpose:

breakers with the inscriptions FIRE CONTROL BUTTON, CAMERA CONTROLLER and CANNON (ПУШКА), LEFT (ЛЕВАЯ), MIDDLE (СРЕДНЯЯ) and RIGHT (ПРАВАЯ).

(b) Reload each cannon separately (See Fig.122), for which purpose press the charging buttons (placed on the left side of the cockpit), in turn with 2 to 3 second time delay. Reloading should be performed energetically. As a result, the cannon "ready-to-fire" warning lamps provided on the round counters should light up.

CAUTION! In this case reloading of the cannons with live ammunition is strictly prohibited.

Cannons should not be reloaded if air pressure in the aircraft supply line is below 40 kg/sq.cm.

(c) By cutting in the circuit breakers CANNONS, LEFT, MIDDLE, RIGHT and pressing the fire control button, arranged on the aircraft control stick, release the locking mechanism of each cannon in turn; see to it that the cannon "ready-to-fire" lamps are in sound condition, i.e. the lamp should go out and the dial of the round counter should turn by one division.

(d) Clean the cannon barrels when the locking devices are in extreme rear position, check the cartridges and load the cannons.

17. Check the ЭКСР-46 electrified signal flare launcher for sound control by means of a pilot lamp.

For this purpose:

(a) Turn out the coupling screw and withdraw the gang of the barrels with the magazine of the electric squib from the casing.

(b) Cut in the switch on the electrified signal flare launcher control panel.

(c) Connect one lead of the pilot lamp to the minus spring contact arranged on the housing cover. See that the pilot lamp lights up when the second lead of the pilot lamp is connected to the plus spring contacts and the appropriate knob on the signal flare launcher control panel is pressed.

(d) After checking set the switch in the OFF (ВЫКЛ.) position, load the signal flare launcher and see to it that

the casing of the signal flare launcher is securely fastened to the fuselage.

18. Examine and make sure that the covers of the access doors to the cannons and to the link collectors are securely closed and the barrel fairings are properly fastened.

19. Make sure that the covers are removed from the barrels.

2. SORTING OUT CARTRIDGES AND LINKS, FILLING CARTRIDGE BELTS BEFORE PLACING IN AIRCRAFT

To ensure trouble-free operation of the cannons, exclude rupture of the barrels and other troubles caused by the use of low-quality cartridges, all ammunition before filling the belts, should be thoroughly examined and sorted out.

The cartridges and links should be rejected, if one of the following troubles is revealed:

1. Damaged or loose fuse discs.
2. Loose ballistic caps.
3. Cracks on cartridge case mouths observed with the naked eye.
4. Rotating and loose shells in cartridges cases.
5. Corrosion on igniting primers, shells and links.
6. Corrosion on fuzes at places where discs are pressed in.
7. Improper fitting of igniting primer.
8. Dents on cartridge cases.
9. Cartridges extracted from cannons.
10. Cartridges without certificate or powder certificate cards.
11. Cracks on links or links with increased pitch.

Clearance between the cartridge case and the hook should not exceed 3.5 mm (Fig.124).

The cartridges available in the aircraft ammunition allowance may be slightly lubricated with grease of the same grade used for the cannon. Lubricant is applied with a piece of cloth soaked in grease and wrung out so that a very thin film of grease will remain on the cartridge surface.

To exclude stoppages of the cannon firing due to the fouled cartridge chamber, the cartridges should be free of sand, rust and the like. Ammunition should be cleaned with

a piece of cloth. A clean piece of cloth may also be used to remove corrosion from the cartridge surface. In no case should emery paper or sand be used for cleaning purposes.

Before packing the cartridge belts in the aircraft, check to see that the inner walls of the feed boxes are clean and dry, and the filled and straightened cartridge belt is sufficiently flexible.

The belts for the fuselage cannon should be placed in the aircraft in accordance with the layout fastened on the feed box, and for the wing cannons - in the wing leading edges, as shown in Fig.120.

To avoid jamming of the cartridge belt in the feed box and in the fuselage cannon feeding sleeve, it is necessary to pack a prescribed number of cartridges, i.e. 55 cartridges.

Prepare for wing cannons the ammunition allowances, consisting of 73 cartridges each.

The belts should be filled with the cartridges of the same lot number, year of manufacture and Manufacturing plant. The remainder of unused ammunition which should be used either to replenish the ammunition allowance of other aircraft, equipped with the cartridges of the same lot number, or for practice firing.

3. PREPARING BOMBS, FUSES, DISTANT-ARMING DEVICES AND BOMB FUZE CONTROL RODS

Inspect bombs, fuzes and distant-arming devices. Select the control rods to fit the calibre of the bombs used.

Examine the control rods to make sure they are in good condition, having first removed lubricant from the surface of the rods.

The bent rods with a plate-to-hook end clearance above 0.5 mm, oval-shaped ARMED - SAFE rings (having a smaller diameter of 15 mm) and ruptured closing caps should not be used for operation and must be replaced.

Note: Bending of rods and oval-shape of ARMED - SAFE rings may be corrected.

4. LOADING CANNONS, CHARGING ELECTRIFIED SIGNAL FLARE LAUNCHER AND CAMERA GUNS

Before loading the weapon units take precaution measures and make sure the units are in proper condition.

Loading of Wing Cannon

1. Open upper and lower cannon access hatches (Fig.125).
2. Remove the feeding mechanism from the cannon.
3. Install the cartridge belt pulling drive on the place where the feeding mechanism is positioned.
4. Open the door located at the wing tip and insert a cleaning rod (Fig.126) into it so that its end together with a carriage moves close to the cannon.
5. Connect the drive cable to the end of the rod, then draw the drive cable to the lower door at rib No.24 and disconnect the cable from the rod.
6. Withdraw the rod from the ring and pull the drive cable down.
7. Carry the bell packed in the cartridge case under the wing and connect the end of the drive cable to the link of the belt extreme cartridge.
8. Pull the cartridge belt to the feed chute by rotating the drive handle.
9. Remove the drive from the cannon and, lifting the drive, pull the cartridge belt to the feed block of the cannon. Then disconnect the drive cable from the link of the cartridge belt.
10. Install the feeding mechanism and leave it in thrown-back position.
11. Release the locking mechanism from the single sear.
12. Insert the cartridge belt into the feed block of the cannon so that the first link rests with its front and rear lugs on the guides of the remover and is positioned along the cannon axis above the feed port or is offset by not more than 3 - 4 mm beyond the cannon axis in the direction of the feed.

Note: Connect an empty link to the cartridge belt for the left cannon.

close the feeding mechanism of the cannon and make sure that the body catches are properly engaged.

CAUTION! Check the electric trigger for proper position. The electric trigger should be securely locked by the feeding mechanism. Check to see that the armature cover is securely locked on the electric trigger.

14. Close the cover of the feeding chute neck and all the hatches which have been opened for loading the cannon.

Loading of Fuselage Cannon

1. Open the weapon door and take the feed box off the aircraft. Open the cover and unfasten the flexible belt. Then place the cartridge belt into the feed box according to the layout so that the cartridges do not protrude beyond the face of the feed box guide-way.

Fasten the flexible belt, close the cover and secure the cartridge belt with a lock arranged on the feed box guide-way.

2. Release the locking mechanism from the single sear.

3. Open the feed chute hatch of the cannon.

4. Install the feed box in the aircraft and lock it.

5. Unlock the cartridge belt, pull it out of the box through the feed chute and connect a blank link to the belt.

6. Hook the blank link on a special device and push it abruptly home in the feed block so that the blank link rests with its front and rear lugs on the guides of the remover and is positioned along the cannon axis above the feed port by not more than 3 to 4 mm in the direction of the feed.

7. Close the hatch hole in the feed chute and cannon access hatches.

After the cannons are loaded, set the cartridge counters on divisions corresponding to the number of the cartridges loaded.

CAUTION! Reloading to feed breech-block extractor with a cartridge should be accomplished by the pilot in flight.

Loading of Electrified Signal Flare Launcher

Before loading the ЭКСР-46 electrified signal flare launcher, inspect the signal cartridges and electric squibs.

Check to see that the bodies are free of dents or rust and the igniting primers and signal cartridges have no dark spots or any other defects, which might cause failure in operation. After inspection of signal cartridges and the electric squibs, cut off the ultra-violet illumination lamps АРУФОМ, circuit breaker portable lamp, flares and make sure that the switch on the control panel is off and the signal control buttons are in initial position.

Note: No work is allowed in the pilot's cockpit while loading the electrified signal flare launcher.

The following procedure should be adopted to load the electrified signal flare launcher:

1. Release the coupling screw of the electrified signal flare launcher from the ratchet pawl, turn out the screw and take the electrified signal flare launcher (the gang of the tubes together with the magazine) out of the case.

2. Pull the container 6 to 8 mm away from the tube gang, turn it through 90° and wipe dry the launcher tubes.

3. Insert the signal cartridges into the tubes according to the colour-painting applied to the end faces of the gang tubes.

Set the container and the tube gang in the initial position.

4. Open the sockets designed to receive the electric squibs, turn the handles of the spring clips, insert the electric squibs into the sockets and turn the handles of the spring clips through 90°.

5. Insert the loaded guns into the case of the electrified signal flare launcher and, pressing the launcher with the left hand, turn in the coupling screw right home and lock it with a ratchet pawl.

CAUTION! Do not stand in front of the launcher tubes when installing the loaded gang in the casing.

Loading of АКС-3М (АКС-5) Camera Mount (Fig.127)

1. Turn out the camera mount attachment screws and remove the cover.

4. Open the cover of the camera mount and remove the holder.

3. Set the diaphragm according to weather conditions and film sensitivity, and install an appropriate light filter.

4. Insert the charged holder into the chamber and close the cover. See to it that the cover of the camera mount fits tightly in its place.

5. Reinstall the hatch cover in its position and secure it with screws.

Loading of СШ-45 Camera Controller

1. Open the cover of the СШ-45 controller and withdraw the holder from the chamber.

2. To load the controller:

(a) insert the loaded magazine; see to it that the film covers the aperture;

(b) set the signal disc sleeve lugs so that the blade of the driven bobbin enters the space between these lugs and then close the cover;

(c) by shaking the film rewinding signal washer make sure that the blade is between the lugs of the film rewinding signal washer.

3. Close the cover of the device and lock it with a clasp.

5. SUSPENSION AND FUZING OF BOMBS

Before suspending the bombs, make sure that the universal rack and the БД-3-56 carrier are in proper condition. Bombs ranging from 50 to 250 kg in calibre (Fig.128) can be suspended from these carriers.

To suspend the bombs:

1. Make sure that all the circuit breakers and the bomb switch are off.

2. Install the bomb rests on the universal rack and release the tips of the bomb rests by turning them counter-clockwise, thus making necessary clearances for suspending the bombs.

3. Cock the rack carrier lock and insert the ARMED - SAFE ring of the УВП-И fuze rod into the lock.

4. Carry a bomb on a special cart, type БТП-15, to the universal rack (as described in the cart operation instructions), bring the bomb suspension lug in the span of the lock carrier lever and make sure that the lock does not open when the cart drawbar is lowered.

5. Turn the bomb rests until they touch the bomb body, and if the bomb is coaxially positioned with the rack, release the bomb rests so as to have a clearance of 0.3 to 0.5 mm between the bomb body and the end face of the bomb rest.

6. Charge the bombs with the bomb fuze control rods according to the respective instructions.

When the bombs of 50 to 100 kg calibre are used, the stabilizer rests against the rear bomb rest under the ОРО-57К rocket pod. Therefore the rear rest should be screwed out of the universal rack before suspending the bombs.

To ensure accurate installation of the rest during bomb suspension, make setting notches on the threaded part of the adjusting bushing (under the locknut) and on the attachment point before unscrewing the rear rest. This will make it possible to adjust the ОРО-57К rocket pod for accurate fire after reinstalling the rear rest.

Notches should be made by means of a chisel, punch or by another tool with subsequent removal of burrs from the threaded portion of the bushing. An identification mark should be made on the bomb rest so that it could not be mixed up with another rack.

Note: In the aircraft of 1958 make setting notches and numbers on the racks are engraved by the Manufacturing plants.

6. SUSPENSION AND LOADING OF ROCKET PODS

The rocket pod suspension either from the left or right wing and from the universal or special rack is identical (Figs 129 and 130).

CAUTION! 1. In no case it is allowed to suspend the pods loaded with rockets.

...ring suspension and loading of the rocket pods the circuit breakers with the inscription ROCKETS (P.C.) and bomb armament should be cut off.

3. Prior to the rocket pod suspension, check the БД-3-56 rack carriers for proper operation and secure fastening of the racks.

Suspension of Rocket Pods

To suspend the rocket pods, proceed as follows:

1. Turn the ear out of the rocket pod approximately through 10 mm by rotating the adjusting bushing clockwise.

Note: The ear should be turned out so that the pod rests (front and rear) do not impede the entrance of the ear into the span of the hook of the БД-3-56 carrier.

2. Suspend the rocket pod from the carrying hook of the БД-3-56 carrier.

3. Remove the hatch covers from the upper fairing.

4. Insert the plug arranged on the rocket pod into the ШР-9 socket located on the rack.

5. Tighten the rocket pod to the rack by turning the adjusting bushing counter-clockwise with a special torque wrench. Tighten it up until the wrench begins to slip (Fig.131).

Note: When tightening up the rocket pod, see that the front and rear rests of the rocket pod are positioned in the respective places of the rests located on the racks.

Loading of Rocket Pods

The following procedure should be adopted, when loading the rocket pods:

1. Remove the rear fairing (Figs 132 and 133). For this purpose proceed as follows:

(a) pull back the catch of the fairing;

(b) turn the rear fairing by 30° counter-clockwise;

(c) pull the rear fairing and take it off.

2. Remove the breech-block (Figs 134 and 135). For this purpose proceed as follows:

(a) release the catch of the breech-block nut by pulling it down;

(b) turn the nut of the breech-block by the handle 90° counter-clockwise;

(c) pull the breech-block and take it out.

3. Take the rocket holders out of the tubes.

4. Clean the tubes and the rocket holders from grease and dirt.

Note: Special cleaning rod with an ejector should be used for removing the rocket holders and cleaning the tubes.

5. Pull the case half the way off the stabilizer fins and clean the positioning bands of paper and grease.

6. Remove the cover and check the stabilizer fins for proper opening.

CAUTION! It should be borne in mind that the stabilizer fins sharply open under spring action. Therefore carefully pull the cover, holding it by the base with hands stretched out so as to avoid injury.

After checking is done, fold the stabilizer fins and put the cover on.

7. Turn the plug out of the fuze hole. Check the threading of the fuze hole and turn the fuze in place.

Note: When the rockets with inert caps are loaded fuzes should not be fitted.

8. Pull off the case again and push the rocket into the tube so that the stabilizer partially comes into the bore and then remove the case.

9. Tear the thread tying up the rocket contact wire and unwind the wire. Inspect and make sure the wire and the plug are free of defects.

10. Fit the holder on the rocket base. Drive the rocket with the helder into the tube until the holder collar rests against the end face of the tube. See that the wire and the key of the rocket holder enter the slot of the tube.

11. Insert the plug into the appropriate socket arranged on the body of the rocket pod (the connection diagram is provided on the upper part of the rear fairing). All eight tubes should be loaded in the same manner.

Notes: 1. When loading the middle tube fit a holder onto the rocket base. This holder differs from other seven holders by its shaped key.

2. If the rocket fails to freely enter the tube it means that the holder is fitted improperly.

12. After all rockets are loaded in the tubes, reinstall the breech-block, close it and mount the rear fairing.

13. Reverse the procedure when installing and closing the breech-block and the rear fairing. The catches of the breech-block nut and the fairing lock automatically.

7. PRE-FLIGHT INSPECTION

Note: Preflight inspection is carried out on completion of the general preparation of the aircraft prior to take-off.

1. Open the cockpit canopy and make sure that the seat ejection gun and the trigger levers are safe-locked and the seat blind grip and the trigger levers arranged on the seat handrails are locked.

2. Check the flexible safety pin for proper condition and interlocking with the head of the seat ejection gun.

3. Check the position of circuit breakers, fire control and bomb release button, service release button, flare launcher knob and sight switch.

4. By external visual inspection make sure that the position of the radio range finder switches and that of the rocket control switch on the control box correspond to the position of the range finder and rockets installed on the aircraft.

5. Perform external visual inspection and make sure that:

(a) armoured glass, light filter, reflector and objective are clean;

(b) illumination rheostat knob as well as the mirror and locating surface angle setting knobs smoothly rotate and are securely [illegible] in any position;

(c) sight reticle lighting device operates normally;

(d) sight head is securely fastened to the bracket.

6. Open the cover of the upper nose section and make sure that the time setting knob of timing mechanism BM-2 is set at a predetermined time division and the switch = in the ON position.

7. Check the rear fairing of the OPO-57K rocket pod for secure fastening, for which purpose turn it around its axis and pull it back without retracting the fairing catch.

8. Check the MV-2 fire control device and TUBES LOADED warning unit in the rocket pods for secure fastening.

9. By external visual inspection check the fastening of the universal rack or rack carrier.

10. By external visual inspection check the front and rear attachment points of the rocket pods both on the rack carrier or the universal rack as well as the front and rear rests on the rocket pods for proper condition.

11. Make sure that the bombs are fuzed according to the flight assignment and the fuzes are of proper set (in case the bombs are suspended).

12. Check the ARMED - SAFE rod for proper installation with respect to the bomb and the stabilizer and make sure that the rod snap-hooks are securely fastened to the shackles of the distant-arming devices.

13. Inspect and make sure that the covers of the cannon and link collector access hatches and the cartridge belt hatches are securely locked and the tube fairings are properly fastened.

Chapter III

POST-FLIGHT INSPECTION

1. GENERAL

All necessary precautions should be taken when unloading the cannons, OPO-57K rocket pods and ЭКСР-46 electrified signal flare launcher or removing undropped bombs after landing of the aircraft.

2. REMOVAL OF UNDROPPED BOMBS

The following procedure should be adopted to remove bombs if the aircraft has not taken off for any reason or upon arrival of the aircraft from a mission.

1. Standing at the side of the bomb detach the snap-hook of the УВП-И vane control rod from the shackle of the distant-arming device and screw the safety cap on the distant-arming device.

2. Holding the device with the hand, turn the fuze together with the distant-arming device out of the bomb hole first by means of a wrench and then with the hand. Remove the distant-arming device from the tail section, tighten up the fuze vane until it rests against the safety lock and then place the distant-arming device and the fuze in the packing boxes.

CAUTION! Take necessary precaution measures when handling the fuzes.

3. Drive the bomb loading cart to the wing. Lift the elevating rod to a height (permissible by the wing plane) so that a clearance of 90 to 150 mm is left between the wing surface and the roller holders.

4. Fasten the elevating band on cables and draw it to the bomb with the aid of a winch.

5. Slacken the lock nuts of the rests and turn in the rests all the way up.

6. Holding the bomb by the stabilizer, lift it slightly with the winch.

7. Release the rack carrier drive, and carefully lower the bomb on the cart cable bands and move the cart aside.

Note: It is more convenient to start the БТП-15 cart from under the wing rearward.

8. Remove the rods from the locks having first taken the rings out of the slots in the ARMED - SAFE levers of the rack carrier.

3. UNLOADING AND REMOVAL OF ROCKET PODS

Unloading of Rocket Pods

If the flight has been suspended or the aircraft has returned from the mission with the rockets, the pods should be unloaded in the following order:

1. Make sure that the circuit breaker with the inscription ROCKETS (РС) and the AIRCRAFT OR GROUND STORAGE BATTERY (АККУМУЛ.БОРТОВОЙ, АЭРОДРОМ) switch are off.

2. Remove the rear fairing.

3. Remove the breech-block.

4. Take the plugs of the rocket ignition cords out of the terminal sockets provided on the pods.

5. Push the rocket out of the tube so that the stabilizer fins are kept closed, i.e. their ends remain in the tube (by means of the cleaning rod staff and the unloading rammer).

6. Take the holder off the rocket.

7. Put a case on the rocket.

8. Withdraw the rocket all the way out of the tube, simultaneously placing the case on it. Substitute a plug for the fuze and place the rocket in a box.

The unloading procedure for the other seven tubes is the same. Any tube may be chosen first for unloading.

Removal of Rocket Pods

The procedures for removing the rocket pods from both wings and from both racks are identical.

CAUTION. 1. In no case it is allowed to remove the loaded pod; unload the rocket pod prior to removal.

2. During removal of the pods it should be borne in mind that during opening of the lock nothing retains the unloaded pod (without rockets), weighing, 36 kg, from falling down.

To remove the rocket pods, proceed as follows:

1. Open the cover on the upper fairing of the rocket pod and disconnect the plug from the socket.

2. Remove the OPO-57K rocket pod, for which purpose:

(a) open the inspection hole of the БД-3-56 carrier on the rack;

(b) holding the rocket pod, open the lock of the БД-3-56 rack carrier and remove the pod.

Note: The lock of the БД-3-56 rack carrier can be opened by pressing the pedal on the upper tooth of the electromagnet sector.

4. UNLOADING OF CANNONS

To unload the cannons (both wing and fuselage ones), proceed as follows:

1. Check the number of cartridges left in the cannon by the cartridge counter and determine the position of the recoil group.

2. Open the cannon access hatches (the upper one for the wing cannon and the lower one located on the left side of the fuselage for the fuselage cannon).

3. Throw open the covers of the cannon feed chute.

4. Open the hatches of the wing link collectors and withdraw the links. For the fuselage cannon, remove the feed box and take the links out. This over, proceed to extracting the cartridge case or the cartridge out of the bolt extractor.

With Complete Expenditure of Ammunition

When the ammunition is used up, the locking mechanism with the cartridge case is in the forward position. To extract the cartridge case, proceed as follows:

1. Reload the cannon to sear the locking mechanism.

2. Open the feed mechanism.

3. Withdraw the cartridge case or the cartridge upward by a wire loop or push it out of the breech-block extractor from below through the case ejection chute (in the fuselage cannon the cartridge case or the cartridge is pushed through the case ejection chute).

4. Close the feed mechanism and release the locking mechanism from the cocking cam.

With Incomplete Expenditure of Ammunition

1. If the locking mechanism is fixed by the single-shot sear with the cartridge in the bolt extractor, check the position of the barrel and locking mechanism assemblies.

If the cannon mechanisms function properly proceed to unloading the cannon, in the following order:

(a) open the feed mechanism;

(b) disconnect the cartridge belt in the feed block and pull its end out;

(c) remove the link stripper and the head of the link ejection chute (for the fuselage cannon);

(d) withdraw the cartridge from the bolt extractor in the same manner as the cartridge case is extracted.

CAUTION! Take care not to drop the cartridge to avoid puncturing of the primer.

(e) if there is no cartridge in the bolt extractor, close the feed mechanism and release the locking mechanism.

2. In case a torn piece of the cartridge belt remains for any reason in the wing nose section and cannot be removed with hands, proceed as follows:

(a) open the lower wing hatch located at rib No.24;

(b) remove the necessary panels in the wing nose section to provide access to the torn piece of the cartridge belt;

(c) by manually shifting the torn piece of the cartridge belt, bring it to the hatch located at rib No.24;

(d) take the torn piece of the cartridge belt through the hatch at rib No.24;

(e) reinstall the wing panels and close the hatch holes.

3. If some trouble (during firing) cannot be eliminated in flight, it is necessary to thoroughly examine the position of the recoil group, next cartridge, cartridge case, links and the condition of the cartridge belt at the block feed way and in the feed chute for trouble-shooting operations as is outlined in the description of the cannon. Then proceed to extracting the cartridge or the cartridge case out of the cannon, taking necessary precautions to avoid a casual shot in the same manner as in case of incomplete expenditure of ammunition.

5. UNLOADING OF ELECTRIFIED SIGNAL FLARE LAUNCHER

To unload the 9KCP-46 electrified signal flare launcher, proceed as follows:

1. Turn the coupling screw out of the bushing of the launcher case.
2. Take the tube gang out of the casing.
3. Pull the magazine by 6 - 8 mm and turn it through 90 degrees with respect to the tube gang.
4. Withdraw the signal cartridges from the tube gang.
5. Turn the handles of the electric squib spring clips through 90 degrees and take the electric squibs out of the container sockets.
6. Place the container and the tube gang in the initial position; put the launcher into the casing in the aircraft and screw in the coupling bolt.

6. POST-FLIGHT INSPECTION

After Flights Involving Firing of Cannon

Fuselage Nose Section

1. Inspect the cannon outside to ascertain that the front and rear attachment points of the fuselage cannon and the feed box are in proper condition.

Make sure that no play is present in the attachment points, the nuts are securely locked and the fire adjustment notches are aligned.

Make sure that there are no dents, cracks, loose rivets or similar defects on the walls of the feed box which might impair its strength. See to it that the feed box rollers freely rotate on their axles. Check to see that the feed box, moving on its rollers along the slide rails, easily occupies its original place.

Check the components of the localizer for proper condition and secure fastening.

2. Examine the components of the air system, feed system, link and case ejection chutes. Make sure that the systems are free of air leakage, pipes are intact and nuts are securely locked. To ascertain that the 9K-48 electric valve operates properly, see that the hand charging lever moves easily under a finger effort and energetically returns to its initial position when the lever is released. Check the air hoses for sound condition and secure fastening.

3. Examine the bundled wires running behind the cannon and make sure they are not burnt.

4. Unload the AKC-3M (AKC-5) camera mount and inspect it. While doing this, check the objective for secure fastening to the body and the condition of the optics, check secure attachment of the camera mount to the frame of the bracket. No play is permissible.

5. Check the BM-2 timing mechanism for secure attachment and see to it that the knob moves smoothly and is properly fixed in position.

After the inspection check the operation of the camera mount together with the BM-2 timing mechanism.

Right Wing

6. Carry out external visual inspection to ascertain that the front and rear attachment points of the wing cannon are in sound condition. Make sure that the attachment points are free of play, nuts are locked securely and the fire adjustment notches are aligned. Tighten up the nuts of the bolts in the attachment points and relock the nuts, if necessary.

7. Proceed, as outlined in Item 2.

8. Inspect the condition of the end part of the guide rails and the feed chute and make sure they are free of cracks, deformation or any other defects.

9. Check the condition of the link collectors and make sure they are free of cracks, dents, scores or any other defects and are securely fastened. In case bending and nicks are detected at the edges of the link collector throat, correct and file them clean.

10. Make sure there are no links in the collector.

11. Check the rack-to-wing fastening depending on the type of rack used (universal or special). Check the condition of the front and rear supports of the racks.

12. Inspect the ОРО-57К rocket pod (if it has been used). Remove the rear fairing and the lock and withdraw burnt plugs with wire leads from the tubes. Check the condition of the rubber sleeves of the contact sockets and replace them if they are burnt. Check the latches of the lock and the fairing for sound operation and lubricate them, if required.

13. Inspect the БД-3-56 rack carrier and clean it, if necessary.

Check to see that the БД-3-56 rack carrier is securely locked and the plug connector is properly tightened.

Tail Unit

14. If the signal cartridges have been used in flight, take the launcher out of the case, unload, clean, examine and lubricate it. Check the electric control system of the electrified signal flare launcher for normal operation. Reinstall the electrified signal flare launcher in the case.

Left Wing

15. Proceed as in the case of the right wing.

Pilot's Cockpit

16. Open the sliding part of the canopy and check for presence of the ground safety lock in the head of the seat ejection gun.

17. Check the fork of the safety pin for proper condition and secure locking with the head of the seat ejection gun.

18. Connect the ground power source to the aircraft mains.

19. Check the cannons, cartridge counters, cannon READY-TO-FIRE warning lamps for proper condition by cocking and releasing the firing parts (first make sure that there are no cartridges in the cannon). Then make sure that the air system is free of air leakage (it is checked by ear).

20. Check the electric control and signal circuits of the rack carriers and the simultaneous jettison automatic unit (this is done, if no fuel tanks are suspended from the aircraft).

21. Inspect the bomb panel and check the signal system and the bomb service release switch for proper operation.

22. Inspect the cannon reloading panel. The knobs should freely move in the holders and readily return to their initial position, when released.

The button holders should be securely fastened in their places and have no cracks or chips. Before attempting to check, cut off all circuit breakers.

23. Carry out external visual inspection of the sight head as is outlined in PRE-FLIGHT INSPECTION, Item 13.

24. Check the sight head for proper operation, as is outlined in PRE-FLIGHT INSPECTION. Item 14.

25. Check the ROCKET PODS SUSPENDED and ROCKETS LOADED signal systems.

26. Unload the СШ-45 camera controller (if it has been in use) and hand the film over for processing.

Inspect and clean the device. Check the controller for secure fastening. Checking being over, eliminate troubles and check the СШ-45 controller for proper operation.

After Flights without Firing of Cannon

If the weapon has not been in use during flight, it should not be dismounted from the aircraft, but inspected and cleaned directly in the aircraft (the scope of the cleaning work is determined in each particular case by the unit armament officer).

Besides, make sure:

(a) nuts of the clamps of the front and rear attachment points are tightened up;

(b) nuts of the air hose pipe unions connected to the cannon reloading cylinders are tightened up;

(c) plug connectors on the electric triggers, ЭК-48 valves and the common connector are properly connected;

(d) cartridge belts are correctly packed.

Inspect the following units in the pilot's cockpit:

1. Control panel of the ЭКСР-46 electrified signal flare launcher.
2. Electric reloading and cannon, rocket pod and bomb release control buttons.
3. Bomb panel.
4. Gun sight АСП-5Н.
5. Camera controller СМ-45.
6. Camera mount АКС-3М (АКС-5).

7. CLEANING AND LUBRICATION OF CANNONS

Timely cleaning and lubrication help preserve cannon characteristics, ensure trouble-free operation under various combat conditions, increase durability of cannon components and preclude corrosion.

The cannons should be cleaned in the following cases:

(a) after firing;

(b) after flight without firing;

(c) if contaminated with snow, moisture or sand;

(d) after 10 days of idle standing.

Depending upon the nature of the flights performed and the amount of shots fired the cleaning procedures may be as follows:

(a) cleaning without disassembly - cannons are not removed from the mounts;

(b) cleaning with incomplete disassembly - cannons are removed from the mounts and are disassembled into major units. They are cleaned, wiped dry, inspected and lubricated (after assembly);

(c) cleaning with complete disassembly - cannons are removed from the mounts and are completely disasssembled. All parts should be thoroughly cleaned and examined.

Cleaning of the cannons without disassembly is carried out after the flight, if the cannons have not been in use or if snow, moisture or sand accumulated on their surface.

Cleaning of the cannons with incomplete disassembly is carried out after firing (within the firing day). As an exception, if such cleaning cannot be done on the day of firing, the cannons may be cleaned next day. However, in this case the cannons should be cleaned all the same without removing them from the aircraft within the firing day.

Cleaning with complete disassembly is carried out during unslushing of the cannons, scheduled maintenance operations or recurrence of troubles caused by the same reasons after firing the rated number of shots. Cleaning and lubrication of the cannons should be carried out either indoors, or on parking sites (on portable tables) or directly in the aircraft. When doing this, take necessary measures to protect the parts of the cannons against sand, dust or moisture.

For disassembly, cleaning, and lubrication, see the Cannon Operating Instructions .

Chapter IV

PREPARATION OF AIRCRAFT WEAPONS FOR REPEATED FLIGHT

Before the repeated flight, ensure that the weapons are in sound condition and prepare them in accordance with the assignment for the next flight.

Preparation of the weapons for the repeated flight can be performed with the aircraft standing either on the take-off line or parking site.

For this purpose, proceed as follows:

(a) perform the post-flight inspection to the extent necessary for carrying out a new flight;

(b) inspect the armament and eliminate troubles revealed during flight or post-flight inspection;

(c) load the aircraft with ammunition according to the assignment;

(d) carry out the pre-flight inspection.

1. If the rated number of shots fired within the flight day is less than that indicated in the cannon operating instructions, clean and lubricate without dismounting the cannons from the aircraft. Make sure that all mechanisms of the cannons and READY-TO-FIRE warning system operate normally.

2. If the number of shots fired is more than that indicated in the instructions, incompletely disassemble and clean the cannons before next flight.

3. In case of use of the signal flares, replenish the missing ones.

4. In case the bombs were used in the flight, proceed as follows:

(a) make external visual inspection of the rack carriers, bomb rests and also wing skin close to the bomb suspension unit;

(b) check for presence of the ARMED - SAFE rods. Take them off the rack carriers and through external visual inspection make sure they are not damaged;

(c) open the hatches above the rack carriers and make sure that the rack carriers are securely fastened. Inspect also the mounting bridges, bundled wires and their fastening;

(d) close the rack carrier locks previously placing the check-up rings in the jaws of the ARMED - SAFE carrying levers;

(e) cut in the BOMB and ARMED - SAFE circuit breakers and SERVICE RELEASE, ARMED switches and make sure the check-up rings are securely held by the rack carrier locks and the bomb suspension signal lamps light up;

(f) press the bomb release button arranged on the aircraft control stick and check the bomb carriers and ARMED - SAFE locks for proper operation. See that the bomb signal lamps go out;

(g) secure the locks of the bomb carriers again and cut in the bomb jettison circuit breaker. Repeat checking for the SAFE position by operating the bomb jettison button.

5. If rockets were used in flight, proceed as follows:

(a) make sure that the ROCKETS circuit breaker is ON;

(b) make sure there are no rockets in the OPO-57K rocket pods;

(c) make sure that the rocket pods and the wing skin in the vicinity of the suspension units are not damaged;

(d) open the hatch holes of the bolts securing the universal or special rack to the wings and make sure that the bolts are securely locked;

(e) check the rack-to-wing connection; see to it that there are no clearances between the rubber profile and the wing skin; the metal sheet of the fairing should not contact the wing skin;

(f) check BA-8-56 rack carrier for secure fastening to the rack, and proper locking;

(g) check the MP-9 plug connector for proper connection, check the rests for secure attachment to the racks and rocket pods;

(h) remove the rear fairing and the lock of the rocket pod, withdraw the burnt-out plugs with the wire leads out of the sockets, clean the tubes of fouling. Clean also the face of the lock contacting the tubes. Clean the rear fairing of the rocket pod from soot.

6. Check the CM-45 camera controller for secure attachment in the cockpit and replace the magazine, if required.

7. Check up the pressure in the aircraft air system. It should be not less than 110 kg/sq.cm.

8. Check the AKC-3M (AKC-5) camera mount for secure attachment and proper operation. Replace the magazine, if necessary.

For further preparation for the repeated flight, see Chapter 2 "Pre-Flight Preparation".

Chapter V

REMOVAL AND INSTALLATION OF WEAPON UNITS

The weapon units are removed from the aircraft with the aim of inspecting, cleaning, repairing or carrying out scheduled maintenance. Do not use unserviceable or improper tools to remove or install the armament equipment. Take all necessary precautions when removing or installing the weapon units.

1. REMOVAL AND INSTALLATION OF WING CANNON

To remove the cannon, open the upper and lower access hatches and proceed as follows:

1. Take off the localizer flash-eliminator and the fairing of the cannon barrel.

2. Disconnect the air hose from the cannon reloading cylinder.

3. Disconnect the plug connector of the cannon electric trigger.

4. Remove the feed mechanism and stripper.

5. Remove the gas exhaust flange.

6. Withdraw the stud and disconnect the half of the clamp holding the gun barrel in the wing nose section.

7. Withdraw two lower and two side cleaning rods of the feed chute hinged part. This done, hinge the feed chute.

8. Holding the cannon with hands, unscrew the nut of the coupling bolt and throw back the movable part of the clamp of the front attachment unit. Lower the cannon until the cannon attachment ring projects from the attachment unit.

9. Moving the cannon forward, withdraw the back-plate from the rear attachment unit, then pull the cannon rear end

down (from the lower hatch) and moving it back carefully take the barrel out of the gas exhaust duct and the wing.

Notes: 1. To move the cannons forward, turn the right cannon counter-clockwise, and the left cannon - clockwise, if looking forward.

2. When lowering the barrel and moving it back and forth, do not press or strike the barrel against the rods and the aileron bell cranks arranged in the wing leading edge.

After the cannon is dismounted or installed, thoroughly examine the bell cranks and aileron control rods.

Install the cannon, in the order reverse to that of its removal.

Special attention should be payed to tightening the front attachment, coupling bolt and to locking the nut.

2. REMOVAL AND INSTALLATION OF FUSELAGE CANNON

Remove the fuselage cannon when two cannon access holes (on the right side) are opened and the feed box is dismounted. This done, proceed as follows:

1. Dismount the localizer flash-eliminator and the barrel fairing.

2. Disconnect the air hose from the cannon charging cylinder.

3. Disconnect the plug connector of the cannon electric trigger.

4. Remove the feed chute.

5. Withdraw the stud of the localizer tube fastening clamp and separate the half of the clamp.

6. Holding the cannon with hands, unscrew the coupling bolt nut and throw back the movable part of the cannon front attachment clamp; lower the cannon until the attachment ring projects from the attachment point.

7. Moving the cannon forward, withdraw the back-plate from the rear attachment unit, then lower the rear part of the cannon and, moving it away from the fuselage, dismount the cannon along with the gas exhaust duct assembly.

Install the cannon in the reverse order, connecting the fuselage cannon plug connector after the cannon is placed in the rear attachment points.

Special care should be exercised to see that the coupling bolt nuts of the cannon front attachment are tightened up and the nuts are securely locked.

When replacing the fuselage cannon or the localizer, see that the ports of the localizer with respect to the fuselage lines are properly positioned. If the position of the ports differs from that shown in Fig.123, turn the localizer as required. Abnormal position of the localizer ports occurs when the fuselage cannon recess for the gas exhaust pipe catch is displaced.

To turn the localizer, proceed as follows:

(a) turn out the bolts securing the localizer to the adapter tube;

(b) install the localizer in accordance with the diagram showing the position of the ports with respect to the fuselage line (Fig.123);

(c) drill holes in the adapter tube and thread them (8x1.25) to fit the size of the holes in the localizer. New and old holes should be positioned at least 8 mm apart. When the holes are reamed, the adapter tube may be faced according to Fig.136; reinstalled bolts should be locked with locking wire KOK-1.

3. REMOVAL AND INSTALLATION OF RACKS

Removal and Installation of Universal Rack

1. Open the cover of the hatch located in the upper skin of the wing nose section.

2. Open four hatch holes and turn out four bolts securing the universal rack to the wing.

3. Holding the rack, disconnect the electric plug connector of the БД-3-56 rack carrier.

4. Remove the rack.

Install the universal rack in the reverse order.

Removal and Installation of Rack

1. Turn out the screws and three bolts fastening the special rack to the wing.

2. Holding the rack, detach the plug connector from which wires run to the ПУ-2 control device on one side, and to the plug connector of the ОРО-57К rocket pod and the bomb carrier, on the other.

To install the special rack, reverse the order.

4. REMOVAL AND INSTALLATION OF RACK CARRIER

To remove the БД-3-56 rack carrier from the universal or special racks, proceed as follows:

(a) open two hatch holes on the rack to provide access to the bolts fastening the rack carrier to the rack;

(b) turn the nuts out of the bolts, withdraw the bolts and remove the rack carrier.

After removal of the rack carrier leave the bolts and nuts in the holes serving for attachment of the rack carrier.

Install the rack carrier on the universal or special rack, in the reverse order.

To install the rack carrier in the wing (in case the drop tanks are suspended) place the БД-3-56 rack carrier through the opening in the lower skin of the wing (having first removed the reinforcing plate), secure it with studs, connect the plug connector through a special hole on the top of the wing, and then reinstall the reinforcing plate and close the hatch hole.

Remove the rack carrier in the reverse order.

Note: Leave the studs securing the rack carrier in their places when removing the rack carrier.

5. REMOVAL AND INSTALLATION OF GUN SIGHT HEAD

To remove the head of the АСП-5Н sight, proceed as follows:

1. Disconnect the plug connectors of the sight head.

2. Turn out four vertical bolts connecting the sight head to the intermediate bracket and remove the sight head.

Install the sight head in the reverse order; in this case the sight head need not be adjusted.

6. REMOVAL AND INSTALLATION OF АКС-3М (АКС-5) CAMERA MOUNT

To remove the camera mount, proceed as follows:

1. Remove the cover from the hatch providing an access to the camera mount.

2. Through the hatch, turn out the bolt securing the bracket of the camera mount to the ball bushing. Then move the camera mount to the right until it comes off the slots and take the camera mount through the upper hatch hole together with the bracket.

Install the camera mount in the reverse order. This procedure for removal and installation of the camera mount should not impair its adjustment.

7. DISMANTLING OF ROCKET POD

Separate assemblies or components of the rocket pod may require repair or replacement after a certain period of operation. All major assemblies and parts of the rocket pods are fastened with bolts or screws and, therefore, can be readily removed (Fig.137).

Removal of Tubes

If it is necessary to remove the tubes, detach the holder, for which purpose turn out seven bolts located on the end face of the rocket pod disc. After removal of the rocket pod holder the tubes can be freely pushed out of the rocket pod housing.

In case the tube cannot be freely withdrawn place a special brass or wooden block to the front end face of the tube. The tube can be driven out by slightly hammering on the block (Fig.138).

Removal of Rests and Suspension Units

The rests and suspension units are attached to the rocket pods by means of a thread connection.

To remove the units, unscrew the locking screws arranged on the side of the rocket pod housing and turn out the appropriate unit.

Disassembly of Suspension Unit

To disassemble the suspension unit, take out the balls connecting the adjusting bushing with the sleeve. To facilitate extraction of the balls it is necessary to turn the suspension unit with the opening down. The balls will fall out one by one when tapping with the suspension unit against a wooden block. If the balls stick in oil, wash the suspension unit in benzine. As soon as twenty balls fall out, the bushing with the lug can be readily detached from the sleeve.

Assemble the suspension unit in the reverse order.

Dismantling the Rocket Pod Electric System

To provide access to the electric wiring and contact terminals remove the upper fairing of the rocket pod and the clamp positioned between the middle skin of the wing and the rear fairing.

To remove the upper fairing, turn out the screws with a cross-slit screw-driver. The contact socket can be removed by turning out the nuts securing the wire leads, disconnecting the wires and turning out the nut securing the contact socket, then withdraw the contact socket (together with the insulating split bushing and the rubber cap) pulling it towards the lock disc (Fig.139).

To disassemble the contact socket, turn out the threaded tail piece and withdraw the spring and the movable contact.

Removal of Skin and Front Fairing

The skin and front fairing should be removed only for repair or replacement of defective parts.

To remove the skin or the front fairing, turn out the screws by a cross-slit screw-driver. The screws are installed on white paste, therefore, additional effort is required to turn them out.

Removal of Lock Sleeves

To detach the sleeve from the lock, turn the sleeve counter-clockwise (by means of a special wrench) until it is completely separated from the lock.

It should be borne in mind that the sleeves are centre-punched at the thread joint.

Removal of Lock Nut

To remove the lock nut, detach the spring ring to allow the nut to freely come out of the lock seat. When detaching the nut, pull back the nut catch to facilitate removal.

Chapter VI

ZEROING AND ADJUSTMENT OF AIRCRAFT WEAPONS

1. ZEROING OF WEAPONS

The zeroing of the weapons installed in the aircraft is performed in the following cases:

(a) upon acceptance of the aircraft from the Manufacturing plant or from the repair agency when the nature of the repair may disturb the setting of the weapons;

(b) after the weapon attachment units have been replaced or repaired;

(c) after the cannons and camera mounts have been replaced;

(d) when the sight is replaced or disadjusted;

(e) after the armoured glass panel has been replaced;

(f) during periodic maintenance after every 100 hours of flying;

(g) in all other cases when the zeroing is disturbed.

Prior to firing sighting shots in the shooting range prepare a service air bottle, wing and under-fuselage jacks, testing target, devices for sighting including a bore sighting gauge spirit level, ammunition tools and accessories for the weapons.

When zeroing the weapons take the following precautions:

1. Arrange a red flag on a well visible place in the shooting range.

2. Arrange red flags at a distance of 4 m. from the cannon barrels on right and left sides and keep everybody away from the dangerous zone in front of the cannon barrels.

3. Cannons must be unloaded when setting a testing target or marking hits.

4. The command FIRE is given only by the officer in charge.

The sight and camera mount are zeroed in horizontal plane of the cannon parallel to the aircraft axis.

The zeroing of the weapons is accomplished, as a rule, by the test firing at the testing target or with the aid of the bore sighting gauge at a shortened distance of 50 m.

Fire Testing of Cannons

The cannons are tested by firing at a shortened distance in the shooting range (Fig.140).

The cannons are calibrated relative to the fuselage cannon which is taken as a base and installed parallel to the aircraft axis at the Manufacturing plant.

To test the cannons by fire, proceed as follows:

1. Using jacks position the aircraft in the line of flight.

2. Install the device for checking the sight laying into the sighting holes on the noze section of the fuselage and place a spirit level on the device.

3. Using wing jacks level up the aircraft laterally.

4. Arrange a testing target in front of the aircraft at a distance of 50 m. from the barrel face of the fuselage cannon so that the cannon barrel axis is perpendicular to the testing target plane.

5. Switch on the circuit breakers bearing the inscriptions SIGHT HEATING, SIGHT and SIGHT.

6. Set the cage control in the GYRO position, armament selector switch to CANNON HP-30 and the computer scale to 0.30 by turning the handwheel located on the right-hand lever of the engine control.

7. Make four single shots from the fuselage cannon, determine the mean point of impact and using this point draw a testing target scheme.

8. Rotating the sight head align the central point of the sight reticle with the appropriate point on the testing target and tighten up the sight adjusting bolts; when doing so make sure that the sight laying is not disturbed.

9. Zero right and left wing cannons with the bore sighting gauge.

10. Make four single shots from each wing cannon in succession and determine the mean points of impact.

The zeroing is all right if the mean points of impact are in line with the estimated ones on the testing target.

In case the mean points are not aligned with the estimated ones on the testing target readjust the cannons and after the adjusting bolts have been lightened, make again four single shots from each cannon.

The zeroing over, lock the adjusting bolts of the cannon rear attachments with wire. Draw notches on the intermediate bracket and the sight bracket with red enamel.

Notes: 1. If the sight head is to be checked for stability of scale setting, do the checking by matching the axis of the fuselage cannon with that of the central point of the sight (set the sight range at 200 m.) on a distant object (1500 - 2000 m.); in so doing use the position of the fuselage cannon axis as a base with the aid of the bore sighting gauge.

2. When the fuselage cannon is replaced, zero the newly installed cannon by the existing testing target taking one of the wing cannons as a base.

11. Align the optical axis of the camera mount with the estimated point on the testing target. The camera mount laying is accomplished by turning the ball-support in the bracket seat.

12. The position of the СШ-45 camera controller is adjusted by the central point of the АСП-5Н gun sight (the target mark should be within the field of vision of the СШ-45 camera controller; the selector switch of the sight must be against the position НР-30.

13. Place adapters into the central tubes of the rocket launcher pods and insert the bore sighting gauge into the adapters (Fig.141). Make sure that the bore sighting gauge crosshairs is aligned with the crosslines of the rocket launcher on the testing target. Adjust the setting of the ОРО-57 rocket pod if necessary.

Ground Test Firing to Check Cannon Automatic Operation

To check the cannon automatic firing proceed as follows:

1. Set the aircraft in the line of flight.

2. Open upper hatches for access to the wing cannons and hatch for access to the fuselage cannon to avoid the explosion-hazard concentration of powder gases.

3. Place wooden boxes under case ejection ports to collect cases and arrange a board to protect the aircraft skin against damage during firing from the fuselage cannon.

4. Place the ammunition allowance into the aircraft and load all the cannons.

5. Switch on circuit breakers bearing the inscriptions SIGHT (ПРИЦЕЛ); SIGHT HEATING, SIGHT (ОБОГРЕВ ПРИЦЕЛА, ПРИЦЕЛ). Set the cage control in the GYRO position, weapon selector switch to CANNON НР-30 and computer scale to 0.30.

6. Begin automatic firing. It is allowed to fire not more than 4 - 5 rounds in bursts either separately from each cannon or simultaneously from two wing cannons.

It is forbidden to conduct volley firing from three cannons or simultaneously from the fuselage cannon and one of the wing cannons.

WARNING: 1. Firing conditions and cooling procedure must correspond to those outlined in the Operating Instructions for the НР-30 cannon.

2. The dispersion test fire should be performed for each cannon separately.

2. ADJUSTMENT OF WEAPONS

The adjustment of weapon units is performed when a new cannon or any other weapon unit is installed and if the adjustment of the weapon is disturbed.

Adjustment of Cannons

Adjust the cannons with the help of the rear attachments in the following order:

1. Set the aircraft in the line of flight.

2. Arrange a board with a testing target at a distance of 50 m. from the barrel end face of the fuselage cannon. Using a plumb line and a level align vertical and horizontal axes of the testing target with those of the aircraft.

3. Open the upper and lower hatches for access to the wing cannons.

4. Open the upper skin access hatches for the cannon rear attachments.

5. Remove cannon fairings and detach barrel clamps.

6. Weaken the clamps (by half a turn of the nut) of the cannon front attachment.

7. Insert the adapter with the bore sighting gauge into the cannon barrel.

8. Unlock the rear attachment of the wing cannons.

9. Adjust cannons separately aligning the bore sighting gauge crosshairs with the corresponding point on the testing target.

The adjustment of the wing cannons in elevation is accomplished by rotating the vertical bushing with a special wrench applied to the bushing hexahedron (prior to rotating, it is necessary to unlock the taper bolt); the access to the bushing is through the upper hatch above the rear attachment.

The adjustment of the wing cannons in azimuth is accomplished by rotating the eccentric with the aid of a special wrench (prior to rotation slacken by half a turn the bolt fastening the eccentric, the access to the eccentric being through the lower hatch for access to the cannon).

After the adjustment of the cannons has been finished, lock the rear attachment, tighten up the eccentric bolts and the taper bolts, retighten coupling bolts of the front attachment clamps, secure the barrel attachment clamps (in the wing leading edges), install the cannon fairing and close the access hatches.

The fuselage cannon is a base cannon and therefore it needs no adjustment as a rule.

Adjust the fuselage cannon only after its replacement or after the aircraft repair which has disturbed the adjustment

of the cannon. In this case adjust the fuselage cannon following the procedure similar to that of the wing cannon adjustment.

Adjustment of ACП-5H Gun Sight

Adjust the sight only after its replacement or repair which has disadjusted the sight.

The adjustment of the sight is accomplished by shifting the intermediate bracket of the sight head. To do this, release two vertical bolts fastening the intermediate bracket to the sight bracket and move the sight head with the intermediate bracket through the required angle (in elevation and azimuth).

This done, retighten the bolts and make a notch with red paint on the intermediate bracket in accordance with the notch on the sight bracket.

Adjustment of AKC-3M Camera Mount

To adjust the camera mount, proceed as follows:

1. Unscrew the lock nut of the AKC-3M camera mount and release the bolt clamping the joint.

2. Turn the camera mount together with the plate and the joint in the desirable direction through the required angle.

3. Retighten the bolt clamping the joint and its lock nut.

Adjustment of CM-45 Camera Controller

The CM-45 camera controller is installed on the aircraft to control the sighting accuracy during practice firing. This device is mounted on the sight and ensures the simultaneous photography of both the target and the sight reticle. The adjustment of the device consists in aligning the cresslines centre with the central point of the sight reticle by means of the adjustment film magazine.

Prior to the adjustment of the CM-45 controller make sure that the sight illumination is switched on, the cage thumb piece is in the GYRO position. Selector switch is set against HP-30 and the time scale is at 0.30.

To adjust the CM-45 controller, proceed as follows:

1. Release three bolts on the controller bracket.

2. Insert the adjustment film magazine into the controller.

3. Observing the eye-piece of the magazine and turning the controller relative to the ball and socket joint of the bracket, align the central point of the sight reticle with the crosslines centre.

4. Secure the three bolts of the bracket.

Adjustment of OPO-57K Rocket Pod

The adjustment of the rocket pods takes place only during bore sighting and is accomplished in the following way:

1. Remove the hatch covers in the rack for access to the front and rear attachment fittings.

2. Unlock the adjusting bolts.

The front attachment fitting is adjusted vertically by turning the lower nut with the aid of a special wrench. The vertical adjustment is accomplished by turning the lower nut with the aid of a special wrench.

The rear attachment fitting is adjusted vertically and horizontally. The horizontal adjustment is obtained by turning the horizontal bolt.

3. When the required position of the rocket pod is obtained, lock the horizontal bolt of the rear attachment fitting and screw up the vertical adjustment lock nuts of the front and rear attachment fittings.

4. Close the panels.

3. PROCEDURE OF FIRING WITH APC-57 (C-5) ROCKETS IN FLIGHT

1. Switch on the circuit breaker bearing the inscription ROCKETS.

2. Set the salvo switch at one of the following positions: 1 SALVO (ЗАЛП), AUTOMATIC (АВТОМ.) or 4 SALVOES (4 ЗАЛПА) (in accordance with the assigned mission).

3. Set the selector switch on the sight in the ROCKETS position.

4. Press the fire control button on the aircraft control stick; in this case the firing procedure will depend on the preliminary setting of the salvo switch.

Each time when the fire control button is pressed:

(a) with the salvo switch set at 1 SALVO two rockets will be launched (one from each rocket pod);

(b) with the salvo switch set at AUTOMATIC all the rockets will be launched in pairs with an interval of 0.075 sec. between the salvoes (while the fire control button is pressed);

(c) with the salvo switch set at 4 SALVOES, two rockets (four altogether) will be launched from each rocket pod with an interval of 0.075 sec. When the fire control button is repeatedly pressed, four more rockets will be launched with the same interval between the salvoes.

Note: Keep in mind that APC-57 rocket fire control system is interlocked with the landing gear extension, i.e. the rocket fire is impossible when the nose strut is extended.

4. EMERGENCY DROPPING OF ROCKET PODS

The pilot action during the emergency dropping of the rocket pod depends on the methods of the rocket pod suspension.

1. When the rocket pods are suspended from the universal racks, proceed as follows:

(a) make sure that the circuit breaker bearing the inscription EMERGENCY BOMB RELEASE, TANKS JETTISON (АВАР.СБРОС БОМБ, СБРОС БАКОВ) is out in;

(b) lift the safety cover (on the cannon charging beard) and press the button with the inscription EMERGENCY BOMB RELEASE, TANK JETTISON;

(c) make sure that the green signal lamps of the suspension unit went out.

2. When the rocket pods are suspended from the special racks:

(a) make sure that the circuit breaker bearing the inscription EMERGENCY BOMB RELEASE, TANK JETTISON is switched on;

(b) press the button with the inscription ROCKET POD EMERGENCY RELEASE (АВАР.СБРОС РО) located on the left-hand console under the safety cover.

Chapter VII
EJECTION GUN LOADING AND UNLOADING

1. LOADING

Load the ejection gun as follows:

1. Prior to fitting the ПК-7Т explosive charges cock the firing mechanism. For this, lift the striker by inserting a screw-driver or a special cramp iron into the hole of the firing mechanism bottom and insert the wedge-shaped safety lock pin. This done, insert the safety pin into the hole in the upper cap of the firing mechanism.

2. When fitting the explosive charge hold the firing mechanism with the lock upward so that the end of the EXPLOSIVE CHARGE LOADED indicator does not protrude beyond the firing mechanism bottom and does not binder the fitting of the explosive charge.

After loading make sure that the end of the EXPLOSIVE CHARGE LOADED indicator (painted red) projects beyond the upper cap of the firing mechanism and cannot be sunk by pressing.

3. Fit the explosive charge into the firing mechanism. For this, insert the case shoulder into the tooth on the firing mechanism by rotating the explosive charge round the dowel on the firing mechanism bottom.

4. Insert the explosive charge with the firing mechanism into the ejection gun.

5. Screw up the union nut of the ejection gun firing mechanism.

6. Screw up the check nut of the ejection gun firing mechanism.

7. Connect the safety lock pin to the rod of the seat trigger on the head rest.

8. Install the canopy on the aircraft and connect the interlocking cable to the pin.

2. UNLOADING

Unload the ejection gun as follows:

1. Unfasten the interlocking cable from the pin and remove the canopy.

2. Disconnect the safety lock pin from the rod of the seat trigger on the head rest.

3. Unscrew the check nut of the ejection gun firing mechanism.

4. Unscrew the union nut of the firing mechanism and remove the firing mechanism with the explosive charge.

5. Take the explosive charge out of the firing mechanism. To this end disengage the case shoulder from the tooth on the firing mechanism by rotating the explosive charge round the dowel of the firing mechanism bottom and then detach the explosive charge from the dowel.

3. CHECKING

The ejection gun operates properly if the percussion caps of the ПК-7Т inert explosive charge are correctly detonated (the work should be carried out by the armament specialist together with the aircraft mechanic).

Check the percussion caps for proper detonation as follows:

1. Unload the seat ejection gun and load it with a blank explosive charge, type ПК-7Т.

2. Check the functioning of the ejection gun. For this slowly pull the seat blind as far as it will go. The ejection gun must operate when the blind is pulled out by 259^{+30}_{-10} mm. The force applied to the firing handle at the moment of the ejection gun operation should not exceed 30 kg.

3. Unload the ejection gun and make sure that both percussion caps of the explosive charge have been properly detonated, that is they are not punctured.

If no detonation whatsoever is observed, remove the ejection gun firing mechanism, eliminate the detected faults and recheck the percussion caps for proper detonation.

4. Check the ejection gun for proper operation from the triggers on the right-and left-hand grips without checking the percussion caps for correct detonation.

5. After the ejection seat has been checked for proper functioning, unload it by removing the inert explosive charge and load the ejection gun with the live explosive charge, type ПК-7Т.

S E C T I O N T H R E E

AIRCRAFT ELECTRIC AND OXYGEN EQUIPMENT

C h a p t e r I

ELECTRICAL EQUIPMENT

1. POWER SUPPLIES AND ASSOCIATED UNITS

Two generator-starters of ГСР-СТ-6000А type are the main sources of electrical energy in the aircraft.

A lead-acid storage battery of 12САМ-28 type is employed as a buffer or stand-by source of power (in the event of generator failure).

The ground source connected to the ground supply receptacle is used to check the electrical and radio communication equipment on the ground without engine racing, and to start the engines.

The following units are designed to maintain the operation of the main, stand-by and ground sources of power:

1. Two differential minimum relays, type ДМР-400А.
2. Contactor, type КМ-200Д.
3. Relay box, type РПА-200А.
4. Two voltage regulators, type Р-27Д and Р-27ПР.
5. Two stabilizing transformers, type ТС-9АМ.
6. Two ballast resistors, type БС-6000А.
7. Six capacitors, type КБМ-3I.
8. Voltmeter, type В-1.
9. Two ammeter shunts, type А-46.
10. Two generator signal relays, type РП-2.
11. Relay, type РП-2 , to disconnect generators when ground source is brought on mains.
12. Generator cut-in pilot lamps.

Generator-Starter

The ГСР-СТ-6000А generator-starter is designed to start the engines with subsequent operation as a D.C. generator to provide power supply for the aircraft mains. The operation of the genera-

tor-starter as starter is based on the principle of reversibility of D.C. electrical machines. At the beginning of starting the ГСР-СТ-6000А generator used as starter operates with compound excitation (8.5 sec. from the beginning of starting), further in the starting cycle it operates with series excitation.

To change the starter-generator over from compound to series excitation, a starting box, type ПКС-6000Е is used.

The ГСР-СТ-6000А generator-starter is coupled to the engine through a gear box which automatically changes the ratio of 1.7 under starting duty to 0.8 under generating duty.

The generator-starter has a flange fastened with six pins. The flange shoulder enters the circular groove of the gear box flange while the splined end of the flexible shaft engages the splined sleeve of the gear box.

The flanges of the gear box and generators are coupled by a collar which is tightened with two bolts. Before removing the starter-generator it is necessary to turn out three screws of the terminal block insulating cover, to disconnect the wires from terminals "+", "-","С","Ш" to remove the intermediate cooling branch pipe and to disjoint the coupling collar of the generator-starter attachment.

To mount the generator-starter on the engine, follow the reverse procedure. Before the installation make sure the generator is not damaged. Check the armature rotation manually by means of a wrench splined on the shaft extension. The armature should rotate freely and evenly, without jamming. Check to see that the brushes freely move in brush holders and have no cracks on their effective surface.

In mounting the generator-starter on the engine the splined end of the flexible shaft should freely engage the splined sleeve of the gear box. The generator-starter should be aligned according to the fitting shoulder on its flange. An adequate gap should be provided between the ball bearing fastening nut on the drive side and the gear box to allow free rotation of the armature (the nut should be clear of the gear box). Tags of connected leads should be securely tightened with nuts on terminal block pins to ensure reliable electric contact.

Before the installation, a new generator-starter should be unslushed. For this purpose remove the slushing compound (gun grease) from surfaces of parts with a piece of cotton cloth slightly moistened in clean gasoline. Wipe dry the cleaned areas and dry the generator-starter in the open for 20 - 30 minutes. Remove the generator name plate as in the course of operation the air from the air blow-off band tears it away and it may get inside the engine. The generator number stamped on the name plate should be punched on the generator frame. Then attach the intermediate cooling pipe to the cooling cowl with four screws. Lock the screws. Check for secure attachment of the cooling cowl to the generator.

In service observe the following requirements:

1. When heavy loads are imposed (especially on the ground), both generators should operate.

2. The stuffing box and vent system of the drive gear box should provide an adequate protection against oil ingress as the generator-starter has no special protection.

During operation periodically check and inspect:

(a) condition of brushes and commutator;

(b) security of elastic washers and special washers used for locking screws;

(c) tightening of screws of the block which covers the terminals; tighten screws, when necessary;

(d) tightening of terminal nuts and bolts; if terminal bolts are found loose, tighten up respective nuts;

(e) attachment of generator intermediate cooling branch pipe;

(f) attachment of end-shield on the side of the commutator and cooling cowl.

To check the condition of the brushes and commutator, as well as to replace the brushes, it is necessary to remove the starter-generator and the protective band.

When the commutator operates normally, its surface shows a glossy, slightly dark film without traces of burning and contamination.

If the commutator bars have a black fatty film, clean the commutator with clean cloth slightly moistened in gasoline. If contamination cannot be removed with cloth, use fine sandpaper No.180-220. Do not use emery cloth.

To clean the commutator, remove the brushes from the holders. After cleaning the commutator, thoroughly blow the interior of the starter-generator with dry clean air at 1.5 - 2 kg/sq.cm., then insert the brushes in the holders.

When brushes wear to a height of 17 mm, replace them. The height of the brush is to be measured along its larger side. New brushes should enter brush holders freely, with a gap of 0.2 to 0.4 mm on both sides. New brushes should be embedded and ground in to fit the commutator.

When the embedding of brushes is over, remove the brush dust by blowing the generator-starter thoroughly with dry compressed air through ports in the frame; brushes in this case should be removed from holders. Blow so as to drive the brush dust out of the generator-starter rather than into its interior.

The ball bearings of the PCP-CT-6000A generator-starter will operate without adding new grease throughout the guaranteed service life.

Storage Battery, Type 12CAM-28

Basic Specifications

1. Rated voltage when discharged at double rated current is 24 V.

2. Rated discharging current is 5.6 A.

3. Capacity when discharged at rated intensity of current and electrolyte average temperature of 25°C is 28 ampere-hours during first half-year of operation and 23 ampere-hours during second half-year. Battery is discharged until one of the cells reaches 1.7 V.

4. At temperature of 20°C storage battery can be discharged four times under conditions tabulated below:

Time from connection, sec.	Current, A (approximately)	Time from connection, sec.	Current, A (approximately)
0	650	25	200
5	510	30	150
10	400	35	125
15	315	40	100
20	250	45	75

In using the battery check the level of electrolyte. If the electrolyte level lowers (due to water evaporation), raise it by adding distilled water. The electrolyte level in batteries after a flight, especially after high altitude flying, should be measured not earlier than 2 hours after landing, since in altitude flight the electrolyte level in the battery lowers. If distilled water is added in battery cells immediately after flight, electrolyte will spill from the battery jars through vent plugs when in service.

In the course of their employment, storage batteries are recharged in two stages:

(a) with 4-A current until the cells reach 2.40 - 2.42 V;

(b) with 2-A current until electrolyte density and voltage in all cells are constant for 2 hours, with violent gassing in all cells.

An hour after the end of charging check to see that the electrolyte level in the cells is 6 - 8 mm above the lower baffle plate at a sp.gr. of 1.260±0.005 (at 25°C).

To increase the electrolyte level and specific gravity to normal values, add distilled water in the cells. To stir the electrolyte, charge the battery for 1 - 2 hr at a current of 2 A.

The battery is recharged once every month. The fully charged battery an hour after charging is again connected to the charging circuit and charged at 2 A until violent gassing commences. Then follows an hour's interval after which the battery is again charged until violent gassing. These operations are repeated three to five times. Successive charges at 2 A and intervals are continued until the electrolyte "boils" directly after the beginning of charging.

A testing cycle is performed once every two months in the following order:

(a) normal charge;

(b) recharge;

(c) discharge;

(d) charge.

Discharge is performed at 5.6 A after recharge until one of the cells reaches 1.7 V.

The battery may be employed for engine starting (without subsequent boost charge) with intervals between starts not less than 3 min. Depending on temperature conditions, the battery can ensure:

not more than 4 starts at +18 to +30°C;

not more than 3 starts at +6 to +17°C;

not more than 2 starts at -5 to +5°C.

Then the battery should be removed from the aircraft and sent for charging.

After each flight and at the close of a flying day, check the degree of the battery charge. If the battery discharges over 25 per cent it should be boost-charged not later than in 8 hours.

The 12CAM-28 storage battery is mounted on the aircraft in a container which is located in the upper equipment bay. To remove the container from the aircraft, unbuckle container attachment straps, screw out the plug connector, turn out the coupling nut of the rubberized fabric hose of the drain pipe and remove the container from the aircraft. Remove the cover from the container, disconnect leads "+" and "-" from the battery terminals and take it out of the container.

To install the battery in the container and to mount the container on the aircraft, follow the reverse procedure.

Before installing the battery in the container, check to see that the battery is normally charged and its monoblock, cover, vent plugs, electric connections between cells, are in good condition. After installing the storage battery in the container, use screws to securely tighten leads "+ and "-" to the identical battery terminals in order to obtain correct and reliable electrical connection. After mounting the container on the aircraft, check the battery voltage under load; the voltage should be not less than 24 V with the pump of tank No.2 operating.

Differential Minimum Relay

The main purpose of the ДМР-400А relay (Fig.142) is to automatically control the generator connection to the aircraft mains. The relay is intended:

1. To connect the generator to the mains when the generator is capable of supplying power, i.e. when its voltage exceeds by 0.3 - 0.7 V the voltage of sources which were earlier connected to the aircraft mains.

2. To protect the generator from the reverse current by disconnecting it from the mains when the generator voltage falls below the mains voltage and a reverse current of 15-35 A flows through the relay.

3. To preclude connection of the generator to the mains if the generator polarity is incorrect.

The ДМР-400А relays are adjusted at the Manufacturing plant and, therefore, they do not need additional adjustment during their service life. Cleaning of contacts is not allowed as the efficiency of contacts depends upon the contant resistance (which should ensure a voltage drop across two contact pairs not exceeding 240 mV at 400 A) which is but slightly affected by brush burning.

If contact resistance is higher than the above which may cause overheating of the contactor busbars, wash the contacts in alcohol and wipe them clean. If the contacts of the auxiliary and differential relays are dirty, wash them in alcohol. Do not clean them. In operation be careful that the leads are securely connected to the terminals of the ДМР-400А relay and that the nuts are reliably locked on the terminal pins of the relay.

To make a check, slightly pull the leads connected to the ДМР-400А relay.

Note: Do not check the security of attachment by rocking the lugs or leads since such a check may result in a break of leads or lugs.

The ДМР-400А relays are located in the power supply units of the aircraft between fuselage frames Nos 13 and 14.

Contactor

To cut in the aircraft storage battery remotely, the aircraft is provided with the КМ-200Д contactor located in the upper equipment bay at frame No.3.

Relay Box

To control the aircraft storage battery and ground source, the aircraft is fitted with the РПА-200А relay box located at the bottom left, near frame No.12.

The joint operation of the КМ-200Д contactor and the РПА-200А box ensures:

(a) remote connection of storage battery or ground source from cockpit;

(b) connection of these sources to mains only when their polarity is correct;

(c) disconnection of aircraft storage battery when ground source of power is brought on mains;

(d) cutting in of heavy loads only with ground source on;

(e) connection of generator to aircraft mains only with ground source off.

The РПА-200А relay box during its service life needs no adjustment. Take care that the inside of the РПА-200А box is clean and the leads are securely attached. Tightening screws on the connection block should be properly drawn up and locked with paint or benzylcellulose varnish. This especially applies to tightening screws of vacant terminals since they may become loose unless drawn up. Do not clean contactor contacts, wash them with alcohol instead. Burning of contacts is permissible if the voltage drop across two pairs does not exceed 240 mV at a rated current of 200 A.

To remove the box, at first drive out three attachment screws of the relay box cover, then four screws of the box base-to-bracket attachment. Before the removal of the box from the aircraft, turn out the screws on the contact block and bring the leads out of the box.

Stabilizing Transformer

Two stabilizing transformers of ТС-9АМ type (Fig.143) are placed into the positive circuits of ГСР-СТ-6000А generator-starters (one transformer in each generator circuit).

The stabilizing transformers are designed to ensure stable operation of both generators (connected to the common load) during transients arising in the mains. Transients (fluctuations of current and voltage) arise in the mains when loads are connected or disconnected, when the generators start parallel operation, or when the voltage of the generators changes sharply (sharp change in engine r.p.m.). The stabilizing transformers stabilize parallel operation of the generators only in case of transient fluctuations and cannot (owing to their operating principles) effect stabilization in case of a gradual or continuous change in characteristics of parallel operation (in event of their maladjustment or voltage regulator failure, etc.).

The ТС-9АМ stabilizing transformer simultaneously operates as current transformer and voltage transformer. The stabilizing transformer needs no adjustment in the course of its employment. It is only necessary to maintain good electric contact between the transformer body and the aircraft structure. The absence of adequate electrical connection will lead to the same results as the break of the wire from terminal Ш of the voltage regulator, that is, to a considerable increase of generator voltage and failure of operating equipment. Contact resistance should not exceed 600 microhms. Special attention should be given to tightening the lugs of the power leads connected to the ТС-9АМ transformer since all current supplied by the generator flows through these contacts. If a fault is detected, replace the transformer.

The stabilizing transformers are located in the right and left power supply units between frames Nos 14 and 15. They are accessible from the side of the power supply units if the voltage regulators are removed.

Voltage Regulators

Voltage regulators, type Р-27 (Р-27Л and Р-27ПР), are designed to maintain constant voltage of the D.C. generator in case of changes in loads or speed of the generators within the operating range, and to ensure parallel operation of the generators.

The voltage regulator set includes also an external resistor for voltage manual regulation when adjusting parallel operation of the generators.

Basic Specifications

(1) Voltage maintained . . . . . 28.5±1.5 V

(2) Maximum power dissipated in carbon pile . . . . . 85 W

(3) Difference in voltage due to change of generator speed over operating range and to change of load from zero to rated value . . . . . —2 V

(4) Voltage regulation range of

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[illegible] resistor (relative to rated voltage of 28.5 V) . . . . . from +1.5 to 2 V
from −2.5 to −3 V

In the course of operation the voltage regulator should be periodically inspected, for which purpose:

1. Check surfaces of the temperature compensating resistor and stabilizing resistor. If surfaces have cracks, swellings, replace the resistors.

2. Check security of electric connections and locking of the core adjusting screw.

3. Check the panel for security of attachment in the aircraft, inspect condition of rubber and spring shock-absorbers.

4. Check condition of contact points and see that nuts on the terminals are tightened.

5. Check the regulator for proper attachment to the panel (check condition of spring locks).

6. Check the position of the rheostat slide. If the slide is near the stop when turned for an increase of voltage, this indicates that the carbon pile is badly worn and should be replaced.

7. Check condition of conductors joined to the terminals of the voltage regulator panel and their condition in the collars which fasten the conductors to the shock-absorbing panel. See that the shock-absorber washer does not rub the conductors and the conductors are not bent excessively.

8. Bear in mind that the seal on the electromagnet side is energized and, therefore, it should be clear of the parts or body of the ДМР-400А relay. To prevent short-circuiting, a rubber strip is glued to the bracket of the ДМР-400А relay.

The voltage regulators are located in the right and left power supply units between frames Nos 13 and 14. To get access to them, remove covers of hatches ELECTRICAL EQUIPMENT (ЭЛЕКТРО - ОБОРУДОВАНИЕ).

Ballast Resistor, Type БС-6000А

Ballast resistors are designed to ensure parallel operation of ГСР-СТ-6000А generators. They are inserted between the negative terminal of the generator and the aircraft structure. The equalizing windings of both voltage regulators are series-connected between the negative terminals of the generators (to ballast resistors).

If loads of the generators become different, potential drops are created in ballast resistors with the result that current will flow through the equalizing windings and the voltage regulators will divide the load between the generators. The value of the ballast resistors is equal to 0.00214 ohm ±6%.

In operation take care that negative power conductors of the generators and leads of the voltage regulator equalizing windings are properly tightened on the terminals of the ballast resistors and that contact resistance in connections between the ballast resistors and the aircraft structure does not exceed 100 microhms. The value of contact resistance and reliability of wire connection from the generator to the ballast resistor considerably influence the parallel operation of the generators. No maintenance operations are needed for ballast resistors.

Voltmeter

The В-1 voltmeter is connected to the busbars to check the mains voltage (of storage battery, generators or ground source).

In operation periodically check readings of the В-1 voltmeter against readings of a reference instrument. Also check the leads for security of attachment to the В-1 voltmeter.

Check periodically the pointer position with the mains power supply off. The voltmeter pointer should be in line with zero. If necessary, set it against zero by the adjusting screw.

Capacitors

Each power supply unit is provided with three capacitors of КБМ-3I type which are connected to voltage regulators and differential minimum relays of the generators. The КБМ-3I capacitors serve to suppress radio interference during operation of the generators and associated devices(Р-27 voltage regulator, ДМР-400А relay).

In operation periodically (especially in the event of radio interference) check contact resistance between the capacitor body and the aircraft structure. Contact resistance should not exceed 200 microhms. In case of high contact resistance improve

contact between capacitor lugs and the aircraft structure by cleaning their contacting spots.

2. PARALLEL OPERATION OF GENERATORS

Load distribution between paralleled generators depends on their voltage values, characteristics and symmetry in connecting the generators to the mains (Fig.144). Load distribution is especially affected by resistances of circuits from the negative terminals of the generators to the aircraft structure and from the positive terminals to the load. The P-27 voltage regulators should have practically the same adjustments and equal sensitivity of the equalizing windings.

To adjust parallel operation of the generators, follow the procedure below:

1. Open the access panels of the right and left power supply units.

2. On both voltage regulators set the slides of the regulating resistors to the middle position.

3. To measure voltages and currents of both generators, plug voltmeters and ammeters (with an equal grade of accuracy and equal calibration) into the receptacles mounted in the left power supply unit.

Note: In case one instrument is available (instead of two), it may be connected to the left or right generator in turn.

4. Before the adjustment warm up the regulators for 5 min. at 10,000 r.p.m. The adjustment should be performed also at 10,000 r.p.m. of the engines. Using the adjusting resistors in the P-27 voltage regulator, set equal voltages (28.5 V) of idle run on each generator for which purpose it is necessary to disconnect the generators from the mains one after another.

5. After setting equal voltages at the idle run, connect the generators to the mains anew.

6. Cut in all the loads and determine the intensity of currents delivered by the generators to the mains (difference in currents should not exceed 25 A).

7. If difference in the currents exceeds 25 A, equalize the generator currents with the help of the adjusting resistors of the voltage regulators. For this purpose, increase the voltage of the generator with lower current (by moving the slide of the adjusting resistor of the voltage regulator in the clockwise direction) and decrease the voltage of the generator having higher current (by moving the slide of the adjusting resistor of the voltage regulator in the counter-clockwise direction).

8. Check the stability in parallel operation of the generators when the engines operate at different speeds, i.e. when one engine operates at low speed (5000^{+200} r.p.m.) and the other at rated speed (11,150 r.p.m.). In this case the generator of the engine operating at low speed should not stop running. In checking the right and left generators, change alternately engine speeds.

9. Measure the voltage at low and maximum speeds to make sure that the regulators maintain constant voltage. The difference in voltage for each generator should not exceed 2 V (check alternately by changing engine speeds).

10. When the adjustment of parallel operation is over, shut down the engines, disconnect the voltmeters and ammeters from the receptacles in the left power supply unit and close the access panels of the right and left power supply units.

Note: Since with all consumers cut in the load of the generators does not exceed 40 per cent of the rated value, glowing of one of the lamps GENERATOR OFF (ГЕНЕРАТОР ВЫКЛЮЧЕН) is not indicative of abnormal operation, if the idle generator starts to operate after manual disconnection of the operating generator. This is true provided P-27 regulators, ДМР-400А relays and generators are in good condition and correctly connected, if the parallel operation of the generators is properly adjusted. The lamp GENERATOR OFF should not keep flickering.

3. AIRCRAFT MAINS

General

The aircraft mains employs single-wire circuits, i.e. the sources of power are connected to the loads by positive wires and the metal structure of the aircraft is used as a negative wire.

Note: To eliminate influence of the supply circuit of the tail warning radar on indications of the ГИК-I compass, the tail warning radar is supplied through a double-wire circuit arranged in the fin area.

The aircraft mains ensures:

(a) automatic disconnection of generators when ground source is switched on;

(b) automatic disconnection of aircraft storage battery when ground source is switched on;

(c) connection of aircraft or ground source to aircraft mains only if polarity is correct;

(d) protection against operation of high-power consumers (radar ranging unit, sight, inverter) from aircraft storage battery;

(e) separate connection and disconnection of generators from cockpit;

(f) connection of aircraft storage battery or ground source from cockpit;

(g) increased reliability of power supply for vital consumers of alternating current (АРК-5 automatic radio compass, РСИУ-4 radio set, ТРЗ-52).

In the event of failure of the ПО-750 inverter which supplied these consumers they may be switched on to the ПО-500 inverter (СРО-2 responder employs two inverters, type ПО-750) which supplies the radar ranging unit and sight. In this case the ranging unit and sight are disconnected from the inverter;

(h) power supply from one generator both in day and night flying.

The aircraft mains consists of the following elements: wires, protection equipment, control equipment, plug connectors, and switchgear.

Wires Used in Aircraft Mains and Their Marking

Wires БПВЛ and БПТ are used in the aircraft mains. They have the following cross-sectional areas: 0.5, 0.75, 1, 1.5, 1.93, 2.5, 3, 4, 5.15, 6, 8.8, 13, 21, 50, 70 sq.mm. Wire with a section of 0.5 sq.mm is used in more than a half of the mains.

Wires БПВЛ have three colour codes: red colour code for armament circuits, blue colour code for radio equipment circuits, white colour code for electrical equipment circuits. To facilitate detection of faults in the mains and to avoid confusion of wires when replacing units, special tags with identification marking are used. The tags are attached to the ends and joints of wires.

The marking of wires is based on the employment of letters and numerals and consists in the following:

1. All equipment associated with the aircraft mains is divided into groups depending on its application. Each group has a letter code (the complete Delivery List of electrical equipment and electrical diagrams is given in the Album of electrical diagrams which is appended to these Instructions).

Code letter of group	Description
З	Subunits of power supply unit (power sources and associated equipment)
М	Electrical actuators
Е	Units for engine starting and ignition
К	Engine control instruments
С	Units for light signalling and lighting
Н	Navigation instruments
Р	Radio equipment units
П	Armament units
Б	Bomb armament (drop tanks) units
Т	Heating devices of instruments

2. All instruments and units of one group have their ordinal numbers.

3. A wire tag indicates:

(a) code letter of equipment group;

(b) number of unit to which wire is attached;

(c) number of electric line (ordinals of lines depend on

quantity of wires from the given unit).

(d) number of terminal (or contact) to which this wire is connected (plug connector, block, instrument or other equipment);

(e) number of line portion from one unit to another (if electrical line has plug connectors, blocks and other elements of switchgear).

The principle of tag marking will be clear from Fig.145 which shows a portion of electric circuit (bunched conductors).

The conductor which joins plug connectors Nos 25 and 115 is fitted with tags: the tag near connector No.25 has the inscription 18-22M1-II, while the tag near connector No.115 has the inscription 1-22M1-II.

The tag 18-22M1-II denotes the following:

(a) inscription 22M1 on tag indicates that conductor passes to unit 22M: letter M denotes equipment group (actuators) and numeral 22 indicates the ordinal number of the circuit breaker A3C-5 (according to Specifications in Key Diagram), numeral 1 denotes number of the electric line from the circuit breaker (22M);

(b) numeral at the left end of the tag shows that the conductor is connected to terminal 18 of plug connector No.25;

(c) Roman numeral II at the right end of the tag denotes the number of the conductor portion in the circuit from the circuit breaker (22M) to the button (24M). The second tag located at plug connector No.115 differs only in left numeral 1 which indicates that the second end of this conductor should be connected to terminal 1 of plug connector No.115.

Shielding of Wires

To reduce electric interference with radio equipment, the mains of units which may cause interference are shielded. An inadequately shielded system may produce more interference with radio reception than an unshielded one owing to the appearance of additional detrimental contacts in shielding. Therefore, it is necessary to check the condition of shielded conductors for damage and contamination of braiding. Shielded conductors must have good electrical connection of their shield to the aircraft structure. The shields should be electrically continuous throughout their entire length.

Plug Connectors

To facilitate hook-up and dismantling of wires and units of electrical equipment, the aircraft mains are fitted with the following plug connectors:

1. Non-sealed plug connectors, type ШР and ШР .., ШК.., НТ.

2. Sealed plug connectors, type ШРТ and ШРТ.., ШК.., НШ.

3. Individual plug connectors, type ШР-I.

4. Receptacles 47-К and 48-К.

Plug connectors, type ШР and ШРТ, are used in D.C. circuits. Plug connectors, type ШРТ.., ШК .., НШ... and ШР.., ШК .., НТ, are used in A.C. circuits.

Individual plug connectors, type ШР-I , are used to connect separate conductors running to the АРУФОШ-45 lamps and ПВД-4 air-speed tube.

Receptacles 47-К and 48-К are designed to connect to the mains the loads and instruments which are not constantly cut into the mains (voltmeter, ammeter, portable lamp ПД-36, etc.).

Protection Equipment

Heavy current fuses of type ТП-400 (29Э in the circuit of the aircraft storage battery) and ТП-200 (20Э, 21Э in the circuit of the left and right generators) are used to safeguard the power sources against overloads due to shorts in power circuits of the sources. To protect the A.C. mains and the sources against overloads due to shorts, СП-5 fuses are used.

The electric wiring and D.C. loads are protected against overloads and shorts with the help of circuit breakers, type А3С, А3Р, and time-lag fuses, type ШП.

Circuit breakers А3С can be manually closed in circuits with a current corresponding to the А3С ratings. In case of overload current and short circuit they are opened automatically, or when load is normal, manually. An automatic cut-out occurs owing to the heating of a bimetallic plate by overload or short circuit currents. The numeral following the abbreviation А3С denotes rated current (in amperes) which passes through this circuit breaker.

Circuit breakers А3Р with free disengagement are used in

circuits where insulation of wires both in circuits and inside units is not capable of withstanding excessive temperature rise (for fire protection).

When employing circuit breakers АЗС:

1. Take care that contact terminals do not get loose during hook-up and dismantling, support terminals by hand when connecting and disconnecting conductors to them.

2. Protect circuit breakers АЗС against moisture and dust as they do not have special protection.

3. Do not exert excessive pressure and violent blows on handles of circuit breakers.

4. At low temperatures approximating -60°C, the handle should move first smoothly, without jerks, then accurately and rapidly.

5. Neither open nor repair circuit breakers. Never install an opened circuit breaker.

6. To prevent a blow-out, operate the breaker handle quickly without delay, otherwise, in the event of overload or short in the circuit, the circuit breaker will blow out as a fuse.

7. The handle may be delayed purposely only in exceptional cases when a possible inflaming of insulation and failure of the breaker itself are disregarded. After such a delay of the handle the circuit breaker becomes faulty and should be replaced.

Control Equipment

To control electric loads, the aircraft is fitted with equipment both for direct switching (switches, buttons, etc.) and remote switching (relays, contactors, relay boxes).

The aircraft is provided with the following equipment of direct switching:

1. Single-pole switch 87-К with two fixed positions.
2. Single-pole throw-over switch 88-К with two fixed positions (without neutral position).
3. Single-pole throw-over switch ПП1-45 with neutral position.
4. Single-pole switch ПЗШ-20 with three operating positions and one neutral position in which all contacts are open.
5. Single-pole switch ПН-45.
6. Two-pole twin switch 2В-45 with two fixed positions.

7. Push buttons 5-КС, 204-КС, 205-КС.

8. Microswitches ВК-2-140В-1, КВ-6А, КВ-6-2 and limit switches ВК-44. The ВК-2-140В-1 single-pole microswitch of instantaneous action is used in the afterburner interlock system (when no pressure exists in the hydraulic system) and in control systems of landing flaps, air brakes and stabilizer. КВ-6А and КВ-6-2 single-pole microswitches of instantaneous action with button control are employed in circuits of drop tank simultaneous jettison and in the control system of landing flaps. The ВК-44 limit switches are used in the system of L.G. position indicating lights.

In employing the control equipment:

1. To reduce wear of contacts owing to electric erosion, connect positive wire to moving contact (to contact support).

2. In mounting and dismounting switches take care that contact terminals do not get loose, support them by hand.

3. Protect switches against moisture and dust as they do not have special protection.

4. Avoid excessive pressure and violent blows on switch handles.

5. At low temperatures approximating -60°C handles should move at the beginning smoothly, without jerks, then they should move more accurately and rapidly.

6. Do not open or repair switches. An opened switch should not be installed in the aircraft.

7. Switches 87-К and 88-К are not fitted with special mechanisms of instantaneous action, therefore, switch their handles as quick as possible. This requirement is especially important in breaking circuits at maximum loads in order to avoid excessive burning of contacts.

8. When a fault in operation of switches is detected, even a slight one, remove and test them carefully, using a voltmeter and a test lamp.

9. Check to see that adjusting screws are properly locked and that leads to limit switches are securely attached to terminals.

10. Terminal screws (both operating and idle) should be safetied with benzylcellulose varnish.

11. Check the ram of the ВК-44 limit switch for adjustment of length and locking.

12. Keep microswitches and limit switches clean. Protect them from dirt and ingress of moisture inside the mechanism. Contamination of microswitches may result in binding of the operating ram rod.

13. Periodically inspect BK-2-140B-1 microswitches for security of their carbolite cases.

14. Check to see that buttons of KB-6A and KB-6-2 microswitches move easily and smoothly.

15. When microswitches and limit switches operate inaccurately, remove them from the aircraft and closely check with the help of a test lamp.

Remote switching in the aircraft is effected with the aid of contactors, type KM, and relays, type РП, ТКЕ, МР. Besides, the equipment of remote switching incorporates the РПА-200А relay box and ДМР-400А differential minimum relays.

In operation contacts may acquire tarnish which must not be removed by cleaning or filing. It is contact resistance (and not tarnish) that is indicative of contact proper operation. Contact resistance should lie within the limits for the voltage drop across two pairs of contacts not to exceed 240 mV, otherwise the contactor should be replaced. Take care that liquid does not get on a contactor.

In operation periodically inspect the connection of wiring to the contactor and attachment of the contactor itself to the aircraft body.

The contactors are located as follows: КМ-50Д contactor to cut in the pump of tank No.1 – in the left power supply unit;

– КМ-200Д contactor to cut in the aircraft storage battery – in the upper equipment bay near frame No.3;

– КМ-25Д contactor to cut in the АПС-4 stabilizer actuator – right top, near frame No.26.

Power Distribution in Aircraft

Power distribution from supply sources to loads is based on simultaneous supply of all consumers from the aircraft storage battery (except for СРД-1М radar ranging unit, АСП-5Н sight, ПО-500 inverter) or from any of the running generators.

The port generator ensures power supply for loads connected to the busbar of the port generator (in the left power supply unit), while the starboard generator feeds the loads connected to the busbar of the starboard generator (in the right power supply unit). The busbars of the starboard and port generators are interconnected through two ТП-200 high-current fuses. Thus, if one of the generators fails, its load is taken over completely by the other one.

Consoles located on the starboard and port sides of the cockpit and power supply units located on both sides of the fuselage constitute main switching and distributing equipment of the aircraft.

The left power supply unit contains circuit breakers АЗС, high-current fuses ТП-200 , shunt of ammeter А-46, capacitors КБМ-3I , receptacles 48-К, relay РП-2, relay ДМР-400А , voltage regulator Р-27Л, stabilizing transformer ТС-9АМ, contactor КМ-50Д , thyratron interrupter ПТ-5IД of kerosene flow meter.

The right power supply unit contains circuit breakers АЗС, time-lag fuses МП-75, high current fuses ТП-200 , shunt of ammeter А-46, capacitors КБМ-3I , relay РП-2, relay ДМР-400А, voltage regulator Р-27ПР , stabilizing transformer ТС-9АМ, afterburner automatic control unit КАФ-2 .

Power from sources is delivered to loads through the left and right power supply units. From the left power supply unit via busbar No.1 power is fed to engine starting units, engine afterburners, fire-fighting equipment, cockpit heating units, de-icing system, wheel brake releasing automatic system, fuel shut-off cocks, flow meter (D.C.), cockpit lamp of white light, left rear lamp АРУФОШ-45 , turn indicator, tank No.1 pump contactor КМ-50Д. Supplied directly from the busbar of the port generator (left power supply unit) are the inverter of the radar ranging unit and sight, relay РШ-6, which switches power supply from one inverter (2P) to the other (17P).

The right power supply unit delivers power:

1. Via busbar No.2 to the gyro horizon, ГИК-I compass, electromotors of rudder and aileron trim tabs, and trimming effect mechanism, radar altimeter, СИРЕНА-2 tail warning radar, radar ranging unit, radio station, heating element of ТП-156 air-speed.

2. Via busbar No.3 to units of gun and rocket armament, to taxiing and landing lights.

3. Via busbar No.4 to units of bomb armament, heating element of the air-speed tube, signalling and control system of landing flaps, air brakes, drag parachute, landing gear, navigation lights, ultraviolet light, control system of hydraulic boosters, signal flare electric launcher, АРУ variable ratio boost control unit.

4. Via busbar No.5 to fuel pumps of tanks Nos 2, 3 and 4.

Besides, connected directly to the busbar of the starboard generator (right power supply unit) are: the inverter of the radio communication station, radio compass, I.F.F. transponder, flow meter, actuators of АРУ-2А and АПС-4 mechanisms.

Specific Features of Mains Employment

1. When disconnected, plug connectors should be plugged or protected with cellophane against moisture, dust and mechanical damage.

2. All plug connectors should be securely joined, coupling nuts should be drawn up until tight and locked. The ends of locking wire should be clear of the cables.

3. In case of rupture of conductors at a solder joint, for resoldering use solder ПОС-40 with flux (mixture of alcohol and colophony). In soldering do not use acid or other soft alloys. After soldering remove overflows of colophony by washing them off with alcohol. Do not allow overflows of solder.

4. Negative terminals of power sources and loads should be securely drawn up and locked. Periodically check the tightening of negative terminals and condition of rubber strip in negative terminals (degree of tightening negative terminal should be determined not by tightening of coupling nut, but by rocking of adapter sleeve).

5. Take care that cables and fuel or hydraulic pipes are located 30 mm apart. Bear in mind that hydraulic pipes when in operation may become heated as high as 100°C and a short circuit to pipes of the fuel system causes a fire. At those places where a gap of 30 mm cannot be ensured, cables, fuel and hydraulic pipes should be protected with leather substitute or leatherette.

6. Take care of cable protection (especially if cables pass near sharp edges of aircraft structure). If protection is damaged, repair it and eliminate the cause of damage, otherwise the cable may be damaged.

7. Owing to high temperatures in the engine bay and especially in the fuselage tail section, observe the following:

(a) vinyl chloride attachment collars must not be used in the engine bay. To attach cables in this bay, use metallic band collars. Rubber tips on terminals of the generator-starter and starting panel are manufactured of heat-resistant rubber;

(b) when the air blow-off bands are open, the cables are affected by the air stream; therefore, the cables should be attached rigidly so as to prevent vibration which may lead to disrupture;

(c) cables of the tail section in aircraft of early series are provided with heat-resistant protection: they are wound with two layers of cord asbestos and coated with water glass. In operation check cables for condition of heat-resistant protection. Employment of vinyl chloride attachment collars and heat-nonresistant protection of cables in the fuselage tail section is prohibited. The gaps between the cables and the inner casing of the fuselage tail section should be not less than 20 mm.

In aircraft of late series bunched conductors in the tail section and engine bay are made of heat-resistant wire, mark ЭНТ When in operation it is necessary to check the state of insulation of heat-resistant wires at places where cables are bent most often. When disjointing plug connectors Nos 48, 56, 57, 58 and disconnecting plug connectors from units mounted in the tail section and engine bay, avoid violent bending and twisting of cables as this may lead to damage of insulation and closure of wires;

(d) near plug connectors of the fuselage the cables are wound with heat-resistant tape АНЭМ (green). At both ends the tape is fastened with wire bindings. Do not replace these heat-resistant materials with heat-nonresistant ones.

8. It is necessary to see that cables have no mechanical load at solder joints of conductors near plug connectors and at joints of wires to terminals of electric units and negative terminals. Near junctions the cables should have supports. Check conductors for condition of soldering at detachment connectors and give attention to security of contacts in them (see

that fibre sleeve does not dry out and fall through into plug connector).

9. Check conductors for security of attachment to ДМР-400А differential relays, Р-27 voltage regulators, ТС-9АМ stabilizing transformers, БС-6000 ballast resistors, КБМ-3I capacitors, АЗС circuit breakers, high-current fuses, generators, РПА-200 relay box, relay boxes in power supply units and other equipment.

10. Keep foreign objects away from units of electrical and radio equipment and their cables.

11. Never remove dust and dirt from electric equipment bays with compressed air. For this purpose use a vacuum cleaner or waste cloth.

4. MAIN ELECTRIC LOADS

Depending on the nature of operation all electric loads of the aircraft may be broken into the following groups:

1. Loads which operate continuously during the entire flight. This group includes:

(a) radio communication station РСИУ-4П , radio compass АРК-5, gyro induction compass ГИК-I ; gyro horizon АГИ-I , sight АСП-5Н , radar ranging unit СРД-1М, I.F.F. transponder СРО, marker receiver МРП-48П, radar altimeter РВ-2, tail warning radar СИРЕНА-2 , turn indicator ЭУП-53;

(b) measurement instruments and lighting equipment, fuel quantity and flow meter ТРЭ-52, warning lamps, navigation lights АНО, ultra-violet illumination light АРУФОШ-45 , etc.

(c) heaters of the clock, impact pressure tube ТП-I56 , air-speed tube ПВД-4;

(d) fuel pump of tank No.1 (unit 495А).

This group consumes rated power during the entire flight.

2. Loads operating once or twice during the flight. This group includes:

(a) hydroelectric valves of landing gear, landing flaps, air brakes, booster valves;

(b) electrically operated pneumatic valves of drag parachute control;

(c) landing and taxiing lights.

These loads are cut in to be supplied with rated power once

or twice during the flight.

3. Loads operating intermittently, with a short-time cut-in (0.5 to 5 min.). This group includes:

(a) actuators to control trim tabs of the rudder and ailerons;

(b) trimming effect mechanism;

(c) control of jet nozzle shutters and engine afterburners;

(d) control of firing;

(e) actuator of automatic unit АРУ-2А;

4. Loads operating continuously with a cut-in of more than 5 min. This group includes:

(a) pumps of tanks Nos 2, 3, and 4;

(b) control pilot lamps.

Electromotors, Types МГП-700, МГП-180 and МГП-100Б

The МГП-700 electromotor serves to actuate the booster pump of tank No.1 (unit 495А). To reduce interference with radio reception, the electromotor supply circuit has the Ф-37 filter.

The МГП-180 electromotor serves to actuate the fuel transfer pump of tank No.2 (ПНВ-2). To reduce interference with radio reception, the supply circuit has the Ф-I4А filter.

The МГП-100Б electromotor serves to actuate fuel transfer pumps (ПДР-1) of tanks Nos 3 and 4. To reduce interference with radio reception, the supply circuit has Ф-14А filters.

In the course of employment see that electric conductors are securely connected to the pump electromotors and check the condition of the commutator and brushes. The minimum permissible height of brushes is 11 - 12 mm. See that fuel does not get inside the electrical equipment of the pumps.

Main Electric Loads and Their Power Consumption

Description	Type	Rated power (W) and quantity	Power consumption, W (direct current)		
			continuous	intermittent	instantaneous
1. Radio communication station	РСИУ-4	19x1	19x1	-	-
2. Radio compass	АРК-5	20x1	20	-	-
3. Radar altimeter	РВ-2	70x1	70	-	-
4. I.F.F. responder	СРО	155x1	155	-	-
5. Radar ranging unit	-	900x1	900	-	-
6. Inverter	ПО-500	1050x1	1050	-	-
7. Inverter	ПО-750	1140x1	1140	-	-
8. Marker receiver	МРП-48П	20x1	11	9	-
9. Inverter	ПТ-125	216x1	216	-	-
10. Turn indicator	ЭУП-53	3.5x1	3.5	-	-
11. Fuel quantity and flow gauge	ТРЭ-52	4x1	4	-	-
12. Electromotor of tank No.1 pump	МГП-700	1000x1	1000	-	-
13. Electromotor of tank No.2 pump	МГП-180	290x1	290	-	-
14. Electromotor of tank No.3 pump	МП-100Б	180x1	180	-	-
15. Electromotor of tank No.4 pump	МП-100Б	180x1	180	-	-
16. Actuator	УТ-6Д	20x2	-	40	-
17. Electric valve	ЭК-48	85x9	-	-	765
18. Electric valve	УП-30/1	24x3	-	72	-
19. Hydroelectric cock	ГА-13	30x1	-	30	-
20. Sight	АСП-5Н	350x1	350	-	-

1	2	3	4	5	6
21. Warning radar	СИРЕНА-2	40x1	40	-	-
22. Electric trigger of guns	ЭПС-1	324x3	-	170	802
23. Ignition coil	КПМ-1	53x2	-	106	-
24. Starting coil	КП-21-Б-1	108x2	-	216	-
25. Hydroelectric control valve	ГА-21/9	30x4	-	120	-
26. Same	ГА-46	30x2	-	60	-
27. Same	ГА-74	240x3	-	720	-
28. Rack carrier	БДЗ-56	135x2	-	-	270
29. Contactor of tank No.1 pump	КМ-50Д	25x1	25	-	-
30. Landing light	ЛФСВ-45	673x1	-	673	-
31. Taxiing light	ФР-100	70x1	-	70	-
32. Heater of air-speed tube	ПВД-4	178x1	178	-	-
33. Heater of clock	АЧХО	10x1	10	-	-
34. Camera mount	АКС-3М	45x1	30	45	-
35. Camera controller	СШ-45	50x1	30	20	-
36. Signal flares electric launcher	ЭКСР-46	240x1	-	-	240
37. Electromotor of АРУ-2А	МУ-100АП	364x1	364	-	-
38. Electromotor	АПС-4	308x1	-	308	-
39. Electromotor	МП-100М	54x1	-	54	-

Taxiing and Landing Lights

The 70-W taxiing light, type ФР-100 ,is mounted on the nose strut of the aircraft and changes its direction as the strut turns.

The ЛФСВ-45 landing light employes the 600-W lamp, type СМФ-2 . To extend and to retract the landing light, a light elevating mechanism, type МПФ-2 , is used.

The ФР-100 taxiing light is set at an angle of 5° down and 10° to the left in relation to the aircraft centre line. The setting angles of the light are changed by turning the light body in the ball socket with the struts released. After setting, (Fig.146) the light body should be securely fastened in the ball socket.

The centre of the light spot is determined by means of a luxmeter.

The ЛФСВ-45 landing light is extended to an angle of 83°10'. Readjustment of the light extension angle is effected by displacing the limit switch of the light in accordance with the Manufacturer's Instructions.

The setting of the ЛФСВ-45 light with the aid of a shield (Fig.147) ensures the position of the light spot on the ground at parking at 5° to the left and 50 m. forward.

When in operation:

1. Periodically check technical characteristics and make preventive inspections of the light.

2. After each 5 minutes of operation the СМФ-2 lamp should be cooled.

3. To avoid burning of contacts, periodically check the electrodes for ruggedness and security of attachment to contact plates by means of pressing screws.

4. When replacing the СМФ-2 lamp, note that the light fairing contains 6 rubber sock absorbers (3 short and 3 long absorbers). Depending on the size of the lamp flange, respective shock absorbers are used. When installing the СМФ-2 lamp respective shock absorbers are installed in those fairing sockets which coincide with lugs on the СМФ-2 lamp.

5. The landing light is removed from the aircraft together with the easily detachable access panel located on the cockpit port side in the bottom. To dismantle, turn out the ever-set screws of the access panel and disjoint the supply connector of the light.

Inverters, Types ПО-750, ПО-500 , ПТ-125 and ПАГ-1Ф

Inverters of ПО-750 and ПО-500 types are designed to convert 27 V direct current into 115 V, 400 c.p.s. one-phase alternating current. The ПО-500 inverter is designed for A.C. power supply of the radar ranging unit and sight, while the ПО-750 inverter - for power supply of the radio communication station, I.F.F. responder, radio compass АРК-5, ТР3-52 fuel quantity and flow gauge.

With the increase of r.p.m. which may cause a failure of the inverter it is cut out by a centrifugal switch. It cannot be started again remotely. Its starting may be effected only after a manual change-over of the centrifugal switch on the ground.

As the inverter voltage remains constant despite changes in load and ambient conditions, ПО-750 and ПО-500 inverters are not provided with external resistors for voltage control.

When employing ПО-750 and ПО-500 inverters periodically check the commutator and brush rigging and see that brushes easily move and fit well to the commutator. Periodically blow inverters with air to remove brush dust, measure the height of brushes and, if necessary, wipe and clean the commutator and slip rings, clean the commutator grooves.

In the course of employment check the commutator and slip rings for the condition of their surfaces, they should be clean, and have no traces of burning. The glossy film on the slip rings and commutator which does not affect the generator operation need not be cleaned off.

Brushes are considered worn-out if the brush height has decreased to 16 mm on the side of direct current, and to 8 mm on the side of alternating current.

If in operation the output voltage does not correspond to the tolerated limits or becomes unstable, the inverter should be removed from the aircraft and sent for repairs. Before installing the inverter, fully depress the reset button of the centrifugal switch in order to make sure that the inverter is ready for operation.

To avoid inadvertent disconnections of the ПО-500 inverter, in replacing the СГ-3С voltage stabilizer install only those stabilizers the Service Log of which contains an inscription "Checked for ignition voltage in darkness".

The ПТ-125 inverter is designed for power supply of the ГИК-1 gyro induction compass and АГИ-1 gyro horizon.

In employing the ПТ-125 inverter make sure that the plug connector is securely attached to the inverter and check the condition of the brushes and commutator.

The ПАГ-1Ф inverter is intended for emergency power supply of the АГИ-1 gyro horizon.

In employing the ПАГ-1Ф inverter make sure the plug connector is securely attached to the inverter. Periodically check the condition of the brushes and commutator. If the brush height has decreased to 10 mm, replace them.

To clean the commutator and to grind in the brushes, use methods outlined for the generator.

Electrical Actuators, Types УТ-6Д and МП-100М

The УТ-6Д electrical actuator is employed in the aircraft to control the aileron and rudder trim tabs. The МП-100М actuator is used to control the trimming effect mechanism.

In employing the actuators:

1. Check current-carrying wires for reliable contact in all places of attachment.

2. Make sure that the brushes are correctly installed in brush holders and check the position of springs which press the brushes against the commutator. The brushes should freely move in brush holders without rocking and binding. The pressure spring should be straight.

3. Check the condition of brushes. The brushes should tightly fit the commutator surface all over. In case of contamination or burning of the effective surface the brushes should be ground in once more to fit the commutator. If the brushes break or wear out, replace them with new brushes from the spare parts set. A brush is considered worn out, if its height is less than 6.5 mm. New brushes should be ground in.

Periodically blow the actuator electromotors with clean dry air at a pressure of 1 - 1.5 kg/sq.cm. to remove brush dust.

Before blowing remove brushes from brush holders. Periodically check the condition of pressure springs of brushes and see that they have no mechanical damage and traces of corrosion.

Converter, Type РУ-11АМ

The РУ-11АМ convertor is a shielded enclosed two-pole single-armature electrical machine designed for feeding power to the РВ-2 radar altimeter. The РУ-11АМ convertor converts the mains voltage into direct current of high voltage (220 V).

In the course of employment periodically check the condition of brushes, commutators, brush holders. If the brushes are worn, replace them. The brushes (both on the side of high voltage and on the side of low voltage) are considered worn if their height is less than 9 mm. After replacement grind in newly installed brushes.

5. PRE-FLIGHT PREPARATION

Before the flight inspect and check the following:

Upper Nose Section

1. Attachment of aircraft battery, security of attachment of plug connector and drain pipe.

Note: If the storage battery was removed, check the degree of its charge, condition of sealing compound surface, attachment of electric wires to storage battery terminals, security of plugs, after which install the battery on the aircraft and connect it to the aircraft mains.

Landing Gear Front Leg

2. Condition and attachment of L.G. external warning light fittings.

3. Attachment and glass of taxiing light.

4. Attachment and condition of electrical wiring.

5. Condition and attachment of limit switches and negative terminals.

Landing Gear Right Leg

6. Condition and attachment of L.G. external warning light fittings.

7. Condition and attachment of limit switches and negative terminals.

8. Attachment and condition of electric wiring.

Starboard Wing

9. Security and cleanliness of AHO navigation light filter and its attachment.

Tail Unit

10. Security and cleanliness of AHO tail navigation light glass and its attachment.

Landing Gear Left Leg

11. Condition and attachment of L.G. external warning light fittings.

12. Condition and attachment of limit switches and negative terminals.

13. Attachment and condition of electric wiring.

Port Wing

14. Security and cleanliness of AHO navigation light filter and its attachment.

Fuselage Port Side

15. Attachment and glass of landing light.

Cockpit

16. Storage battery voltage at double rated discharge current; it should be not less than 24 V (voltage should be checked with the ПНВ-2 pump cut in).

17. Attachment of fittings of lamps АРУФОМ , КЛСРК-45 and condition of their electric wiring. Condition of caps and light filters of pilot lamps.

18. With the ground power supply cut in, check:

(a) condition of L.G. position pilot lamps, FIRE ALARM (ПОЖАР) lamp and generator lamps;

(b) condition of warning lamps in lamp register ТАБЛО-6;

(c) operation of navigation and ultra-violet light, cockpit lighting lamps and landing light;

(d) operation of booster and transfer fuel pumps and pressure warning mechanisms;

(e) heaters of the ПВД air-speed tube and ТП-156 impact pressure tube;

(f) operation of air distribution cock of cockpit air supply;

(g) operation of the АРУ-2А system relative to speed and altitude and from manual control as outlined in "Maintenance of Stabilizer Controls" (the check should be conducted with the participation of the aircraft's mechanic and instrument mechanic);

(h) operation of trim tab actuators and trimming effect mechanisms;

(i) operation of the stabilizer control follow-up system as is outlined in "Maintenance of Stabilizer Controls" (the check should be carried out with the help of the aircraft's mechanic).

After all operations are completed, make sure that all consumers of electric power and aircraft storage battery are cut out, trim tabs and trimming effect mechanism are set to the neutral position.

Note: When preparing electrical equipment for a next sortie, do not carry out operations of Item 1, 5, 7, 12, 17 and 18 if the pilot has no remarks on operation of the units concerned.

6. POST-FLIGHT INSPECTION

Inspect and check:

Upper Nose Section

19. Condition of sealing compound surface, plugs, container warning, level of electrolyte, attachment of electric wires to storage battery terminals, voltage of loaded battery.

20. Attachment of storage battery.

21. Reliability of connections in container connector, tightening and locking of plug connectors.

22. Reliability of battery negative wire-to-aircraft frame connection.

23. Box with КМ-200Д contactor and connection of electric wiring to it.

24. Tightening of nuts and condition of wire insulation at ТП-400 fuse in storage battery circuit.

25. Storage battery drain system.

Landing Gear Front Leg

26. Attachment, operation and smooth travel of rams of L.G. position limit switches.

27. Serviceability and attachment of L.G. external warning light fittings.

28. Attachment and glazing of taxiing light.

29. Attachment and condition of electric wiring and negative terminals.

30. Attachment of inertia switch and УП-30/I pneumatic valve of wheel automatic braking system.

Right Main Leg

31. Attachment and operation of limit switches, smooth travel of rams.

32. Serviceability and attachment of L.G. external warning light fittings.

33. Attachment of inertia switch and УП-30/I pneumatic valve of wheel automatic braking system.

34. Attachment and condition of electric wiring and negative terminals, bonding of doors and cables.

Starboard Wing

35. Security and cleanliness of navigation light filter and serviceability of fittings.

36. Attachment and operation of limit switches of landing flaps.

37. Jumpers of landing flaps bonding.

Fuselage Starboard Side

38. Condition and attachment of right power supply unit assemblies, attachment of electric wiring to assemblies and fuselage.

39. Attachment of generator, ballast resistor, pressure warning mechanism after tank No.1 and connections of electric wiring.

40. Condition and attachment of cockpit air distribution cock, landing flap valve, ЭК-48 electric valve, connections and attachment of electric wiring.

41. Security of connections in connectors of electric wiring, tightening and locking of coupling nuts in plug connectors and negative terminals.

42. Attachment of fire sensitive units.

43. Condition and security of attachment of accessible portions of electric wiring in engine bay and fuselage.

44. Bonding jumpers.

Tail Unit

45. Condition and attachment of tail navigation light fittings and security of light filter.

Fuselage Port Side

46. Condition and attachment of power supply unit assemblies, attachment of electric wiring to assemblies and fuselage.

47. Attachment of generator, ballast resistor and connection of electric wiring.

48. Condition and attachment of L.G. electro-hydraulic valve, ЭК-48 electric valve, starting panel, attachment, condition and connection of electric wiring.

49. Attachment of fire sensitive units, connection of negative wire of FIRE ALARM (ПОЖАР) warning system and its attachment.

50. Condition of ground supply cut-in plug.

51. Attachment of РПА-200А relay box, connection of electric wires, their condition and attachment.

52. Attachment and glazing of landing light.

53. Security of connections in connectors of electric cables, tightening of coupling nuts in plug connectors and negative terminals.

54. Condition and attachment of accessible portions of electric wiring in engine bay and fuselage.

55. Bonding jumpers.

Port Wing

56. Serviceability of navigation light fittings, security of light filter.

57. Attachment and operation of limit switches of flaps retracted position and intermediate position microswitches (the check should be carried out together with the aircraft's technician).

58. Bonding jumpers of flaps.

L.G. Left Main Leg

59. Inspection should be carried out as instructed under Points 31, 32, 33, 34.

Cockpit

60. Aircraft storage battery voltage (with ПКВ-2 pump started).

61. Attachment of electric boards, warning lamp fittings, РУФО rheostats, fittings of АРУФОШ lamps and cockpit lighting lamps.

62. Attachment of ТРТВК-45М cockpit air temperature thermo-regulator.

63. Reliability of connections in connectors of electric cables, tightening and locking of coupling nuts.

64. Condition of electric wiring and its attachment.

65. Bonding jumpers.

66. Check with ground supply on:

(a) operation of actuators of rudder and aileron trim tabs and of trimming effect mechanism;

(b) operation of fuel booster and transfer pumps and fuel pressure warning system;

(c) heaters of ПВД air-speed tube and ТП-156 impact pressure tube;

(d) serviceability of АНО, УФО lamps and cockpit lighting;

(e) serviceability of L.G. position pilot lamps, FIRE ALARM and generator lamps;

(f) serviceability of ТАБЛО-6 pilot lamps;

(g) serviceability of pilot lamps indicating positions of flaps and air brakes (simultaneously with check of their control systems);

(h) operation of air distribution cock of cockpit air supply system;

(i) operation of ТРТВК-45М cockpit air temperature thermo-regulator;

(j) operation of gyro horizon supplied from ПАГ-1Ф emergency inverter;

(k) operation of radio station and radio compass from inverter which supplies power to sight and radar ranging unit.

Upon completing all operations of post-flight inspection ascertain that all loads and the aircraft storage battery are cut out, the trim tabs and the trimming effect mechanism are set to the neutral position.

Chapter II

AIRCRAFT INSTRUMENTS

1. GENERAL

Aircraft instruments include:

1. Flight control and navigating instruments.
2. Engine instruments.
3. Control instruments of individual aircraft systems.

The aircraft instruments are located in the cockpit on the instrument panel and on the right-hand and left-hand consoles.

The aneroid and diaphragm type instruments are included into the systems of impact and static pressure of the ПВД-4 air speed tube and into the impact pressure system of the ТП-156 tube.

The instruments are located as is shown in Figs 148 - 153

2. FLIGHT CONTROL AND NAVIGATING INSTRUMENTS

The flight control and navigating instruments include:

1. Combined speed indicator, type КУС-2000.
2. Undisturbed gyrohorizon, type АГИ-1.
3. Induction gyrocompass, type ГИК-1.
4. Two-pointer altimeter, type ВД-20.
5. Climb indicator, type ВАР-150.
6. Electrical turn indicator, type ЭУП-53.
7. Mach number indicator, type М-1.5.
8. Aircraft clock, type АЧХО.
9. Accelerometer, type АМ-10.
10. Indicator of АРУ variable-ratio boost control unit.

Combined Speed Indicator

The КУС-2000 combined speed indicator is designed for measuring indicated and true speeds of aircraft at altitudes from 0 to 20 km. within the following ranges of speed:

(a) indicated speed from 150 to 1,600 km/hr;

(b) true air speed from 400 to 2,000 km/hr provided the indicated speed exceeds 400 km/hr.

Values of indicated and true air speeds are read off by means of two pointers, large and small, on a common dial.

The instrument dial is calibrated within the range from 100 to 2,000 km/hr with a division value of 20 km/hr. Divisions marked with numbers indicate 100 km/hr within 100 to 400 km/hr and 200 km/hr within 400 to 2,000 km/hr. A portion of the dial up to 150 km/hr is non-effective.

To increase the accuracy of measurement at low speeds the distances between divisions on the dial from 150 to 400 km/hr approximately two times exceed the distances between divisions on the remaining part of the dial.

The indicated speed indicator in the КУС-2000 device shows the air stream impact pressure; while the true air speed indicator shows the air stream impact pressure automatically corrected for air static pressure changes.

The instrument is mounted on the instrument panel. Pipe union Д by means of a rubberized fabric hose is connected to the dynamic line of the air speed tube, while pipe union С is connected to the static line.

After the installation check the instrument and its dynamic and static lines for air tightness.

Mach Number Indicator

The М-1.5 Mach number indicator is designed to measure the ratio of true air speed to sound speed, i.e. the Mach number. The instrument reads Mach numbers from 0.6 to 1.5 at altitudes from 0 to 16 km.

The instrument is fitted into the air speed tube system.

The airtightness of the instrument system should meet the following requirements:

1. If rarefaction in the case corresponds to indications of the instrument (with the impact pressure pipe union open), the pointer drop should not exceed one dial division during

1 min. when testing the static system.

2. The dynamic system at a pressure corresponding to the maximum indication of the instrument should be airtight.

Gyrohorizon

The АГИ-1 gyrohorizon with a slip indicator is designed to indicate the relative position of the aircraft in reference to the true horizon and to indicate side slipping and its direction.

With the help of the АГИ-1 gyrohorizon it is possible to do the following:

1. To check the attitude of the aircraft in bank and pitch under level flight conditions with an accuracy up to 1°

2. To check all manoeuvres: turns with unrestricted bank, chandelle, cabring and diving with an unrestricted pitch angle, etc., with an accuracy of up to 3°.

3. To determine the aircraft's attitude in bank and pitch with a 3° accuracy in case the pilot loses orientation in space.

4. To determine the angle of attack in level flight.

The АГИ-1 gyrohorizon set contains:

(a) АГИ-1 gyrohorizon mounted on the instrument panel;

(b) ПАГ-1Ф inverter (for emergency power supply of the instrument if ПТ-125 inverter fails), mounted on the starboard side under the cockpit floor between frames Nos 6 and 7.

Voltage drop in wires connecting the gyrohorizon to the inverter and the inverter to the mains should not exceed 0.5 V.

When in operation take care that the plug connector receptacle is correctly assembled. The receptacle body should be fully screwed into the threaded bushing and tightened.

Before securing the gyrohorizon to the instrument panel, check the instrument for correct connections. For this purpose, facing the dial, take the gyrohorizon in hands and keep it in a horizontal plane, switch it on and observe the reaction of the horizon bar.

If the spheric dial of the instrument returns to its operating position and its horizon bar takes up a horizontal position and aligns with the indicator-plane, then it means the mounting has been carried out correctly.

If, on the other hand, the horizon bar with the instrument on, departs from the indicator-plane upwards and downwards or inclines to it, or starts rotating, it means, the mounting was carried out incorrectly and it is necessary to check the plug connectors of the inverter and gyrohorizon for correct connections.

When the instrument is connected from the 27-V mains to the ПАГ-1ФП inverter, the latter should supply to the АГИ-1 instrument A.C. voltage of not less than 36 V; voltage is measured by means of a portable desk.

The АГИ-1 gyrohorizon is fastened to the instrument panel with four screws.

Caution: When installing the АГИ-1 gyrohorizon on the instrument panel do not push in the button marked PUSH BEFORE START (НАЖАТЬ ПЕРЕД ПУСКОМ).

The instrument is checked for correct installation on the panel in the course of operation (with power supply on).

With the aircraft in the flight path the indicator-plane should be aligned with the horizon bar on the spherical dial and also should be in line with fixed reference marks on the banking scale of the instrument. The meridian line should be in line with the zero division of the banking scale. Permissible misalignment of the above elements should not exceed 1°. The ball of the slip indicator should be between the fixed reference marks.

To regulate the lateral installation of the instrument, place the instrument body laterally with relation to the instrument panel.

The АГИ-1 gyrohorizon is fitted on the right side with a starting button which should be fully depressed and released before switching the power supply on. Do not depress the button after the power supply is on. When the power supply of the instrument has been cut out and will be switched on again after a short period of time (10 minutes or less), the button must not be depressed before the second switching-on.

The АГИ-1 gyrohorizon is supplied together with the ГИК-1 compass from the ПТ-125 inverter which operates normally at a load of not less than 70 per cent of the rated value. With the ГИК-1 compass removed, do not connect the gyrohorizon to the ПТ-125 inverter because at a low load the

inverter may fail and, besides, it delivers higher voltage which may result in a failure of the АГИ-1 gyrohorizon. In this case, to check the operation of the gyrohorizon, use the emergency inverter, type ПАГ-1Ф.

Induction Gyrocompass

The ГИК-1 induction gyrocompass in conjunction with the АРК-5 radio compass serves to determine the magnetic heading, turn angles, relative bearing of the radio station in instrument landing.

The ГИК-1 set includes (Fig. 154):

1. Induction transmitter, type ИД.
2. Gyro unit, type Г-2.
3. Correction mechanism, type КМ.
4. Amplifier, type У-6М.
5. Connection box , type СК-11.
6. Indicator, type УГР-3.
7. Slaving button, type 5-К.

In addition, the ГИК-1 set includes a correction cut-out, type ВК-53РБ, which cuts out azimuth correction (correction for magnetic heading) in turns with angular speed of 0.6 degree per second and more.

The ГИК-1 compass operates from:

(a) D.C. source of 27 V ± 10%;

(b) A.C. source of $36^{+3.6}_{-2.1}$ V, 400 c.p.s.

Power consumption does not exceed 60 W.

The induction transmitter is designed to correct the signals (with reference to magnetic heading) which pass from the potentiometer of the gyro unit to the indicator. In the transmitter the sensitive element (comprising cores of special alloy and windings) interacts with the Earth's magnetic field; in the winding of the sensitive element an e.m.f. is induced, its value depending on the transmitter position in relation to the magnetic meridian.

The gyro unit serves to average the indications taken off the induction transmitter and to indicate the aircraft turn angles.

The basic element is a motor-driven gyroscope.

The correction mechanism serves to connect the induction

transmitter and the potentiometer follow-up system of the gyro unit and to eliminate deviational, instrumental and measurement method errors.

The amplifier amplifies the signals coming in from the induction transmitter.

The connection box is designed to provide for electrical connections between units of the ГИК-1 compass.

The indicator shows all characteristics of the ГИК-1 compass.

The slaving button is intended for speedy matching of the indicator display with the transmitter position in switching on or after manoeuvring.

Basic Specifications

1. Readiness of compass for operation after switching on ..... for not more than 1 min. at +20°C and 3 min. at -60°C
2. Error in relation to magnetic heading under normal conditions ..... not more than ±1.5°
3. Error in relation to magnetic heading within temperature range of +50 to -60°C ..... ±2°
4. Compass operates at all altitudes up to ..... 20,000 m.

Before each flight see that electrical wires are securely connected and check the amplifier sensitivity regulator for its position which should be against figure 3 for the mean latitudes.

To check the efficiency of the instrument, switch the power supply on and 1 - 3 min later, by depressing the slaving button, match the system in accordance with the Operating Instructions on the ГИК-1 gyrocompass.

Electrical Turn Indicator

The ЭУП-53 turn indicator shows deviations of the aircraft in level flight from the heading.

1. Current consumed ..... not exceeding 0.13 A
2. Instrument sensitivity in flat turn at rate:
   $\omega = 0.6^\circ$/sec. ..... $4\pm2^\circ$
   $\omega = 1.5^\circ$/sec. ..... $12\pm2^\circ$
3. Error of instrument at banks of 15, 30, 45° with respective rates of 1.1, 2.3, and 4°/sec..... not more than $\pm1.5^\circ$
4. Stagnation angle of moving reference marker should not exceed ..... $\pm1.5^\circ$ with instrument operating

Altimeter

The ВД-20 two-pointer altimeter serves to indicate the relative altitude of the aircraft flight (in reference to the take-off place, landing place or some other point whose barometric pressure is known).

Basic Specifications

1. Range of altitude measurement ..... 0 - 20000 m.
2. Instrument case should be airtight at vacuum corresponding to 5,000 m. of altitude on instrument dial. shift of pointer should not exceed ..... 100 m. per 1 min.
3. When pointer is set to zero and pressure iuside case is 760 mm Hg., indications of barometric scale do not

differ from 760 mm Hg more than 2 mm Hg., and indications of moving reference markers do not differ from 0 by more than . . . . $\pm$10 m.

4. When pointer is set to 0 altitude, indications of barometric scale should not differ from meteo report atmospheric pressure by more than ..... 2 mm Hg.

When mounting the instrument, screw the plug out of the case and screw in the pipe union which is connected to the static line of the air speed tube through a rubberized fabric hose. In mounting avoid sharp bends and dents on the pipe (radius of bend should be not less than 150 mm).

After the installation check the lines for airtightness by creating the vacuum corresponding to the altitude of 5,000 m. on the instrument dial. On the expiration of 1 min. the shift of the large pointer should not exceed 100 m.

Before the take - off the altimeter pointers are set by the rack handle against zero so that the barometric scale in the slit on the right side indicates the pressure of the take-off place while the reference markers indicate the altitude with respect to 760 mm Hg. pressure.

Climb Indicator

The ВАР-150 climb indicator with a measurement range of 0 - 150 m/sec. is designed to measure the vertical component of climb and descent speed. The variometer is mounted on the instrument panel with the help of a special standard attachment ring.

Basic Specifications

1. Shift of pointer from dial zero does not exceed:
   (a) at normal temperature ..... $\pm$1 m/sec.
   (b) within temperature range from +50 to -45°C ..... 3 m/sec.
2. Hermetical sealing of system ensures vacuum drop for 1 min. not exceeding 2 mm Hg. at vacuum of 380 mm Hg.

When mounting, remove a rubber cap from the pipe union and connect the latter to the static line of the air speed tube by means of a rubberized fabric hose.

After mounting check the lines for airtightness.

Accelerometer

The AM-10 small-size accelerometer is designed to measure load factors acting on the aircraft in the direction perpendicular to the wing plane. Load factors are proportional to accelerations.

The accelerometer serves to determine load factors when flying in bumpy air and when performing advanced aerobatic manoeuvres.

Acceleration of gravity equal to 1 g (9.81 m/sq.cm.) is used as a unit for measuring acceleration. The accelerometer can measure load factors within the range from 5 g to +10 g.

Operation of the AM-10 accelerometer is based on the action of inertia forces on the mass located on the arm so that the mass within a definite angle freely rotates about the instrument axis in the scale plane. This shift is counteracted by the torque of the operating spring.

In a static check a permissible error in indications is not more than +0.2 g.

Before mounting uncage the instrument. For this purpose screw the plug out of the instrument case and with a screwdriver turn out the cage until it meets the stop then reinstall the plug. By depressing the button, set the fixing pointers to the initial position.

Under operating conditions inspect the instrument in order to make sure that it has no external damage and faults, and that the reset button and fixing pointers operate properly when the main pointer is shifted.

Aneroid and Diaphragm Instruments and Air Speed Tubes

Aneroid instruments are connected to the static and impact pressure lines of the air speed tubes ПВД-4 and ТП-156

The ПВД-4 air speed tube is mounted on the rod in the fuselage nose section (Figs 155 and 156) and serves to

receive the impact pressure encountered by the flying aircraft, and separately the static pressure.

The ТП-156 Pitot tube is mounted over the nose section, to the right. The navigational equipment supplied from the ПВД-4 and ТП-156 air speed includes the following instruments (Fig. 157):

1. Combined speed indicator, type КУС-2000.
2. Altimeter, type ВД-20.
3. Climb indicator, type ВАР-150.
4. Cabin altitude and pressure drop indicator type, УВПД-15.
5. Mach number indicator.

In addition to the above instruments of navigational equipment the system includes unit No. 6 of the sight and transmitters МРД-106, МРД-126 of the АРУ-2А variable ratio boost control unit.

In service and when installing the equipment observe the following:

Systematically check rubberized fabric sleeves and their attachment collars (externally). Rubberized fabric hoses should be put on all over the pipe union length without use of lubrication.

The ends should be wound with insulating tape to prevent ingress of dust and moisture.

After pipes and instruments are installed check the entire system for airtightness.

Before attaching pipes to the instruments and ПВД-4 and ТП-156 air speed tubes blow the static and impact pressure lines. Then connect the pipes to the instruments and test for airtightness. To determine airtightness, use the speed indicator located on the instrument panel.

In blowing and checking follow the procedure below:

1. Disconnect static and impact pressure pipes from all spring-diaphragm instruments and blow them with the help of a special device.

2. Check to see that pipes are correctly installed.

Pipes should be blown 2-3 times during 10-15 sec. at a pressure of 4-5 kg/sq.cm. Blow the pipes with dry clean air from the side of the air speed tubes with the shut-off cock set

to both positions in turn, i.e. OPERATIONAL ПВД(ПВД.РАБ.) and EMERGENCY ТП-156 (ТП-156 АВАР.).

3. Install air speed tubes and connect instruments.

4. Test static and impact pressure lines for airtightness for which purpose:

(a) set the shut-off cock to OPERATIONAL ПВД position;

(b) connect the КПУ-3 device to the static chamber of the ПВД-4 tube and smoothly, for at least 2 min., deliver vacuum to the line until the speed indicator shows 1300 km/hr; then shut off the pipe to the device.

Pipes are considered airtight if indications of the speed indicator do not fall by more than 40 km/hr for 1 min.

To locate leakage, i.e. inadequate airtightness, shut off separate portions of the line in succession;

5. Smoothly reduce vacuum in the static line during at least 2 min.

6. Disconnect the КПУ-3 device and connect it to the impact pressure chamber.

Smoothly build up pressure in the line until the speed indicator shows 1,000 km/hr and shut off the cock. The line is considered airtight if the pointer of the speed indicator does not drop by more than 10 km/hr during 1 min.

Smoothly reduce pressure in the impact pressure chamber during at least 2 min.

To check the impact pressure chamber for airtightness from the ТП-156 air speed tube, set the shut-off cock of the ТП-156 tube on the left-hand console to the position EMERGENCY ТП-156, connect the КПУ-3 device to the impact pressure tube of the ТП-156 tube by means of end pieces, build up pressure until the speed indicator shows 1000 km/hr and close the cock on the КПУ-3 device.

Pipes are considered airtight if the speed indicator pointer does not drop by more than 10 km/hr during 1 min.

All aneroid instruments are checked for accuracy with continuous buzzing or test vibration at vibration loads within 0.1 g to 0.3 g (when indications are read off vibration or buzzing may be switched off).

When in operation, systematically check the instrument externally; see that the cover glass and case are secure,

also drain off moisture condensation from moisture collectors of the ПВД-4 and ТП-156 tube systems.

After replacing any instrument, blow the system through with clean air and check it for airtightness.

Aircraft Clock

The АЧХО clock is designed for 6 day's continuous operation, although for normal operation it is recommended to wind it up once every 5 days.

A daily correction at a temperature of $+20\pm5^{\circ}C$ should be not more than ±1 min.

At a temperature below $-25^{\circ}C$ accurate operation is guaranteed if an electric heater is on.

3. ENGINE INSTRUMENTS

The set of engine instruments comprises:

1. Remote electric tachometer, type 2Т315-1.
2. Fuel quantity and flow gauge, type ТРЗ-52.
3. Thermoelectric temperature gauge, type 2ТВГ-411.
4. Pressure warning mechanisms, type СД-3, 4 pcs.

Remote Electric Tachometer

The electric tachometer, type 2Т315-1, is designed to give continuous indications of r.p.m. of the two engines.

The tachometer is a set composed of two three-phase generators whose frequency is proportional to the engine r.p.m., and a two-pointer indicator for the two engines which has two measuring elements mounted in a common case. Thus the r.p.m. of the two engines is read off a single scale of the indicator according to the two pointers.

The 2Т315-1 set includes:

1. Tachometer generator, type ДТ-3, 2 pcs.
2. Indicator, type 2Т315-1, 1 pc

Basic Specifications

1. Indicated r.p.m. .....1,000 to 15,000 r.p.m.

2. Scale division value ..... 200 r.p.m. (scale is uniform)

3. Tolerance for pointer at zero .. not more than +175 r.p.m. after buzzing or tapping cover glass of instrument.

In the range of 1,000 to 2,000 r.p m. permissible oscillations of the pointers should not exceed +100 r.p.m., over the remaining part of the scale the shift of the pointers should not exceed 1 mm along the scale arc; oscillations of the pointers should be not more than ±1 mm.

The voltage between each two phases of the tachometer generator connected to one electromotor should be 18 - 20 V at 12,000 r.p.m. on the indicator scale. The indicators and generators are interchangeable. The 2Т315-1 indicator is mounted on the instrument panel. The ДТ-3 generator is attached to the engine drive shaft (between frames Nos 16 and 17 of the fuselage) by means of a coupling nut which is locked to the bushing cast in one piece with the cover.

Before attaching the generator to the engine shaft check the wires for proper connection to the plugs by manually turning the generator shaft in the direction of engine shaft rotation. In this case the indicator pointer should turn clockwise.

Fuel Quantity and Flow Gauge

The ТРЗ-52 fuel quantity and flow gauge is designed to control the quantity of fuel in the aircraft tanks and to warn the pilot about the critical level of fuel in these tanks.

The ТРЗ-52 gauge is a combined instrument comprising two independent gauges: fuel quantity gauge, type ТЭС-47, and totalizing flow gauge, type РТС-16.

The scale of the fuel quantity gauge indicates the amount of fuel in tank No.1.

The scale of the fuel flow gauge indicates the changing quantity of fuel in the aircraft tanks depending on the amount of fuel filled.

In flight the indications on the flow gauge scale decrease and the pilot is aware of the quantity of the remaining fuel.

Note: In case the wing tanks containing fuel are dropped, the scale of the quantity gauge will show no changes, therefore the indications will be incorrect.

The set of the fuel quantity and flow gauge includes:

1. Indicator, type ТРЗ-52 (on the instrument panel).
2. Transmitter flow gauge, type РТС-16 (mounted in the engine supply manifold between frames Nos 15 and 16).
3. Transmitter of fuel quantity gauge, type ТЭС-1417 (mounted in fuel tank No.1).
4. Thyratron interrupter, type ПТ-51Д (mounted in the left-hand power supply unit between frames Nos 11 and 12)

The arrangement of the ТРЗ-52 set on the aircraft is shown in Figs 158 and 159.

Basic Specifications

Flow Gauge

1. Indicating range ..... 4,000 lit.
2. Scale division value ..... 100 lit.
3. Consumption of fuel .....1,200 - 19,000 lit/hr
4. Number of pulses per 1 lit. 0.3
5. Test pressure in inner chamber of transmitter case ..... 9 kg/sq.cm.

Quantity Gauge

1. Indicating range ..... 1,400 lit.
2. Scale division value ..... 100 lit.
3. Critical level of fuel as indicated by instrument . ..... 550 lit.

Before flight the scale of the indicating instrument should be set exactly to the figure denoting the amount of fuel filled in all tanks of the aircraft.

Exhaust Gasses Temperature Gauge

The temperature gauge of 2ТВГ-411 type with a measurement range from 300 to 900°C is a thermoelectric set with a

twin indicator and is designed to measure the temperature of exhaust gasses leaving the engines.

The 2TBГ-411 set includes:

1. Indicator, type 2TBГ-4, 1 pc (mounted on the instrument panel).

2. Thermocouples, type T-1, 8 pcs (4 pcs per each engine, between frames Nos 24 and 25).

3. Connection block with leads, 2 pcs (mounted in the fuselage tail section on frame No.24).

The operation of the temperature gauge is based on employment of the thermoelectric e.m.f. generated in the couples due to the temperature difference of hot and cold junctions.

Basic Specifications

1. Measurement range .....from 300 to 900°C
2. Operating range .....from 450 to 750°C
3. Resistance of each external circuit of temperature gauge (four thermocouples and leads).not exceeding 2.5 ± 1 ohms

Indicators and thermocouples are interchangeable within one group of calibration, also interchangeable are leads from any thermocouple to the connection block.

When in operation periodically check and, if necessary, clean the recess and hole of the thermocouple.

Thermocouples are fitted in the exhaust pipe in specially designed pipe unions and are fastened by aid of coupling nuts. See that the thermocouple pin enters the pipe union slit to ensure the correct position of the thermocouple in relation to the gas stream.

Leads are joined to the thermocouples by means of lugs and are fastened by screws.

The indicator is attached to the instrument panel with four screws and self-locking nuts built into the flange of the indicator case.

Fuel Pressure Warning Unit

The СД-3 pressure warning unit is designed to warn the pilot about the pressure drop in the fuel line below tolerance.

Operation of the warning mechanism is based on the relationship between pressure and reaction of the elastic sensitive element.

The aircraft is provided with four pressure warning units serving:

(a) to control operation of the pump of tank No.1 (mounted in the engine bay, top, frame No.15). Simultaneously it serves to interlock the afterburner cutting-in. If fuel pressure is less than 0.3 kg/sq.cm., augmented and maximum ratings are not switched on;

(b) to control operation of the pump of tank No.2 (mounted on the port side, bottom, between frames Nos 13 and 14);

(c) to control operation of the pump of tanks Nos 3 and 4 (mounted on frame No.22, bottom);

(d) to control the fuel level in drop tanks (mounted on frame No.15, top, along the aircraft axis of symmetry).

Basic Specifications

1. Warning mechanism cuts in warning light when excessive pressure in line drops below 0.3 kg/sq.cm.

2. Mechanism is rated to cut in and to cut out 5-W warning light at 27 V ± 10%.

3. Operating error of mechanism does not exceed ±0.05 kg/sq. cm.

4. Airtightness of mechanism should meet the following requirement: at air pressure of 3 kg/sq. cm. reference pressure gauge should indicate no pressure drop for 10 min.

5. When pressure of 300 mm Hg. is simultaneously delivered to static and impact pressure lines the airtightness of the mechanism case should ensure pressure drop not exceeding 8 mm Hg.for 1 min.

6. Mechanism withstands impact pressure overload of 5 kg/sq. cm. for 5 min.

4. CONTROL INSTRUMENTS OF SEPARATE AIRCRAFT SYSTEMS

Control instruments of separate aircraft systems include:

1. Cabin altitude and pressure drop indicator, type УВПД-15.

2. Air and hydraulic pressure gauges.

Cabin Altitude and Pressure Drop Indicator

The cabin altitude and pressure drop indicator is designed to measure "altitude" in the pressurized cockpit and the difference between cabin and atmosphere pressures. The УВПД-15 indicator is a combined instrument incorporating an altimeter and differential pressure gauge located in a single case and independent of each other.

Basic Specifications

1. "Altitude" measurement range ..... from 0 to 15 km. according to pressure drop from -0.04 to + 0.6 kg/sq.cm.
2. Deflection of pointer from zero mark on altitude scale at pressure of 760 mm Hg ..... not exceeding ±300m.
   Deflection of pointer from zero mark on pressure drop scale ..... not exceeding ±1 division of scale
3. Airtightness of impact pressure line of instrument ... at vacuum corresponding to 15 km.on instrument scale drop of pointer does not exceed 400 m. during 1 min.

4. Static system of instrument at vacuum corresponding to +0.6 kg/sq.cm. on pressure drop scale is ..... airtight

The instrument is mounted on the instrument panel by aid of an attachment ring. Pipe union C by means of a rubberized fabric sleeve is joined to the static line of the aircraft, pipe union Д remains open.

Air and Hydraulic Pressure Gauges

The МТ-250М pressure gauge intended for checking the pressure in the booster hydraulic system is mounted at the bottom, on the fixed part of the instrument panel. Mounted there also is a two-pointer pressure gauge, type МВ-12М, rated for 12 kg/sq.cm. and designed to check the operation of the brake system.

The horizontal part of the right-hand console carries: pressure gauge, type МВ-80М, rated for 80 kg/sq. cm., and designed to check the pressure in the system of flap emergency extension; pressure gauge, type МТ-250М, rated for 250 kg/sq. cm. and designed to check the pressure in the main hydraulic system; pressure gauge, type МВ-250, for 250 kg/sq. cm. to check pressure in the system of L.G. emergency extension, and pressure gauge, type АМВ-250М, for 250 kg/sq. cm., to check the pressure in the main air bottle line.

Basic Specifications

1. Basic error of pressure gauges should not exceed the values given below:
   МВ-250М and МТ-250М .....+10 kg/sq.cm.
   МТ-150М .....+4.8 kg/sq.cm.
   МВ-80М .....+3.2 kg/sq.cm.
   МВ-12М ..... +0.48 kg/sq.cm.
2. Variation of indications should not exceed the value of basic error;
3. Unsmoothness of pointer travel should not exceed 1 per cent of upper measurement limit.

Control Unit of APU Automatic System

The control unit of the APU automatic system consists of two transmitters and relay devices and is mounted at the back of the instrument panel in the cockpit.

The sensitive elements of MPД-106 and MPД-126 transmitters receiving impact pressure and barometric (static) pressure, convert them into electrical voltages which are then sent to relay devices controlling the electromotor of the APU-2A boost control unit.

The check of operation of the APU automatic system is outlined in "Maintenance of Stabilizer Controls".

5. PRE-FLIGHT INSPECTION

Fuselage Nose Section

1. Examine attachment of the ПВД air speed tube rod and of the ТП-156 pitot tube.

2. Examine rubberized fabric hoses in static and impact pressure lines and wires for heating the air speed tube in the L.G. nose strut well, at the hinge joint of the air speed tube rod and in the nose section.

Cockpit

3. Inspect attachment of the instrument panel and instruments on it.

4. Check position of instrument pointers.

5. Check operation of:

(a) gyroscopic instruments;

(b) engine instruments (with engines running);

(c) ГИК-1 gyrocompass;

(d) aircraft clock.

6. Set the altimeter pointers to zero and set the barometric scale to the value of atmospheric pressure existing at the moment of take-off.

7. Check static and impact pressure lines (when checking air speed tubes) for airtightness.

8. Check accuracy of speed indicator readings at scale marks of 300, 750 and 1.000 km/hr.

9. Check position of the change-over cock of the air speed tubes.

Note: When preparing the aircraft for a repeated sortie, carry out operations of Paras 1 and 2 provided the pilot has not reported on defects of the instruments.

Instruments which are said to be faulty should be checked in the scope of postflight inspection.

6. POST-FLIGHT INSPECTION

Fuselage Nose Section

1. Check security of attachment of the ПВД air speed tube rod and of the ТП-156 pitot tube; make sure they carry jackets and red warning flags.

This operation should be carried out with the help of the aircraft's technician (mechanic).

2. Check condition of rubberized fabric hoses in static and impact pressure lines, electric wiring of heaters of the ПВД air speed tube in the L.G. nose strut well (at the hinge joint of the air speed tube rod) and lines to the ТП-156 air speed tube in the nose section. Drain moisture condensation off moisture collectors.

3. Examine attachment of the static line to the sight unit. This should be carried out under the supervision of the armament mechanic.

Fuselage

4. Make certain that transmitters of pressure warning units are securely attached.

5. Check attachment of tachometers generators, transmitters of the fuel quantity and flow gauge, and of receivers of the exhaust gas temperature gauge.

6. Ascertain that the potentiometer chamber of the fuel quantity gauge transmitter does not contain any fuel.

7. Check attachment of the ГИК-1 gyrocompass units:

(a) transmitter;
(b) amplifier;
(c) inverter;
(d) connection box.

8. Check attachment and condition of insulation of accessible wiring supplying power to instruments.

Cockpit

9. Open up part of the instrument panel and check:
(a) attachment of rubberized fabric hoses to instruments and pipes of static and impact pressure lines;
(b) tightening of union nuts of plug connectors on instruments;

10. Check attachment and proper shock-mounting of the instrument panel and instruments.

11. After reinstalling and fastening the hinged part of the instrument panel, check operation of aneroid-diaphragm instruments and airtightness of static and impact pressure lines of the ПВД and ТП-156 air speed tubes.

12. Check operation of caging devices of instruments.

13. Make certain that cover glass panels of instruments are secure.

14. Check operation of gyro and electric instruments when energized.

15. Check position of instrument pointers.

16. Check operation of gyro horizon from emergency inverter.

Chapter III

OXYGEN EQUIPMENT SET

1. GENERAL

The aircraft is provided with the oxygen equipment set, type KKO-1, building up excessive pressure of oxygen in the mask and in the pressure suit pneumatic system (Fig.160).

The excessive pressure in the mask (in the breathing system) and in the pneumatic system of the pressure suit tensioner is regulated automatically depending on the flight altitude.

Mounted inside the pressure suit is the anti-G device which serves to reduce the effect of G's developing during the aircraft manoeuvres. The operation of the anti-G device is ensured by delivering air through the АД-5 automatic pressure unit from the cabin pressurization system.

The oxygen equipment set, type KKO-1, is designed to supply one pilot with oxygen under the following conditions:

(a) for a long period of time - during flights in a pressurized cabin at altitudes up to the service ceiling and in a depressurized cockpit at altitudes up to 12 km.;

(b) for a short period of time (up to 5 or 10 minutes) in case the cabin pressure is lost at altitudes from 12 km. up to the service ceiling, the set being employed as an emergency means of oxygen supply during the descent to a safe altitude;

(c) for a short period of time - during the ejection at altitudes up to the ceiling with a simultaneous automatic change-over to oxygen supply from the parachute breathing apparatus.

Principle of Operation

The oxygen equipment set, type KKO-1, may be used in high-pressure (from 30 to 150 kg/sq.cm) and low-pressure (from 6 to 30 kg/sq.cm.) oxygen systems.

The equipment installed on the aircraft is provided with oxygen cylinders charged up to 150 kg/sq.cm.

At altitudes up to 12 km. oxygen is delivered to the mask by the economizer. At altitudes up to 10 km. a mixture of oxygen with air is delivered, while at altitudes over 10 km. pure oxygen is supplied.

To prevent oxygen deficiency at altitudes from 8 to 12 km. (by the cabin altitude and pressure drop indicator, type УВПД-15) a small amount of excessive pressure is maintained in the breathing system to exclude the suction of the atmospheric air into the mask in case it does not fit tightly to the pilot's face.

To ensure a short-time flight at altitudes above 12 km. the excessive pressure in the breathing system maintains the same absolute pressure in the lungs as during the respiration with pure oxygen without excessive pressure at altitudes from 12 to 13 km. Oxygen is delivered to the mask in a continuous flow. At the same time due to the pressure in the tensioner pneumatic system the pressure suit exerts mechanical pressure over the surface of the wearer's body equal to the excessive pressure in the suit system. The excessive pressure in the mask (in the breathing system) and in the pressure suit pneumatic system is automatically regulated according to the altitude.

The KKO-1 set is provided with a manually-operated regulator which makes it possible in ground conditions to create by hand an excessive pressure in the mask and in the pressure suit pneumatic system so as to check the operation of the set prior to flight.

During the ejection the detachment of the parachute oxygen breathing apparatus with the mask from the aircraft oxygen breathing apparatus and the change-over to oxygen supply from the parachute oxygen breathing apparatus are performed automatically. In this case excessive pressure in the mask and in the pressure suit pneumatic system is regulated according to altitudes by means of the mask pressure regulator.

The oxygen equipment set, type KKO-1, includes the following:

(a) oxygen equipment installed on the aircraft;

(b) oxygen equipment included in the pilot's outfit.

The oxygen equipment mounted on the aircraft includes:

1. Inboard oxygen breathing apparatus, type КП-30 .
2. Oxygen reducer, type КР-26.
3. Oxygen indicator, type ИК-18.
4. Excessive pressure gauge, type М-1000.
5. Oxygen valve, type КВ-2.
6. Inboard oxygen hoses, type КШ-26.
7. Set of inboard oxygen fittings, type КАБ-14.
8. Remote control panel, type ДУ-1.

The oxygen equipment included in the pilot's outfit comprises:

1. Parachute oxygen breathing apparatus, type КП-27М .
2. Oxygen mask, type КМ-30, with the mask-to-face tightness compensator and the lock.
3. Altitude pressure suit, type ВКК-2.

The communication lines of the aircraft and those of the pilot are conneoted by means of the common connector, type ОРК-1М, installed on the pilot's seat left-hand side (Fig.161).

Basic Specifications of КП-30 Breathing Apparatus

1. The КП-30 breathing apparatus operates at a pressure of 30 to 6 kg/sq.cm. of oxygen delivered to it (or 150 to 30 kg/sq.cm. through the reducer, type КР-26).

2. The high-pressure cavity and the economizer valve are gastight at a pressure of 30 kg/sq.cm.

3. With oxygen delivered to the apparatus under a pressure of 6 to 30 kg/sq.cm., the adjusting (static) pressure in the apparatus reducer is within 3 - 6 kg/sq.cm.

4. The economizer valve opens at a pressure within 7 - 15 kg/sq.cm. in the reducer cavity.

5. The gastightness of the low-pressure cavity of the apparatus is as follows:

(a) at a pressure of 100 mm of water the permissible air suction is not in excess of 0.8 litre per minute;

(b) at a pressure of 1000 mm of water the permissible leakage of oxygen is not in excess of 1 litre per minute.

6. With oxygen delivered to the apparatus under a pressure of 15 kg/sq.cm., the continuous oxygen delivery can amount to a value from 15 to 25 lit/min.

7. The excessive pressure in the apparatus produced by the manually operated regulator in ground conditions is not less than 1000 mm of water, with oxygen delivered to the apparatus under a pressure of 15 kg/sq.cm.

Parachute Oxygen Breathing Apparatus

The parachute oxygen breathing apparatus, type КП-27М, employed in conjunction with the inboard oxygen breathing apparatus, is designed to supply the pilot with oxygen:

(a) in the event of ejection from the aircraft;

(b) for descent to a safe altitude (4000 m.) in case the inboard oxygen breathing apparatus fails to operate during altitude flights.

The КП-27М breathing apparatus differs from those of earlier makes in the employment of the common connector, type ОРК-1М. Due to this the apparatus is brought into operation without disconnecting the hose right on the apparatus.

Basic Specifications

1. The parachute oxygen breathing apparatus is used in conjunction with the aircraft oxygen breathing apparatus, type КП-30.

2. The oxygen delivery by the breathing apparatus charged at a temperature of 20°C to a pressure of 150 kg/sq.cm., is not less than 12.5 lit/min. 1 minute after the apparatus is brought into operation and not less than 3 lit/min. 11 minutes after the apparatus is brought into operation.

Oxygen is delivered continuously without sharp increases or decreases.

3. The apparatus charges the pressure suit pneumatic system with oxygen up to a pressure of 1 kg/sq.cm. during 15 sec. at the most.

4. The apparatus high-pressure cavity is gastight at a pressure of 150 kg/sq.cm. in the apparatus.

5. The apparatus is reliably brought into operation by pulling out the cotter pin (automatically or manually) of the automatic cut-in operating cable.

6. The apparatus low-pressure cavity is gastight at a pressure of 2 kg/sq.cm. The permissible leakage of oxygen is characterized by a pressure drop of 0,4 kg/sq.cm.at the most in the course of 1 minute.

The КП-27М breathing apparatus can be used with any type parachute which has a special pocket for the oxygen breathing apparatus.

2. CHECKING OPERATION OF OXYGEN EQUIPMENT

Checking System for Leakage

Check the oxygen equipment for leakage in the following manner:

1. Check the gastightness of the high-pressure system. For this open the КВ-2 valve and close it as soon as the system is charged with oxygen.

If the pointer of the ИК-18 oxygen indicator remains immovable during two minutes, the system is gastight.

If the ИК-18 indicator readings decrease, the system is leaky. This being the case, detect the leaky places by means of soapy water.

As a rule leakage is eliminated by tightening the union nuts and attachment screws. If leakage is caused by damage to the economizer valve, replace the defective apparatus by a new one.

2. Check the low-pressure system for leakage. For this divide the system into three sections:

(a) the first section – from the mask (with the mask-to-face tightness compensator) to the upper block of the common connector, type ОРК-1М, inclusive;

(b) the second section – from the lower block of the common connector up to the КП-30 oxygen breathing apparatus;

(c) the third section – the КП-30 oxygen breathing apparatus.

To check the first section, disconnect the upper block of the ОРК-1М common connector, close the central outlet hole

of the common connector upper block with hand and make a long shallow inhalation. If you cannot make an inhalation, the section is gastight.

Then mount the upper block on the body of the OPK-1M common connector.

To check the second section, disconnect the КШ-26 hose from the КШ-30 oxygen breathing apparatus, close with hand the hole in the angular pipe union of the large diameter pipe line and make a long shallow inhalation. If you cannot make an inhalation, the section is gastight.

This done, connect the КШ-26 hose to the КШ-30 oxygen breathing apparatus. Check previously whether the apparatus valve, type КВ-2, is closed, the air dilution switch handle is set to the 100% O_2 position and the indicator pointer is set to zero.

To check the third section, make a long shallow inhalation. If it is impossible to inhale, the third section is gastight.

If you can make an inhalation, the low-pressure cavity of the КШ-30 breathing apparatus is leaky.

In this case the defective breathing apparatus should be replaced by a new one.

Note: Since the gastightness of the low-pressure cavity depends to a great extent on the condition of rubber gaskets in the joints, pay attention to the condition of the joints and replace the defective gaskets by new ones in due time.

Checking Operation of Oxygen Equipment Set

At excessive pressures the checking is performed as follows:

1. Open the КВ-2 valve.

2. Put on the flying helmet with the mask-to-face tightness compensator and the КМ-30 mask and pressure suit adjusted beforehand.

3. Connect the mask to the mask-to-face tightness compensator, pressure suit, parachute oxygen breathing apparatus and the OPK-1M common connector by means of the upper block of this connector attached to the mask hoses, close with finger the hole on

the regulator body and set the handle on the remote control panel to the OXYGEN SUPPLY TO SUIT (ПОДАЧА O_2 В КОСТЮМ) position.

4. By means of the manually-operated regulator on the remote control panel (central handle) create in the mask excessive pressure not higher than 1000 mm of water as read by the pressure gauge, type М-1000 (indicator flaps must get apart).

5. Make several inhalations and exhalations. If the pressure gauge, type М-1000, reads a pressure decrease during the inhalation and a pressure increase during the exhalation with the pressure suit tightly compressing the wearer's body, the ККО-1 set operates properly.

Note: Bear in mind that in this case the oxygen indicator may fail to react to inhalations and exhalations which is considered to be normal.

Without excessive pressure the checking is performed as follows:

1. Open the КВ-2 valve.

2. Set the suit oxygen supply handle to the NEUTRAL (НЕЙТРАЛЬНО) position.

3. Close the manually-operated regulator as far as it will go.

4. Perform two or three inhalations and exhalations. If the indicator flaps move apart and get together, the ККО-1 oxygen equipment set operates properly.

Checking Change-Over of Oxygen Supply from Aircraft Breathing Apparatus to Parachute Breathing Apparatus

The mechanism switching on the parachute oxygen breathing apparatus, type КШ-27М , provides for an automatic (during ejection) or manual (in the event of failure of the КШ-80 apparatus) bringing of the apparatus into operation, therefore it is necessary to check the change-over of oxygen supply for two cases.

(a) Checking Automatic Switching of КШ-27М Apparatus

Checking the automatic switching of the КШ-27М apparatus is performed by pulling out the seat with the pilot in the event of replacement of the OPK-1M common connector or cabin repair. The

performed by pulling out the seat with the pilot in the event of replacement of the OPK-1M common connector or cabin repair. The pilot should have a complete flying outfit on with all the supply lines connected.

Prior to pulling out the seat:

1. Remove the canopy.

CAUTION. The ejection gun should be unloaded.

2. Prepare the seat for removal.

3. Check whether the communication lines are properly connected at the OPK-1M common connector to the flying helmet and to the pressure suit, type BKK-2.

4. Check the attachment of the connector upper block with a special rubber (shock absorbing) cord and a strap, as well as the connection of the cable to the lever of the connector lower block.

5. Turn on oxygen supply by opening the KB-2 valve.

6. Pull out the seat with the pilot. The pilot should assume the position as during the ejection of the seat.

While pulling out the seat, make sure that:

1. The common connector lower block gets detached, the KM-26 inboard oxygen hoses and the hose of the pressure suit anti-G device line preserving some sagging.

2. Oxygen supply becomes changed over from the KM-30 inboard oxygen breathing apparatus to the KM-27M parachute apparatus, the securing pin of the automatic cut-in operating cable being pulled out of the hole in the stud pin releasing the latter.

The pilot should continue breathing with the mask connected to make sure that oxygen is properly supplied by the breathing apparatus.

Pull out the seat by 250 mm, approximately. After checking place the seat in position and prepare the oxygen equipment for use.

CAUTION. When connecting the automatic cut-in operating cable of the KM-27M apparatus to the apparatus oxygen starter (by inserting the cable securing pin into the starter stud pin) do not forget to lock the operating cable securing pin with linen thread having a tensile strength of not more than 12 kg.

(b) Checking Manual KM-27M Breathing Apparatus

Check the manual switching of the KM-27M breathing apparatus after its automatic switching has been checked and the whole of the oxygen equipment is quite ready for use.

When checking the manual switching the pilot should wear the same flying outfit as during the automatic switching check.

To check the manual switching, pull the KM-27M apparatus manual switching cable the whole way out by sharply shifting the handle and make sure that the cable securing pin has come out of the hole in the stud pin. This must bring about oxygen supply from the KM-27M parachute breathing apparatus to the mask.

Note: In case the seat is to be adjusted to fit another pilot's height, carry out the check as prescribed in Item (a).

3. POSSIBLE FAULTS AND THEIR ELIMINATION

The repair of the KKO-1 oxygen equipment set requiring its disassembly and adjustment is not permitted in the field. The items of the set which need repair must be replaced by new serviceable ones; the items which have been removed should be sent to repair agencies.

Mask, Type KM-30

1. Leaky outlet valve.

In most cases the leakage of the outlet valve is caused by its fouling (dust, sand and other foreign matter might get under the valve).

This being the case, scavenge the outlet valve with air containing no oil or with oxygen (without removing the valve from the mask). After scavenging recheck the valve for leakage.

Note: The valve can be also scavenged by an abrupt exhalation.

If the outlet valve remains leaky after scavenging, replace mask by a serviceable one.

2. Leaky connections of the mask with the mask-to-face tightness compensator, the upper block of the common connector,

the pressure suit and parachute breathing apparatus.

In these cases replace the gaskets and then recheck the connections for leakage.

3. Leaky mask body, corrugated hose and mask-to-face tightness compensator.

In the first two cases the mask should be replaced by a serviceable one, while in the third case the mask-to-face tightness compensator should be replaced.

4. Leaky valve of the excessive pressure regulator.

In this event the mask should be replaced by a serviceable one.

Oxygen Fittings with Non-Return Valves

If one of the non-return valves is found leaky, disassemble the unit with the non-return valve and then wipe the valve and the seat with a clean piece of waste cloth slightly moistened with pure gasoline (without admixture of oil). In doing so see that no foreign matter (white or brown coating) remains on the valve and the seat. This done, wash the parts of the disassembled unit in pure gasoline (without admixture of oil), scavenge them with oxygen and only after this assemble the unit.

If the unit in question is still leaky, do as follows:

(a) replace the defective valves and seats in the unit by serviceable ones, or

(b) replace the unit by a new one.

Faulty KM-30 breathing apparatus, KP-26 reducer, pressure suit, MK-18 oxygen indicator, M-1000 pressure gauge, KM-26 hose and KB-2 valve must be replaced by new ones.

4. RATING OF OXYGEN

The aircraft carries six 2-litre cylinders.

Since oxygen consumption ranges widely depending on the flight altitude, free air temperature and peculiarities of the pilot, it is difficult to accurately calculate the required stock of oxygen.

The average oxygen consumption per man during the period the breathing apparatus is used is assumed to be equal to 9 lit/min. (reduced to temperature of 15°C and pressure of 760 mm Hg).

The required stock of oxygen can be determined as follows:

Six oxygen cylinders of 2-litre capacity each are charged to a pressure of 150 kg/sq.cm.

Determine the time during which this amount of oxygen will last.

Solution. Multiply the cylinders capacity by the pressure in the cylinders, subtract the reserve of 30 kg/sq.cm. not taken into account and divide the result by the average rate of oxygen consumption per minute.

The value thus obtained is the duration of flight with oxygen supply in minutes:

$$T = \frac{6 \cdot 2\ (150 - 30)}{9} = 160 \text{ min.}$$

or 2 hours 40 minutes.

5. CONNECTING BKK PRESSURE SUIT

The BKK pressure suit bladders are connected to the automatic pressure unit, type AD-5, designed to produce necessary pressure of air coming from the engine compressor depending on the value of positive load factor (Fig.162).

The filter is designed for cleaning the supplied air from mechanical impurities.

6. STORAGE OF OXYGEN CYLINDERS

In the event of a long-time parking the oxygen system should be kept charged with oxygen under a pressure of 5 kg/sq.cm. at least, with the KB-2 valve closed.

If it is necessary to remove the cylinder from the aircraft, first completely let oxygen out of the system and then remove the cylinder together with the tee-piece pipe union.

CAUTION. When letting oxygen out of the cylinders, disconnect the high-pressure pipe line from the pipe union of the KB-2 valve or from the high-pressure pipe union of the KP-26 reducer; it is prohibited to let out the oxygen through the reducer.

In the event the oxygen is stored or shipped, screw a special cap on the outlet of the tee-piece pipe union, charge the cylinder with oxygen up to 5 kg/sq.cm. and then close the inlet pipe union

with a special plug (the plugs are included into the aircraft individual set).

Note: The tee-piece pipe unions of the cylinders have non-return valves.

7. PRE-FLIGHT INSPECTION

Examine and check:

1. The cylinders for pressure of oxygen (by the pressure gauge).

2. The KI-30 oxygen breathing apparatus for proper switching from the remote control panel.

3. In the KKO-1 oxygen set:

(a) the high-pressure oxygen system, for leakage;

(b) the low-pressure oxygen system, for leakage;

(c) the oxygen apparatus for proper operation at excessive pressure and without excessive pressure;

(d) the oxygen mask outlet valve, for leakage;

(e) the switch cables for good condition and reliable attachment;

(f) the common connector pull-out cable for good condition and reliable attachment;

(g) the parachute breathing apparatus for proper amount of pressure and intactness of the seals;

(h) the oxygen hoses for reliable attachment.

4. The parachute oxygen breathing apparatus for proper packing in the parachute pocket and the securing pin of the automatic cut-out operating cable for proper locking.

5. Remove the plug from the common connector, mount the detachable part and check the reliability of its attachment.

6. After the pilot has donned the parachute and got into the cabin, check the connection of the common connector upper block, the attachment of the pressure regulator in the lock on the left foot strap of the parachute harness and the position of the parachute breathing apparatus oxygen hose.

Notes: 1. When preparing the aircraft for a second flight, do as prescribed in Item 1 if there are no remarks on the part of the pilot concerning the operation of the oxygen system.

2. Prepare the oxygen equipment for flight after

the engines have been tested and after the pre-flight inspection has been carried out by the specialists of all services.

8. POST-FLIGHT INSPECTION

Examine and check:

1. The oxygen cylinders and pipe lines for reliability of attachment. See that they are free from dust and dirt.

2. The inboard filler adapter for proper condition.

3. Examine the oxygen breathing apparatus.

4. Check the gastightness of the high- and low-pressure oxygen systems (if there are remarks on the part of the pilot concerning the operation of the oxygen system) and make sure that the KI-30 breathing apparatus remote control operates properly.

5. Check the condition of the oxygen hoses and the mask.

6. Wipe the mask with rectified alcohol.

7. Check in the parachute breathing apparatus:

(a) the amount of oxygen pressure in the apparatus;

(b) the intactness of the seal on the apparatus;

(c) the securing pin of the automatic cut-in operating cable for proper locking.

8. Remove the detachable part of the common connector and plug the latter.

9. Recharge the oxygen system.

SECTION FOUR

RADIO AND RADAR EQUIPMENT

The following radio and radar equipment is available on board the aircraft:

USW receiving-transmitting radio telephony set, type РСИУ-4П , responder, type СРО, tail warning radar, radio range finder, type СРД-1М , and simplified ILS equipment ОСП-48.

The radio set, type РСИУ-4П, is used for two-way communication with the aircraft and with ground stations of the РАС-УКВ type.

The responder on board the aircraft picks up interrogation signals from aircraft, ship and ground interrogators and responds to them by automatically transmitting coded identification signals.

The tail warning radar is designed to sweep the rear hemisphere for enemy aircraft if the enemy aircraft uses a 3-centimetre radar or a radio range finder.

The ILS equipment consists of:

1. Automatic radio compass АРК-5.
2. Marker receiver МРП-48П.
3. Low range radio altimeter РВ-2.

Chapter I

RADIO SET

The РСИУ-4П radio set is a USW receiving-transmitting set used for plane-to-plane and plane-to-ground communication.

The frequency range extends from 100 to 150 Mc/s (wavelength 3 - 2 m.).

The frequency range is covered in 501 fixed waves which are evenly distributed throughout the entire range and are stabilized by 11 crystals.

The radio set may be pretuned to 6 waves out of 501 (adjustments are performed on the ground) which ensures fixed-wave communication in flight on any of the 6 frequences chosen.

Basic Specifications

1. The specified communication ranges for the set are:
(a) not less than 120 km. at an altitude of 1000 m. and not less than 350 km. at an altitude of 10,000 m. for communication with a ground radio station, type РАС-УКВ;
(b) not less than 120 km. at an altitudes of 500 m. and higher for plane-to-plane communication.
2. The set is designed to operate continuously for 12 hours according to the following arrangement: 1 min. for transmission and 3 min. for reception. When on reception the set can operate for 24 hours.
The transmitter can operate continuously for 20 min. with subsequent cooling.
3. Frequency range . . . . . 100 - 150 Mc/s
4. Total number of fixed waves 501
5. Minimum wave separation during tuning 2
6. Current through antenna equivalent at R = 50 ohms . . . . . not less than 0.35 A
7. Voltage supply for laryngophones . . . . .2.8 - 4.2 V
8. Receiver sensitivity as measured at 30% modulation and 30 V across the earphones . . . . . not worse than 12 μV
9. D.C. voltage supply . . . . . 27 V
10. A.C. voltage supply (from inverter ПО-750) . . . . . 115 V, 400 c.p.s.

The set РСИУ-4П consists of:

1. Transmitter (unit А) with receiver (unit Б) assembled on a common shock-proof frame.
2. Selenium rectifier (unit В) arranged on a shock-proof frame.
3. Control desk (unit П).
4. Rod antenna.

The complete list of the radio set components is given in the Service Log. Interunit connection diagram of the set is presented in Fig.163.

Arrangement, Removal and Installation of Units of Radio Set

The transmitter and receiver assembled on one shock-mounted frame occupy the top nose compartment of the fuselage, between frames 1 and 3 along the aircraft centre line.

To remove the transmitter with the receiver (neither of them may be withdrawn separately) proceed as follows:

1. Open the upper cover of the hole, providing access to the fuselage nose compartment.
2. Disconnect the plug connectors of the cables running to the receiver and transmitter.
3. Disconnect the antenna feeder.
4. Disconnect the bonding strip.
5. Remove two screws arranged in the corners of the transmitter.
6. Take out two attachment nuts of the receiver.
7. Withdraw the transmitter together with the receiver.

When installing the transmitter and the receiver in place the outlined procedure should be reversed.

The selenium rectifier is installed between frames Nos 5 and 6 under the cockpit floor on the right side.

To remove the selenium rectifier:

1. Remove the starboard access panels between frames Nos 5 and 9.
2. Remove the cannon as is laid down in the instructions on removing the cannon.
3. Remove the protective case of the equipment.
4. Disconnect the plug connectors from the selenium rectifier.
5. Remove the front attachment bracket of the rectifier.
6. Remove the box of A.C. fuses.
7. Take out two studs for securing the rectifier frame.
8. Remove the selenium rectifier with the frame.

When installing the selenium rectifier in place the outlined procedure should be reversed.

The remote control desk is arranged in the pilot's cockpit on the left side at frame No.5.

To remove the control desk of the radio set:

1. Take out four screws and remove the top front cover of the cabin left-hand desk.
2. Unscrew the locks and withdraw the side front cover of the cockpit left-hand desk.
3. Disconnect the plug connectors of the cables running to the control desk.
4. Remove the bracket for securing the connectors of the control desk.
5. Disconnect the bonding strip.
6. Take out screws securing the desk and withdraw the control desk from the aircraft.

To re-install the desk on board the aircraft, reverse the operations outlined above.

The rod antenna is positioned in the upper part of the fuselage, to the right, between frames Nos 9 and 10, and is secured to a special panel made of pressed powder.

To withdraw the antenna from the aircraft, it is necessary first to unscrew four attachment bolts, then to move the antenna slightly upwards, to disconnect the feeder and to remove the antenna from the aircraft.

To re-install the antenna on board the aircraft reverse the operations outlined above.

The radio set is supplied with 115 V, 400 c.p.s. A.C. from the ПО-750 inverter.

The ПО-750 inverter is arranged between frames Nos 4 and 5 to the left of the centre line under the cockpit floor.

To remove the ПО-750 inverter:

1. Remove the port access panel between frames Nos 5 and 7, having previously disconnected the connector from the headlight.
2. Disconnect the connector of the cable running to the inverter.
3. Disconnect the wires leading to the "+" and "–" terminals of the inverter (the "+" wire should be isolated).
4. Remove the frame with the dehydrator of the radio compass, type APK-5.
5. Unscrew two screws attaching the frame of the ПО-750 inverter.
6. Remove the ПО-750 inverter.

When installing the inverter in place the outlined procedure should be reversed.

Safety Precautions

When inspecting, adjusting, repairing the set as well as when localizing faults it should be remembered that:

1. The set circuits carry large A.C. and D.C. voltages of high and low frequencies. High D.C. voltage is developed across the valve anodes, rectifier output and the pins of the supply connectors whereas high frequency voltage is found across the antenna receptacle, antenna relay and in the anode tanks of the transmitter.

To avoid possible burns keep your hands out of contact with components under high potential.

2. The replacement of fuses in the supply unit should be attempted only with the set de-energized.

3. The valves should be replaced with the set switched off.

4. It is strictly forbidden to inspect and clean the contacts of plug connectors with the set switched on.

Testing and Tuning Radio Set on Board the Aircraft with Meter Unit (Unit И)

Prior to switching on the radio set for tuning proceed as follows:

1. Make sure that the cables are properly connected.

2. Remove the case protecting the channel selector of the receiver and transmitter.

3. Release the channel selector push-buttons on the control desk and meter unit.

4. Connect the meter unit to the plug connector MEASUREMENT (ИЗМЕРЕНИЕ) on the receiver panel and set the switch RECEPTION-TRANSMISSION (ПРИЕМ – ПЕРЕДАЧА) on the meter unit to RECEPTION (ПРИЕМ).

CAUTION. Connecting the meter unit to the receiver with the push-buttons on the meter unit and control desk depressed will result in idle rotation of the receiver and transmitter motors. Should this continuous rotation exceed 2 minutes the mechanisms may be damaged.

5. Connect the micro-telephone headgear to unit И.

6. Connect the aircraft mains to the ground D.C. source of 24 – 28 V.

7. Switch on the circuit breaker RADIO,RADIO COMPASS АРК, MARKER RECEIVER МРП , FLOW METER (РАДИО, АРК,МРП,РАСХОДОМ) on the right-hand desk; the ПО-750 inverter will start operating. The set should not be tested or adjusted until the valve heater voltage has been on at least for one minute.

Sequence of operations during adjustment and tuning of the set (with the help of unit И)is suggested in the operating instructions for the РСИУ-4П set.

8. With the transmitter and receiver tuned, proceed to checking communication using all six channels; make sure that the monitoring circuit is in order, communication is reliable and the channel selector is well adjusted.

When checking the set for proper communication switch 1 on unit И should not be in the position ANTENNA CURRENT (ТОК АНТЕННЫ). If it is, shift it to any other position.

9. Disconnect unit И from the receiver. The connector MEASUREMENT should be capped.

Install covers of the transmitter and receiver mechanisms.

10. Check communication with a ground station through all six channels operating the set from the control desk; make sure that communication through all six channels is reliable, the channel selector operates smoothly, the volume control and the switch NOISE SUPPRESSOR (ПОДАВИТЕЛЬ ПОМЕХ) are adjusted properly. With the switch NOISE SUPPRESSOR operated ON and OFF, the noises of the receiver proper should appear and disappear respectively.

11. Check the set for reliable communication with a ground station when supplied from the emergency inverter ПО-500 (ПО- 750), in which case the circuit breaker EMERGENCY SUPPLY, RADIO, RADIO COMPASS, MARKER RECEIVER, FLOW METER (АВАР.ПИТ., РАДИО,АРК,МРП,РАСХОДОМ) should be switched on.

12. Check the set for proper communication with the engines running and all permanent consumers connected. Cut in the switch NOISE SUPPRESSOR on the control desk and make sure that radio interference caused by operating electric equipment is not heard in the earphones.

If heavy interference is experienced, trace the equipment responsible for it by subsequently disconnecting the "suspected" electric devices.

The interference being cancelled out the radio set may be considered ready for operation.

Testing Radio Set before Flight
(with engines running)

1. Cut in the circuit breaker RADIO, RADIO COMPASS АРК, MARKER RECEIVER on the right-hand panel; the ПО-750 inverter will start operating.
2. Set the switch on the control desk to RECEPTION(ПРИЕМ).
3. After one or two minutes have elapsed select the required channel by depressing the respective push-button on the control desk.
4. Depress the TRANSMITTER ON push-button, arranged on the right-hand engine control lever and call the ground station.
5. Use the volume control on the control desk to obtain the required strength of received signals.
6. Proceed to check the operation of the set in other channels as arranged with the ground station.
7. Check the operation of the set with emergency supply on.
8. Check the switch RECEPTION, RADIO COMPASS (ПРИЕМ,АРК) for proper operation.

Notes: 1. The change-over from reception to transmission is effected by depressing the push-button on the right-hand engine control lever and requires not more than 0.5 sec. – the time practically negligible. To reverse the operation release the push-button.

2. If the ПО-750 inverter fails to operate during flight the set should be switched over for emergency supply by cutting in the circuit breaker EMERGENCY SUPPLY, RADIO, RADIO COMPASS АРК, MARKER RECEIVER МРП, FLOW METER,in which case the inverter ПО-500 starts operating.

Testing Radio Set after Flight

1. Ask the pilot to give information on the set operation.
2. Test the set units, cable connectors and H.F. feeders for proper attachment.
3. Examine the rod antenna for reliable connection.
4. Remedy the faults reported by the pilot.
5. Check the radio set operation on the operating channel and carry out self-monitoring on the rest of the channels.

The РСИУ-4П radio set should be checked periodically according to the instructions on servicing the set.

Chapter II

AUTOMATIC RADIO COMPASS

The APK-5 automatic radio compass is designed to navigate the aircraft with the help of homing and broad-casting stations.

Basic Specifications

1. The radio compass covers the continuous frequency range from 150 to 1300 Kc/s (2000 - 230 m.) in three bands:

1st band . . . . . 150 - 310 Kc/s
2nd band . . . . . 310 - 640 Kc/s
3rd band . . . . . 640 - 1300 Kc/s

2. Communication range of the device when used as an automatic radio compass (in case of homing stations with output of 500 W):

at altitude H = 1000 m. . . . . 160 - 200 km.
at altitude H = 10,000 m. . . . . .320 - 340 km.

3. The radio compass receiver sensitivity during reception of modulated and unmodulated oscillations should not be worse than 12μV for the 1st band and 10μV for the 2nd and 3rd bands.

4. D.C. voltage supply . . . . . .27 V ± 10%

5. A.C. voltage supply
(from inverter ПО-750) . . . . . .115±3.5 V

The APK-5 radio compass consists of:

1. Receiver.
2. Loop antenna (inside the fuselage).
3. Control panel.
4. Course indicator (an integral part of ГИК-I set).
5. Dehydrator.
6. Non-directional antenna.

To operate the radio compass during instrumental landing (with the use of the ОСП-48 equipment) the following equipment is provided on the port side:

1. Switch for homing stations DISTANT - CLOSE (ДАЛЬНЯЯ - БЛИЖНЯЯ).
2. Band selector for CLOSE radio station.

Interunit connection diagram for the radio compass is given in Fig.164.

Arrangement, Removal and Installation of Units

The radio compass receiver is arranged under the cockpit floor between frames Nos 6 and 7A.

To remove the radio compass:

1. Remove the starboard access panels between frames Nos 5 and 9.
2. Remove the cannon.
3. Take off the protective casing of the equipment.
4. Disconnect cables, antenna lead-in, flexible shaft and bonding strips from the receiver.
5. Unscrew three screws attaching the receiver frame.
6. Remove the port access panel between frames Nos 5 and 7A.
7. Remove the branch pipe of the РД-2МА regulator.
8. Take out two studs attaching the receiver frame.
9. Remove the receiver together with the frame.

To re-install the radio compass reverse the operations outlined above.

The loop antenna is mounted on the lower fuselage skin between frames Nos 5 and 6A.

To remove the antenna:

1. Remove the port access panel between frames Nos 5 and 7A.
2. Disconnect the cables and the rubberized hose of the dehydrator.
3. Loosen screws attaching the plexiglass panel of the lower cover between frames Nos 5 and 7A.
4. Remove the loop antenna together with the plexiglass panel.

To re-install the antenna reverse the operations.

The control panel of the radio compass is positioned on the right side of the cockpit between frames Nos 6 and 7.

To remove the panel:

1. Take off the mockup panel of the cockpit heating system cock on the right-hand desk.
2. Disconnect the flexible shaft and the earphone plug.
3. Take out screws attaching the radio compass panel.
4. Remove the radio compass panel from the aircraft.

To re-install the panel reverse the operations outlined above.

The radio compass dehydrator is mounted near to the loop antenna and is held in position by two simple locks.

Switching On and Tuning

The radio compass is fed from the aircraft mains or the ПО-750 inverter. The ПО-750 inverter is started automatically when the radio compass is switched on.

The radio compass is controlled with knobs and switches arranged on the control panel as well as with the switch DISTANT-CLOSE and the band selector for the CLOSE homing station.

With the switch set at DISTANT the radio compass operates on the band selected by the band switch on the control panel whereas with the switch set at CLOSE the radio compass band is selected by the band selector for the CLOSE homing station.

To cut in the radio station, the mode-of-operation switch on the control panel should be operated to the required position (COMPASS, ANTENNA or LOOP). Green light on the panel will indicate that the radio compass is on.

To cut out the radio compass, set the mode-of-operation switch to OFF.

The receiver is tuned as follows:

1. Adjust the tuning dial and tuning indicator illumination by turning the knob ILLUMINATION (ПОДСВЕТ).
2. Set the switch controlling the reception of modulated and unmodulated signals TELEGRAPH-TELEPHONE (ТЛГ – ТЛФ) as required.
3. Shift the band switch on the control panel or the band selector for the CLOSE homing station to the necessary position.
4. Use the knob TUNING to set the required frequency

against the index line.

5. After the radio compass has been on for one or two minutes (time required for the valves to warm up) proceed to carry out fine tuning of the receiver by turning the knob TUNING in either direction until the tuning indicator pointer deflects all the way to the right. With the radio station operating continuously for a long time the fine tuning of the receiver should be checked periodically.

Testing Radio Compass on Ground

For all modes of operation (COMPASS, ANTENNA, LOOP) the radio compass should be tested with the canopy closed, the procedure being as follows:

Tune to various radio stations whose frequencies lie in the 1st, 2nd and 3rd bands.

When tuning, make sure:

(a) that the indicator pointer moves smoothly;

(b) that the course indicator pointer is not stiff;

(c) that slight knocking on the receiver and on the control panel does not produce any noise and crackling (due to poor contact);

(d) that the switch DISTANT-CLOSE and the band selector for the CLOSE homing station are properly adjusted;

(e) that the receiver sensitivity is within rated values when measured as set forth in the instructions on adjusting threshold of sensitivity;

(f) that the radio compass operates normally when supplied from the emergency A.C. power source (inverter ПО-500);

(g) that the radio compass operates normally with the engines running;

(h) that the automatic deviation compensator is properly adjusted which is found out by taking bearings on the known radio station on courses 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°.

Testing Radio Compass after Flight

1. Ask the pilot for the information on the radio compass operation.
2. Remedy the defects, reported by the pilot.

3. Connect the aircraft to the ground power source for 24 - 29.7 V. Voltage is measured with all the consumers switched on.

4. Close the canopy to connect the antenna to the antenna lead-in.

5. Operate the mode-of-operation switch to COMPASS to switch on the radio compass; the ПО-750 inverter should start operating and the illumination and signal lights on the control panel must go on.

6. Rotating the knob TUNING from one extreme position to the other make sure that the remote tuning system is reliable, the flexible shaft moves smoothly and the index line STOP (УПОР) on the 3rd band dial is aligned with the line on the cursor.

7. Set the switch on unit П of the РСИУ-4П radio set in the position АРК-5.

8. Check the radio compass on all bands for proper operation by setting the switch DISTANT - CLOSE either to DISTANT or to CLOSE as is laid down in the instructions on the radio compass, type АРК-5.

Chapter III

MARKER RECEIVER

The МРП-48П marker receiver is used to pick up USW signals from marker beacons and to indicate the position of the aircraft (the moment the aircraft is flying over the beacon antenna the pilot lamp on the instrument panel flashes and the bell rings).

The marker receiver operates at a frequency of 75 Mc/s. Altitude range within which the signalling system responds to the beacon signals is not less than 2000 m.

Receiver sensitivity is from 1.8 to 4 mV at 30% modulation with a frequency=3000 c.p.s. and output current through the relay coil=0.8 mA. The receiver relay picks up at a current of 0.6 mA ±10%.

The anode circuits of the receiver are fed with 220 V from the АРК-5 radio compass.

The connection diagram for the marker assembly is given in Fig.165.

The marker assembly consists of:

1. Receiver.
2. Loop antenna (mounted inside the fuselage).
3. Electric bell.
4. Pilot lamp MARKER (МАРКЕР).

Arrangement, Removal and Installation of Units

The МРП-48П receiver is installed on the left side under the cockpit floor between frames Nos 8 and 9.

To remove the receiver:

1. Remove port access panel of the ammunition box between frames Nos 7A and 9.

2. Disconnect the H.F. feeder, connector and bonding strip.

3. Take out the stud attaching the receiver frame.

4. Remove the receiver.

To re-install the receiver reverse the operations outlined above.

The loop antenna is mounted inside the fuselage above lower skin between frames Nos 6 and 7A along the centre line.

To remove the loop antenna:

1. Remove the receiver of the APK-5 radio compass as instructed above.

2. Remove the plexiglass cover of the access hole leading to the loop antennas of the radio compass and marker receiver arranged between frames Nos 5 and 7A.

3. Remove 24 bolts securing the loop antenna.

4. Remove the loop antenna.

When re-installing the loop antenna the above procedure should be reversed.

The electric bell is placed on the right side of the cockpit between frames Nos 7 and 8.

To remove the bell:

1. Take off the side cover of the right-hand desk between frames Nos 7 and 8.

2. Open the bell and disconnect input wires (wires labelled "+" and "c" should be isolated).

3. Turn out screws securing the bell.

4. Remove the bell.

To re-install the bell reverse the operations laid down above.

The pilot lamp MARKER is installed on the instrument panel.

Testing and Adjustment of Marker Receiver on Aircraft

To switch on the МРП-48П receiver, it is necessary to cut in the circuit breaker RADIO ALTIMETER PB-2, МРП located on the right-hand control desk (valve filaments will be fed with low voltage); after one or two minutes have elapsed, switch on the radio compass as indicated in "Radio Compass Switching On" (the МРП-48П receiver will be supplied with 220 V from the

radio compass receiver).

To switch off the marker receiver, it is sufficient to cut out the circuit breaker RADIO ALTIMETER PB-2, МРП; if the radio compass is not to be used for other purposes it should be switched off, too.

The marker receiver is tuned only after repairs or replacement of one of its components; the detuned antenna or faulty output circuits of the receiver (found out during tests) may call for tuning operations, too.

The marker receiver is tested and tuned on the ground with the help of the МИП-48 marker radio beacon simulator, the sequence of operations being as follows:

1. Switch on the marker receiver.

2. After 30 seconds have elapsed for the valves to heat up, produce a signal from the simulator of МИП-48 for the receiver antenna. The simulator is to be placed 0.5 - 1 m. from the marker receiver antenna in the direction of its reception and in such a manner as to position the simulator antenna in parallel with the longitudinal axis of the aircraft; the simulator being adjusted to operate at stabilized frequency of 75 Mc/s.

3. Set the modulation frequency switch of the simulator to a position corresponding to 3000 c.p.s. modulation frequency.

4. Plug the M-45 volt-milliammeter from the set of the МИП-48 simulator into the jack CHECK (КОНТРОЛЬ) on the receiver (meter, type ПМ-70, with a 1-mA scale may be used, too). In the presence of the signal from the simulator the volt-milliammeter will read output current through the receiver relay.

Change the magnitude of the simulator signal (by varying the output power or the distance to the antenna) to make sure that the receiver relay operates at current 0.6 mA ±10% causing the pilot lamp to light up and the bell to ring.

5. If there is no current or it is very low, use a special screw-driver (supplied with the set of the marker receiver) to adjust the trimmer CHECK I (I КОНТ.) or the trimmer CHECK II (II КОНТ.) on the receiver front panel, adjustments being made by maximum current through the volt-milliammeter (which is to be left connected during adjustments).

After that check the relay pick-up and drop-out current once more.

6. Having ascertained that the marker receiver operates

normally, switch off the receiver.

Note: Testing procedure as outlined above is resorted to when carrying out routine maintenance operations on the marker receiver or removing the defects reported by the pilot. In case of a detuned antenna, detuned receiver input circuits or other failures use H.F. band generator of the МИП-48 simulator to test and tune the marker receiver МРП-48П , connecting the simulator to the receiver with the help of a special coaxial cable.

Chapter IV

RADIO ALTIMETER

The PB-2 low range radio altimeter serves to determine actual flight altitudes above the ground within 0 – 1200 m.

The radio altimeter is used under unfavourable weather conditions, when breaking through low clouds or landing in poor visibility; together with other navigation equipment the radio altimeter helps to solve navigation problems during instrument landing.

Basic Specifications

1. Altitudes being measured:	
Range I (low range)	0 – 120 m.
Range II (high range)	100 – 1200 m.
2. Error during measurement:	
Range I	±2 m. ±5% of altitude measured
Range II	±20 m. ±5% of altitude measured
3. Radiated power	not less than 0.15 W
4. Overall sensitivity as indicated by tester T-1:	
Range I	not less than 80 db or 46 points
Range II	not less than 70 db or 36 points

5. Power supply . . . . . aircraft mains, 27 V ±10%

Radio Altimeter Components

The radio altimeter consists of:

1. Receiver-transmitter with a shock-mounted frame.
2. Altitude indicator ПРВ-46 .
3. Converter РУ-IIАМ.
4. Receiving and transmitting antennas.

Interunit connection diagram of the radio altimeter is given in Fig.166.

The receiver-transmitter is installed in the upper nose compartment between frames Nos 3 and 4.

To remove the receiver-transmitter:

1. Remove the upper cover of the nose access hole.
2. Disconnect the cable and H.F. feeder from the receiver-transmitter.
3. Unlock two locks securing the receiver-transmitter.
4. Remove the receiver-transmitter.

To re-install the unit reverse the operations outlined above.

The altitude indicator is arranged on the instrument panel in the pilot's cockpit.

The РУ-IIАМ converter is mounted in the nose compartment between frames Nos 3 and 4, on the left side.

To remove the converter:

1. Remove the upper cover of the nose access hole.
2. Withdraw the receiver-transmitter observing the instructions laid down above.
3. Remove the frame securing the receiver-transmitter.
4. Turn out bolts attaching the converter frame.
5. Disconnect the plug of the converter cable from the 48-K receptacle.
6. Remove the converter.

Reverse the above operations to re-install the converter.

The receiving antenna is installed on the right-hand wing whereas the transmitting antenna is on the left-hand wing. Each antenna is attached to the wing skin by four screws.

Switching On and Testing on Aircraft

The altimeter is energized by cutting in the circuit breaker RADIO ALTIMETER PB-2, МРП (РВ-2, МРП) on the right-hand desk.

To switch on the radio altimeter turn the indicator knob labelled ON (ВКЛ.) all the way clockwise; in 2 ÷ 3 minutes the indicator pointer will leave the extreme left position, approach the zero index and settle against it within ±2 m. The indicator knob designated RANGE (ДИАПАЗОН) should be advanced to cover low range (0 - 120 m.).

The radio altimeter is switched off by turning the indicator knob OFF counter-clockwise as far as it will go. If the marker receiver is not to be used for some other purpose the circuit breaker RADIO ALTIMETER PB-2, МРП should be switched off,too.

Note: Do not exercise undue effort when rotating knobs ON and RANGE so as not to damage the switches.

Testing Radio Altimeter on Aircraft

When testing the radio altimeter on the ground the sequence of operations is as follows:

1. Check the radio altimeter indicator for accurate zero reading when it is set to operate within the low range. It should be borne in mind that various objects such as other aircraft, cars, structures, etc.(when located closer than 20 m. from the aircraft),as well as people in close proximity of the radio altimeter under check (especially of its antennas) may cause erroneous deflections of the pointer.

It is recommended to carry out testing with the engines running at a low speed. If it is found out that the pointer deflection from zero is not any longer within ±2 m. proceed to correct zero setting as follows:

(a) remove the cover to expose the receiver of the radio altimeter;

(b) use a special screw-driver from the set of the radio altimeter to turn out the screw securing the protective cap over the adjusting screw and set the cap into the horizontal position;

(c) use the same screw-driver to correct zero setting by turning the adjusting screw (potentiometer spindle); turning the

adjusting screw clockwise deflects the pointer to the right and vise versa.

The adjusting screw is turned slowly because it is necessary to simultaneously observe the position of the indicator pointer..

The above re-adjustment of zero setting should not exceed 4 m.; re-adjustment involving higher values should be carried out with the T-1 tester and undergo subsequent calibration.

(d) zero setting completed, set the cap in position and close the access hole leading to the receiver.

2. Check the transmitting antenna for efficient radiation and examine the feeder of the receiving antenna for continuity by connecting it to the transmitter.

Testing is attempted several minutes after the radio altimeter is switched on by using the T-1 tester power indicator; reliable performance is indicated by a normal glow of the indicator lamp.

3. Check the range relay for proper operation and examine the high-range dial for reliable setting by switching on the radio altimeter to work on the high range for a short period of time. The indicator should read 0 – 1200 m. and the pointer should slightly deflect from its initial position which evidences the operation of the range relay.

4. Check the radio altimeter for correct calibration on low and high ranges; proceed to calibrate the altimeter, if necessary.

The radio altimeter is calibrated to compensate for its residual altitude, thereby procuring correct indicator readings during take-off and landing.

The sequence of operations when calibrating the radio altimeter is provided in the relevant operating instructions.

When taxiing the aircraft on the airfield the indicator pointer deviation may be within ±5 m.

Chapter V

TAIL WARNING RADAR

The tail warning radar is designed to sweep the rear hemisphere for enemy aircraft.

The radar sends signals to the pilot's earphones if the enemy aircraft is provided with a radar operating in a 3-centimetre band.

Basic Specifications

Detection range at sensitivity of equipment of 36 db	8 – 9 km.
Polarization of antenna	rotating
Radar frequency band	from 3.15 up to 3.45 cm.
Amplitude of output voltage	not less than 20 V at load resistance of 3.3 kilohms and not less than 30 V at load resistance of 25 kilohms
Indication mode	sound; the radar output feeds signals to the self-monitoring circuit of PCHY-4II set

Radar supply . . . . . from D.C. aircraft mains of ±27 V ±10%

Power consumed from 27 V mains . . . . . not exceeding 40 W

Radar Components

The radar comprises the following main components (Fig.167):

1. Antenna with detector unit.
2. Amplifier-indicator unit.
3. Control desk.

The receiving antenna with a detector unit is installed in the upper tip of the fin.

To remove the antenna:

1. Remove the fin tip.
2. Disconnect the H.F. cable.
3. Turn out screws securing the antenna frame.
4. Take off the antenna with the frame.

Reverse the operations to re-install the antenna.

The amplifier-indicator unit is positioned in the fin between ribs Nos 15 and 17.

To remove the unit:

1. Take off the access-hole cover in the fin between ribs Nos 15 and 17 on the port side.
2. Disconnect the connector and the H.F. feeder.
3. Loosen the nuts securing the unit.
4. Remove the amplifier-indicator unit.

Reverse the operations to re-install the unit.

The control desk is installed on the left side of the pilot's cockpit, between frames Nos 5 and 6.

Testing of Warning Radar

1. Cut in the circuit breaker TAIL WARNING RADAR (СИРЕНА) and RADIO, FLOW METER (РАДИО, РАСХОДОМ.).
2. Switch on the radar for reception.
3. Cut in the switch on the control desk of the warning radar. Simultaneously a pilot lamp flashes up and a signal is heard in the earphones which fades out in several seconds.
4. With a signal no longer heard in the headset, switch on a buzzer and place it 50 cm. away from the antenna (the buzzer

pointer should be oriented at the antenna). The headset should reproduce a signal whose tone varies with the distance between the buzzer and antenna.

If single high-pitched signals are audible in the earphones at a distance of 90 and 95 cm. the radar is considered operating normally.

Tuning of Radar

The warning radar is tuned and adjusted on board the aircraft with a voltage in the aircraft mains not lower than 24 V.

When adjusting proceed as follows:

1. Switch on the radar as instructed in Paras 1, 2 and 3 above.
2. 3 or 5 minutes after the radar has been switched on turn resistor R_{20} in unit 2 (the amplifier) by using a screw-driver. This will cause the headset to reproduce a signal.
3. Turn resistor R_{20} in the opposite direction and set it in such a position that the signal fades out and only weak crackling persists.
4. Test the warning radar as indicated above.
5. In case of excessive signal strength take off the amplifier jacket, and adjust resistor R_{31} whose spindle projects through the amplifier chassis.

Chapter VI

RADIO RANGE FINDER

The СРД-1М aircraft radio range finder is designed to operate in conjunction with the АСП-5Н optical sight.

Distance in the radio range finder is measured in terms of time elapsed between the transmission of the signal and the reception of the reflected signal. The range finder ensures searching, look-on and tracking of the detected target; it ensures a continuous automatic determination of the distance to the detected target and introduction of the voltage, proportional to the distance, into the computer.

The СРД-1М radio range finder with the АСП-5Н sight makes aimed fire effective within a range of 1500 – 300 m. at an altitude of 2000 m. and higher.

Basic Specifications

1. The range finder determines a distance to the target, automatically introduces the voltage proportional to this distance into the computer and tracks the target within a range of 300 – 1200 m. (not less).
2. Maximum error during distance determination within a range from 300 to 2000 m. does not exceed 25 m.
3. Peak power is not less than 7 kW.
4. Power drawn from 27 V circuit amounts to 1200 W.
5. Power consumed from 115 V, 400 c.p.s. circuit (from inverter ПО-500) attains 380 VA.
6. Under normal conditions the range finder is designed for continuous operation during 4 hours; at temperatures +50°C and -60°C the time is reduced to 2 hours.

The radio range finder includes (Fig.168):

1. Antenna-feeder assembly.
2. Receiver-transmitter unit.
3. Range unit.
4. Supply unit.
5. Checking unit.

The antenna is mounted in the nose section of the fuselage (Fig.169).

The receiver-transmitter unit is installed in the nose compartment between frames Nos 1 and 3.

To remove the receiver-transmitter.

1. Open the nose access hole leading to the equipment.
2. Remove the receiver together with the transmitter of the РСИУ-4П set as described above.
3. Disconnect the H.F. feeder and bonding strips from the receiver-transmitter of the range finder.
4. Unfasten two clamping clips.
5. Remove the receiver-transmitter.

Reverse the operations to re-install the receiver-transmitter.

The supply unit is installed behind the instrument panel in the pilot's cockpit. In symmetry with it to the left side of the instrument panel the range unit is mounted.

To remove the range and supply units:

1. Remove the left-hand and right-hand boards of the instrument panel.
2. Disconnect cables and bonding strips from the panels.
3. Turn out two nuts securing the range and supply units.
4. Withdraw the units.

Reverse the operations to re-install the units.

The checking unit is positioned on the left side in the pilot's cockpit, between frames Nos 8 and 9, and is secured in place by two screws.

Switching of Range Finder and Sight ON and OFF

The range finder and sight should be connected to supplies 10 – 15 minutes before their actual employment.

CAUTION. Never switch on the range finder with the sight circuit breakers de-energized.

On the ground the range finder and sight are switched on only when the aircraft mains are connected to the ground supply source of the АПА-7 type.

The sequence of operations is as follows:

1. Make sure that circuit breakers SIGHT (ПРИЦЕЛ), SIGHT HEATING, SIGHT (ОБОГРЕВ ПРИЦЕЛА, ПРИЦЕЛ) and RANGE FINDER (РАДИАЛЬ) on the right-hand desk are cut out, that the lock knob on the sight is in the position FIXED (НЕПОД.) whereas the switch RADIO-SIGHT (РАДИО - ОПТИКА) is in the position SIGHT.

2. Cut in circuit breakers SIGHT, SIGHT HEATING, SIGHT and RANGE FINDER.

3. Set the switch RADIO-SIGHT in the position RADIO, 3 - 4 minutes after the lamp on the sight switch flashes up indicating that H.V. is on.

4. Allow 5 or 10 min. for the valves to heat up and frequencies to attain the rated values, then set the sight lock knob to GYRO (ГИРО). This operation completes the preparation of the range finder and sight for employment or testing.

To switch off the range finder and sight the above operations should be reversed.

Checking of Range Finder

1. Connect the aircraft mains to the ground supply source of the АПА-7 type and make sure that the mains voltage amounts to 27 V ±10 %.

2. Switch on the range finder and sight as is laid down above.

3. After the range finder has been on for 10 minutes, remove the antenna jacket and check the range finder serviceability.

For this purpose remove the jacket from the antenna, thus radiating some ground target. If a distance to the target does not exceed 2000 m., a green light (lock-on lamp) on the sight head should burn steadily, and a range voltmeter should read the distance to the target.

The diameter of the sight reticle will decrease and the reticle will move downwards.

When the antenna is covered with the protective jacket the light should go out, the voltmeter should settle at 2 and the reticle must move to its initial position. Repeat this procedure two or three times.

4. Check the range finder for resetting targets. With the antenna open and the target locked on (green light on) press the push-button RESET (СБРОС) on the instrument panel. The light should go out.

Having ascertained that the range finder operates normally, switch off the range finder and sight. To test the range finder for proper modes of operation and to calibrate it against a corner reflector, use the operating instructions for the СРД-1М radio range finder.

Chapter VII

PRE-FLIGHT SERVICING OF RADIO AND RADAR EQUIPMENT

Effective range (of communication or detection) of the radio equipment is ensured only if the following conditions are observed:

1. Sensitivity and output voltages should be kept within rated values.
2. Antennas and their leads-in are reliable.
3. Contacts in plug connectors are clean and reliable.
4. Cables and H.F. feeders make good contact.
5. Screening and bonding are not damaged and are reliably connected to the aircraft structure.
6. Noise caused by the electric equipment during the flight is not above the rated values. Otherwise disconnect the electric consumers one by one from the supplies, localize the fault and remedy it.

Loose connections both in negative and positive circuits result in sparking thus creating radio interference. Sparking may adversely affect the operation of the radio compass and of the radio set sharply decreasing their range. To prevent this, check the protective jackets of inverters for reliable connection with their chassis, examine bonding components of all units of the radio equipment for cleanliness and reliable connection with the aircraft structure.

To reduce the effect of electrostatic charges on the radio equipment operation the aircraft wings are provided with special electrostatic dischargers (wick type) fitted at the wing ends (Fig.171).

To keep the resistance low, the dischargers are impregnated

with a solution of glycerine (80%) and ethyl alcohol (20%). In operation the discharger wicks should be damp. The solution is to be changed every 25 flying hours and at least once a month. The solution is fed through a hole closed by a stop end-screw. The length of the wick should be 35 - 50 mm.

During pre-flight servicing inspect and check the following:

1. On the fuselage - attachment and continuity of the radio set antenna, the loop radome of the radio compass, the antenna of the marker receiver and attachment of the responder and range finder antennas.
2. On wings - attachment and continuity of the radio altimeter and responder antennas and of dischargers.
3. On the fin - condition of the warning-radar antenna radome.
4. On the canopy and in the cockpit - continuity of the radio compass non-directional antenna and its lead-in; condition and attachment of pointer and light indicators; serviceability of the equipment and effective performance of switches, knobs and push-buttons as well as locking of a protective cap over the DESTRUCTION (B3PHB) button.

Upon completion of the inspection set all the switches and knobs into the initial position and switch off the equipment.

Testing should be performed with mains voltage of 24.3 - 29.7 V.

During inspection:

(a) check the radio set operation by establishing communication with an airfield station or a radio set of some other aircraft on all working channels and by self-monitoring on the remaining channels;

(b) examine the radio compass performance by receiving signals and taking relative bearings on the homing stations and changing bands by means of the switch DISTANT-CLOSE;

(c) test the radio altimeter serviceability by observing deflection of the altitude indicator pointer after selecting different bands;

(d) inspect the marker receiver operation by using any kind of the simulator provided it has been varified at 75 Mc/s against crystal-controlled equipment.

(e) examine the warning radar performance by using a buzzer;

(f) test the range finder operation by locking (pilot lamps burn) and resetting (pilot lamps go out) echo signals with the push-button TARGET RESETTING (СБРОС ЦЕЛИ) depressed and released.

Chapter VIII

AFTER-FLIGHT SERVICING OF RADIO AND RADAR EQUIPMENT

During after-flight servicing check:

1. On the fuselage - attachment and continuity of the set antenna, radomes of the radio compass and marker receiver antennas (there should be neither oil nor moisture inside the radome cavities); attachment and continuity of the responder and range finder antennas.

2. On wings - attachment and continuity of the radio altimeter antennas and of electrostatic dischargers.

3. On the fin - condition of the warning radar antenna radome.

4. In equipment compartments - attachment of units and of antenna lead-in; make sure that the inertia switch of the responder has not operated.

5. In the cockpit - continuity of the radio compass nondirectional antenna and its lead-in; condition and attachment of units, pointer and light indicators, serviceability of equipment when supplied from the main and emergency inverters; effective performance of switches, knobs and push-buttons.

Note: Prior to inspection it is necessary to ask the pilot about operation of the equipment in flight.

When inspecting:

(a) check the radio set operation by establishing communication with an airfield station or station of some other aircraft on all channels;

(b) test the radio compass serviceability by receiving signals and taking relative bearings of homing and broadcasting

stations in all the bands;

(c) inspect the radio altimeter performance by observing deflection of the altitude indicator pointer after switching on and changing bands;

(d) examine the marker receiver operation by observing response of the pilot lamp and bell to the simulator signals;

(e) check the responder operation; having ascertained that the DESTRUCTION circuit is de-energized make sure that the circuit is in good condition;

(f) examine the warning radar performance by using a buzzer;

(g) test the range finder performance against some standard equipment.

SECTION FIVE

SCHEDULED MAINTENANCE

Chapter I

AIRCRAFT SCHEDULED MAINTENANCE

Scheduled maintenance operations on the engines are to be carried out in compliance with the respective instructions of the Manufacturing plant.

Every 10 ± 1 Hours
(but not less than once every 14 ± 2 days)

1. Check operation of the duplicating slide valves in the BU-13M and BU-14MC boosters. In order to check the booster for operation from the duplicating slide valve, wedge the main slide valve by means of a special device as follows. Slip the restrictor on the neck of the main slide valve, shift the cover aside and open the port in the plug. Then fit the special slots of the screw clamp onto the head and nut of the main slide valve bolt and turn in the screw clamp so that its end enters the plug port. Then tighten the screw slightly to clamp the previously installed restrictor between the faces of the main and duplicating slide valves. Then check operation of the booster from the duplicating slide valve. Make sure the booster operates normally, remove the special device and check to see that, with the boosters engaged, there is no displacement of the duplicating slide valve when the control stick is moved.

Every 25 ± 5 Hours

Landing Gear

2. Wash in gasoline and inspect with a magnifying glass the L.G. struts and shock-absorbers for cracks. Check the shock-absorber packing nuts for proper locking.

3. Check the landing gear locks for opening from the emergency system without opening the L.G. emergency cock. Examine the linkage of the L.G. emergency lock opening system and make sure the cable linkage is in good order. Wipe cable

sections having minor corrosion with pieces of cloth and grease them. A heavily corroded cable should be replaced.

4. Check the struts for play in the longitudinal and lateral directions, taking measurements at the wheel axles.

When an effort of 15 kg is gradually applied to the wheel axle in either direction, the total play should be:

(a) main landing gear strut: longitudinal play must not exceed 6 mm, lateral play must not exceed 10 mm;

(b) nose landing gear strut: longitudinal and lateral play must not exceed 5 mm.

Should the play exceed the permissible limits, find the joint that has the maximum play or has the greatest influence on the total play and tighten this joint or replace one of the joint components.

5. Use a feeler gauge to check the clearance between the rest on frame No.4 and the upper link of the nose strut. The clearance should be 0.05 – 0.15 mm when an effort of 15 - 20 kg is applied to the wheel axle in the flight direction with the L.G. control valve in neutral position.

6. Check the pressure of the nitrogen in the L.G. shock-absorbers using a pressure gauge. The pressure in the main L.G. shock-absorber should be 70 ± 1 kg/sq.cm, and in that of the nose landing gear it must be 30 ± 1 kg/sq.cm.

7. Replace the grease in the grease fittings of the L.G. strut hinges and shimmy damper guide hinges.

8. Remove the wheels, examine the brake shoes, the plate springs and drums. Check the shoes for wear. Remove, wash, inspect and lubricate the wheel bearings with HK-50 grease. Check the brake collar attachment screws for proper tightening.

Note: In winter, after a preliminary tightening of the screws, give the wheel 5–6 revolutions, then tighten the screws finally.

Cracks in the brake collar are not permissible if they penetrate the entire depth of the cast iron layer and extend to the outer face of the collar. If the brake blocks are less than 8 mm thick, they should be replaced.

Resin deposit and oil stains are removed from the brake shoes by emery paper No.180. Then the shoes should be wiped with pieces of cloth soaked in gasoline and blown with

compressed air. See that no gasoline gets in the brake chamber.

Bearings having cracks, traces of wear and temper colour should be replaced; if the bearing outer races can be taken out of the drums by hand or if they rotate in the drums when the races are lightly tapped upon through a wooden block, replace the wheel.

Turn the nut onto the main wheel axle until resistance to wheel rotation is felt, then give the nut 1/8 to 1/10 of a turn back and look it.

The nose wheel attachment nut must be screwed on until the wheel axial play is taken up and an easy rotation of the wheel is ensured.

9. Blow the brake system hoses through with compressed air for which purpose press the brake lever in the cockpit. with the pipes disconnected from the wheels. Connect the pipes to the wheel pipe unions and check the brake system for leakage.

10. Perform trial retraction and extension of the landing gear, check operation of the retracted wheel automatic braking cylinder, sequence valves, and limit switches of the landing gear warning lights. With the landing gear retracted and the cock in the neutral position, make sure that the clearances between the landing gear doors, as well as between the doors and the wing are within the permissible limits, and that the doors do not protrude over the wing surface. Wash, clean and lubricate the ball joint between the strut door rod and the strut.

At training centres where the aircraft are used for circling flights maintenance operations on the landing gear and wing flaps are to be carried out after every 30 ± 5 landings independent of the accumulated flying hours.

The 50-hour operations on the landing gear and wing flaps of such aircraft are to be carried out every 25 ± 5 hours.

Wing

11. Clean the interceptor mechanisms, examine them and lubricate. Check the interceptors for correct operation: the interceptor should begin to move out when the aileron is deflected downwards by 3 ± 0.5 degrees, and it should be fully out when the aileron is deflected downwards by 10.5 ± 2 degrees.

Maximum protection of the interceptor is 57 ± 5 mm.

12. Wash with gasoline and examine the wing flap guide rails, carriages, slides and pins. Check the attachment of the hydraulic cylinders and locking of the fastening nuts.

Lubricate the guide rails, slides and hinges. Examine, through the access hatches in the top skin, the attachment fittings of the wing flaps for corrosion. Check the wing flaps for synchronous extension. The permissible difference in the extension of the wing flaps is not more than 15 mm when set at 15 degrees and not more than 20 mm when set at 25 degrees.

13. Examine the parts made of electron, paying special attention to the condition of the paint coating. See that they have no corrosion or scratches. Corrosion on electron parts is revealed by bulging of the paint coating or by a loose wet deposit under which metal deterioration is observed. For corrosion removal see instructions in Appendix 3.

Fuselage

14. Lubricate the air brake attachment fittings and the hinged joints.

15. Wash in gasoline and lubricate hinges of the drag parachute doors, then check them for proper opening by pressing the button DRAG PARACHUTE (ТОРМОЗ.ПАРАШЮТ) located in the cockpit.

16. Examine the parts made of electron.

Fuel System

17. Check the fuel system for leakage with the engines at standstill; check also the pressurization valve in the tanks with the right-hand engine running. For detailed instructions see Chapter X "Fuel System".

18. Check the fuel shut-off cocks for proper closing by pushing the button FUEL SHUT-OFF (ПЕРЕКРЫВНОЙ КРАН) in the cockpit, then open the cocks and lock them with КОК-0.8 wire, also locking the button caps with brass wire Л62, 0.25 mm in diameter.

19. After first 25 hours of flying the aircraft (for each new fuel drop tank), wash the fuel filters placed in the delivery line from the drop tanks, for which purpose open the access hatches on the wing top surface near the aerodynamic fences. Further, these operations shall be carried out during the 50-hour maintenance operations.

Hydraulic System

20. Check the system for a correct change-over of the booster feed from the booster hydraulic system to the main hydraulic system, as is prescribed in Chapter VIII "Maintenance of Hydraulic System" of Section I.

21. Check the air pressure in the hydraulic accumulators. It must be 40^{+5} kg/sq.cm.(at zero pressure in the hydraulic systems).

22. Check operation of the hydraulic systems as prescribed in Chapter "Pre-Flight Preparation".

Cockpit

23. Remove the seat from the aircraft after the expert on armament has unloaded the seat ejection gun. Then wash in gasoline, visually examine and grease all the hinges and moving parts of the seat mechanisms and cable linkage.

24. Check, on the removed seat, the operation of the safety harness lock and foot grip opening system, as well as the mechanisms of the lowering footrests and safety harness locking system.

After the flexible stud of the АД-3 automatic unit has been pulled out, the foot grips as well as the safety harness lock should open promptly without seizure, as described in Section I, Chapter VII "Ejection Seat". Repeat the check.

25. Wash in gasoline and inspect the parts of the locks and of the canopy jettison mechanism on the fuselage and canopy, as well as the attachment of the tubes of the cable linkage and of the spring feel mechanism.

Lubricate all the lock and canopy jettison mechanisms.

26. Examine the condition of the rubber pressurizing tubes, check them for chafing and for damage to the coating protecting the tubes against sun rays.

Should places be detected with no coating (compound 23 СА), restore it in accordance with Appendix 10.

27. Check the pressure of the air that is fed into the tube through the РВ-1.5 reducing valve; the reducing valve outlet pressure should be from 1.8 to 2.55 kg/sq.cm.

Note: With the reducing valve adjusted for this pressure, the safety valve should start operating at 28 kg/sq.cm. and become fully open at 3.3 kg/sq.cm.

28. Check the operation of the canopy jettison system simultaneously with the check of the seat ejection gun and of the explosive charge cap detonation. This check should be carried out together with the expert on armament. Check the canopy locks for simultaneous operation as the opening system is being slowly displaced. Check the rods for moving out of the canopy remover guns. The rod travel must be approximately 65 mm.

It is well to remember that during the check for proper canopy jettisoning the membrane of the canopy remover gun valve located on frame No.9 gets pierced through. Therefore, after the check is over, do not fail to replace this membrane by a new one.

CAUTION! Use membranes of the same set only. Never should a membrane of another set be used.

29. Examine the joint of the branch pipes of the cockpit feed system and canopy air heating manifold.

30. Check operation of the electric air distributing cock (unit 525) when controlled manually and automatically.

31. Check the condition of the flexible sheathing and control cable of the ПУ-7 valve, the attachment of the ПУ-8 differential brake control unit and their control levers and rods. Wash the hinges in gasoline, examine and lubricate them.

32. Examine all places where the control rods pass through their seals.

Aircraft Control

33. Check the rudder, aileron and stabilizer control for excessive play.

Perform the check as follows:

(a) with the БУ-13М booster engaged, move sharply the trailing edges of the ailerons by hand to make sure there is no noise in the connections from the aileron to the БУ-13М booster;

(b) clamp the rudder by means of a screw clamp and deflect the pedals sharply to check for noise in the connections;

(c) swing the ends of both stabilizer halves, with the booster disengaged.

Should the noise be detected, find this place and replace the damaged part or rod.

If "crunch" is heard as the rods move in the bearings, wash the bearings in gasoline and blow with compressed air. If this fails to eliminate crunching in bearings, replace the bearing, rod or bell crank.

34. Examine aileron, rudder and stabilizer controls:

(a) in cockpit (especially under seat);

(b) in engine bay;

(c) in fuselage tail portion (including the spring feel mechanism, trimming effect mechanism, АРУ-2А variable-ratio boost control unit, БУ-14МС booster and АПС-4 electric mechanism);

(d) in wings (the БУ-13М booster included).

Check to see that there is no damage or corrosion on control system components.

See also that they do not brush against each other or some other elements.

35. Check the МУС-2 motor and the АПС-4 emergency drive hydraulic coupling for correct automatic engagement, as well as the БУ-14МС booster for disengagement by the КВЭМ valve and by the change-over cylinders as is described in Chapter IV "Aircraft and Engine Controls".

When checking the stabilizer emergency (electrical) control system, note the time necessary for shifting the stabilizer from one extreme position to the other (on the АРУ unit longer arm). This time period must be approx. 7 seconds.

36. Check operation of the АРУ unit according to altitude and speed as is instructed in Section I, Chapter IV "Aircraft and Engines Controls".

CAUTION! In order to avoid failure of the АРУ-2А electric motor, the check should be carried out with the МУС-2 motor running or with the БУ-14МС booster engaged.

37. Coat the rod of the АРУ-2А unit with a film of ЦИАТИМ-201 lubricant.

38. Use a grease gun to pack ЦИАТИМ-201 lubricant into stabilizer beam outer bearings.

39. Wash, examine and lubricate the rudder and aileron attachment fittings. A better penetration of the lubricant into

the attachment fitting hinges is ensured by turning the rudder and ailerons several times in either direction and by coating the attachment fittings again. Remove the excessive lubricant accurately with a clean piece of cloth, seeing that the lubricant is not spread over the skin.

Hydraulic Booster

40. Check the booster for outside leakage. Before starting the check, wipe the booster carefully.

During service the operating fluid may be pressed out along the booster working surfaces in the following amounts:

(a) with the booster engaged and normal pressure of the operating fluid in the hydraulic system – up to 4 cu.cm. per hr, which makes two drops per minute;

(b) with the booster disengaged and zero pressure in the system – not more than 5 drops per hour.

Increased leakage through rubber seals, as a result of a long interval in operation, may be eliminated by operating the boosters (after a pressure is created in the hydraulic system).

41. Check the condition of the actuating rods, see that there are no traces of wear, scores or nicks.

Make sure that the tip of the actuating rod is reliably locked with a locking nut (being properly positioned), and that its plate lock is not damaged.

42. Make sure that the booster main slide valves are not wedged.

Mind the following indications of wedging:

(a) if the slide valve is wedged in the neutral position, an additional effort of 4–5 kg will be felt on the control stick. This effort is created by the spring of the duplicating slide valve;

(b) if the slide valve is wedged in any other position, then the control stick will be deflected from the neutral position. The maximum speed of stick deflection will also change (it will be reduced approximately three times in one direction and increased two times in the other direction).

43. Check to see that the longitudinal play in the hinged joints of the distributing rod has not increased. If the connection is normal, the movement of the slide valve is practically not felt.

Should an increased clearance be detected, remove the

booster and have it repaired.

Check the locking arrangements of the booster head hinged joints for good condition.

44. Examine and wash with clean non-ethylated gasoline the screen filters mounted in the nipples of the fluid supply pipe units.

Should the filters be found contaminated:

(a) remove the booster from the aircraft;

(b) drain the operating fluid from the booster into a clean container. If the fluid is clean (no dark deposit, sand grains or fibre lint are visible), wash the booster under pressure without stripping, as well as the filter with clean hydraulic fluid.

If the drained fluid is polluted, send the booster to a repair shop for overhaul, washing and testing. In the latter case, prior to installing a new booster, wash the booster hydraulic system and fill it with clean operating fluid.

After installing the booster on the aircraft (if there is pressure in the hydraulic system), before connecting the control rod, check the main slide valve for its suction effort, for which purpose move the main slide valve out of the booster and let it go; responding to the suction effort the slide valve should move in while the actuating rod should displace.

Notes: 1. Prior to installing the filters, examine the wire screens with a magnifying glass for good condition.

2. After the filters have been checked, install the pipe unions and hoses so that they do not brush against the aircraft structural elements when the aircraft control stick is shifted.

45. After the operations on the boosters and hydraulic system are over, try the aileron and stabilizer controls with the BU-13M and B2-14MC boosters engaged and disengaged.

Power Plant

46. Examine the engine controls in the cockpit during which remove the side cover from the left-hand desk and grease the parts.

47. Make sure that with the engine control levers in the position "Idling Rating", the lever of the HP-10A pump of

each engine is between the notches of the idling rating flat.

If necessary, adjust the control linkage and then check the engine control system for proper functioning.

48. Visually examine the engine control system elements in the engine bay.

49. Inspect the attachment fittings of the engines and tail pipes.

50 ± 5 Hour Inspection

Landing Gear

50. Check the level of the fluid in the L.G. shock absorbers and shimmy dampers, replenish them, if necessary.

51. Check the landing gear and wing flap emergency system for proper operation and for leakage.

Fuselage

52. Disconnect the fuselage tail part and examine the condition of the inside skin, checking it for burnt-through places and deformation, as well as its attachment screws and rivets for looseness.

Examine the condition of the rubber gasket on frame No.20.

53. Check the condition of the butt joint attachment fittings as well as the thread on their studs.

54. Examine the air intakes and the engine bay from the inside.

55. Examine the units, pipe lines and vents of all the systems located in the engine bay and in the tail part of the fuselage.

56. Remove the wing and tail unit fairings and examine the butt attachment joints.

57. Fill OKB-122-4 oil into the bearings of the turbine-and-cooler unit in the following amounts: 6 cu.cm. of the oil into the front bearing and 1 or 2 cu.cm.of the oil into the rear one.

Should oil get on the body or screen of the turbine-and-cooler unit, remove it with white spirit, xylol or any other dissolving fluid that does not smell.

The inspection being over, connect the tail part to the fuselage. When securing the attachment shackles of the tail pipes apply graphite grease to the bolts to avoid burning of the bolts.

Fuel System

58. Check the bag fuel tanks for reliability of attachment and locking.

Hydraulic System

59. Remove and wash in gasoline the throttle valves, placed in the wells of the main landing gear and in the headlight access hatch, as well as the throttle valves connecting the delivery and return lines of the main and booster hydraulic systems.

60. Wash in gasoline the coarse filtering element of the ФТ-11 filter and replace the fine filtering element by a new one.

Compressed Air and Fire Extinguishing Systems

61.Disassemble, wash in gasoline, dry, examine and assemble the main air system cleaner, as well as the filter of the cockpit canopy pressurization system.

62. Remove and weigh the fire-extinguishing system bottle after having removed the explosive charge.

If the weight of the bottle is less than that indicated in the Service Log and on the bottle by more than 100 gr, recharge the bottle.

Aircraft Control

63. Open the cover of the control rod sealing box on frame No.9 and wash the hinged joints inside the box, blow the box with compressed air and see that the sealing box does not contain foreign objects(or ice in winter). Check the bell cranks for play on the shafts. Check condition of the rubber sealing and of the cover gasket in the sealing.

64. Wash and examine aircraft control system hinged joints and coat them with grease again.

65. Check attachment of the rudder and stabiliser balancing weights. One rudder balancer is located in the rudder support, whereas the other is in the rudder leading edge between the upper and middle attachment fittings of the rudder. The stabiliser balancers are arranged at the ends of the stabiliser. Check also the attachment of the weight on the stabiliser control system bell crank (near the APУ-2A control unit).

66. Feed oil into the inside bearings of the stabiliser

beams for which purpose remove the casing from the fuselage tail part in the vicinity of the stabilizer.

67. Disconnect the rods from the aileron and rudder trim tabs to make sure that there is no play in the attachment fittings and that the trim tabs move easily. Then connect the rods to the trim tabs again.

68. Check the attachment and condition of the weight balancers (compensators), as well as the condition of the aileron aerodynamic compensation fabric.

Power Plant

69. Check the tail pipes for proper attachment to the engines and see that there are no dents on the casings.

70. In accessible places check all connections of the fuel and oil lines for proper tightening; check also visually the systems for leakage.

71. After connecting the fuselage:

(a) check operation of the jet nozzle shutter control with the engines at a standstill. The check must be carried out as is described in Section I, Chapter XIII "Replacement of Engines";

(b) start the engines and try them at all ratings; check operation of the generators, instruments, hydraulic system (without retracting the landing gear) and aircraft controls;

(c) visually inspect the connections of the fuel, oil and hydraulic systems of the aircraft and of the engines for leakage.

100 ± 5 Hour Inspection

Landing Gear

72. Change the fluid in the landing gear shock absorbers, shimmy dampers and tail skid shock absorbers. The change of the fluid should be carried out along with the preparation of the aircraft for winter.

Wings

73. Wash, inspect and lubricate aileron attachment fittings, make sure that the bearings rotate easily and that the bearing separators and rings are not damaged.

Fuselage

74. Examine the wing-to-fuselage attachment fittings, check the bolts for proper tightening and change the lubricant.

75. Examine the stabilizer beam attachment fittings; check the beams for play which should be not more than 90 microns as measured by the forth bolt of the stabilizer-to-beam attachment fitting.

Fuel System

76. Wash and inspect fuel tank No.1, its float valves and inverted flight chamber, for which purpose:

(a) remove the lower plate along with the inverted-flight chamber. Clean the tank bottom and walls of dirt and examine the tank from the inside for swelling, separation or other damage to the tank rubber;

(b) check the parts and joints of the levers in the inverted-flight chamber. Check the travel of the cylinder with the load as well as the action of the disc valves, located in the inverted-flight chamber.

CAUTION! If the cylinder of the inverted-flight valve was removed, do not turn it by 180° during re-installment to avoid any distortion.

(c) examine the condition of parts and action of float valves by shifting them up and down;

(d) check visually the tank bottom and walls for cuts and chafing. Re-install the inverted-flight chamber in the tank.

77. Remove the ПНВ-2 pump from fuel tank No.2 and, working through the hole in the tank, remove dirt from the bottom and walls of the tank. Examine the tank from the inside and outside for chafing on the tank bottom and walls.

78. Remove fuel tanks Nos 3 and 4, wash them and check for dents, bulging, cracks and chafing. Examine the attachment of the tanks, see whether it is not loose due to the extension of the attachment straps. Wash the screen filters at the inlet of the ПНР-1 pumps.

Note: After installation of the tanks, check the fuel system for leakage.

Compressed Air and De-Icing Systems

79. Remove the main bottles of the air system and the emergency bottle of the wing flaps. Examine their appearance and fastenings; drain the condensate from the bottles.

The condensate from the bottles of the landing gear emergency system located inside the recesses of the main landing gear struts

should be drained through the charging connections after removing the struts.

The condensate from the cockpit pressurizing bottle is drained, with the canopy removed, without removing the bottle from the canopy. The condensate from the air system bottle should be drained along with the preparation of the aircraft for winterization.

Clean corrosion-attacked places on the bottles with emery paper No.180, coat them with AMT-8 primer and paint with black enamel. If necessary, restore the entire paint coating of the bottles.

Put the bottles in place, charge the system with air and check it for air-tightness.

80. Remove and wash the de-icer system reservoir in alcohol, then put it in place. Check the de-icing system for leakage with air at a working pressure of 3 kg/sq.cm. and for alcohol consumption through the de-icer spraying tube.

Cockpit

81. Take the slide valve out of the cockpit air supply cock, wash it in gasoline, wipe the cock body, lubricate the slide valve and cock body and put the slide valve in place.

82. Remove, clean and wash the OKH-80 valve and the engine-mounted unit of non-return valves in the cockpit air supply system. This operation is to be carried out along with the replacement of the engines.

83. Check the cockpit for pressure-tightness.

Hydraulic System

84. Drain the fluid from the main and booster hydraulic systems, remove the reservoirs of both systems, wash them in clean hydraulic fluid, install them again and wash out the systems as is prescribed in Chapter VIII "Hydraulic System" of Section I.

Notes: 1. The hydraulic systems should be washed out and the AMT-10 fluid should be changed once every two years (not less than once every 200 flight hours).

2. The washing out of the hydraulic system should be carried out along with the preparations of the aircraft for winterization.

Maintenance during Aircraft Storage

85. If the aircraft is not to be flown for more than 10 days, it should be subjected to the corrosion-preventive treatment and stored in compliance with the respective instructions.

If due to some reasons an aircraft has not been flown for a long time, and it is not being prepared for storage, coat the rods of the APU-2A variable-ratio boost control unit, of the hydraulic cylinders and the landing gear shock absorber inner tubes with grease and in addition carry out the following operations.

Every 10 ± 2 Days

86. Perform pre-flight inspection of the aircraft.

87. Remove the safety valves of the main fuel tank vent systems and make sure that the valve discs move in their guides without binding. Put the valves in place again.

88. Start the engines and check their operation at all ratings, checking simultaneously the value of pressurization.

CAUTION! The aircraft fuel system should be kept primed throughout the entire storage period.

89. Flush the booster hydraulic system for which purpose deflect the control stick 8 to 10 times from one extreme position to the other with the engines running. This operation is to be carried out at normal working pressure in the hydraulic system, both with the boosters engaged and disengaged. Perform a trial retraction and extension of the landing gear, wing flaps and air brakes; check operation of the boosters (from the duplicating slide valves as well).

Every 30 ± 5 Days

Carry out the 10-day operations and in addition:

90. Examine all the cockpit pressure seals for the control rods. Check the condition of the glued surfaces of the stabilizer and rudder control rods passing through the pressure-tight bulkhead located on frame No.15. In case their surfaces get damaged, remove the deposit and coat the shanks with a thin layer of VNIINP-201 lubricant. Check the pressurizing filler tube. Check the cockpit for pressure-tightness.

91. Check the pressure in the hydraulic accumulators.

92. Drain the sediment from the fuel tanks to see whether there is any water in the fuel.

93. Examine the parts made of elektron.

Every 3 Months + 10 Days

Carry out the 30-day operations, and in addition:

94. Check operation of the emergency canopy jettison system. Check also the canopy sliding part remover guns for proper operation. Wash, examine and lubricate the mechanisms of the locks and of the canopy jettison system.

95. Examine and check operation of the spring mechanism opening the seat grips and the safety harness lock. To this end, strip the spring mechanism, wash the parts in gasoline, lubricate, assemble and install on the aircraft, then check the mechanism for proper operation from the AD-3 automatic unit.

96. Examine and check operation of the seat footrest dampers. Wash hinged joints in gasoline and coat with grease.

97. Remove, disassemble and wash the cockpit air supply cock in gasoline and coat it with grease.

98. Check the landing gear and flap emergency system for operation and pressure-tightness. Check the linkage of the manual landing gear lock opening system.

99. Check the drag parachute doors for proper opening. Wash all the hinges in gasoline and coat them with grease.

100. Check the condition of the aircraft and engine fuel system paying due attention to tightness of the joints and condition of the flexible hoses.

101. Carry out the 25-hour maintenance operations on the boosters.

Chapter II

ARMAMENT SCHEDULED MAINTENANCE

Every 25 ±5 Flight Hours

1. Inspect the armament to the extent prescribed in the chapter "Pre-Flight Inspection".

2. Remove the holders, wash them in gasoline and make sure they are not damaged. Check the mechanical control lever for proper operation.

3. The following should be also checked:

(a) amount of clearance between the tip of the ARMED-SAFE mechanism MBH-48 and the ARMED - SAFE lever with the 3-mm dia. shaft installed on the carrying lever. The clearance should be not less than 0.3 mm;

(b) amount of the overlay of the sector bearing surface of the electric magnet gear tooth. The coverage area should be 2.5 - 3 mm throughout the entire surface.

4. Check the value of minimum voltage at which the electromagnet drives of the rack carriers start to operate.

5. Install the rack carriers on the wing, fuselage, connect to each other and lock the electric plug connector.

6. Check the operation of the rack carriers from the ARMED service release circuit and the ARMED - SAFE circuit. Check the electric wiring of the special racks.

7. Check operation of the interlocking system of the fuel tank jettisoning.

8. By external visual inspection and testing, make sure that fire control and bomb release knobs and the cannon charging buttons operate normally.

9. Fire three times the seat ejection gun with percussion caps from the seat blind and the seat triggers arranged on the handrails.

In the other two positions the seat should be adjusted to suit the pilot's height and the gun checked for tripping without using the percussion caps.

10. Disassemble the ejection gun, clean, lubricate and reassemble it. Make sure that the ball lock is securely closed and the tube of the ejection gun is securely locked in the lower support. Then check the seat ejection gun for proper tripping without using the peroussion caps.

11. Inspect and clean the camera guns (without disassembling them). Clean all the instruments, magazines and prism-type attachment.

12. Check the photo control devices for accurate adjustment.

13. Inspect, clean and lubricate the electrified signal flare launcher, ЭКСР-46. Check the launcher control wiring for proper condition.

14. Inspect the sight to the extent, outlined in the "Post-Flight Inspection".

15. Disassemble completely and clean the contact sockets receiving the igniting plugs of the rocket pods.

16. Check the OPO-57K rocket pod jettison system for proper functioning.

Every 50 ±5 Flight Hours

1. Using the КП-5СМ checking instrument check the following:

(a) serviceability of the sight electric circuits;
- stabilized D.C. voltage;
- heating current of the sight head;
- heating current of the main gyrosoope;
- heating current of the zero gyrosoope;

(b) accuracy of sight setting data and angular correction and accuracy of range data obtained by the computer with the aid of the radio range finder simulator;

(c) accuracy of T setting as taken from the computer scale depending upon the range, altitude and ballistic properties of the weapon;

(d) accuracy of plotting the range finder rings;

(e) precession of the main gyroscope;

(f) controllability of the main gyroscope by currents in the correction coils.

Check as prescribed in the Instruction Book on operation of the sight.

18. Check the electric cables connecting the sight units and make sure that the units are properly bonded to the aircraft hull.

19. Check the weapon zeroing (including the OPO-57K rocket pods) with a bore sighting gauge.

Note: The weapons should be also zeroed on the pilot's request if he is not sure that they are properly adjusted.

20. Check the lock and the tubes of the OPO-57K rocket pod for proper condition.

Every 100 ±5 Flight Hours

21. Adjust the cannons by firing.

Note: Fire adjustment should be made upon receipt of the aircraft from the Manufacturing plant, after repair, replacement of the cannons, sights and their attachment units as well as on demand of the pilot, if he doubts the serviceability of the above mechanisms.

22. Inspect and clean the cannons, completely disassembling the cannons. Make sure the parts are in sound condition and free of cracks, scores or undue wear.

The defective parts which cannot be corrected by the unit repair agencies should be replaced by new ones from the cannon individual or group set of spare parts.

After assembly of the cannon in order, check the gunner he is outlined in the Instruction Book on operation of the cannon. Clean the contacts and check the electric trigger for proper operation. The bearing surfaces of the gear and of the pusher of the lever should be free of dents or scars.

The armature should freely move in the coil.

In the other two positions the seat should be adjusted to suit the pilot's height and the gun checked for tripping without using the percussion caps.

10. Disassemble the ejection gun, clean, lubricate and reassemble it. Make sure that the ball lock is securely closed and the tube of the ejection gun is securely locked in the lower support. Then check the seat ejection gun for proper tripping without using the percussion caps.

11. Inspect and clean the camera guns (without disassembling them). Clean all the instruments, magazines and prism-type attachment.

12. Check the photo control devices for accurate adjustment.

13. Inspect, clean and lubricate the electrified signal flare launcher, ЭКСР-46. Check the launcher control wiring for proper condition.

14. Inspect the sight to the extent, outlined in the "Post-Flight Inspection".

15. Disassemble completely and clean the contact sockets receiving the igniting plugs of the rocket pods.

16. Check the OPO-57K rocket pod jettison system for proper functioning.

Every 50 ±5 Flight Hours

1. Using the КП-5СМ checking instrument check the following:

(a) serviceability of the sight electric circuits;
- stabilized D.C. voltage;
- heating current of the sight head;
- heating current of the main gyroscope;
- heating current of the aero gyroscope;

(b) accuracy of sight setting data and angular correction and accuracy of range data obtained by the computer with the aid of the radio range finder simulator;

(c) accuracy of a setting as taken from the computer scale depending upon the range, airframe and ballistic properties of the weapon;

(d) accuracy of plotting the range finder rings;

(e) precession of the main gyroscope;

(f) controllability of the main gyroscope by currents in the correction coils.

Check as prescribed in the Instruction Book on operation of the sight.

18. Check the electric cables connecting the sight units and make sure that the units are properly bonded to the aircraft hull.

19. Check the weapon zeroing (including the OPO-57K rocket pods) with a bore sighting gauge.

Note: The weapons should be also zeroed on the pilot's request if he is not sure that they are properly adjusted.

20. Check the lock and the tubes of the OPO-57K rocket pod for proper condition.

Every 100 ±5 Flight Hours

21. Adjust the cannons by firing.

Note: Fire adjustment should be made upon receipt of the aircraft from the manufacturing plant, after repair, replacement of the cannons, sights and their attachment units as well as on demand of the pilot, if he doubts the serviceability of the above mechanisms.

22. Inspect and clean the cannons, completely disassembling the cannons. Make sure the parts are in sound condition and free of cracks, scores or worn spots.

The defective parts which cannot be corrected by the unit repair agencies should be replaced by new ones from the common individual or group set of spare parts.

After assembly of the cannon is done, check the gunner as is outlined in the Instruction Book on operation of the cannon. Clean the contacts and check the electric circuit for proper operation. The bearing surfaces of the breech and the pusher of the lever should be free of dents or scores. The armature should freely move in the coils.

Note: Cleaning with complete disassembly and inspection should also be done in case of unslushing, permanent troubles or when an appropriate number of shots is fired.

23. Inspect the cannon attachment points with the help of a magnifying glass.

24. Inspect electropneumatic valves, type ЭК-48, and make sure they are hermetically sealed. Check also the minimum voltage and current intensity required for the valves to operate.

25. Clean, blow off with compressed air and inspect the commutators of the ДР-3.5 electric motor (of the computer) and ДП-4М electric motor (of the sight head).

26. Lubricate the gyroscope gimbal axle of the sight head with oil, grade ОКБ-122-5, and check the time of precession.

27. Inspect the camera guns and check the heaters and thermoregulators for proper operation.

28. Examine and check the set of spare parts, tools and accessories for the cannons, mounts, sight, camera guns and ОРО-57К rocket pods.

Reslush the set of spare parts, tools and accessories.

29. Completely disassemble the rocket pods. Then clean, lubricate and reassemble them. Check the terminals of the electric wires for solidity and secure fastening.

MAINTENANCE OF AIRCRAFT UNDER STORAGE

Every 10 ±2 Days

30. Clean the cannons and ЭКСР-46 electrified signal flare launchers.

31. Check the weapons for operation under current to the extent outlined in the chapter "Pre-Flight Inspection".

Every 30 ±5 Days

32. Carry out operations to the extent specified for the post-flight inspection.

33. Check the condition of silica gel in the sight.

34. Inspect the electron-made parts.

Every 3 Months ±10 Days

35. Carry out operations scheduled for every 30 ±5 days.

36. Check the seat ejection gun by firing it three times with percussion caps from the seat blind as well as from the trigger levers arranged on the handrails. Make sure that both caps are detonated properly.

37. Remove and disassemble the seat ejection gun. Clean it of rust, dust or dirt. Apply a thin coat of lubricant to the parts, reassemble the ejection gun and reinstall it in place.

Make sure that the ball lock is securely closed and the ejection gun tube is locked in the lower support. Then check the ejection gun for proper operation without using percussion caps.

38. Using the КП-5СМ instrument check the sight setting and angular correction data.

Chapter III

ELECTRICAL EQUIPMENT MAINTENANCE

Every 25+5 Flying Hours

Generator-Starter, Differential Minimum Relay, Carbon-Pile Voltage Regulator and Ballast Resistor

1. Check generator-starter for absence of oil (on the drive side).

2. Check attachment of **generator-starter,** serviceability of air intake pipe of cooling system and attachment of cooling cowl on generator-starter.

3. Check condition of commutator, brushes and their pig tails.

4. Check security and attachment of brush springs.

5. Check reliability of attachment of electric wires.

6. Blow interior of generator-starter with dry clean air (at a pressure of 1.5 - 2 kg/sq.cm.).

7. In starting varify time required for engine to reach low speed.

Operation should be carried out together with aircraft technician (mechanic).

8. Check sealing of P-27 voltage regulator, security of rubber shim between regulator and ДМР-400А relay and security of lead-to-lug soldering joints on panels of carbon-pile voltage regulator, minimum relay and ballast resistor, as well as attachment and tightness of terminal bolts.

9. Attachment and condition of insulation of wires in power supply units.

10. With engines operating check adjustment of voltage regulators and parallel operation of generators.

This operation should be performed together with aircraft technician (mechanic);

Storage Battery

11. Inspect container and fasteners of storage battery, plug connector and electric conductor inside container.

12. Blow drain line of container with air (at a pressure of 1.5 - 2 kg/sq.cm).

Note: Routine maintenance of storage batteries should be carried out in accordance with Operating Instructions on them.

Contactors and Relays

13. Check condition, attachment and security of connection of leads.

Control System Electric Mechanisms

14. Check condition and security of attachment of trim tab electric control mechanisms, trimming effect mechanism, cockpit air distributor and АПС-4 stabilizer emergency drive.

15. Connection of leads on blocks of electromotor plug connectors and attachment of electric wiring.

16. Operation of АРУ-2А automatic control system with respect to speed and altitude as outlined in "Maintenance of Stabilizer Controls" (this is performed when checking stabilizer controls in accordance with Description and Instructions on the АРУ-2А system).

All this should be carried out under supervision of aircraft mechanic and instrument mechanic.

Inverter, Type ПТ-125

17. Inspect commutator and brushes; see that brushes move freely and are well ground in.

18. Blow inverter with dry air to remove carbon dust (at a pressure of 1.5 - 2 kg/sq.cm.).

Lights

19. Check condition and attachment of landing light control electromechanism.

20. Check condition and attachment of taxiing light.

21. Check tightening of plug connectors, condition of insulation and attachment of leads.

Cabin Air Temperature Thermoregulator

22. Check condition and attachment of thermoregulator.

Aircraft Mains

23. Check security of attachment of plug connectors, tightening of coupling nuts of plug and negative connectors, their locking, security of bindings, attachment collars and integrity of shims under them.

24. Check condition of electric boards, distributing devices and associate equipment; in case of dry weather, leave them for 2 - 3 hours in the open to dry out.

25. By manually switching on and off, check condition of mechanical part of circuit breakers, switches, rheostats PYΦO and buttons, also make sure they are securely attached.

26. Inspect attachment of limit switches of L.G. struts, flaps and air brakes.

27. Check, together with aircraft technician:

(a) operation of inertia switches and electrical air valves in wheel brakes automatic release system;

(b) control of jet nozzle shutters with engines inoperative;

(c) operation of afterburner units;

(d) time required to completely switch over cabin air distributor from one line to another which should make up from 20 to 40 sec.;

(e) alignment of limit switch rams and pressing devices, (attention should be payed to correct adjustment of limit switches for flap intermediate positions).

28. On completion of routine maintenance operations check energised electrical equipment in scope of post-flight inspection

Every 50+5 Flying Hours

Generator-Starter, Differential Minimum Relay and Carbon-Pile Voltage Regulator

29. Remove generator-starter and check spring pressure, height of brushes and smoothness of brush movement in brush holders, condition of commutator; clean commutator with sand paper No. 200, if necessary.

Measure height of brushes at its larger side. Height of brushes should be at least 17 mm.

30. Mount generator-starter on engine and see that it is securely attached.

31. Check security of contacts of stabilizer transformer lead and its attachment, with particular attention paid to transformer-to-aircraft frame electric connection.

32. Check condition and attachment of capacitors in power supply units.

33. See that generator voltage is within the rated values (27 - 29.5 V) at 6,000, 8,000, 10,000 and 11,150 r.p.m. of engine.

34. Check value of cut-in voltage and value of cut-out reverse current of generator-starter.

35. Check engine r.p.m. at which generator-starter is brought on and removed from mains.

36. Using phones, examine operation of voltage regulators and ascertain that no sparking occurs between carbon discs of regulator.

37. Check condition and attachment of differential minimum relay.

38. Check attachment of carbon-pile voltage regulator panels and condition of their shock-absorbers.

39. Check operation of relay and contactor.

40. Together with the aircraft technician check operation of starting system in all operating conditions: ground and air start, cranking of engine from generator-starter.

Starting Coils

41. Check operation of coils.

42. Examine condition of interrupter contacts, if necessary, clean contacts, then adjust primary coil current which should be $2^{+0.25}$ A at supply voltage of 24^{+1} V.

Fuel Pump Electromotors

(except ПНВ-2 pump and unit 495А)

43. Screw out plugs in commutator shield and check to see that electromotor has no fuel inside.

44. Check condition of brushes and commutator.

45. Blow interior of electromotors with dry clean air compressed to 1 - 1.5 kg/sq.cm.

46. Check intensity of current drawn by electromotor of each pump, also combined operation of transfer pumps and pressure warning system.

47. Open electromotor cowl and check condition of commutator, brushes and serviceability of brush springs and brush holders, ease of brush movement in brush holders, measure and record brush wear. Brushes worn to 12 mm in height should be replaced.

Inverters ПТ-125 and ПАГ-1Ф

48. Inspect commutators and brushes, see that brushes move easily and are ground in.

49. Measure brush wear; wipe and clean commutator; clean commutator grooves.

50. Blow inverters to remove brush dust.

External Lights

51. Check security of attachment and serviceability of wires running to landing and taxiing lights, to fittings of navigation and tail lights, to L.G. external lights.

52. Check condition of packings, fittings of navigation and tail lights, landing and taxiing lamps.

Air Distributor Electromechanism

53. Blow interior of distributor electromotor with dry clean air compressed to 1 - 1.5 kg/sq. cm.

Aircraft Mains

54. Examine shielding portions of mains and make certain that:

(a) mechanical braiding is secure;

(b) shielding portions are securely connected between each other and with aircraft structure.

55. Check condition of wiring in electric boards and control desks, termination of wires in lugs; blow interior with compressed air.

56. Examine insulation of accessible portions of mains.

57. Examine condition and attachment of ammeter shunts.

58. Open protective case of РПА-200А relay box and check condition of contacts, see that leads are securely attached and screws on contact box are locked.

59. Check attachment, security of connection in wires and condition of insulation at ТП-400 fuse in storage battery circuit.

60. See that negative wires of power sources and loads are properly connected to aircraft structure.

Electromagnets of Hydraulic Locks

61. Check tightening and locking of coupling nuts and connection of negative wires to aircraft structure.

Every 100±5 Flying Hours

Generator-Starter, Differential Minimum Relay and Carbon-Pile Voltage Regulator

62. Remove generator-starter and check to see that armature does not bind when rotated manually. Clean generator band and check condition of commutator, if necessary, clean commutator with sand paper No. 210. Check condition of brushes and brush springs.

63. Remove and check condition of differential minimum relay.

64. Check value of cut-in and cut-out voltages as well as operation of relay and contactor.

65. Check cut-out of differential minimum relay by reverse current.

66. Check adjustment of carbon-pile voltage regulator and serviceability of its panel shock-absorbers.

67. With engine running at 6,000, 8,000, 10,000 and 11,150 r.p.m. check combined operation of generator-starter, differential minimum relay, voltage regulator as well as parallel operation of generators.

Operation should be carried out together with aircraft technician (mechanic).

Starting Coils

68. Remove and check:

(a) condition of coils and interrupter contacts;

(b) current in primary winding, which should be not less than 1.75A for КПМ-1А coil and КП-21Б1 and КП-21М1 coil units.

Control Electromechanisms

69. Check condition of commutators, brush holders, springs and brushes. Measure brush height which should be not less than 6.5 mm.

70. Remove brush dust from electromotor parts.

71. Check program operation of electromechanisms, measure current drawn (not more than 0.75А at 20-kg load) and response time of УТ-6Д electromechanism (not more than 30 sec. at 40-kg load applied to rod).

Lights

72. Check condition and attachment of taxiing light. Remove landing lamp with electrical actuator and check commutator, brush holders, springs and brushes.

73. Blow interior of electromotor with dry clean air (compressed to 1 - 1.5 kg/sq.cm.).

74. Check current drawn, program operation and operating time.

75. Check adjustment of taxiing and landing lights on aircraft, using reference marks.

Electromotors of Fuel Pumps

76. Open protective cowl and check to see that electromotors have no oil inside.

77. Check condition of brushes and commutators.

78. Remove brush dust from protective cowl.

79. Blow interior of electromotor with dry clean air (compressed to 1 - 1.5 kg/sq.cm.).

Note: Operations outlined under Items 76 - 79 should be performed on expiration of Manufacturer's guaranteed service life.

Starting Panel

80. Remove starting panel and check:

(a) condition of wiring and attachment of units;

(b) condition of commutator, electromotor brushes and contacts of centrifugal governor of timer (to be performed on expiration of Manufacturer's guaranteed service life);

(c) condition of relay contacts and contactors;

(d) time required for fulfilment of starting program;

(e) current drawn by panel.

Switchgear

81. Check reliability of operation of relays and contactors, their attachment, condition of wiring and protective caps.

82. Check circuit breakers for operating time when carrying double rated current.

83. Examine connectors and sealed connectors.

Aircraft Mains

84. Check tightening of bolts of electric terminals.

85. Check termination of wires and security of lugs.

86. Open L.G. warning system panels, T-6 lamp register, check cleanliness and attachment of fittings in them.

Filters

87. Open filter covers, examine wiring, blow with dry clean air (compressed to 1 - 1.5 kg/sq.cm.) and check to see that wires are securely attached.

Fittings of Navigation and Tail Lights

88. Make sure that fittings are clean and serviceable, that packings are in good condition.

89. Check to see that leads are securely connected and contacts are not burnt.

Storage Battery Container

90. Check condition of container, felt packing, plug connector, insulation of leads and their lugs..

Technical Servicing of Aircraft in Storage

Every 10+2 Days

91. Perform operations in scope of pre-flight inspection.

Every 30+5 Days

92. Perform operations in scope of post-flight inspection and check functioning of all equipment when energized from ground supply.

Every 3 Months + 10 Days

Carry out 30-day operations and in addition:

93. Open electric boards, panels and check condition of wiring and security of wiring connection.

94. Examine and check plug connectors.

95. Check to see that negative wires are reliably connected to aircraft structure.

96. Check operation of electrical equipment when energized from ground power supply.

Chapter IV

MAINTENANCE OF INSTRUMENTS AND OXYGEN EQUIPMENT

This Chapter deals with checks on supply systems of oxygen equipment and instruments. In performing routine maintenance of instruments their technical characteristics should be checked in accordance with Specifications of instrument in question.

Every 25±5 Flying Hours

Instruments

1. Open middle part of instrument panel, examine and check:

(a) condition of instruments (check to see that cases and cover glass are not damaged. Glass panels are not loose, pointers have no bends and do not bind, luminous paint is not chipped off dials and pointers);

(b) at back of instrument panel — attachment of instruments, mounting of pipes, wires and units, tightening and locking of plug connectors;

(c) condition of attachment and shock absorbers of instrument panel, condition of guides and rods (lubricate guides and rods with ЦИАТИМ-201 grease).

2. Drain moisture condensate from moisture collectors of ПВД and ТП-156 air speed tubes. If collectors do not contain moisture condensation, it is not necessary to blow the line with compressed air.

3. Check attachment of transmitters of fuel quantity and flow gauge, tachometer, attachment of thermocouples, cleanliness of holes for passage of gas stream and position of recesses of thermocouples.

4. Check to see that pipes and wires are securely connected.

5. Check to see that instruments are correctly connected and give accurate indications, that static and impact pressure lines are air-tight (using instrument КПУ-3), and make sure indications of instruments meet Specifications.

6. Check error in indications of remote compass, oscillation of indicator pointer in matched position, rate of matching and sluggishness of transmitter.

7. Check aircraft clock for accuracy of indication in 24-hour period.

8. Check gyros and engine instruments for proper operation.

9. Check to see that parachute automatic release mechanism operates accurately in relation to time and altitude (check should be made in pressure chamber).

10. Check to see that pilot safety belts release unit operates properly.

11. Check operation of АРУ control unit in relation to speed and altitude .

Oxygen Equipment

12. Ascertain that units of oxygen equipment set are securely attached, check condition and attachment of pipes, condition of hoses and rubber spacers.

13. Check oxygen system for air-tightness, using tester КУ-6 .

14. Check disconnection of upper and lower blocks of ОРК-1М common connector.

15. Check operation of supply system of anti-G suit at low and high pressures. Check remote control of oxygen apparatus КП-30.

Every 50±5 Flying Hours

Instruments

16. Disjoint durite hoses of impact and static pressure lines from pipe unions of instruments, sight unit and ПВД and ТП-156 air speed tubes. Blow pipes with compressed air (at 0.5 - 1 kg/sq.cm).

17. Remove altimeter, speed indicator and climb indicator from instrument panel and check them on test installations to see that their indications meet Specifications. After

mounting instruments on instrument panel make certain that rubberized fabric hoses are correctly joined to instruments and that impact and static pressure lines are air-tight.

18. Check error in indications of exhaust gas temperature gauge, oscillation and overshooting of pointer.

19. Check plug connectors of remote compass.

20. Check to see that remote compass operates in accordance with Specifications.

21. Remove inverter, examine commutator and brushes. Blow interior of inverter with dry clean air (at 1 to 2 kg/sq.cm.).

22. Remove electrical turn indicator and check to see that it operates in accordance with Specifications.

23. Remove generators and indicator of electrical tachometer, examine them and check to see that they operate in accordance with Specifications.

24. Remove pressure warning mechanisms and check to see if they meet Specifications.

25. Check condition of thermocouples and their leads.

26. Make the following operations on parachute automatic release mechanism and safety belts release unit:

(a) disassemble pull-out mechanism;

(b) wash component parts in gasoline;

(c) wipe with soft brush and blow with compressed air;

(d) examine and ascertain that units have no damaged coatings, dents, nicks and scratches;

(e) examine hose and cord, see that cord lug is not displaced and separate wires of hose and cable are not broken.

Operating springs and piston with roller should be lubricated with thin layer of oil ОКБ-122-3, cord and hose — with oil МПВ.

27. Check pressure delivered by automatic device АД-5 . Clean and examine filter. Cleaning should be done carefully, with soft hair brush.

Oxygen Equipment

28. Check operation of remote control (in checking comply with relevant Instructions).

29. Perform all operations in scope of post-flight inspection and, using testers КУ-6 of laboraty or field type,

ascertain that equipment characteristics meet Specifications.

Every 100±5 Flying Hours

Instruments

30. Check to see that all identification marks are intact at pipe unions of static and impact pressure lines of speed indicator and on rubberized fabric hoses. If necessary, restore marks.

31. Remove fuel quantity and flow gauge, examine it and check to see that it operates in accordance with Specifications.

32. Remove pressure gauges, examine them and check to see that they operate in accordance with Specifications. After mounting pressure gauges check gauge-to-pipe connections for air-tightness.

Oxygen Equipment

33. Remove oxigen equipment and bottles, plug open ends of pipes and, by use of tester КУ-6 , check to see that they operate in accordance with Specifications.

34. Check condition of paint on pipes and oxygen bottles and, if necessary, restore paint.

35. Ascertain that bottles have no scale and check return valves; wash bottles with rectified alcohol.

36. Check strainers in front of oxygen system valves and wash them with rectified alcohol.

37. Check condition of return valve of charging pipe union.

38. Reinstall equipment, blow system with oxygen, charge to normal level and check operation in scope of post-flight inspection.

Once Every Two Months

(Irrespective of Flying Hours)

39. Fly aircraft to check errors of gyrohorizon after performing 180° turns to right and left with banks of 20, 45, 60 and 80° and after performing rolls, loop, half-loop, and chandelle.

Care of Aircraft in Storage

Every 10±2 Days

40. Make pre-flight inspection of instruments and oxygen equipment. Drain moisture condensation from moisture collectors of ПВД and ТП-156 systems.

Every 30±5 Days

Perform 10-day operations and in addition:

41. Check static and impact pressure lines for air-tightness. In periods of high humidity of air blow ПВД and ТП-156 tube lines with air and clean openings for moisture drainage from ПВД air speed tube. Check to see that openings of ПВД tube are clean.

42. Check to see that barometric pressure of altimeter corresponds to surface pressure at given moment.

43. Check aircraft oxygen apparatus by means of КУ-6 tester.

Every 3 Months ±10 Days

Perform 30-day operations and in addition:

44. Remove speed indicator and check to see that it operates in accordance with Specifications.

45. Check parachute oxygen apparatus for:

(a) oxygen supply by apparatus;

(b) air-tightness of return valve of charging pipe union.

46. Together with aircraft's technician (mechanic) check mounting and operation of anti-G device.

47. Check parachute automatic release mechanism for:

(a) accuracy of operation with respect to time;

(b) accuracy of operation with respect to altitude (to be carried out in pressure chamber of any type).

48. Check to see that safety belts release unit operates in time specified.

Chapter V

RADIO AND RADAR EQUIPMENT MAINTENANCE

Every 25±5 Flying Hours

Radio Set

1. See that the antenna is properly attached and shows no signs of discontinuity.

2. Check cable sheathing, feeder VC jackets, bonding strips for cables and units as well as attachment of cables and feeders.

3. Make sure that all valves are properly fitted in their sockets. Clean burnt contacts of relays. Renew lubricant in mechanisms.

4. See that union nuts of cable and feeder connectors are tight.

5. See that the units are properly attached and shock-protected.

6. Examine the headset.

7. Check the set operation in accordance with the working instructions.

Responder

8. Make sure that the antenna and units are reliably attached and show no signs of discontinuity.

9. Examine cable sheathing, feeder VC jackets, bonding strips of cables and units as well as attachment of cables and feeders.

Inspect the wiring of the DESTRUCTION circuit and check the voltage on the destructor plug.

10. Check the responder operation in accordance with operating instructions.

APK-5 Radio Compass

11. Inspect the antenna, its lead-in and loop radome and see that they are reliably attached and show no signs of damage. Examine condition of the moisture absorber.

12. Examine cable sheathing and bonding strips of cable and units. Look for loose connections, bad contacts and broken wires.

13. See that union nuts of cable connectors are tight.

14. See that the units are properly attached and shock protected.

15. Feed a solution of glicerine (80%) and ethyl alcohol (20%) into wick-type dischargers (at least once a month).

16. Check the radio compass operation as is laid down in the after-flight servicing.

PB-2 Radio Altimeter

17. Examine cable sheathing, feeder VC jackets, bonding strips of cables and units as well as attachment of cables and feeders.

18. See that union nuts of cable and feeder connectors are tightly screwed home.

19. Make sure the units are reliably attached and shock-protected; examine the antennas for signs of damage.

20. Check the radio altimeter for effective performance as set forth in the pre-flight servicing.

Marker Receiver

21. Make sure the antenna radome is properly attached and shows no signs of damage.

22. Examine the cable sheathing and feeder VC jacket.

23. See that union nuts in cable and feeder connectors are properly screwed home.

24. See that the units are properly attached and shock-protected.

25. Check (on board the aircraft or on a bench) receiver sensitivity varying with the distance (1 – 3 m.) between the antenna of the receiver and that of the simulator; check the frequency (75 Mc/s).

26. Check the receiver performance as is laid down in the after-flight servicing.

Warning Radar

27. Examine the antenna radome for signs of damage.

28. Check the radar operation as is stated under the after-flight servicing.

Radio Range Finder

29. Make sure the antenna is properly attached and shows no signs of damage.

30. Examine cable sheathing, feeder VC jackets, bonding strips of cables and units as well as attachment of cables and feeders.

31. Test (on board the aircraft or on a bench)
(a) receiver output;
(b) sensitivity of the receiving channel;
(c) calibration against a corner reflector.

32. See that union nuts of cable and feeder connectors are tightly screwed home.

33. See that the units are properly attached and shock-protected; examine the locks securing the receiver-transmitter to the casing and make sure that they are tight.

34. Check the range finder operation in accordance with the operating instructions.

Inverters

35. Note if output voltage of the inverters on board the aircraft is normal.

Every 50±5 Flying Hours

Radio Set

36. Examine wiring, components and relay for loose connections.

37. Examine pins and connector sockets for signs of damage (do not open hermetically sealed connectors).

38. Remove the equipment from the aircraft and test valves for effective performance.

39. Make a thorough overhaul of power units as stated in the operating instructions.

40. With the engines running note if the noise level does not exceed the rated value (not more than 5 - 7 V).

I.F.F. Responder

41. Examine pins and connector sockets for signs of damage (do not open hermetically sealed connectors).

42. Make sure that union nuts of connectors are tightly screwed home.

APK-2 Radio Compass

43. Examine pins and connector sockets for signs of damage (do not open hermetically sealed connectors).

44. Carry out bench tests observing receiver sensitivity (20 μV), calibration accuracy (±25%) and overall sensitivity in homing (50 μV/m).

45. Check the speed of automatic rotation of the loop antenna.

PB-2 Radio Altimeter

46. Examine pins and connector sockets for signs of damage (do not open hermetically sealed connectors).

47. Test (on board the aircraft or on a bench) sensitivity (80 db, 70 db) and calibration of the altimeter.

Marker Receiver

48. Examine pins and connector sockets for signs of damage (do not open hermetically sealed connectors).

49. Check (on board the aircraft or on a bench) receiver sensitivity by varying the distance (1 - 3 m.) between the antenna of the receiver and that of the simulator; check the frequency (75 Mc/s).

Warning Radar

50. See that units are properly attached and shock-protected.

51. Note sensitivity value according to the distance between the antenna and a buzzer.

Radio Range Finder

52. Examine pins and connector sockets for signs of damage (do not open hermetically sealed connectors).

53. Check (on board the aircraft or on a bench) the receiver-transmitter for proper air-tightness.

Every 100 ±5 Flying Hours

CPO Responder

54. Remove the receiver-transmitter from the aircraft. Examine wiring, components, relays for loose connections; see that valves are properly fitted into their sockets. Test all valves of the set for normal performance.

APK-5 Radio Compass

55. Remove the receiver. Examine wiring, components and relays for loose fixing; see that valves are properly fitted into their sockets.

56. Remove the loop unit. Renew lubricant in the loop bearings; clean brushes and slip rings; renew lubricant in all bearings of the reduction gear and of the ДРК-627 motor.

57. See that the loop unit is free of dust, dirt; remove the moisture absorber crystals.

PB-2 Radio Altimeter

58. Remove the antennas. Wash and clean the mating surfaces on the antennas and on the wings. Mount the antennas and paint the antenna base edges.

59. Remove the receiver-transmitter and inverter. Examine wiring, components and relays for proper connection; see that valves are properly fitted into their sockets.

60. Blow through the inner cavities of the inverter. Clean the commutator and brushes and renew lubricant in ball bearings.

Marker Receiver

61. Remove the receiver from the aircraft. Examine wiring, components and relays looking for loose connections, bad terminals and broken wires; see that valves are properly fitted into their sockets.

62. Carry out bench tests observing sensitivity (1.8 - 4 mV), frequency (75 Mc/s), pick up (0.04 - 0.66 mA) and drop out (0.36 - 0.44 mA) currents of the relay.

Warning Radar

63. Remove units 1 and 2. Examine the wiring, renew the protective coating, if necessary.

64. Use testing equipment to check radar sensitivity.

Radio Range Finder

65. Remove the receiver-transmitter unit, ranging and supply units as well as antenna. Clean the antenna place of installation. Open the units, examine wiring, components and relays for proper connection; see that valves are properly fitted into their sockets.

Inverters

66. Remove inverters, blow through inner cavities, clean commutator and brush assemblies and renew lubricant in all bearings.

67. Carry out bench tests to check the inverter output voltage.

Maintenance during Storage

Every 10±2 Days

68. Perform operations included in pre-flight servicing.

Every 30±5 Days

In addition to the operations stated under 10-day maintenance:

69. Check the condition of the dehydrator.

70. Perform operations included in after-flight servicing.

APPENDICES

APPENDIX 1

AIRCRAFT TRIMMING IN FLIGHT

An aircraft is trimmed in accordance with the present Instructions in the following cases:

1. After assembly of the aircraft, if it was transported to the using arms by railway.
2. After repair of the aircraft disturbing to any extent the control system and its components.
3. In case of complaints of the flying personnel.
4. For training purpose to allow the flying personnel to master the aircraft.

Note: When adjusting the aircraft controls on the ground according to Paras 1 and 3 (during the check of aircraft trimming), observe the adjustment data contained in the Trimming Chart for the given aircraft, the chart being appended to the aircraft Service Log.

1. INSTRUCTIONS FOR FLYING PERSONNEL

In aircraft trimming it is recommended to get familiarized with the instructions contained in the Pilot's Manual.

Pre-Flight Check of Controls

Before the flight aimed at trimming the aircraft the pilot must acquaint himself with the trimming chart and check to see:

(a) that the APU-2A variable-ratio boost control unit is set at its longer arm which is indicated by lighting up of the warning lamp and by the indicator;

(b) that the trimming effect mechanism is in the neutral position.

The neutral position warning lamp should light up when the left half of the stabilizer is deflected to an angle of $0^{\circ}30' \pm 20'$, its leading edge upwards ("scissors" according to notches 54; 55 left- $\Delta = 8 \pm 8$ mm, notch 55 on the stabilizer leading edge is below notch 54 on the fairing).

The trimming effect mechanism is set to the neutral position by pulling the selector switch on the control stick after, having previously switched off the warning lamp by pushing the selector switch;

(c) that the aileron trim tab is in the neutral position.

The "scissors" between the trailing edges of the aileron and of the trim tab should correspond to the value indicated in the trimming chart.

Longitudinal Trimming of Aircraft in Flight

The longitudinal trimming of the aircraft is accomplished with the stabilizer booster engaged.

The purpose of the mission is to trim the aircraft with zero efforts on the control stick using the trimming effect mechanism when picking up an altitude up to 3000m. in a straight flight, with both engines running at NORMAL rating, at a speed of 750 ± 50 km/hr by the wider pointer of the instrument, with the landing gear wing flaps and air brakes retracted and without fuel drop tanks.

Trimming is effected by the trimming effect mechanism with a subsequent indication of its neutral position by the warning lamp on the ground.

Trimming Sequence

Start trimming immediately after taking off when picking up the 3000-m. altitude. After the aircraft has been trimmed, do not use the trimming effect mechanism in this flight any more.

If it has been found during the trimming flight that the trimming effect mechanism needs ground regulation, then perform a check trimming flight with the booster engaged.

Note: It is not recommended to perform the aircraft longitudinal trimming with the stabilizer controlled electrically since the trimming rate does not change.

In order to check the electric control system do as follows: at a speed of 600–700 km/hr change over to the electric control for which purpose disengage the stabilizer booster and make sure the electric control operates normally.

Lateral Trimming of Aircraft in Flight

The aim of the mission is to perform lateral trimming of

the aircraft on all ratings.

Trimming is accomplished as follows:

1. With the aileron booster engaged – by adjusting the aileron "scissors" and the neutral position of the aileron trimming mechanism, as well as by adjusting the "scissors" of the wing flaps which is achieved on the ground by means of eccentric bushings.

2. With the aileron booster disengaged – by means of the trim tab during the flight.

In checking the lateral trimming of the aircraft, the latter should fly without slipping. The shifting of the ЭУП-58 turn-and-slip indicator ball up to one diameter in either direction is permissible. If the aircraft has not yet been trimmed directionally it is allowed to eliminate slipping by deflecting the pedals.

Trimming Sequence with Aileron Booster Engaged

In checking lateral trimming, special care should be paid to aircraft performance when the maximum permissible M-number and the maximum permissible indicated speed are approached.

Acceleration of the aircraft up to the indicated maximum permissible values of M-number and V_{ind} is to be performed at the respective altitudes.

In case of aircraft trimming disturbance at some of the ratings, the pilot should record the flight rating characteristics: indicated speed or M —number, altitude, direction of bank, approximate effort on the control stick and stick travel required for elimination of the bank.

At maximum permissible M-numbers and indicated speed, the aileron control handle may be deflected by 1/4 of the stroke.

Should the aileron "scissors" or the neutral position of the spring feel mechanism be adjusted on the ground after a trimming flight, do not fail to perform a trial trimming of the aircraft in flight.

Trimming Sequence with Aileron Booster Disengaged

The aim of the mission is to trim the aircraft by means of the aerodynamic trim tab at a speed that is by 50 to 70 km/hr

less than the maximum permissible indicated speed (wide pointer) at an altitude of 2500 to 3000m.

At an altitude of 4000 m.and a speed of Vind=600 km/hr (by the wide pointer) disconnect the aileron booster and trim the aircraft, if necessory, with the aid of the trim tab. Then lower the aircraft gently from this altitude with the engines running at MAXIMUM rating to accelerate the aircraft to a speed which is by 50 to 70 km/hr less than the maximum permissible speed at an altitude of 2500 to 3000 m. Trim the aircraft at this speed by means of the trim tabs. This done, do not use the trim tab any longer, reduce aircraft speed to V_{ind}=600 km/hr and engage the aileron booster.

When reducing speed with the booster disengaged, the efforts on the handle should not exceed 10-15 kg.

Directional Trimming of Aircraft in Flight

Purpose of the mission is to carry out directional trimming of the aircraft at all ratings.

Trimming is effected by bending the trailing edge of the rudder bend tab on the ground, or by deflecting the rudder trim tab on those aircraft that are equipped with rudder trim tabs.

Trimming Sequence

In trimming the aircraft directionally pay special attention to the directional stability of the aircraft and to its performance when the maximum permissible M-numbers and indicated speed are approached.

Should the aircraft prove untrimmed at some flight rating, the pilot must record the flight rating characteristics: indicated speed or M-number and altitude of flight, direction and amount of ЭУП-58 turn-and -slip indicator ball deflection with the pedals not exercised, as well as the approximate effort to be applied to the pedals to eliminate the aircraft turn.

At a flying speed of more than 1000 km/hr (by the indicator wider pointer) at an altitude from 1000 to 2000 m.and at the M-number exceeding 0.9 at an altitude of 2000 m.and more in a straight flight (without overload), a gradual shift

of the ball of the turn-and-slip indicator by one diameter to either side is permissible with the pedals not exercised.

When the ball is deflected by 0.5 to 1 diameter, the aircraft controls should enable the pilot to neutralize aircraft turning by depressing the pedals without applying excessive efforts that might cause fatigue of the pilot in a prolonged flight.

No sharp turns of the aircraft or yawing is allowed.

The determination of the ball position in various flights must be exact within ±0.5 diameter.

Should the rudder be adjusted on the ground by bending off the rudder bend tab after the aircraft was trimmed in flight, it is necessary to perform a trial check of aircraft trimming in flight.

Filling in Trimming Chart

After the flight, the pilot must fill in the trimming chart entering the speed values of longitudinal trimming and the characteristics of flight ratings, that require additional adjustment of the controls on the ground.

Note. After the aircraft was trimmed, the pilot must check the trimmed position of the trimming effect mechanism and of the rudder and aileron trim tabs before every next flight. The correct position of the mechanism and rudder trim tab is indicated by the warning lamp which should light up, whereas that of the aileron trim tab is checked by the inscription on the trim tab.

2. INSTRUCTIONS FOR MAINTENANCE PERSONNEL

Pre-Flight Check of Aircraft Control

Before the flight, the "scissors" of the left and right-hand halves of the stabilizer should not exceed $0^{\circ}\pm15'$

The APY-2A variable-ratio boost control unit should be on the longer arm.

With the trimming effect mechanism in the neutral position, the warning lamp should light up at a deflection angle of the stabilizer left-hand half which is indicated

in the Trimming Chart.

CAUTION. The value of this angle by the aircraft Levelling Diagram should be within $0^{\circ}30'\pm20'$ with the stabilizer leading edge upwards. The "scissors" according to notches 54-55: $Д=8\pm3$ mm, notch 55 being below notch 54.

Instructions on Setting Trimming Effect Mechanism at Neutral on Ground and in Flight

The trimming effect mechanism is set in the neutral position by shifting the selector switch on the control stick backward after having previously extinguished the warning lamp by shifting the selector switch forward. Move the trim tab until it reaches the neutral position which is indicated by the lighting up of the lamp.

The aileron trim tab should be placed in the neutral position in accordance with the size indicated in the Trimming Chart.

The "scissors" of the left and right-hand ailerons are to be checked in accordance with the Trimming Chart.

CAUTION. The "scissors" tolerance is $+0.5^{\circ}$ according to the aircraft Levelling Diagram (the "scissors" at points 38-14 of the right-hand aileron are ±3.0 mm when points 38-14 of the left-hand aileron are lined up)

Check the adjustment of the aileron interceptors. The interceptor should begin to move out of the wing when the aileron of the same wing is deflected by an angle of $3^{\circ}\pm0.5^{\circ}$.

The adjustment of the aircraft control after a trimming flight, if such adjustment is necessitated, should be carried out in compliance with the instructions contained in Chapter IV of Section One, Para.3 "Adjustment of Stabilizer Control System".

APPENDIX 2

CARE OF ELECTRON PARTS

1. As far as corrosion is concerned, electron parts are less resistant than parts made of other material and therefore they demand thorough and systematic care.

Corrosion of electron parts is revealed by bulgings on the varnish coating or by the formation of a wet loose light-grey deposite beneath which traces of damage to the metal are observed.

The corrosion process may develop very intensively if measures are not taken in due time. It is therefore necessary to examine the electron parts at regular intervals.

These parts must be inspected during 25-hour inspections but not less than once every month.

2. Should sea water, salt solutions, acids, alcalis or fire-extinguisher foam get on electron parts, the latter should be carefully washed with warm water, dried (or wiped with dry wipe cloth) and wiped several times with a piece of cloth soaked in clean gasoline.

3. Clean the parts of corrosion and recondition the varnish and paint coating directly on the aircraft or after the removal of the parts from the aircraft (depending on their accessibility and degree of corrosion).

4. In case of corrosion formation on electron parts do as follows:

(a) thoroughly clean the corroded place with glass paper No.00 or 000, as well as with a scraper. In cleaning, do not try to eliminate the corrosion pits completely. It is sufficient to remove the corrosion products.

Note: Heavily corroded parts with a considerable number of deap pits all over the part surface, as well as parts with single but very deep and large pits on the rated section should be replaced.

Parts with considerable traces of corrosion in places where bearings are pressed in should also be replaced.

(b) degrease the parts with a clean piece of cloth soaked in clean gasoline;

(c) apply a coat of АЛГ-8 primer to the cleaned and degreased area of the part and allow it to dry for 6 to 8 hours at a temperature ranging from +18 to +35°C;

(d) after prime-coating, apply enamel A9 or A9Ф to the inner parts of the aircraft and enamel A24Г to parts of the L.G. wheels. Allow the enamel-coated parts to dry at a temperature from +18 to +35°C for 24 to 36 hours;

(e) should the part get dirty during the drying period (entry of dust, etc.), do not fail to wipe the area to be coated with the next layer with a clean piece of cloth, soaked in clean gasoline;

(f) prevent moisture from getting on the parts when treating corrosion-attacked surfaces or when reconditioning their varnish coating.

5. It is strongly prohibited to connect electron parts with chrome-plated, silver-clad or copper-coated parts.

6. Steel, bronze or brass parts (bolts, sleeves, etc.) contacting electron parts should be zinc or cadmium-plated, whereas parts of aluminium alloys should be anodized.

Ball bearings may be used without zinc-plating the rings, but they must be coated with dehydrated gun grease.

7. Places cleaned for bending strips but not covered by them must be prime-coated with АЛГ-8 primer.

It is not allowed to use silver or brass terminals for bonding electron parts.

8. Before a rivet is inserted into an electron part, it should be dipped in АЛГ-1 primer. Riveting should be done with the primer still wet. The rivets should be zinc-plated or anodized. The rivet seams along the rivet heads should be coated with АЛГ-8 primer on both sides.

9. Electron part surfaces damaged when rolling in or calking ball bearings and bushings must be coated with АЛГ-8 primer.

APPENDIX 3

CARE OF AIRCRAFT OUTER SURFACES

The aircraft paint coating is designed to protect metal parts of the aircraft against corrosion, as well as to improve the aerodynamic properties of the aircraft.

The protective qualities of the paint coating are impaired by a direct influence of fuel, oils and acids as well as by mechanical damage resulting from the improper handling of the coating.

The maintenance personnel must take all measures to maintain the aircraft paint coating in good condition. It must be remembered that inobservance of these rules may result in premature deterioration of protective qualities of the paint coating; and its service life will be reduced, respectively.

In order to protect the outer surfaces against the direct influence of sun rays, precipitance and ice formation, observe the following conditions:

1. With the aircraft parked in the open, they should be covered with canvas irrespective of the season of the year.

2. Dirty or wet surfaces of an aircraft must not be covered with canvas.

3. The canvas covers should be kept clean; they should be checked for damage at regular intervals. Never should damaged covers be used.

4. In order to maintain the aircraft paint coating under high ambient air temperatures (above +40°C) it is recommended to built up an air space, 5 to 10 cm. thick, between the covers and the surfaces of the airframe, using for this purpose special devices made by own facilities.

5. In case condensate has formed on the aircraft skin under the canvas cover, remove the canvas, wipe the skin dry with cotton waste and put the canvas covers on again.

6. Should ice form on a canvas-covered aircraft, roll up the cover to facilitate ice removal.

7. It is absolutely impossible to allow sulphuric acis from the storage battery to get on the skin, therefore utmost care

must be exercised when installing or removing the storage battery.

All the maintenance operations on the storage battery should be carried out outside the aircraft.

Should acid get on the skin (or on some other parts of the aircraft), the latter should be thoroughly and repeatedly washed in warm water and then wiped with clean cotton waste.

Places, where spilled acid may remain (clearances, seams, etc.), should be washed most carefully and the parts should be subsequently dried with compressed air.

All instances of acid spillage should be entered in the Service Log and the part should be regularly checked for condition of the acid-attacked area during a time period of three months. If it has been found that parts are attacked by corrosion resulting from acid, report it immediately to the unit engineer so that respective measures can be taken in due time.

8. Should oil get on the skin, wipe the oiled surface immediately with clean pieces of cloth soaked in non-ethylated gasoline.

9. Should corroded areas be detected on the skin, do as follows:

(a) wipe these places with clean pieces of cloth soaked in non-ethylated gasoline;

(b) clean these areas with soft, grass or bristle brushes; if this fails to remove corrosion products, clean the area with emery powder No.200, applied to gasoline-soaked cotton waste;

Note: In removing the detected corrosion products, it is not recommended to completely eliminate the corrosion pits, since it is sufficient to remove the corrosion products.

(c) wash the treated area once more with clean pieces of cloth soaked in gasoline and then dry the surface;

(d) use a spray gun or a soft brush to apply primer AK-I mixed with 5-% of aluminium powder;

(e) let the primer dry at a temperature ranging from +12 to +17°C for 36 hours or at a temperature from +18 to +35°C for 24 hours;

(f) spray or brush pentaphtal varnish 170 mixed with 8% of aluminium powder over the prime coat of the outer airframe sur-

faces (colourless skin) or pentaphtal varnish 170 over the inner surfaces (golden colour);

(g) allow the varnish coating to dry at a temperature from +12 to +17°C for 36 hours or at a temperature from +18 to +35°C for 24 hours.

10. In winter, when corrosion is detected on the aircraft skin, coat the attacked surfaces with a thin layer of vaseline oil МВП heated to a temperature from +20 to +25°C.

11. In winter, examine the vaseline-coated areas not less than twice a month and, if necessary, restore the vaseline coating. When it becomes warm, treat the surfaces as instructed under Item 9 of the present Appendix.

12. Information on corrosion of the aircraft and on steps taken to remove it should be entered into the aircraft Service Log.

13. Places with damaged varnish coating should be coated with varnish 170 if no corrosion has shown up. The bare places are to be coated with varnish during the warm spring or summer season.

14. Recondition the varnish film in the following sequence:

(a) remove the damaged varnish film by means of pieces of cloth soaked in special СД solvent;

(b) use a spray gun or brush to apply one coat of varnish 170;

(c) wait 24 to 36 hours for the coat to dry at a temperature from +12 to +35°C.

15. Before starting to prime-coat or paint the aircraft the latter should be placed on an area of the airfield that is protected against dust; besides, the area near the aircraft must be sprinkled with water.

16. To reduce the drying time for oil-containing prime coats and enamels, it is allowed to heat the surfaces by means of air heated to a temperature of not more than +50 or +60°C.

17. It is prohibited to apply varnish or paint and to dry them in the hot sun or fog, dew or strong wind.

18. Oil-containing enamels should be applied at a relative air humidity of not more than 80 per cent at a temperature not below 12°C.

19. The aircraft may be taken out into the open in cloudy weather (rain, snow, fog) not earlier than 12 hours after the paint coating has been dried up.

APPENDIX 4

CORROSION-PREVENTIVE TREATMENT OF AIRCRAFT

Corrosion of parts is one of the main causes of aircraft defects in service.

Depending on its degree, corrosion results in premature wear of parts and increases the clearances between friction parts.

Corrosion-preventive treatment of the aircraft is one of the main steps intended to protect the parts against corrosion and to maintain the aircraft material during the storage period and also to ensure its normal operation during service.

With the aircraft parked for a period up to 20 calendar days, it is recommended to carry out every 10 days the maintenance operations indicated in Para. "Every 10±2 Days".

With the aircraft parked for more than 20 calendar days, as well as before it is packed for transportation, subject the aircraft to corrosion-preventive treatment as instructed below.

Before the aircraft is subjected to corrosion-preventive treatment its parts should be cleaned of dust, moisture, dirt, and old grease by means of clean wipe cloth soaked in non-ethylated gasoline.

The following corrosion-preventive compounds are recommended:

(a) lubricant ЦИАТИМ-201 ;

(b) petrolatum.

1. Lubricant ЦИАТИМ-201 is used to coat the cables, ball bearings (the ball bearings of the wheels are coated with grease НК-50) and all aircraft mechanisms, such as:

(a) canopy mechanisms;

(b) seat mechanisms;

(c) aircraft control mechanisms;

(d) engine control mechanisms;

(e) landing gear control mechanisms and hydraulic system units;

(f) armament mechanisms.

2. Petrolatum, heated to 60 - 80°C, is used to treat all non-painted steel units and parts:

(a) butt joints of wing, fuselage, and empennage;
(b) attachment fittings of engine mounts;
(c) attachment fittings of units, brackets;
(d) tailpipe attachment brackets;
(e) nipples and union nuts of pipe lines;
(f) springs;
(g) flexible sheathings;
(h) landing gear struts;
(i) engine jet nozzles.

3. The canopy must be protected with a flannel cover.

4. The rubber articles (canopy pressurizing rubber tubes, sealing boots, packing rubber on hatch edgings) should be wiped with talc.

5. Painted elektron parts are not treated with corrosion-preventive compound. Should their protective coating be damaged, it should be reconditioned as instructed in Appendix 3.

6. The ball bearings of the disconnected rods (when the aircraft is being transported) should be wrapped in two layers of paraffine paper and in calico and bound with twine, after they have been coated with corrosion-preventive compound.

7. In tracing pipe lines with a damaged paint coating it is necessary to repaint the pipe surfaces.

8. With the wings disjointed and the empennage removed, all openings in the fuselage, wings, fin and stabilizer should be tightly closed with fabric or glued over with calico to avoid clogging of the inner surfaces.

9. All the open ends of the pipe lines should be closed with rubber caps or plugs and sealed.

10. The engine intake ducts and the jet nozzles should be plugged and sealed.

11. Never should the oxygen system fittings be coated with corrosion-preventive compound.

12. The ready-made articles (hydraulic boosters БУ-13М, БУ-14МС, storage battery 12САМ-28, valve ПУ-7, differential control unit ПУ-8, cannon НР-30, etc.) should be treated in accordance with the respective instructions of the Manufacturing plants.

13. The hydraulic and fuel systems should be completely

primed (if the aircraft is to be transported, the fuel system must not be primed).

14. After subjecting the aircraft to corrosion-preventive treatment, all its protective covers should be put on.

If the aircraft is to be parked for a long time, its units and mechanisms should be maintained in good condition, as prescribed in the present instructions in Paras "Every 30±5 Days" and "Every Three Months±10 Days".

APPENDIX 5

CORROSION-PREVENTIVE TREATMENT OF ROCKET PODS

If the pods are to be stored for a long time, they should be treated as follows:

1. Remove the rear fairing, lock and take the rocket holders out of the tubes.

2. Slush the inner surfaces of the tubes and all accessible places of the lock. Do not slush the other parts and places of the lock; they should only be wiped clean.

CAUTION. When treating the disc, see that no compound gets into the contact sockets.

3. The rocket pods are treated with grease made up of a fifty-fifty mixture of gun oil and cannon grease.

4. Slush the spare parts and tools of the rocket pod.

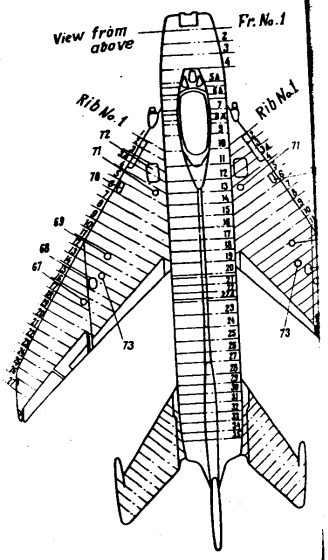
The rocket pods are treated for a storage period of one year.

The rocket pods are removed from long-term storage in t following way:

1. Wipe the entire surface of the rocket pod and remove rear fairing.

2. Remove the safety clamp, disconnect the electric wiri from the contact sockets, take the latter out of the body. Af this has been done, put the clamp in place and start removing the slushing compound.

3. Deslushing consists in washing the parts in kerosene or gasoline, after which the parts should be wiped dry and slightly coated with grease No.9.



APPENDIX 3

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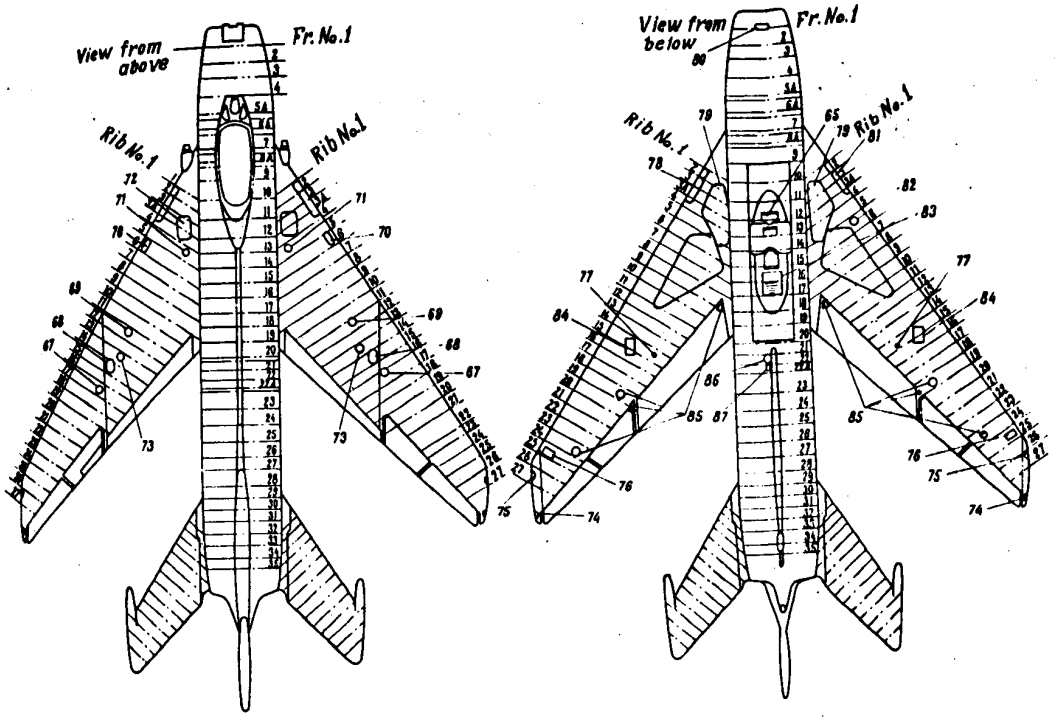


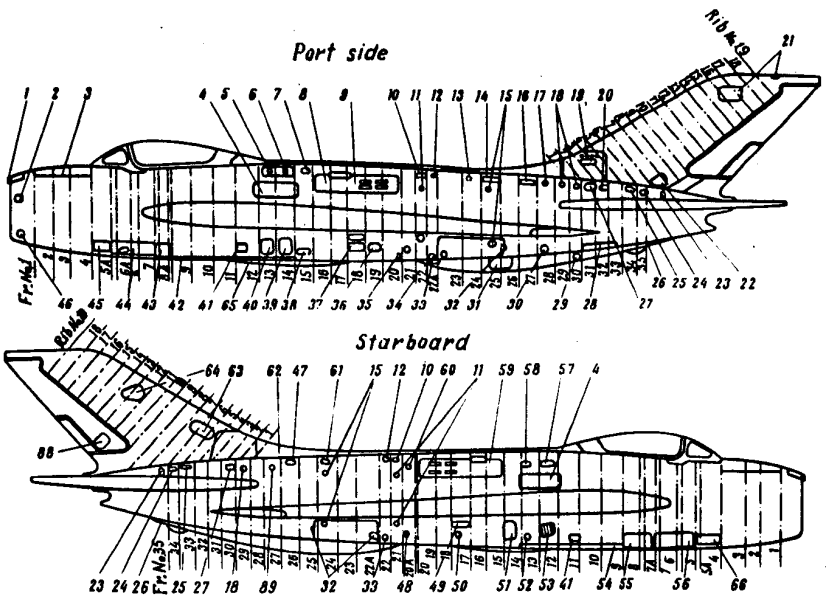
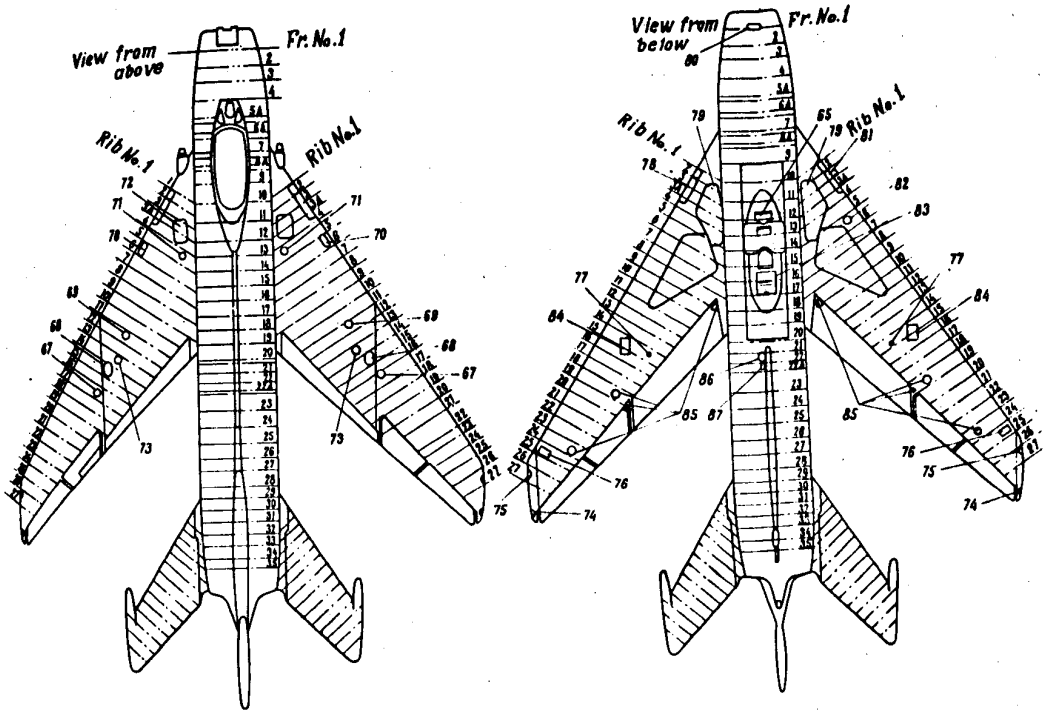


Fig.171. Service Access Hatches and Inscriptions on Them

1 - AKC camera mount; 2 - de-icer fluid filler neck; 3 - radio-equipment, storage battery; 4 - electrical equipment; 5 - fuel for tank No.1; 6 - gasoline for ПНР starting pump; 7 - joint of ПНР pump; 8 - engine inspection, fluid for hydraulic booster; 9 - airfield hydraulic pump; 10 - fuel filter; 11 - starting unit; 12 - oil filling; 13 - pipe joint; 14 - hydraulic units; 15 - thermocouples; 16 - controls; 17 - kerosene for tanks Nos 3 and 4; 18 - linkage joints; 19 - flare pistol; 20 - controls; 21 - radio equipment; 22 - controls; 23 - tailpipe attachment; 24 - nozzle control disconnect valves; 25 - pipe joint; 26 - tail support cylinder; 27 - lubrication of stabilizer bearings; 28 - drag parachute; 29 - ПНР pump; 30 - joint of fuel system; 31 - drain of fuel from tanks Nos 3 and 4; 32 - engine vent system; 33 - air brake shaft; 34 - joint of fuel system; 35 - charging connection of hydraulic accumulator; 36 - airfield storage battery; 37 - pipe joint; 38 - СД-8 pressure warning unit, units Ф-14 and Ф-37; 39 - carbon dioxide bottle; 40 - РМА-200А relay box; 41 - link chute; 42 - radio equipment; 43 - cartridge box; 44 - radio equipment; 45 - charging connection for oxygen; 46 - drain of de-icing system; 47 - control units; 48 - engine vent system; 49 - airfield hydraulic pump; 50 - drain of gasoline; 51 - joint of hydraulic piping; 52 - air radiator; 53 - turbine-and-cooler unit; 54 - adjustment of rear attachment; 55 - access to special equipment; 56 - radio equipment; 57 - pipe joint; 58 - fuel meter; 59 - engine inspection; 60 - charging connection for hydraulic fluid; 61 - air brake control valve; 62 - controls; 63 - nozzle control valves; 64 - gyro induction compass; 65 - pump of tank No.1, drain line; 66 - radio equipment; 67 - pipe union of fuel drop tank; 68 - bridge of special suspension; 69 - landing gear strut pivot; 70 - belt inspection; 71 - adjustment of rear attachment; 72 - armament; 73 - aileron bell crank; 74 - aileron attachment pivot; 75 - rod for belt loading; 76 - arrangement of cartridge belt; 77 - support for jack horse; 78 - aileron hydraulic booster; 79 - armament; 80 - support for jack horse; 81 - compressed air bottle; 82 - charging connection for air compressed to 110-130 kg/sq.cm; 83 - pump of tank No.2, drain line; 84 - 16-mm bolts; 85 - aileron bell crank; 86 - ПНР pump; 87 - drain line of ПНР pump; 88 - УТ-6 mechanism of rudder trim tab; 89 - pipe joint.



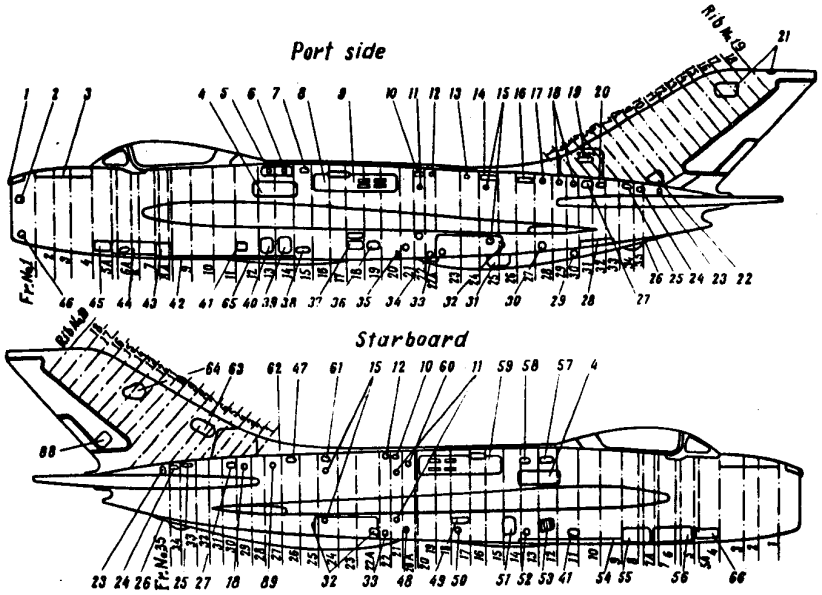


Fig.171. Service Access Hatches and Inscriptions on Them

1 - AKO camera mount; 2 - de-icer fluid filler neck; 3 - radio-equipment, storage battery; 4 - electrical equipment; 5 - fuel for tank No.1; 6 - gasoline for ПНР starting pump; 7 - joint of ПНР pump; 8 - engine inspection, fluid for hydraulic booster; 9 - airfield hydraulic pump; 10 - fuel filter; 11 - starting unit; 12 - oil filling; 13 - pipe joint; 14 - hydraulic units; 15 - thermocouples; 16 - controls; 17 - kerosene for tanks Nos 3 and 4; 18 - linkage joints; 19 - flare pistol; 20 - controls; 21 - radio equipment; 22 - controls; 23 - tailpipe attachment; 24 - nozzle control disconnect valves; 25 - pipe joint; 26 - tail support cylinder; 27 - lubrication of stabilizer bearings; 28 - drag parachute; 29 - ПНР pump; 30 - joint of fuel system; 31 - drain of fuel from tanks Nos 3 and 4; 32 - engine vent system; 33 - air brake shaft; 34 - joint of fuel system; 35 - charging connection of hydraulic accumulator; 36 - airfield storage battery; 37 - pipe joint; 38 - СА-8 pressure warning unit, units Ф-14 and Ф-87; 39 - carbon dioxide bottle; 40 - РПА-200А relay box; 41 - link chute; 42 - radio equipment; 43 - cartridge box; 44 - radio equipment; 45 - charging connection for oxygen; 46 - drain of de-icing system; 47 - control units; 48 - engine vent system; 49 - airfield hydraulic pump; 50 - drain of gasoline; 51 - joint of hydraulic piping; 52 - air radiator; 53 - turbine-and-cooler unit; 54 - adjustment of rear attachment; 55 - access to special equipment; 56 - radio equipment; 57 - pipe joint; 58 - fuel meter; 59 - engine inspection; 60 - charging connection for hydraulic fluid; 61 - air brake control valve; 62 - controls; 63 - nozzle control valves; 64 - gyro induction compass; 65 - pump of tank No.1, drain line; 66 - radio equipment; 67 - pipe union of fuel drop tank; 68 - bridge of special suspension; 69 - landing gear strut pivot; 70 - belt inspection; 71 - adjustment of rear attachment; 72 - armament; 73 - aileron bell crank; 74 - aileron attachment pivot; 75 - rod for belt loading; 76 - arrangement of cartridge belt; 77 - support for jack horse; 78 - aileron hydraulic booster; 79 - armament; 80 - support for jack horse; 81 - compressed air bottle; 82 - charging connection for air compressed to 110-130 kg/sq.cm; 83 - pump of tank No.2, drain line; 84 - 16-mm bolts; 85 - aileron bell crank; 86 - ПНР pump; 87 - drain line of ПНР pump; 88 - УТ-6 mechanism of rudder trim tab; 89 - pipe joint.

APPENDIX 7

LIST OF GROUND EQUIPMENT FOR AIRCRAFT

MiG-19C

No.	Description	No. of drawing	Quantity
1	2	3	4
	1. EQUIPMENT SUPPLIED WITH EVERY AIRCRAFT		
1	Cockpit entrance ladder	CM9811-00	1
2	Towing arrangement	CM9884-00	1
3	Chocks for wheels	CM9880-00	2 {1 L.G. 1 R.H.
4	Gangway on wing	CM9890-00/Б	2 {1 L.H. 1 R.H.
5	Screw clamp for controls	CM98116-00	3
6	Front plug for intake duct	CM9877-00/A	1
7	Rear plug for jet nozzle	CM9887-00	2
8	Bucket with spout, dipstick and cover	CM98I7-00	1
9	Pan	CM9897-00	1
10	Dolly for work under aircraft	CM98114-00	1
11	Protecting cover for upper wing hatch	CM9805-00	2
12	Plug for pipe unions of fuel drop tanks	CM9351-31 CM9351-32	1 set
13	Plug for release openings in engine shutters	CM98176-00	2 {1 R.H. 1 L.H.
14	Ground safety pins for seat	CM7A-9100-20	1
15	Safety caps for canopy remover pneumatic gun cylinders	CM0605-801	2
16	Ground safety pin for spring of canopy emergency pin	CM7804-275	1
17	Plug for fuel line (when fuel drop tanks are removed)	CM6120-1650 CM6120-5037	2 2
18	Plug	CM2-2044-11	2 {1 R.H. 1 L.H.
19	Cover for closing special suspension bridge		

1	2	3	4
20	Plug for РД-2ИА regulator	CM7623-60	1
21	Hose for charging aircraft and canopy compressed air systems, with device for charging L.G. shock absorbers, hydraulic accumulators, wheel bottles and for checking pressure in landing gear wheel bottles	155H570	1 set
22	Covers for wing cannon barrels	CM2-9211-00/A	2
23	Screw clamp for checking booster	CM9819-00	1
24	Cover for front part of fuselage	CM9201-00/A	1
25	Cover for wing	CM9202-50/A	2
26	Cover for nose part of fuselage	CM9206-00/A	1
27	Cover for tail part of fuselage	CM9213-00	1
28	Cover for nose wheel	CM9204-00	1
29	Cover for main wheel	CM9205-00	2
30	Cover for canopy	CM9207-00	1
31	Cover for cannon barrel	CM9208-00	1
32	Cover for air-speed tube (ПВД)	CM9209-00/A	1
33	Flannel cover for canopy with holes for blowing	CM2-9210-00	1
34	Safety cap for aircraft responder aerial	CM9823-00 CM9824-00	1 set
35	Plug for ejection chute	CM98135-00	1 set
36	Cover for engine	-	2
37	Cover for Pitot tube(ТП-156)	ЭСИ7702-250	1

1	2	3	4
38	Funnel for oil filling (with silk filter)	CM98138-00	1
39	Adapter for charging hydraulic accumulators	CM5505-860	1
40	Mat for work on cockpit floor	CM98131-00	1
41	Portable lamp with 12 m.length of cord	ПЛ-36	1
42	Pad for parachute	CM9100-340	1
43	Seat ejection interlocking pin	155Н3-6-85	1

2. GROUND EQUIPMENT FOR AIRCRAFT ELEMENTS (ONE SET FOR EVERY 4 AIRCRAFT)

1	Hydraulic jack for wing, type ПК-4	9200-00/A	2
2	Service ladder for empennage	CM98110-00	1
3	Jack horse for safety step bearing	CM98133-00/A	1
4	Device for sight laying	CM98166-00 CM98166-30	1 set
5	Device for checking pressure in main and drop fuel tanks	-	1 set
6	Airfield oil gun	АМЗ-53	1
7	Dolly for wings	CM9883-00	2 (1 R.H., 1 L.H.)
8	Screw jack for fuselage nose part	CM9895-00	1
9	Box with instruments for checking engine operation on the ground	CM6430-00	2 sets
10	Kettle, 6-litre capacity	CM9816-00	1
11	Funnel for hydraulic fluid (with silk filter)	CM98137-00 CM98136-00	1 2
12	Funnel for alcohol and gasoline (with silk filter)		

1	2	3	4
13	Portable headlight, ФР-100, with 15-m. cord	CM98101-00	1
14	Dolly for jointing nose part of fuselage with tail one	CM9881-00	1
15	Winch for drawing belt	CM8604-80	2
16	Tie-rod	CM2-8604-600	2
17	Adapter for bore sighting gauge	CM2-8604-190	1
18	Device for adjustment of tailpipe	CM98134-00/A	1
19	Remover for tyres of main and nose wheels	CM98148-00	1
20	Truss used to run engine with tail disconnected	CM98118-00/A	1
21	Hose for fuel	CM7804-1060	1
22	Plug for engine compressor intake part when engine is removed	CM98106-00/A	2
23	Dolly for removal of drop fuel tank (760 litres)	CM98153-00	2
24	Dolly for removal and installation of engine	CM9892-00/A	1
25	Dolly for tailpipe	CM98115-00	1
26	Crosspiece for engine lifting	CM98102-00/A	2
27	Jack for frame No.15 of fuselage	CM98117-00	1
28	Jack for frame No.20 of fuselage	CM98111-00	1
29	Device for checking cockpit and fuel system for pressure-tightness	CM9893-00/A	1
30	Remover for main wheel	CM98156-00	1
31	Protractor for measuring aileron and stabilizer deflection	CM98159-00	1

1	2	3	4
32	Remover for nose wheel	CM98155-00	1
33	Plug for pipe lines when fuselage tail section is disconnected	CM9812-00 CM9813-00 CM9814-00 CM9815-00	2 set
34	Small painter's brush		4
35	Painter's brush No.20		4
36	Clamp (band) used to suspend control rods when fuselage is disjointed	CM9818-00	1
37	Device for ejecting cases and for loading	CM2-8604-370	1

3. GROUND EQUIPMENT FOR AIRCRAFT SERVICING GROUPS (ONE SET FOR 12 AIRCRAFT)

1	Service ladder for aircraft	CM98127-00	1
2	Tank with hoses used for engine slushing	CM98107-00	1
3	Remover for wing-to-fuselage clamp bolts	CM98103-00	2
4	Airfield desiocator	CM98168-00	2
5	Dynamometer for 10 kg		1
6	Dynamometer for 20 kg		1
7	Protective casing for nose strut	CM98142-00	1
8	Device for setting gyroscope to zero position	CM98166-00 CM98166-30	1 set
9	Device for removing L.G. wheel bearing cover	-	2
10	Clamp for charging АД-3 mechanism	-	1
11	Small painter's brush		2
12	Painter's brush No.20		2

1	2	3	4
13	Device for checking clearances of L.G. struts, with dynamometer	-	1
14	Device for expanding pipes	-	1
	4. GROUND EQUIPMENT FOR SCHEDULED MAINTENANCE GROUPS (ONE SET FOR 20 AIRCRAFT)		
1	Ground equipment for each article, without covers (as listed in Section 1 of this Appendix)	-	2 sets
2	Ground equipment for aircraft element (as listed in Section 2 of this Appendix)	-	2 sets
3	Ground equipment for aircraft servicing groups (as listed in Section 3 of this Appendix)	-	1 set
	5. GROUND EQUIPMENT (ONE SET FOR 40 AIRCRAFT)		
1	Towing rod	CM98121-00	1
2	Dummy legs	CM98105-00	1 R.H. 1 L.H.
3	Slinger system for wing lifting	CM98109-00	1
4	Rack for transporting wings on vehicle	CM98119-00	1
	6. UNLOADING EQUIPMENT DELIVERED WITH EACH TRANSPORTATION UNIT		
1	Ramp for rolling article out of container	CM93100-170/A	3
2	Ramp for front wheel	CM93100-190	1 set
3	Crosspiece for container	CM9320-00	1

APPENDIX 8

LIST OF TOOLS

No.	Description	No. of drawing	Quantity
1	2	3	4
	1. SMALL TOOLS KIT DELIVERED WITH EACH AIRCRAFT		
1	Standard kit for aircraft tools	CM7804-170/A	1
2	Wrench, S=5x7	32105/002	1
3	Wrench, S=9x11	32105/005	1
4	Wrench, S=10x12	32105/006	1
5	Wrench, S=14x17	32105/009	1
6	Wrench, S=19x22	32105/012	1
7	Wrench, S=24x27	32100/015	1
8	Wrench, S=30x32	32105/026	1
9	Wrench, S=41x50	C7804-26	1
10	Wrench, S=32x36	C7804-31	1
11	Wrench for brace struts of fuel drop tanks, S=17x19	CM8604-992	1
12	Socket wrench for wheel brake shoes, S=17	CM7804-98	1
13	Wrench for unit 317A (oil combined filler neck)	CM9501-269	1
14	Socket wrench for hydraulic accumulator, S=11	CM7804-285	1
15	Wrench for plug of fuel drop tanks	CM7804-46	1
16	Wrench for L.G. wheels, S=19	CM7804-120	1
17	Grease gun	155H428	1
18	Nozzle for grease gun 155H428	CM7804-310	1
19	Sliding mirror	CM7804-55	1
20	Centre punch, L=90 mm	CM7804-88/003	1
21	Drift, duralumin, dia. 20, L=300 mm	CM7804-88/009	1
22	Drift, duralumin, dia. 10, L=100 mm		

1	2	3	4
23	Fitter's hammer with round face, 200 gr		1
24	Handle for hammer	54636/003	1
25	Screw-driver with wooden cheeks, L=150 mm		1
26	Screw-driver with wooden cheeks, L=200 mm		1
27	Combined general use flat pliers, L=200 mm		1
28	Screw-driver for cross splines	H-2	4
29	Screw-driver for cross splines	H-2	2
30	Screw-driver for engine access doors	C7804-160	1
31	Six-article knife		1
32	Lock of spring hook type	CM7804-300	1
33	Clamp for seat fins	ЭСД7804-I60	1
34	Wrench for tightening seat blind spring	ЭСД7804-I50	1
35	Triangular file, L=200 mm	Nos 4-5	1
36	Handle for file	34747/002	3
37	Key for cocking lock of fuel drop tank, БД-3-56		1
38	Screw-driver for self-locking bolt of ПВД-4 air-speed tube	CM9501-206	1
39	Wrench for removal of main L.G. wheels	CM7804-52	1
40	Flat file, L=200 mm	Nos 4-5	1
41	Round file, L=200 mm	Nos 4-5	1
42	Wrench for arming spring mechanism	CM7804-490	1

1	2	3	4
	2. AIRCRAFT ELEMENT KIT (ONE KIT FOR EVERY 4 AIRCRAFT)		
1	Standard kit for aircraft tools	CM7804-150	1
2	Wrench, S=46	C7804-27	1
3	Wrench, S=60	C7804-28	1
4	Wrench, S=55	C7804-29	1
5	Wrench for disconnect valves, S=36x46	CM7804-30	1
6	Wrench for removal of nose strut pivot, S=27	CM7804-90	1
7	Wrench for fuselage jointing, S=19	CM7804-11/B	2
8	Wrench for aileron attachment nuts, S=7x14	CM7805-140	1
9	Wrench for rear vent pipe, S=11	CM7804-290	1
10	Wrench No.14 for side vent pipe	CM7804-295	1
11	Wrench for thermo-couple, S=22	CM7804-I20	1
12	Wrench for fuel drain cocks, S=24	CM7804-75	1
13	Wrench No.14 for disconnecting engine vent pipe	CM7804-80	1
14	Wrench for disconnecting engine vent pipe, S=17	CM7804-81	1
15	Wrench for disconnecting engine vent pipe, S=19	CM7804-82	1
16	Wrench for turning out pipe union of fuel drop tank float valve, S=60	C7804-25	1
17	Wrench handle for changeable heads	CM7804-24	1
18	Wrench handle for changeable heads	CM7804-27	1

1	2	3	4
19	Wrench head, S=36	CM7804-23/02	1
20	Wrench head, S=46	CM7804-23/04	1
21	Wrench head, S=50	CM7804-23/05	1
22	Wrench head, S=60	CM7804-23/07	1
23	Wrench for main L.G. strut	CM7804-65	1
24	Awl for cable splicing	C7804-170	1
25	Wrench for removing No.3 fuel tank pump	-	1
26	Wrench for air brake	CM9501-270	1
27	Wrench for air brake	CM9501-271	1
28	Wrench for float valve of rear tank group	CM7804-50	1
29	Remover tool for disjointing nose and tail parts of fuselage	CM7804-230	1
30	Device for adjusting simultaneous opening of canopy locks	CM7804-325	1
31	Lock of spring hook type	CM7804-300	5
32	Painter's brush, dia. 30	-	2
33	Magnifying glass, 10 power	-	1
34	Clearance gauge (from 0.05 to 1 mm)	No.5	1
35	Handle bar	07804-52	1
36	Squirt gun	C7804-370	1
37	Bench vice	-	1
38	Cold chisel, L=150 mm	-	1
39	Fitter's hammer, 400 gr	-	1
40	Handle for hammer	54636/005	1
41	Hammer with removable faces (three pairs of faces)	CM7804-40	1

1	2	3	4
42	Socket wrench for БУ-14МС booster, torgue=330 kg-cm	54428-03	1
43	Extension for attaching stabilizer beam to frame No.30	CM7804-380	1
44	Extension for installing БУ-14МС booster and bracket of АПС-4 electrical mechanism	CM7804-443	1
45	Torque indicating wrench for stabilizer	CM9501-240	1
46	Wrench for tightening stabilizer tapered bush	CM7804-445	1
47	Remover tool for stabilizer pivot pin	CM9501-235	1
48	Wrench, S=30, for easily detachable joints of control rods	CM9501-274	1
49	Slide gauge (0-125)		1
50	Measuring tape, 10 m.		1
51	Wrench, S=75, for removal of kerosene tank	CM7805-336	1
52	Cable for installing tank in container	CM7804-305	1
53	Socket wrench, S=5x7	СД7803-160	1
54	Socket wrench, S=9x11	C7804-245	1
55	Socket wrench, S=14	C7803-50	1
56	Wrench, S=24, for joining wing	CM7804-15/B	1
57	Screw-driver for stabilizer	CM9501-215	2
58	Wrench for stabilizer	CM9501-216	1
59	Socket wrench, S=19	CM7804-203	1
60	Drift for stabilizer bolts	CM9501-217	2
61	Pin	CM9501-218	2
62	Wrench, S=41, for joining wing	CM7804-20	1

1	2	3	4
53	Wrench, S=48, for joining wing	CM7804-21	1
	3. TOOLS OF ARTIFICER (ONE SET FOR 4 AIRCRAFT)		
1	Standard kit for tools	CM7804-100/A	1
2	Wrench for front attachment of cannon and for beam suspension	CM2-8604-07	1
3	Wrench for rear attachment fitting of cannon (for fuselage and wing tapered bolt)	CM2-8604-26	1
4	Wrench for pod adjustment and for rear attachment fittings	CM2-8604-38	1
5	Wrench for sight adjustment	CM2-8604-44	1
6	Wrench for third point of wing cannon	CM2-8604-80	1
7	Wrench for sight head	CM8604-993	1
8	Collar for supports	CM8601-481	1
9	Screw-driver	B250x1	1
10	Screw-driver No.2 for cross splines	H-2	2
11	Screw-driver No.1 for cross splines	H-2	2
12	Hammer with changeable faces	CM7804-40	1
13	General purpose flat pliers		1
14	Lock of spring hook type	CM7804-300	1
15	Wrench for rear attachment fittings of wing cannon	CM2-8604-670	1

1	2	3	4
16	Wrench for round nuts of seat ejection gun	CM7804-370	1
17	Handle bar	C7804-52	1
18	Wrench, S=45x52, for round nuts of seat ejection gun		1
19	Wrench for supports	CM2-8604-704	1
20	Cleaning rod with two brushes	CM9501-24	1
21	Hook	CM9501-40	1
22	Mandrel	CM9501-39	1
23	Wrench for camera controller CM-45	CM2-8604-700	1
24	Wrench for rear attachment fittings of left-hand wing cannon	CM7804-81	1
25	Wrench for camera mount AKC-3M	CM2-8604-29	1
26	Wrench for cannon rear attachment fittings	CM2-8604-754	1
27	Wrench for suspension beam	CM2-8604-780	1
28	Wrench for third point of fuselage cannon	CM2-8604-720	1
29	Wrench for lock БД-3-56		1
30	Smooth flat file, L=250 mm, No.2		1
31	Brass drift, dia. 4 mm	CM9501-304/1	1
32	Brass drift, dia. 6 mm	CM9501-304/2	1
33	Wrench for nut of seat ejection gun trunnion	32100/015	1
34	Angular screw-driver	CM2-8604-750	1
35	Screw-driver for cartridge box	CM9501-09	1

1	2	3	4
36	Screw-driver for cannon front access hatch door	CM9501-13	1
37	Screw-driver for special beam	CM9501-15	1
38	Wrench for installation of ejection gun	34104/013	1
39	Wrench, S=19, for adjustment of universal beam	CM9501-08	1
40	Wrench, S=14, for sight	CM9501-12	1
41	Handle for file	34747/002	1
	4. TOOLS FOR RADIO EQUIPMENT MECHANIC (ONE SET FOR 4 AIRCRAFT)		
1	Kit for tools of radio equipment mechanic		1
2	Wrench, S=5x7	32105/002	1
3	Wrench, S=9x11	32105/005	1
4	Socket wrench, S=9x11	C7804-245	1
5	Socket wrench, S=7x8	СД7803-I70	1
6	Six-article knife		
7	Forceps	54450/012	1
8	Metal mirror	CM7804-55	1
9	Screw-driver, L=150 mm, with 5-mm blade	B150x1	1
10	Screw-driver with 4-mm blade	32001/003	1
11	Combination flat pliers, L=150 mm		1
12	Wire cutters with 20-mm blade, L=100-150 mm		1
13	Screw-driver for clock with 2- and 4-mm blades	21H3442	1
14	Soft brush, L=160-200 mm		1
15	Screw-driver No.1 for cross splines	H-2	1
16	Screw-driver No.2 for cross splines	H-2	1

1	2	3	4
17	Lock of spring hook type	CM7804-300	5
18	Ebonite rod with 2-mm blade, dia. 6 mm, L=200 mm, for МРП-48П radio set	CM9501-277	1
19	Wrench for attachment of АРК-5 radio compass contact block	CM9501-267	1
20	Screw-driver with 4-mm blade, L=150 mm, for ПО-500 convertor	54430/003	1
	5. TOOLS OF ELECTRICIAN (ONE SET FOR 4 AIRCRAFT)		
1	Standard Kit	C7804-00	1
2	Double-head wrench, S=5x7	32105/002	1
3	Double-head wrench, S=9x11	32105/005	2
4	Double-head wrench, S=10x12	32105/006	1
5	Wrench, S=11x12	CM7804-727	1
6	Wrench, S=9x11	C7804-245	1
7	Socket wrench, S=7x9	CM7804-715	1
8	Wrench for СЛП lamp	C7804-340	1
9	Combination general use flat pliers, L=200 mm		1
10	Insulating tape, coil, 200 gr		1
11	Six-article knife		1
12	Metal mirror	CM7804-55	1
13	Socket wrench, S=14	C7803-50	1
14	Double-head wrench, S=30x32	32100/018	1
15	Double-head wrench, S=14x17	C7804-50	1
16	Screw-driver with 4-mm blade	32001/003	1

1	2	3	4
17	Screw-driver with 7-mm blade, L=200 mm	32000/д-200, blade being finished to 7 mm	1
18	Screw-driver No.1 for cross splines	H-2	1
19	Screw-driver No.2 for cross splines	H-2	1
20	Lock of spring hook type	CM7804-300	5
21	Screw-driver with 4-mm blade, L=400 mm, T-handle	CM9501-305	1
22	Soft brush	CM9500-8I	1
23	Wrench for distributing box of ГИК-1 compass, S=6	СД7803-I50	1
24	Socket wrench, S=8	CM9501-268	1
	6. TOOLS FOR INSTRUMENT MECHANIC (ONE SET FOR 4 AIRCRAFT)		
1	Standard kit for tools	C7804-00	1
2	Wrench, S=14x17	32105/009	1
3	Wrench, S=5x7	32105/002	1
4	Wrench, S=9x11	32105/005	1
5	Socket wrench, S=5x7	СД7803-I60	1
6	Screw-driver with wooden cheeks, 7-mm blade, L=200 mm		1
7	Screw-driver with 4-mm blade	32001/003	1
8	Awl for cleaning holes in thermocouples	СД7803-I48	1
9	Demagnetic screw-driver	CM9501-272	1
10	Six-article knife		1
11	Metal mirror	CM7804-55	1
12	Wrench for attachment of thermocouple, S=22	СП7804-I20	1
13	Wrench for instrument glass holding nuts	СД7803-I49	1

1	2	3	4
14	Combination universal flat pliers, L=150 mm		1
15	Forceps		1
16	Screw-driver for clock with 2- and 4-mm blades		2
17	Soft brush		1
18	Screw-driver No.1 for cross splines	H-2	1
19	Screw-driver No.2 for cross splines	H-2	1
20	Vacuum remover for instrument glass	CM7804-728	1
21	Socket wrench, S=9x11	C7804-215	1
22	Wrench for tachometer generator, S=60		1
23	Lock of spring hook type	CM7804-300	5
24	Extension for checking ПВД-4 air-speed tube and ТП-156 Pitot tube	CM9501-289	1
25	Pump for extension used to check ПВД-4 and ТП-156 tubes for leakage	CM9501-306	1
	7. CHROME-PLATED TOOLS FOR OXYGEN EQUIPMENT MECHANIC (ONE SET FOR 4 AIRCRAFT)		
1	Standard kit for tools	C7804-00	1
2	Wrench for charging connection, S=27	CM9501-231	1
3	Wrench, S=14x17	32100/009	1
4	Wrench, S=17x19	CM8604-05	1
5	Wrench for ИК-18 indicater	CM9501-225	1
6	Wrench for adjustment of КП-30 apparatus remote control	CM9501-226	1

1	2	3	4
7	Screw-driver with handle of plastics	CM9501-223	1
8	Screw-driver, S=250	CM9501-224	1
9	Metal mirror	CM7806-II	1
10	Screw-driver with 4-mm blade, S=175	CM9501-222	1
11	Wrench for oxygen pipe union	CM7804-480	1
12	Combination flat pliers, L=150 mm		1
13	Wire cutters, L=150 mm	34400/002	1
14	Six-article knife		1
15	Wrench for opening valve of two-litre ball bottles	CM9501-329	1
16	Lock of spring hook type	CM7804-300	5

8. TOOLS FOR AIRCRAFT WEAPON SERVICING GROUP (ONE SET FOR 12 AIRCRAFT)

1	Special bucket, 10-litre capacity	CM9807-00	1
2	10-power magnifying glass		1
3	Set of clearance gauges No.5 (14 blades)		1
4	Level gauge		1
5	Fitter's hammer with round face, 200 gr	31002/200	1
6	Handle for hammer	54636/003	1
7	Hack-saw blade frame	54600/002	1
8	Hack-saw blade, L=300 mm		1
9	Triangular file No. 3-4, L=150 mm		1
10	Round bastard file No.1, L=200 mm		1
11	Flat file No.2, L=250 mm		1
12	Round barette file No.3, L=150 mm		2
13	Handle for file	34747/001	3

1	2	3	4
14	Handle for file	34747/002	1
15	Handle for file	34747/003	1
16	Six-article knife		2
17	Hand vice	54464/012	1
18	Cotter pin remover	54650/001	2
19	Small wire cutters, L=150 mm		2
20	Measuring tape, 10 m.		1
21	Standard kit for tools	C7803-00/34	1

9. TOOLS FOR RADIO EQUIPMENT SERVICING GROUP (ONE SET FOR 12 AIRCRAFT)

1	Standard kit for tools	C7803-00/31	1
2	Single-way hand bit brace with chuck, up to 6 mm	54610/071	7
3	Set of carbon steel drills, dia. 1.1, 1.6, 2.1, 2.6, 3.1, 3.6, 4.1, 5.1, 6.0 mm		2 sets
4	Case for drills	CM9500-70	1
5	Electric soldering iron, 24V, 90W	32805/067	1
6	Straight tip (for soldering iron), type I	58249/001	1
7	Bent tip (for soldering iron), type II	58249/002	1
8	Bent tip (for soldering iron), type III	58249/003	1
9	Bench vice	125	1
10	Metal ruler, L=300 mm	31000003	1
11	Fitter's hammer, 150 gr	5436/002	1
12	Handle for hammer		

1	2	3	4
13	Six-article knife		1
14	Flat smooth file No.2, second class, L=150 mm		1
15	Flat barette file No.3, third class, L=150 mm		1
16	Triangular smooth file, L=200 mm		1
17	Handle for files	34747/002	3
18	Flat needle file Nos 1, 2 and 3		1
19	Round needle file		1
20	Triangular needle file		1
21	Screw-driver No.1 with cross splines	H-2	1
22	Screw-driver No.2 with cross splines	H-2	1
23	Screw-driver with wooden cheeks and 7-mm blade	32000/001	1
24	Screw-driver with 4-mm blade	32001/003	1
25	Screw-driver with 2-mm blade	32001/001	1
26	Combination flat pliers		1
27	Round pliers, L=100-150 mm	34420/002	1
28	Awl	СД7803-148	1
29	Crucible for silica gel drying	СМ7804-660	1
30	Metal mirror	СМ7804-55	1
31	Portable lamp with 12-m. cord	НЛ-36	1
32	Hand vice (adjustable wrench)	54464/003-135	1
33	Wrench for ШРГ-4 plug connectors		1

1	2	3	4
34	Wrench for ШРГ-3 and ШРГ-7 plug connectors	СД7803-200/2	1
35	Wrench for ШРГ-13 plug connector	СД7803-200/3	1
36	Wrench for ШРГ-9 plug connector	СД7803-200/4	1
37	Wrench for ШРГ-23 and ШРГ-19 plug connectors	СД7803-200/5	1
38	Wrench for airfield supply plug connectors	СД7803-200/6	1
39	Wrench handle	СД7803-190	1
40	Wrench for СШ lamp	СД7804-150	1
41	Bent wrench handle	СД7803-190А	1

10. TOOLS FOR ELECTRICAL EQUIPMENT SERVICING GROUP (ONE SET FOR 12 AIRCRAFT)

1	Standard kit for tools		1
2	Single-way hand bit brace with chuck, up to 6 mm	54610/071	1
3	Set of carbon steel drills, dia. 1.1, 1.6, 2.1, 2.6, 3.1, 3.6, 4.1, 5.1, 6.0 mm		1
4	Case for set of drills	СМ9500-70	1
5	Electrical soldering iron, 24V, 90W	32805/067	1
6	Straight tip (for soldering iron), type I	58249/001	1
7	Bent tip (for soldering iron), type II	58249/002	1
8	Bent tip (for soldering iron), type III, tip angle 90°	58249/003	1
9	Hand vice		1
10	Metal ruler, L=300 mm	31000/003	1
11	Fitter's hammer, 150 gr	54636/002	1
12	Handle for hammer		1

1	2	3	4
13	Six-article knife		1
14	Flat smooth file No.2, second class, L=150 mm		1
15	Flat barette file No.3-4, L=150 mm		1
16	Triangular smooth file No.2, L=150 mm		1
17	Handle for file	34747/001	1
18	Flat needle file Nos 1, 2, 3		1
19	Round needle file		1
20	Triangular needle file No.20		1
21	Screw-driver No.1 for bolts with cross splines	H-2	1
22	Screw-driver No.2 for bolts with cross splines	H-2	1
23	Screw-driver with wooden checks and 7-mm blade	32000/9-200, blade being finished to 7 mm	1
24	Screw-driver with 4-mm blade	54430/202	1
25	Screw-driver with 2-mm blade	54430/261, blade being finished to 2 mm	1
26	Combination flat pliers	ПК-200	1
27	Round pliers, L=100-150 mm	34420/002	1
28	Straight forceps, L=110 mm	54450/011	1
29	Awl for cleaning thermocouple openings	СП7803-148	1
30	Movable mirror	CM7804-55	1

1	2	3	4
4	Wrench for nut of main L.G. wheel axle	CM7804-65	1
5	Wrench, S=90x95, for filler neck of tank and fuel suction hose		1
6	Wrench for removing stabilizer from fuel drop tanks	CM7804-350	1
7	Wrench for carbon dioxide charging connection	C3515	1
8	Handle for above wrench	C7804-331	1
9	Remover tool for main L.G. wheel axle	CM7804-280	1
10	Tube for wrench of carbon dioxide charging connection	CM7804-360	1
11	Centre punch	31200/002	3
12	Straight bucking bar	33212/003	1
13	Bent bucking bar	CM7804-675	1
14	Bent bucking bar	CM7804-674	1
15	Bent bucking bar	33212/323	1
16	Insulating tape, coil, 200 gr		1
17	Machine for inserting hollow rivets	54392-010	1
18	Metal ruler, L=300 mm	54610/071	1
19	Hand bit brace for 6-mm drills	54434/012	1
20	Powered screw-driver	C7804-52	1
21	Handle lever	CM7804-300	1
22	Lock of spring hook type		1
23	Set of straight carbon steel drills, dia. 1.1, 1.6, 2.7, 3.1, 3.6, 4.1, 5.1 mm		

1	2	3	4
31	Portable lamp with 12-m. cord	ПЛ-36	1
32	Hand vice (adjustable wrench)	54464/003-135	1
33	Straight handle for plug connector wrench	СМ7803-190	1
34	Bent handle for plug connector wrench head	СД7803-190А	1
35	Wrench for ШРГ-4 plug connectors (Drawing СД7803-200)	СД7803-200/1	1
36	Wrench for ШРГ-7 and ШРГ-3 plug connectors (Drawing СД7803-200)	СД7803-200/2	1
37	Wrench for ШРГ-13 plug connectors (Drawing СД7803-200)	СД7803-200/3	1
38	Wrench for ШРГ-9 plug connectors (Drawing СД7803-200)	СД7803-200/4	1
39	Wrench for ШРГ-23 and ШРГ-19 plug connectors (Drawing СД7803-200)	СД7803-200/5	1
40	Wrench for СЛЦ lamp	СД7804-150	1
41	Wrench for airfield power source receptacle plug connectors (Drawing СД7803-200)	СД7803-200/6	1

11. TOOLS FOR SERVICING GROUP
(ONE SET FOR 12 AIRCRAFT)

1	Kit with tools delivered with each aircraft	И-2I	1
2	Box for tools	СМ9310-00	1
3	Wrench for discharge bonnet of fire-extinguishing bottle	21Н3521	1

1	2	3	4
24	Case for set of drills	СМ9500-70	1
25	Cable for installation of landing flap cylinder in wing	СМ7804-390	1

12. TOOLS FOR ARMAMENT SCHEDULED MAINTENANCE GROUP
(ONE SET FOR 20 AIRCRAFT)

1	Standard kit for tools	С7803-00/35	1
2	10-power magnifying glass		1
3	Set of clearance gauges No.5 (14 blades)	ГОСТ 882-41/5	1
4	Extension on rod used to clean and lubricate seat ejection gun	СМ9501-24	1
5	Bench vice with 120-mm jaws	Т-140	1
6	Hand bit brace with chuck, up to 6 mm	54610/071	2
7	Set of carbon steel drills, dia. 1.1, 1.6, 2.1, 2.6, 3.1, 3.6, 4.1, 4.6, 5.1, 5.6 mm		3 sets
8	Cold chisel	31100/103	2
9	Hack-saw blade frame	54600/022	1
10	Round needle file		3
11	Flat needle file		3
12	Triangular needle file		3
13	Triangular bastard file, L=150 mm		2
14	Round bastard file, L=200 mm		2
15	Flat smooth file, L=250 mm		2
16	Round barette file, L=150 mm		3

1	2	3	4
17	Six-article blade		2
18	Cotter pin remover	39800/ЕЦ 023	2
19	Awl for cable splicing	C7804-170	2
20	Electrical soldering iron, 24V, 90W	32805/067	2
21	Straight tip, type I (for soldering iron)	58249/001	2
22	Bent tip, type II (for soldering iron)	58249/002	2
23	Bent tip, type III (for soldering iron)	58249/003	2
24	Slide gauge, 0-125		1
25	Measuring tape, 10 m.		1
26	Electrical soldering iron, 220V, 80W, with bent and straight tips		1
27	Set of tools for armament (one set for 4 aircraft)	M-23	1 set
28	Wire cutters, L=150mm		3
29	Screw-driver No.2 for cross splines	M-2	2
30	Flat screw-driver, L=360-400 mm, with 5-6 mm blade	CM9501-328	1
31	Hack-saw blades, L=300 mm		10
32	Handle for file	34747/002	7
33	Handle for file	34747/003	2

13. TOOLS FOR RADIO EQUIPMENT SCHEDULED MAINTENANCE GROUP (ONE SET FOR 20 AIRCRAFT)

1	Kit with tools for radio equipment mechanic (one kit for 4 aircraft)	M-26	3 sets

1	2	3	4
2	Kit for tools	C7803-00/33	2
3	Single-way hand bit brace with chuck, up to 6 mm	34010/001	2
4	Set of carbon steel drills, dia. 1.1, 1.6, 2.1, 2.6, 3.1, 3.6, 4.1, 5.1, and 6.0 mm		4 sets
5	Case for drills	CM9500-70	4
6	Electrical soldering iron, 24V, 90W	32805/067	2
7	Straight tip, type I (for soldering iron)	58249/001	2
8	Bent tip, type II (for soldering iron)	58249/002	2
9	Bent tip, type III (for soldering iron)	58249/003	2
10	Electrical soldering iron, 220V, 80W, with bent and straight tips		2
11	Parallel bench vice with 60-80 mm wide jaws		2
12	Hack-saw blade frame	32310/003	2
13	Metal ruler, 300 mm		2
14	Fitter's hammer, 150 gr	31000/003	2
15	Six-article knife		2
16	Flat smooth file, 2nd class, L=150 mm		2
17	Flat barette file, 3rd class, L=150 mm		2
18	Triangular file, L=200 mm		2
19	Handles for files Nos 1, 2, 3	34747/002	6
20	Flat needle file		2

1	2	3	4
21	Round needle file No.2		2
22	Triangular needle file No. 2		2
23	Screw-driver No.1 for cross splines	H-2	2
24	Screw-driver No.2 for cross splines	H-2	2
25	Screw-driver with wooden cheeks	32000/002	2
26	Screw-driver with 4-mm blade	54430/202	2
27	Screw-driver with 2-mm blade	54430/201, blade being finished to 2 mm	2
28	Combination flat pliers	ПК-200	2
29	Round pliers, L=100-150 mm	34420/002	2
30	Small wire cutters	34400/004	2
31	Side wire cutters	54161/021	2
32	Straight forceps, 110 mm	54450/011	2
33	Tinsmith shears	54110/011	2
34	Awl	СД7803-148	2
35	Crucible for silica gel drying	СИ7804-660	2
36	Metal mirror	СМ7804-55	2
37	Portable electrical lamp with 12-m. cord	ПЛ-36	2
38	Hand vice (adjustable wrench)	54464/003135	2
39	Wrench for НРТ-4 plug connectors	СД7803-200/1	2
40	Wrench for НРТ-3 and НРТ-7 plug connectors	СД7803-200/2	2

1	2	3	4
41	Wrench for НРТ-13 plug connectors	СД7803-200/3	2
42	Wrench for НРТ-9 plug connectors	СД7803-200/4	2
43	Wrench for НРТ-23 and НРТ-19 plug connectors	СД7803-200/5	2
44	Head of wrench for НРТ-20 and НРТ-26 plug connectors	СД7803-200/7	2
45	Wrench handle	СД7803-190	2
46	Handle for plug connector heads	СД7803-190/А	2
47	Wrench for СЛЦ lamp	СД7804-100	2
48	Double-head wrench, S=17x22	32105/011	2
49	Electrical soldering iron, 24V, 20W (small)	58240/001	2
50	Hack-saw blades, L=300 mm		20
51	Handle for hammer	54636/002	2

14. TOOLS FOR ELECTRICAL EQUIPMENT SCHEDULED MAINTENANCE GROUP (ONE SET FOR 20 AIRCRAFT)

1	Kit with tools for electrical equipment mechanic (one set for 4 aircraft)	К-24	3 sets
2	Kit with tools for instrument mechanic (one set for 4 aircraft)	К-25	3 sets
3	Kit with tools for oxygen equipment mechanic (one set for 4 aircraft)	К-27	1 set
4	Kit for tools	С7803-00/32	2

1	2	3	4
5	Single-way hand bit brace with chuck, up to 6 mm	34010/001	1
6	Set of carbon steel drills, dia. 1.1, 1.6, 2.1, 2.6, 3.1, 3.6, 4.1, 5.1 and 6.0 mm		4 sets
7	Case for drills	CH9500-70	4
8	Electrical soldering iron, 24V, 90W	32805/067	2
9	Straight tip, type I (for soldering iron)	58249/001	2
10	Bent tip, type II (for soldering iron)	58249/002	2
11	Bent tip, type II (for soldering iron)	58249/003	2
12	Electrical soldering iron, 220V, 80W, with bent and straight tips		2
13	Parallel bench vice with 80-mm wide jaws		2
14	Vice for clock repair operations	54464/003	2
15	Hack-saw blade frame	32310/003	2
16	Metal ruler, 300 mm		2
17	Hammer for clock repair operations		2
18	Handle for hammer	54636/001	2
19	Hammer, 150 gr	31000/003	2
20	Handle for hammer	54636/002	2
21	Six-article knife		2

1	2	3	4
22	Flat smooth file No.2, 2nd class, L=150 mm		2
23	Flat barette file No.3-4, 3rd class, L=150 mm		2
24	Triangular smooth file No.2, L=200 mm		2
25	Handles for file	34747/002	6
26	Flat needle file Nos 1, 2 and 3		2
27	Round needle file No.2		2
28	Triangular needle file No.2		2
29	Screw-driver No.1 for cross splines	H-2	2
30	Screw-driver No.2 for cross splines	H-2	2
31	Screw-driver with wooden cheeks and 7-mm blade	32000/002	2
32	Screw-driver with 4-mm blade	54430/202	2
33	Screw-driver with 2-mm blade	54430/202, blade being finished to 2 mm	2
34	Combination flat pliers	IK-200	2
35	Round pliers, L=100-150 mm	34420/002	2
36	Small wire cutters	34400/004	2
37	Straight forceps, L=110 mm	54450/011	2
38	Tinsmith shears	54110/011	2
39	Awl	CД7803-148	

1	2	3	4
40	Metal mirror	CM7804-55	2
41	Portable lamp with 12-m. cord	ПЛ-36	2
42	Hand vice (adjustable wrench)	54464/003-135	2
43	Wrench for ШРТ-4 plug connectors		2
44	Wrench for ШРТ-8 and ШРТ-7 plug connectors		2
45	Wrench for ШРТ-13 plug connector		2
46	Wrench for ШРТ-9 plug connector		2
47	Wrench for ШРТ-23 and ШРТ-19 plug connectors		2
48	Wrench for plug connectors of air-field power source receptacle		2
49	Head of wrench for ШРТ-20 and ШРТ-26 plug connectors		2
50	Wrench handle		2
51	Electrical soldering iron, 24V, 20W	58240/001	2
52	Handle for plug connector heads		2
53	Wrench for СШ lamp	C7804-340	3
54	Hack-saw blades, L=300 mm		10
55	Box for kits	-	1

1	2	3	4
	15. TOOLS FOR SCHEDULED MAINTENANCE GROUPS (ONE SET FOR 20 AIRCRAFT)		
1	Small aircraft kit with tools	M-2I	2
2	Kit with tools for aircraft element (supplied with every four aircraft)	M-22	2
3	Ground set of tools (for servicing groups, one set for 12 aircraft)	M-28	1
4	Standard kit for small additional tools for scheduled maintenance groups	C7803-00/29	1
5	Box for tool kits of scheduled maintenance groups	-	1
6	Wrench, S=5x7	32105/002	8
7	Wrench, S=14x17	32105/009	8
8	Wrench, S=9x11	32105/005	8
9	Wrench, S=19x22	32105/012	8
10	Wrench, S=24x27	32105/015	8
11	Screw-driver with wooden cheeks, L=150 mm	32000/5-150	8
12	Screw-driver with wooden cheeks, L=200 mm	32000/5-200	8
13	Combination general use flat pliers, L=200 mm		8
14	Screw-driver No.1 for cross splines	M-2	4
15	Screw-driver No.2 for cross splines	M-2	8
16	Wrench, S=19, for fuselage jointing	CM7804-11/3	8

1	2	3	4
17	Round pliers, L=150 mm		2
18	Wire cutters	34400/004	2
19	Powered screw-driver	54434/012	4
20	Protected hammer	54290/021	1
21	Cotter pin remover	54650/001	2
22	Wrench for disassembly of ФГ-11 filter	CM9501-275	2
23	Torque indicating wrench for hydraulic accumulator cover	CM9501-65	2
24	Wrench for removal of БУ-13М booster filter from aircraft	CM9501-273	2
25	Extension for hydraulic accumulator wrench	CM9501-85	2
26	Device for clamping the hydraulic accumulator	CM9501-90	2
27	Wrench for fuel tank, S=68	CM9501-220	2
28	Wrench for fuel tank, S=18x27	CM9501-221	2
29	Wrench for attachment of aileron	CM9501-219	2

APPENDIX 9

INSTRUCTIONS ON TREATING CANOPY PRESSURIZING RUBBER TUBES WITH COMPOUND 23 CA

1. The present instructions deal with restoration of the 23 CA compound on rubber tubes where it is partially or completely damaged.

2. Rubber pressurizing tubes do not possess a sufficient degree of resistance to influences of light and ozone and their extension ability is insignificant. The surface of such tubes gets covered with a net of very small cracks.

To avoid cracking of the rubber pressurizing tubes, they are coated with a special compound 23CA during manufacture.

3. Areas of rubber pressurizing tubes, that are damaged mechanically or whose initial light-and-ozone protective coating is impaired, should be coated with compound 23CA again.

4. The tubes are coated with the 23CA compound by means of stencil soft brushes of medium sizes.

5. Before application of the compound, the damaged portions of the tube should be wiped once or twice with a clean piece of cloth soaked in gasoline.

6. Then brush three coats of 23CA compound over the washed and dried canopy pressurizing rubber tubes.

Wait at least 2-3 minutes for each coat to dry.

After application of three coats allow the compound to dry for 24 hours.

7. The 23CA compound may be applied at a temperature not below $+10^{\circ}$C.

8. The canopy pressurizing rubber tubes must be examined at least once a month, especially at the beginning of the spring. In case of damage to the compound (scratches, chafing, peeling off, etc.), treat the damaged places in compliance with the present Instructions.

APPENDIX 10

CARE OF CANOPY ORGANIC GLASS

In care of the canopy organic glass panels, pay special attention to the condition of the glass surface. Damage to the surface - dents, cracks, scratches, notches, "silver", etc. - considerably impair the optical characteristics of the organic glass and reduce its mechanical strength.

With the aircraft parked, organic glass panels should be protected against lengthy exposure to moisture and sun rays, organic solvents and their fumes (acetone, benzol, dichlorethane, ethyl alcohol, РДВ solvent) causing formation of "silver" on the glass surface.

Parts made of organic glass should be protected against mechanical damage.

Care of the organic glass in using units should be performed in compliance with the following rules:

1. When the aircraft is parked, the organic glass parts should always be covered with canvas covers to protect them against sun rays, rain, snow and mechanical damage.

Before the canvas covers are put on the aircraft, they should be carefully cleaned of sand and dust, especially on the inner side.

2. Before a flight, or after a flight (in case of glass pollution) clean the glass panels of dirt and dust. This is done as follows:

(a) wipe the glass panel with soft cloth soaked in clean water and wrung out (the piece of cloth should be often rinsed). Then wipe the glass panel dry with a soft dry piece of cloth;

(b) remove oil stains, if any, by wiping the glass gently with dry soft cloth, then put some ВИАМ-2 paste on a piece of soft cloth and wipe the glass once more. If no ВИАМ-2 paste is available, wipe the glass with a piece of soft cloth soaked in soapy water (3 to 5 per cent solution) and duly wrung out.

Then wipe the glass panel with soft cloth washed in clean water and wrung out, after which wipe the glass with a piece of dry soft cloth.

Note: 1. In wiping the inner side of the glass panel, see to it that water does not drop on the heat-insulating gaskets positioned along the glass panel edges.

2. The cotton, linen and flannel waste should be clean and have no solid inclusions, for which purpose they should be previously washed in clean water.

3. It is prohibited to use woollen or silk pieces of cloth in wiping the glass panels, since they cause electrostatic charges resulting in attraction of dust to the glass surface.

3. The following faults are permissible:

(a) hair-like scratches, but if they do not form a solid net;

(b) scattered minor surface scratches or notches up to 30 mm long;

(c) minor surface cracks on the inner side of the glass panels where the glass is secured in the frame, if the length of each crack does not exceed 10 mm and the cracks form separate chains or interrupted lines whose total length does not exceed 60 mm ;

(d) minor radial surface cracks not more than in two places on an area where the glass is held in the framework.

4. Should hair scratches or notches show up on the glass, they should be polished off with paste ВИАМ-2.

Polishing is accomplished manually with a wad of water-absorbing cotton wool with a small amount of paste first along the scratch, then across it and finally by making circular motions, lightly pressing the wad to the glass without rubbing the same place for a long time in order to avoid overheating the glass surface. Polishing may be done over the entire glass surface.

Use of emery cloth for cleaning scratches and notches is not allowed irrespctive of their location on the surface.

It is also prohibited to remove "silver" by means of emery cloth, cleaning, grinding, polishing or local heating.

5. During repair operations on the aircraft, glass parts should be protected against mechanical damage by special covers or by glueing them over with thick paper.

When painting the aircraft after repair, protect the glass panels with thick paper. During repair operations, the removable glazing of the aircraft should be taken off while the glass surfaces should be protected with a cover or glued over with thick paper.

When painting the glass framework after repair, the glass must be glued over with thick paper whereas, in the zone where the glass is secured in the framework, sticky transparent tape (264 АМТУ-48) is used to protect the glass all along its perimeter.

Notes: 1. For the composition of glue , its preparation and method of glueing paper over the glass panels see special Instructions No.521-54. Use of any other grade glue is not allowed.

2. During repair operations that do not last more than 10-12 days, thick paper may be attached to the glass surface by means of petrolatum. Traces of petrolatum are to be removed (after taking off the paper) in compliance with Item 2 (b) of present Instructions.

6. During operations on cockpit glazing sealing at repair organizations, the bolts attaching the glass panels to their frames must be tightened with a torque - indicating wrench rated for not more than 25 kg -cm.

APPENDIX 11

CONTROL OF ENGINES FEATURING THRUST REGULATION AT MAXIMUM AND AUGMENTED RATINGS

1. GENERAL

Provision is made on aircraft of latest make for formation flights at MAXIMUM and AUGMENTED ratings, for which purpose engines are used whose thrust can be adjusted at the above ratings.

The engine control system is equipped with a new throttle control sector (Fig. 172) installed in the cockpit and having two buttons for cutting in the MAXIMUM and AUGMENTED ratings. The control panel, type ПУ-8, is replaced by a new control panel, type ПУ-9БМ , with two new limit switches, while the КАФ-2 afterburner automatic control unit is replaced by type КАФ-5 unit equipped with a new system of relays.

Engine control has the following peculiarities:

1. The rests STOP (СТОП) and NORMAL (НОМИНАЛ) serve as the extreme rests restricting the travel of the levers.

2. The aircraft thrust is throttled at ratings MAXIMUM and AUGMENTED by shifting the engine control levers gradually from the rest NORMAL to the ball retainer on the throttle control, set at 16° from the position NORMAL and back.

With the lever on the ball retainer, engine speed will be 10400±200 r.p.m.

3. NORMAL or MAXIMUM rating is engaged by depressing the respective button for 1-2 sec., and the rating will change over automatically. Each button switches on both engines simultaneously.

When the MAXIMUM or AUGMENTED rating is to be switched on, one of the engines should by all means run at NORMAL rating (the throttle control lever should be in the extreme front position); in this case, if the lever of the other engine is positioned between the ball retainer and the rest of the "NORMAL" rating, the engine will also get engaged.

4. When trying the engines on the ground, the AUGMENTED

rating may be switched on from the NORMAL as well as from the MAXIMUM rating.

5. To switch off the MAXIMUM or AUGMENTED rating it is necessary to pull the control lever past the ball retainer and engine speed will be reduced to 10.400± 200 r.p.m.

6. To change over from AUGMENTED to MAXIMUM rating, pull the engine control lever past the ball retainer, then set the lever to the position NORMAL again and press the button MAXIMUM .

For the wiring diagram serving to switch on the MAXIMUM and AUGMENTED ratings see the Album of Wiring Diagrams.

2. CHECKING ENGINE CONTROL

Engine control is checked in the following sequence:

1. Check in turn the left - and right-hand engines for proper operation and for proper locking of the control levers on the sectors by the rests.

The levers should move evenly, without binding and slackening.

2. When setting the control lever at the position STOP, make sure that the notch "0" on the ПУ-9БМ engine panel is opposite the notch "С" on the panel body, the lever of HP-10 pump is thrust against the rest STOP, and that the lever in the cockpit has a travel margin of 1-2 mm towards closing.

Check the levers for proper locking in the position STOP when they are pushed forward.

3. Press the lever latch, shift the lever to the position IDLING RATING and make sure that the lever of the HP-10 pump on the engine is between the extreme notches on the idling rating flat, that the control lever is locked by its latch when it is pushed.

4. Shift the lever to the position NORMAL and make sure that the lever of the HP-10 pump on the engine is thrust against the rest and the lever of the ПУ-9БМ control panel is turned through 86° from the position STOP according to the panel dial, and that the lever in the cockpit has a travel margin of 1-2 mm towards the rest and moves freely backwards.

5. When shifting the lever from the rest STOP to the rest NORMAL , check operation of the panel limit switches.

When a limit switch trips, a click should be heard. The limit switch should operate at the following turning angles of the control panel lever (by the control panel dial):

(a) switch "ХП" ..... at an angle of $4^{\circ}_{-1^{\circ}}$
(b) switch "З" ..... at an angle of $20^{\circ}\pm1^{\circ}$
(c) switch "МБ" ..... at an angle of $70^{\circ}\pm1^{\circ}$
(d) switch "Б" ..... at an angle of $86^{0+1^{\circ}}$

The МБ switch should operate for closing when the lever in the cockpit passes the ball retainer.

As the control lever goes in the reverse direction, i.e. from the rest NORMAL to the position STOP , the limit switches should operate at the same turning angles of the panel lever (by the dial), but in the reverse sequence. If required, adjust operation of the limit switches in accordance with the Instructions of the engine manufacturing plant.

6. Check the engines for easy control, simultaneous and correct fixing of the levers by the rests on the throttle control as the levers of both engines are being shifted simultaneously. To this end, connect both levers with a strap and repeat the check, is indicated above.

Notes: 1. The adjustment of the engine control system is accomplished by changing the length of the aircraft rods, as well as the length of the engine control panel lever arms and aircraft bell crank between frames Nos 17 and 18, which may be changed by shifting the racks.

2. Engine control adjustment is checked with the engines running. This is done as prescribed in the engine operating instructions.

3. The position of the HP-10 pump lever within the flat should be checked twice:

(a) with the lever smoothly shifted to the rest IDLING RATING, the hand being taken off the lever in the end;

(b) with the lever shifted sharply, until it is pressed against the IDLING RATING rest, without taking off the hand.

3. CHECKING JET NOZZLE SHUTTER CONTROL SYSTEM WITH ENGINES AT STANDSTILL

Operation of the jet nozzle shutters should be checked on each engine in the following sequence:

1. Switch on (on the left control desk) the circuit breakers ENGINE INSTRUMENTS ; AUGMENTED, MAXIMUM ; SHUT-OFF VALVE, OIL PRESSURE of the respective engine and make sure that the circuit breaker of the jet nozzles in the left power supply unit is switched on.

2. Disconnect the plug connector from the hydraulic flow meter of the HP-10 pump of the engine under check and fit a plug connector (contactor) with a jumper between terminals A and Г onto the disconnected part of the plug connector.

3. Disconnect the plug connectors of the СД-3 pressure warning unit tank No.1 and of the ДСД-2 afterburner fuel minimum pressure warning units.

4. Turn on the ground source of power and connect the ground pump to the main system charging connections.

5. Turn on the switch AIRCRAFT OR GROUND STORAGE BATTERY and build up a pressure of 135±7 kg/sq. cm. in the main hydraulic system.

6. Make certain that with the control lever of the engine under check resting against STOP the jet nozzle shutters are in maximum open positions corresponding to idling and augmented ratings.

7. Check in turn operation of the jet nozzle shutters on each engine for which purpose:

(a) shift the engine control lever gradually forward from the position STOP to the position NORMAL . As the lever shifts approximately through 20° from the position STOP , the jet nozzle shutters should occupy their central position corresponding to the engine normal rating;

(b) manually close the air blow-off band and turn on the maximum rating for which purpose press the button MAXIMUM for 1-2 sec. and release it.

The jet shutters should occupy the fully open position corresponding to the engine maximum rating. The lamp

MAXIMUM on the instrument board should light up,

(c) turn on the augmented rating, for which purpose press the button AUGMENTED for 1-2 sec. and release it.

At the same time, close terminals 1 and 2 on the other part of the plug connector of the ДСД-2 pressure warning unit. The contactor with the jumper between terminals 1 and 2 is attached to the set of engine tools.

The jet nozzle shutters should be completely open which will correspond to the augmented rating of the engine. The warning lamp MAXIMUM will go out and the lamp AUGMENTED will light up.

Notes: 1. The shutters are opened by the gas pressure of the operating engines, therefore the position of the shutters during the check is determined by the position of the shutter closing control ring.

2. Keep the engine at augmented rating for not more than 5-6 sec. since the following elements operate in this position: the КПМ-1А ignition coil, СМ-1 spark plug and the precombustion ignition carburettor valve.

(d) turn off the augmented rating, for which purpose shift the throttle control lever past the ball retainer on the throttle control. At the same time switch off the contactor on the ДСД-2 pressure warning unit. The warning lamp AUGMENTED will go out. The shutters will occupy a position corresponding to the normal rating of the engine.

8. Couple the engine control levers in the position STOP and check the jet nozzle shutters for simultaneous operation in positions NORMAL , MAXIMUM and AUGMENTED .

9. Check interlocking of the augmented rating by the pressure in the hydraulic system, for which purpose turn on the augmented rating on both engines and reduce pressure in the hydraulic system completely. Both lamps AUGMENTED will go out and the КПМ-1А ignition coil and the СМ-1 spark plug will get disconnected.

10. Check blocking of MAXIMUM and AUGMENTED ratings by the air blow-off bands, for which purpose couple the levers, set them in the position NORMAL and turn on the maximum rating.

Open the engine air blow-off bands; the lamps MAXIMUM should go out, and the jet nozzle shutters will occupy the position, corresponding to the normal rating of the engines.

Close the air blow-off bands; this will again change over the rating to the MAXIMUM and the lamps MAXIMUM will light up and the shutters will return to the position of the maximum rating.

Turn on the augmented rating by pressing the button AUGMENTED for 1-2 sec. Both lamps AUGMENTED will light up, whereas the lamps MAXIMUM will go out and the shutters will occupy the position corresponding to the augmented rating. Open the air blow-off bands on one of the engines. At this the augmented rating of the engine will turn off, the lamp AUGMENTED will go out, and the shutters will take the position corresponding to the normal rating. Close the air blow-off band on this engine, this resulting in changing over to the maximum rating, the lamp MAXIMUM will light up and the shutters will take the position corresponding to the maximum rating of the engine. Thus, one engine will operate at the augmented rating, whereas the other engine will run at the maximum rating.

To turn on the augmented rating on the engine, whose afterburner blocking system has been checked by the air blow-off band, it is necessary to press the button AUGMENTED once more and the shutters will pass over from the MAXIMUM position to the AUGMENTED position; the lamp MAXIMUM will go out, whereas the lamp AUGMENTED will light up.

The afterburner blocking system must be checked by the air blow-off band on both engines in turn.

11. Set the coupled levers in the position NORMAL and close the air blow-off bands on both engines. Then, without opening the bands, set the coupled levers to the position IDLING RATING. The shutters should remain in the position NORMAL . Open the air blow-off band, the shutters should occupy the position corresponding to the idling rating, i.e. they should be completely open.

After the operation of the shutter control system has been checked, switch off all the engaged circuit breakers, join the plug connectors to the hydraulic accelerator of the HP-10

pump, СД-3 fuel pressure warning unit of tank No.1 and to the ДСД-2 afterburner fuel minimum pressure warning unit.

To protect the air cooling casings of the shutter control cylinders from melting, during the installation of the engines, do as follows:

1. Check the jet nozzle diameter with the shutters in the position AUGMENTED rating for compliance with the data of the Service Log.

Note: Engines with jet nozzle diameters exceeding 508 mm should be adjusted until size 508 mm is obtained.

The check is to be accomplished by means of a ruler as shown in Fig.173.

2. Check the installation of the ejector with respect to the nozzle shutters by measuring size "a" when the shutters are in the augmented position. Size "a" should be at least 41 mm.

3. Check size "b" between the tapered ring and the ejector. This size should be at least 22 mm.

Sizes "a" and "b" should be obtained by adjusting the position of the ejector.

CONTENTS

Appendices:

50X1-HUM