INFORMATION REPORT INFORM

CENTRAL INTELLIGENCE AGENCY

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English translation of pages 1 - 222 of a Russian-language manual on the MIG-21F-13 aircraft entitled, *Aircraft Ye-6T, Technical Description, Book III, Construction, Parts I and II* 50X1-HUM

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SECRET

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YE-6T AIRPLANE

TECHNICAL DESCRIPTION

BOOK III

DESIGN

PAGES 1 - 222

SECRET

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For convenience, the material is collected into two separate volumes:

First volume: Chapter I - General information

Chapter II - Design of the airframe

Chapter III - Power plant

Second volume: Chapter IV - Take-off and landing devices

Chapter V - Air and hydraulic systems

Chapter VI - Control of the aircraft

Chapter VII - Fire-fighting equipment

Chapter VIII - Ventilation, pressurization, and air-temperature control

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C H A P T E R I

GENERAL INFORMATION

The YE-6T aircraft is a single-seat light fighter with high performance characteristics.

The craft is powered by one A7F turbojet engine with an afterburner.

Structurally, the plane is an all-metal midwing monoplane with a delta wing controlled by a stabilizer and normal wing-tip fins.

The fuselage is divided into the nose and tail sections.

Structurally, the plane is an all-metal midwing monoplane witha delta wing controlled by a stabilizer and normal wing-tip fins.

The fuselage is divided into the nose andtail sections.

On the front part of the fuselage, on the air-intake duct, there is a movable cone which decreases the plane's resistance and creates optimum working conditions for the engine during flight.

To prevent disturbances of the air-intake duct, on the fuselage there are automatically controlled vanes on opposite sides; ahead of the engine inlet on the sides of the fuselage there are auxiliary air-intake vanes (take-off (?) vanes).

On the fuselage are three brake flaps: two front and one rear flap.

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The cockpit enclosure canopy is streamlined, affording the pilot a good view ahead and to the sides. The canopy is designed so that the ~~fxxx~~ forward part can be opened on the groupd, or ejected if necessary during ~~thx~~ flight by means of the emergency release handle.

The canopy has a liquid de-icer.

The plane has a type "SK" catapult seat which allows the pilot to eject himself from the plane in an emergency, at high or low flight speeds. The hinged part of the canopy, during ejection, is used to protect the pilot from the oncoming air stream; the canopy is not released but covers the seat, which during ejection retains the canopy.

To keep the pilot from being hit, the plane has armor, consisting of an armor screen forward under the canopy, armor plate on frames 6 and 11, and an armor-plated head rest on the seat.

The wings of the plane are delta wings with a sweepback angle of 57°; the trailing edge of the wing forms a 90°-angle with the fuselage axis. The wing is made of high-speed profiles. The area is 23 m^2, the span is 7.16 m, the chord with respect to the axis of the plane is 5970 mm. The setting angle is = 0° and the lateral dihedral is -2°.

On the wing are ailerons with axial aerodynamic compensation and "floating-type" wing flaps. The "floating-type" design assures a decrease in the flapping angle of the wing flaps under the influence of impact pressure with increasing speed.

The horizontal tail section consists of a controlled stabilizer with a sweepback angle of 55°.

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The stabilizer consists of two symmetrical halves--the right and left.

The vertical tail section, cons'sting of a vertical fin and a rudder, has a sweepback angle of 60°. The rudder has axial aerodynamic compensation.

The 37F turbojet engine with controlled boost makes possible smooth regulation of the thrust in boost regimes--from the position "minimum boost" to the position "full boost."

The fuel system consists of the basic system, including seven tanks inside the fuselage, four wing-tank units [?] divided into three groups, and one suspended tank. There is a ______________ starting system for starting the engine on the ground and aloft.

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The plane has a three-wheel landing gear which is retracted during flight. The wheel base is 4810 mm, the wheel track is 2692 mm. The front landing gear is retracted forward and housed in the lower part of the front of the fuselage. The main landing gear is housed in the wings. When the main landing gear is retracted, the wheels turn relative to the strut and are housed in the fuselage, while the struts are housed in the wing. The main landing gear has KT-82 wheels with 660 x ___ tires; the front landing gear has a KT-38 wheel with a 500x180A (?) tire.

To decrease the landing distance, the plane has a drogue chute in the tail section of the fuselage. The parachute is designed to be released the moment the main wheels touch ground.

The pneumatic system consists of two independent systems: the main system and an emergency one.

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The main system serves the following purposes: to brake the wheels, lift and pressurize the canopy, release the canopy in an emergency, recharge, close the fuel shut-off valve, operate the de-icer, release and eject the drogue chute, and feed the anti-G suit. The emergency system releases the landing gear and brakes the wheels in an emergency.

The hydraulic system consists of two different systems. Pressure is created in each of them by a variable-output pump which creates a maximum pressure of 210 kg/cm^2.

The first hydraulic systems serves the control system (the two-chamber BU-51MS stabilizer booster and the BU-45A aileron booster).

The second hydraulic system serves the

landing gear, the wing flaps, the brake flaps, the adjustable engine nozzle, the cone at the air-intake duct inlet, the fire-prevention vanes, and one chamber of the BU-51MS booster (the other chamber is served by the first hydraulic system); it also takes over for the first system for the aileron boosters in case of a breakdown in the first system.

In the event of a drop in pressure or a breakdown in one of the two systems, the BU-51MS booster continues to operate on one chamber, fed by the system that still operates.

The hydraulic system that serves to control the plane includes an emergency pumping station which, if the system breaks down or the engine stops, maintains the required pressure in the hydraulic system to assure a safe landing. The pumping station is switched in automatically.

The stabilizer is controlled by a control handle using a BU-51M booster and an ARU-3V automatic device.

The ailerons are controlled by a control handle with the aid of BU-45A boosters. In the event the BU-45A boosters are cut out and both hydraulic systems fail, the boosters perform the functions of rigid units of the aileron control system.

The rudder is controlled by pedals, a system of rigid connecting rods, and a nonlinear mechanism.

The pilot's cockpit is pressurized, affords a good view, and a roomy enough for the pilot to work conveniently. The cockpit is ventilated and conditions by hot and cold air taken from the engine compressor. The cockpit has automatic temperature and pressure control.

To assure normal conditions for the pilot at great altitudes, the plane has an oxygen feed and compensation system for the pilot.

Electrical and radio equipment. The d-c power source is a GSR-ST-12000 VT generator-starter. As a reserve power supply source theplane has two 1fSTsS-45 silver-zinc storage batteries.

The plane has provisions for starting the engine by means of the on-board storage batteries. A converter sesves as the d-c power source.

The plane has the following radio equipment:

1. A composite ultrashortwave receiver-transmitter;

2. An automatic radiocompass;

3. A low-altitude radioaltimeter;

4. A marker radio receiver;

5. The airplane equivalent of a radar identification system;

6. An aircraft radio rangefinder.

The aircraft has a fighter course system KSI.

The technical description of the plane is given in four books: I, II, III, and IV. In this book we describe the aircraft design.

The general views of the aircraft are given in Figs. 1, 2, and 3 in Book I.

Fig. 4. Exploded view of the plane.

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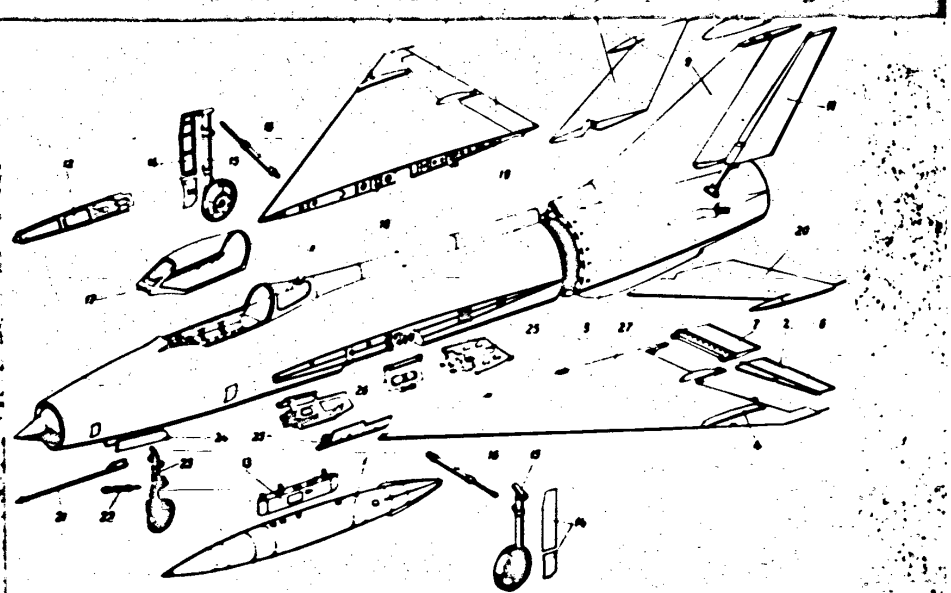

Рис. 4. Конструктивные разъемы самолета.

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Fig. 4. Exploded view ofthe plane.

1. Drop tank.
2. Trim tab.
3. Below-fuselage wedge.
4. Valve wedge.
5. Right wing cantilever.
6. Aileron
7. Wing flap.
8. Right half of the stabilizer.
9. Vertical fin.
10. Tip of vertical fin.
11. Rudder.
12. Cowling.
13l Pylon.
14. Flaps on main wheel strut.
15. Main landing-gear strut.
16. Cylinder for raising and lowering main landing-gear strut.
17. Canopy.
18. Nose section ofthe fuselage.
19. Tail section of the fuselage.
20. Left half of the stabilizer.
21. Air-pressure receiver (Pitot tube).
22. Cylinder for raising and lowering nose landing-gear strut.
23. Nose landing-gear strut.
24. Flaps on nose landing-gear strut.
25. Air brakes.
26. Flap for main wheel housing in fuselage.
27. Left wing cantilever.

CHAPTER II

DESIGN OF THE AIRFRAME

1. The Fuselage

General Information

The fuselage is a cigar-shaped body of elliptical cross section with cut-away nose and tail cones.

It is a semimonocoque fuselage made mainly of D06 and B95 material using SZOKhGSA and SZOKhGSHA steel for the main joints.

For mounting, removing, and examining the engine for regulation operations, the fuselage can be split into two parts--thenose and tail sections.

The transverse assembly of the nose of the fuselage consistsof 28 frames, of which Nos. 2, 6, 11, 13, 16, 16A, 20, 22, 25, and 28 are the main ones.

The longitudinal assembly consists of longerons and trusses with a few stringers, which is compensated for by using a relatively thick covering.

Such a design makes possible maximum use of the inside of the framework.

The nose section of the plane is assembled in xxxx panels.

The transverse assembly of the tail section of the fuselage consists of 13 frames, of which 34, 35A, and 36 are the main ones. Stringers make up the longitudinal assembly.

I. Make-up of the Nosexof the Fuselage

(Fig. 5)

The nose section of the fuselage is made up as follows: along the forward section of the fuselage is the air-intake duct with anxxxxxxx inlet section which canbe regulated using an adjustable three-position cone (1).

The upper section between frames 2 and 6 contains the radio and electrical equipment (2); the lower part of this section is for access to the nose landing-gear strut.

Pressurized cabin (4) is located between frames 6 and 11; the storage battery section is beneath the cabin.

Behind the cabin, between frames 11 and 28, are the holders for seven light kerosene tanks:

from frame 11 to frame 13 - tank No. 1 (7);

from frame 13 to frame 16 - tank No. 2 (8), and a second auxiliary tank bxx (14) between frames 14 and 16;

from frame 16 to frame 20 - tank No. 3 (9) consisting of anx upper and lower part;

from frame 20 to frame 22 - tank No. 4 (11);

from frame 22 to frame 25 - tank No. 5 (12);

from frame 25 to frame 28 - tank No. 6 (13).

Tanks Nos. 5 and 6 consist of two parts connected together.

The air duct for the engine passes throughthe nose section of the fuselage; ahead of the cabin it separates into two parts and circumvents the cabin. Behind the

Fig. 5. Airframe and make-up of the nose section of the fuselage.

a) Pitot tube, b) intake cockpit canopy, c) air duct, d) engine housing; e) engine-mount beam, f) air duct, g) [illegible], h) front ....., i) cockpit floor, j) left brake flap, k) compartment for second auxiliary tank, l) cross section A-A, m) rear brake flap, n) cross section B-B, o) service hatch, p) air ducts, q) nose-wheel housing, r) upper ~~cavity~~ back-fairing, s) tank No. 2, t) air duct.

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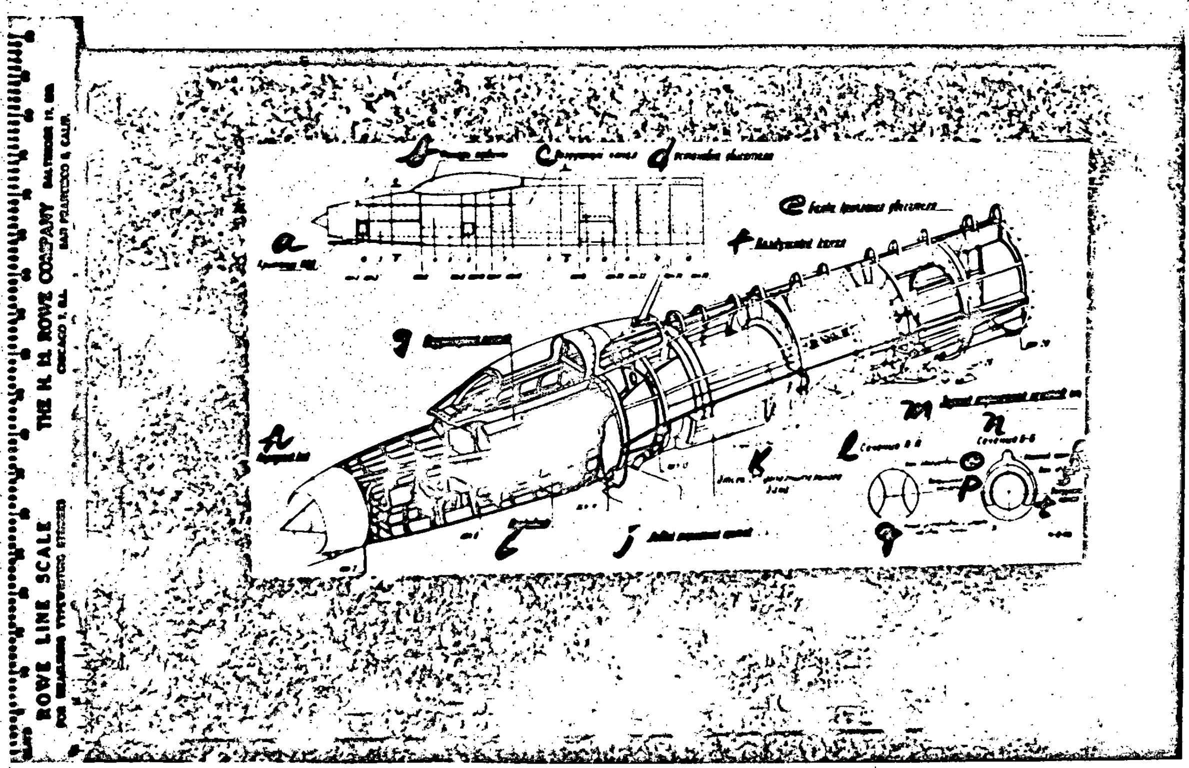

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cabin both sections converge into a common duct to feed air to the engine compressor.

On the side panels of the fuselage, on both sides between frames 2 and 3 are located adjustable anti-surge valves (16), while between frames 9 and 10 there are two air-duct pressure-relief valves (6).

In the duct ahead of the engine intake, between frames 21 and 22, is located the air-air radiator for the cabin system.

Between frames 16 and 20, in the sides of the fuselage, there are housings for the main landing-gear wheels (10).

The region between frames 22 and 28, along the fuselage axis, is occupied by the power plant.

In the lower part of the fuselage, between frames 11 and 14, are two brake flaps (15), while between frames 22 and 25 there is the rear brake flap (17).

The brake flaps are locked with special locks if there is no pressurein the hydraulic mixture.

There are a number of hatches in the nose section of the fuselage for servicing of the equipment. All the hatches are main hatches and require daily maintainence to assure that they are fastened.

The placement of the hatches is shown in Fig. 6.

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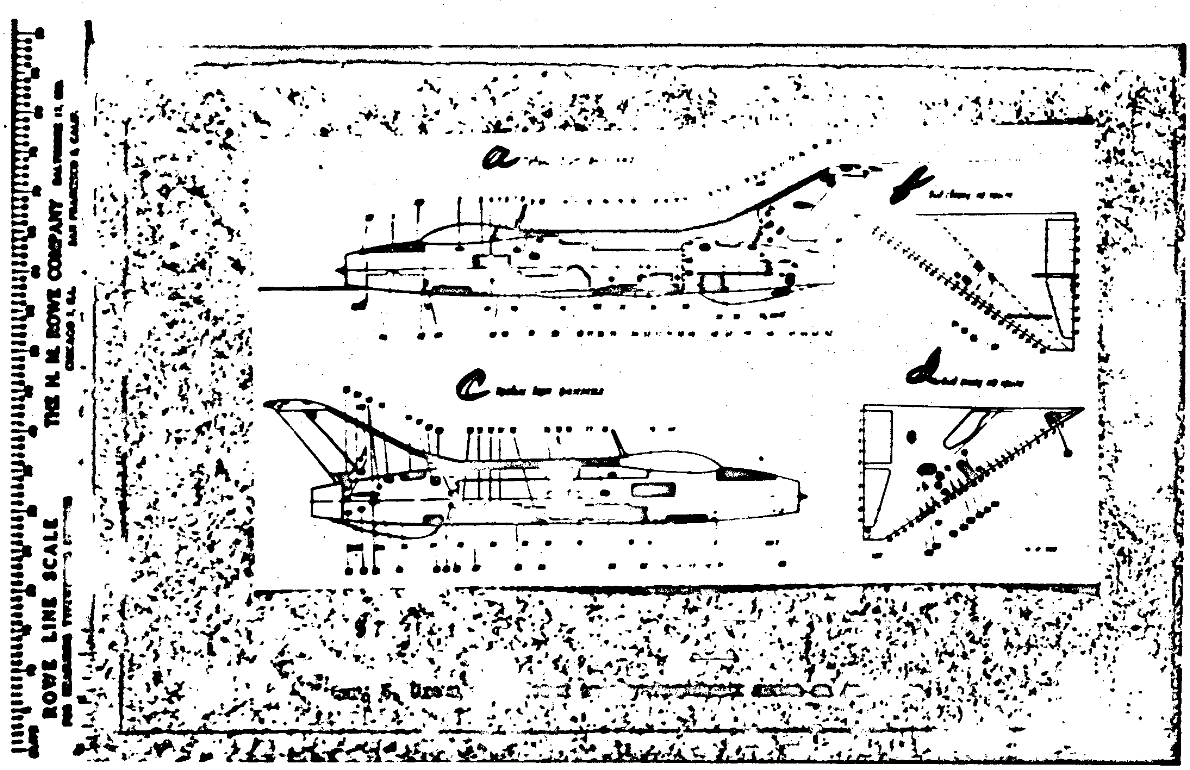

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Fig. 6. Diagram of the location of the operational hatches on the aircraft. a) left side of fuselage, b) view of wing from above, c) right side of fuselage, d) view of wing from below.

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Fig. 6. Diagram of the location of the operational hatches on the aircraft.

1. Radio equipment; 2. "Open canopy, install ground lock on emergency cockpit handle; 3, 79. Electrical equipment; 4. Technological hatch; 5. Kerosene system units 6. Oxygen-feed reducer; 7. Inspection hatch; 8. Aileron actuating arm; 9. Wing-tank joint; 10. Tank fill; 11. Float valve and emergency supply signal; 12, 93. Kerosene tank drain and aircraft control; 13. Gasoline fill; 14. Tank fill; 15. Kerosene tanks 4, 5, and 6; 16, 52, 86, 87. Engine units; 17, 72. Engine mounts; 18. Engine and hydraulic system units; 19. Kerosene tank drain, and control; 20. Booster-system pump connection; 21. Hydraulic-system tank fill; 22. Kerosene-line joint; 23. ARU-ZV; 24. Thermocouple; 25. ARU-ZV loading mechanism; 26. Hydraulic accumulator of the booster system;

27. NP-27 pumping station. Power-assisted control [redacted] and MRP-56P; 28, 35, 36, 37. Fastenings for radio wires and slot-antenna [redacted] driver; 29, 41, 65. Stabilizer control; 30, 31, 32, 33. Actuating arm for control of R.P; 34. ID-2 transducer (KSI); 42, 64. nozzle cylinder; 43. nozzle hydraulic tube; 44, 92. Afterburner attachment; 45. Bxx Drogue chute lock; 46, 91. Bearing lubrication; 47. Drain for telescoping connection; 48. Drogue chute; 49, 89. Detachable hydraulic valves; 50. Fuselage butt joints; 51. Kerosene drain; 53, 71. Engine and hydraulic system units; 54. Kerosene drain; 55. Sediment drain; [redacted] 56. Kerosene and hydraulic systems units; 57. Pump for third kerosene tank. Control; 58, 74. Kerosene tank No. 3; 59. Kerosene system units; 60. Kerosene line and line for cockpit ventilation; 61, 82. Brake flap attachment;

62, 81. Landing-gear strut axle; 63. Rudder actuating arm; 66. Hydraulic accumulator for the basic system; 67. Thermocouple; 68. Hydraulic tank fill; 69. Fuel-tank safety valve; 70. Connection for ground pump of the basic hydraulic system; 73. Hydraulic units; 75. Bolts for attachment of kerosene tank No. 3; 76. Charging of oxygen feed; 77. Wing-tank connection; 78. Inspection hatch; 80. Tow-line attachment point, in emergency; 83. Voltage regulator. KAF-IZA turbocoolers. Connector with catch; 85. Fire-prevention cylinder; 88. Heat warning device; 90. EK-48, MRP-56P; 94, 97, 100, 103. Attachment for special suspension; 95. PUS-36. Electrical detachment; 96. Landing-gear strut axle; 98. Nonlinear mechanism; °9. Air cylinders; 101. Kerosene fill; 102. Electrical separation of carrier; 104. Aileron actuating arm; 105. Access to BANO ....;

107. Power-assisted control; 108. Wing-flap cylinder; 109. Place for ground jack; 110. Destruct button; 111. Alcohol fill; 112. Battery hatch; 113. Element control for [redacted] emf of the storage batteries; 114. Access [redacted] to RVU(?) units; 115. Airfield powering; 116. Access [redacted] to electrical units; 117. Hatch for access [redacted] to front landing-gear strut units; 118, 119. Hatches for examining the bolts of the control actuating arms; 120. Hatches for access [redacted] to the bolts that hold the booster in place; 123. [redacted] Access to aileron axle.

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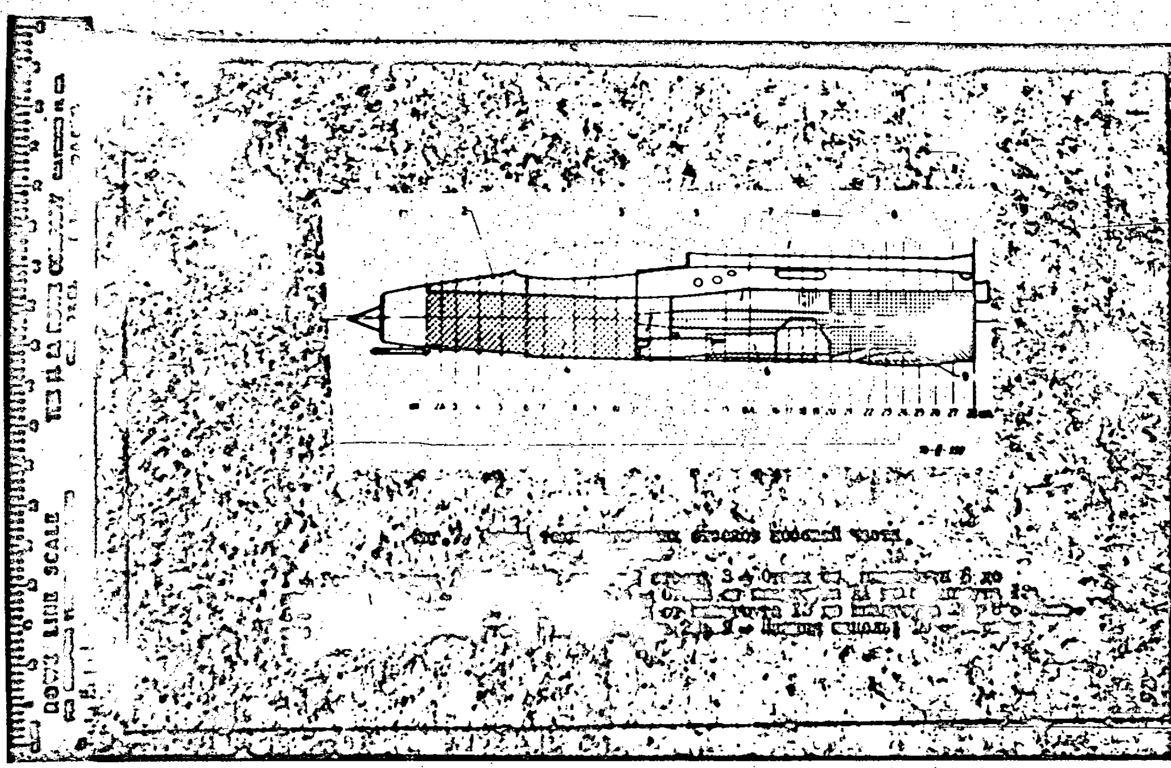

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Fig. 7. Diagram of technological compartments of the nose section of the fuselage.

1) nose nacelle; 2) forward upper compartment; 3) compartment from frames 6 to 11; 4) side panels; 5) compartment from frames 11 to 13; 6) bottom panel; 7) side panels from frames 13 to 20; 8) side panels from frames 20 to 28; 9) bottom panel; 10) upper panel.

Design of Nose Section of Fuselage (Fig. 7)

The nose section of the fuselage, to facilitate assembly, is divided into the following compartments and panels: the nose nacelle up to frame 2 (1); the front upper compartment from frames2 to 6 (2); the compartment from frames 6 to 11 (3); side panels from frames 2 to 11 (4); compartment from frames 11 to 13 (5); the upper panel from frames 11 to 28 (10); the lower panel from frames 11 to 20 (6); the side panels from frames 13 to 20 (7); the side panel from frames 20 to 28 (8); the lower panel from frames 20 to 28 (9); the inner side panel from frames 20 to 28; the engine mounting frame; the forward brake flaps; the housing for the right brake flap; the housing for the left brake flap; and the third brake flap.

Nose Nacelle (Fig. 8)

The nose nacelle, from the nose to frame 2, is in the form of a machined shell.....with a sharp leading edge.

In the center of the air-intake duct is radio-transparent cone (2) made of triplex glass textolite: two layers are 1.2 mm thick, and one ____[illegible].

The cone is attached to three-position cylinder (5) which moves along tube (3), which is along the axis of the cone. The tube is made of ZOKhGSA material, and

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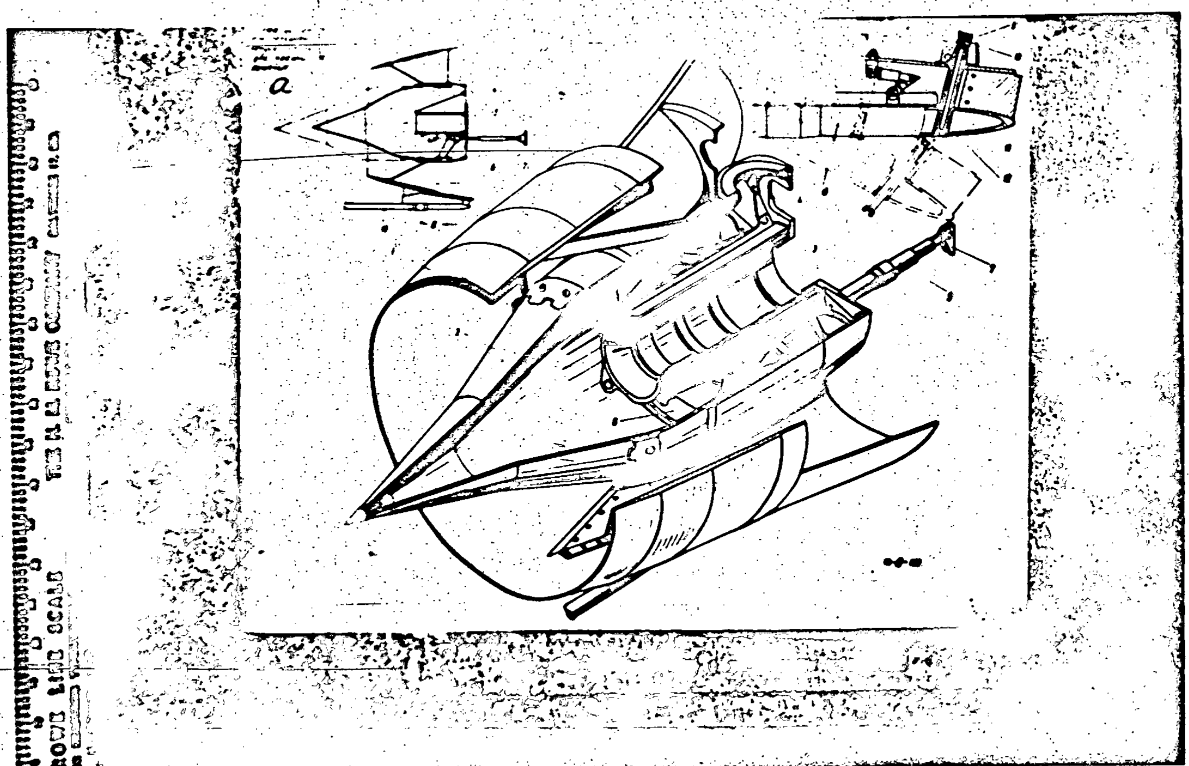

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Fig. 8. Nose nacelle with ~~moving~~ telescoping cone. a) diagram of the three-position cone (the two outer surfaces are shown).

Fig. 8. Nose nacelle with telescoping cone.

1. Nose nacelle; 2. telescoping cone; 3. guide tube; 4. disc; 5. three-position cylinder; 6. adjusting slider; 7. hanger; 8. articulated cantilever; 9. support; 10. spring; 11. self-locking bolt; 12. bushing; 13. rod for Pitot tube intake.

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is attached to frame 2. One end of cone-control hydraulic cylinder (5) is attached to frame 3 and the other end is attached to adjusting slider (6).

The lower part f the front nacelle contains a revolving rod for the Pitot tube intake (13). It is attached to the front nacelle by two steel assemblies--the front and rear--which are located on the lower spoke.

The front rod-attachment assembly has a universal bolt joint. The rear assembly is in the form of a conical pin which is attached by the self-locking vertical bolt to a corresponding assembly on the fuselage. The rod between the assemblies has an opening for the condensate trap, and for exit of the communication lines.

Articulating cantilever (8) is used to fix the rod in an inclined position; the rod attachment un't is covered on the outside with a detachable cowling.

The lower spoke of the front nacelle has a tube for passage of the communication lines, and a tow unit is attached, made of ZOKhRSA steel.

Frame 2 is a main partition ~~wall frame~~ made of ...... material; in the upper part is an insert of .... material. A disc, of AK4-1 material, is riveted to the frame; the cone tube is attached to this disc.

Thecantilever of frame 2 has an end switch which signals that the cone is extended.

Front Compartment from Frame 2 to Frame 6

The compartment from frame 2 to frame 6 contains:

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[redacted]

an upper hatch for the radioequipment, and a housing for the front landing-gear strut.

The compartment has four Z-shaped stamped trusses made of sheet duralumin D-16 with tubular spacers, and a horizontal bulkhead (also of D-16 duralumin) which separates the equipment compartment from the nose landing-gear housing. The horizontal bulkhead has a small hatch for access to the RVU units.

The main longitudinal assembly of the compartment consists of two upper and two lower W-shaped longerons.

The side walls of the compartment are made of 1.2-mm sheet D-16. These serve as the inside walls for the air duct.

Compartment from Frame 6 to Frame 11

Frames 6 and 11 form the cockpit and the bottom equipment hatch which are divided by the cockpit floor.

The main transverse assembly of the cockpit compartment consists of two main wall frames 6 and 11 and 8 intermediate frames. The longitudinal assembly is formed by the upper and lower W-shaped longerons and the panel beneath the canopy with a groove for the pressurization hose. Sheet D-16 is the material for the main elements and the covering.

[redacted]

The control cables which pass along the cockpit floor are covered by an auxiliary removable subfloor.

The ~~main~~ cockpit is pressurized by means of a U-30M pressurizer.

The framework of the lower part of the fuselage under the cockpit is an assembly of frames made of sheet D-16.

To frame 7 is attached the hanger ~~[illegible]~~ that contains the lock for locking the front landing gear in the retracted position.

Frame 6 is a main frame, a ~~[illegible]~~ partition of D-16 duralumin, is attached by means of D-16 angular profiles placed along the outside contours of the frame, by vertical molded angular profiles made of V-95 material, and by two extruded trusses of V-95T material.

To this partition are attached the forward armor plating and the unit for suspension ofthe front landing gear.

The lower part of the frame is cut out for the front landing gear and has a support for the landing gear in the "down" position.

Frame 11 is a main frame, a partition of V-95 material with an assembly of profiles made of V-95 and D-16 material. To it are attached the rollers for the ejection seat, the rear armor plating, the canopy bulkhead, them upper fuselage panel, and the actuating arms for the aircraft control system.

Side Panels from Frame 2 to Frame 11

The side panels from frame 2 to frame 11 form the outside walls of the air ducts. From frame 2 to frame 7 the panels are made of 3.5-mm D-16 sheet duralumin. On the panels between frames 2 and 3 are attached two adjustable anti-surge valves made of MA-8 Elektron [a magnesium alloy] [Tr. note] ~~from the MA-8 aileron.~~

Thepanel from frames 9 to 11 has two coverings (the outside one from frame 9 and the inner one from frame 8 made of 1.2-mm D-16 duralumin).

The transverse assembly consists of Z-shaped frames of D-16 duralumin.

Between frames 9 and 10 on the left and right panels are pressure-relief valves, made of ~~from aileron~~ Elektrons ML-8, with the inner sheet made of D-16 duralumin.

On the right side of the bottom part of the panel is a groove made of 1Kh18N9T-11 steel.

Compartment from Frame 11 to Frame 13

The compartment from frame 11 toframe 13 is made of D-16 sheet duralumin. It serves as the housing form kerosene tank No. 1 and consists of: panels 11 and 13, upper removable hatch on the right side, and outside covering on the left side.

The air-intake duct which passes through this compartment ~~isxx~~ made of D-16 sheet duralumin.

Frame 13 is a main frame, made in the form of a partition of V-95 material with an opening for the air-intake duct. Near tank No. 1 the partition of the frame is attached by means of extruded profiles; at other places it is attached by means of angular profiles made of D-16 material. To the left and right on the frame are the units for attaching the wings to the fuselage.

The bottom arc of the frame is a double T-section. To it are attached three aileron actuating arms. The coupling units are cast of ML5-I Elektron.

The Upper Panel from Frame 11 to Frame 28

The upper panel from frame 11 to frame 28 is in the form of a partition made of sheet D-16, to which are attached two main longerons. The longerons are made of V-95 and are strengthened by angular steel profiles.

The panel at frame 11 has a flat cutout for the canopy. To it are attached the units for coupling the aircraft-control actuating arms.

To the longerons from frame 11 to frame 14 is attached the rear of the canopy with its glasswork; to the longerons from frame 14 to frame 28 is attached the removable back-fairing which consists of three parts with joints along frames 20 and 25. The back-fairing is made in the form of a parabolic-cross-sectional second structure of sheet D-16. The back-fairing is attached crosswise by extruded frames of D-16.

The back-fairing contains the stabilizer [redacted] and rudder control wires and also the electrical- and radio-equipment cables.

The Lower Panel from Frame 11 to Frame 20

The lower panel from frame 11 to frame 20 is attached to the bottom longerons of the side panels and to frames 11, 13, 16, 16A, and 20. The longitudinal assembly from frame 11 to frame 13 consists of three channel-section trusses on the right and two on the left, made of V-95 material; from frames 13 to 16 it consists of two channel-section cast trusses of ML5-I-4 material; from frames 16 to 20 the profiles are made of 30khGSA steel.

The panel has a number of intermediate half-frames 12, 14, 15, 17, 18, and 19, the lower parts of frames 16 and 16A, and also auxiliary transverse elements in the form of two side longerons passing from the trusses of the brake-flap housings to frame 20.

On the cast trusses at frame 15 is attached the unit for coupling the line for feeding the drop tank. To frame 16 is attached the bracket for forward attachment of the pylon of the drop tank.

At frame 16, to the trusses are attached two angle plates made of SZOKhRSA steel; these extend to frame 20. At frame 20 they are joined to the bracket for the rear attachment of the pylon of the drop tank.

The panel covering is of sheet D-16 duralumin.

The housings for the wheels of the main landing gear are between frame 16 and frame 20.

The duct from frame 13 to frame 20 is of round cross section and is made of riveted D-16 sheets.

Frame 16, a main frame, is in the shape of a ring formed by a V-95 partition and angle profiles of V-95 and SZOKhGSA materials. In the middle ofthe frame there are extruded plates of V-95 alloy to which are attached the steel assemblies for coupling the wing and the fuselage.

The Side Panels from Frame 13 to Frame 20.

The side panels from frame 13 to frame 20 are made of sheet D-16 and V-95. Longitudinally, they are attached by the longerons with hatch framing made of D-16 angle profiles and bulb-profiles along the contours of the cutouts for the housings of the main landing-gear wheels.

Inside, between frames 13 and 14, on the right is a sleeve consisting of a Z-shaped profile and a covering.

On the left side, between frames 14 and 16, there is the housing for the second auxiliary fuel tank.

The side panels are fastened to frames 13, 16, and 20. The upper and lower longerons of the panels are riveted to the upper and lower panels.

Frame 20, a main frame, is a partition of V-95 material, in the form of a ring, and attached by profiles of D-16.

On the right and left, angle profiles are used to join the walls of the main wheel wells to the frame.

The lower part ofthe frame contains the bracket for the rear attachment of the drop-tank pylon. The bracket is drop-forged of AK4-1 material.

The Side Panels from Frame 20 to Frame 28

The side panels from frame 20 to frame 28 are made of sheet V-95 and D-16. They are attached to frames 20, 22, 25, and 28. The upper and lower panels are fastenedto the longerons of the side panels.

The longitudinal assembly of each side panel consists of the following: upper and lower longerons of V-95 material, stringers and molded profiles of D-16 material, and profiles laid out along the contourof the wing profile.

Frame 22 is the main frame for attachment of the wing. At this frame the air-intake duct ends and the engine compartment begins. The frame consistsof four sections bolted together. The upper and lower parts of the frame are of channel ~~xmmtimm~~ cross section, extruded of V-95 material.

In the center of the upper part of the frame is attached the engine frame; to the bottom part are attached the units for coupling the control actuating arms.

The right and left parts of the frames are forged channel-section cross beams, made of SZOKhGSNA steel.

V

Each has four collar fittings for attachment to the upper and lower parts of the frame, and four horizontal eyelets for junction with the wing-attachment fittings.

The Lower Panel from Frame 20 to Frame 28

The lower panel from frame 20 toframe 28 is a longitudinal Π-shaped ~~xxxx~~ truss molded of V-95 material.

At frame 22 to the truss is attached the duraluminium fitting for attaching the rear brake flap; at frame 25 is the fitting for attaching the brake-flap hydraulic cylinder made of 3ZOKhOSNA steel.

Inner Side Panel from Frame 20 to Frame 28

The inner side panel from frame 20 to frame 28 can be divided into two parts: the compartment from frame 20 to frame 22, and the panel from frame 22 to frame 28.

The compartment from frame 20 to frame 22 is part of the round air-inlet duct, made of D-16 material.

The panel from frame 22 to frame 28 is the inside plate of the housing for kerosene tanks Nos. 5 and 6, on which are installed tracks for mounting the engine.

The Engine Mounting Truss

The engine-mounting truss is between frames 22 and 28.

The truss is a built-up beam of V-95 material; it is a wall with a lipped upper flange and a lower flange made from a molded T-profile.

At frame 25 a recess is made in the truss for the coupling bolt of the main engine mount.

A forked fitting it attached to the upper part of the recess for the coupling bolt; a support fitting of SZOKhOSNA steel is attached to the lower part of the recess.

<u>Frame 25</u> is a main frame. It is in the form of a horseshoe with a lower arc-shaped tie piece of double-T cross section, forged from SZOKhGSNA steel.

The main part of the frame consists of two halves joined to the engine-mounting truss; they are made of a V-95 partition and flanges made from V-95 molded angle plates.

On the partition of the frame are a number of reinforcing struts, while in the middle, from both sides, there are brace plates and profiles of V-95, to which the steel wing junction fittings are attached.

The bottom part of the frame consists of two forged partitions, between which is attached a truss of ZOKhGSNA steel. To this truss are attached the fitting for the cylinder of the third brake flap and the engine-mounting fittings.

Housing for Right Brake Flap

The housing for the right brake flap, between frames 11 and 13, is made in the form of three channel-section extruded trusses of V-95 material which are bolted to frames 11 and 13.

At frame 13 the universal joint of the brake-flap cylinder, made of SZOKhOSNA steel, is attached to the trusses. At frame 11, the trusses have a bulge for the brake-flap attachment fittings. The trusses are connected by sheet D-16 partitions.

Housing for Left Brake Flap

The housing for the left brake flap near frames 11-13 is similar to that for the right flap, except that it is made in the form of two extruded trusses. Between frames 13 and 14 there is an additionaltruss extruded of V-95, and a horizontal partition made of D-16.

Half-frame 16A is extruded of sheet D-16 with flanges of D-16 angle pieces and with ML5-T4 fittings for attaching the lower trusses and fittings to support a special suspension.

Frame 28 terminates the nose section of the fuselage and is the joining frame for the nose and tail sections of the fuselage.

The frame is a rim of V-95T molded angle iron with a SZOKhGSA reinforcing angle ; platex to which is attached a partition made of sheet D-16.

The inner flange of the frame is made of molded angle plate from V-95 material. To the outer rim are attached support and lock washers, made of D-16T, for clamp bolts.

To the center of the frame are attached three V-95T fittings for auxiliary attachment of the engine, and also fittings for attachment of the rear of the wing, in the form of telescoping supports with caps of SZOKhGSNA steel.

Joint Fitting (Fig. 9)

The nose and tail sections of the fuselage are joined at frame 28 of the nose section and frame 28A of the tail section. The fuselage joint is a flange-type, having three guide pins and 18 joint ....[rest of paragraph illegible]

Wing-Fuselage Hinge Fittings

The wing-fuselage hinge fittings are at frames 13, 16, 22, 25, and 28.

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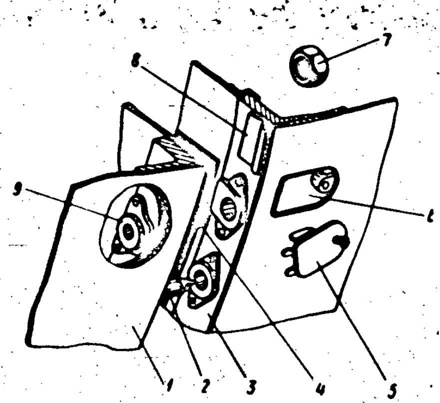

[redacted]

Фиг. [illegible]. Узел стыковки носовой и хвостовой частей фюзеляжа.

1 – Шпангоут [illegible]; 2 – Направляющий штырь; 3 – Шпангоут 29; 4 – Фиксаторный штырь; 5 – Кронштейн; 6 – Замок; 7 – Гайка; 8 – Резиновый уплотнитель; 9 – Ограничитель.

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Fig. 9. Butt joint of nose and tail sections of fuselage. 1) frame 28; 2) guide pintle; 3) frame 29; 4) joint pintle; 5) cap; 6) hatch; 7) nut; 8) rubber seal 9) limiter.

[redacted]

The joint at frame 13 is a fork-type joint with one vertical bolt.

The joint at frame 16 has an upper and lower fork, in the horizontal plane, and a middle lug in the vertical plane. The joint at each fork is accomplished by a vertical stepped bolt. The joint at the middle lug is accomplisbdd by a horizontal bolt, fastened in cantilever fashion in the lug of the wing spar.

The joint at frame 22 is of the collar type, with two vertical clamp bolts.

The joint atframe 25 is of the forked type, with one bolt and a nut.

The joint at frame 28 is accomplished by a bolt which is inserted and locked, at the first wing rib, in the telescoping collar fitting.

[redacted]

2. Design and Make-Up of the Tail Section of the Fuselage (Fig. 10)

The transverse main assembly of the tail section of the fuselage consists of 13 frames; the longitudinal main assembly consists of stringers; the covering is made of D_6ATM- 11, 2, and D-16AT, 115.

Frames 34, 35A, and 36 are main frames, made of SZOKhGSNA steel; joining frame 28A is made of molded D-16 profile, and the other frames are made of X-shaped D-16 sheets.

The stringers are made of molded D-16 angle pieces. The four stringers that frame the cutouts for the parachute and the MRN antenna are thicker.

At the bottom left between frames 30 and 32 is the well for the drogue chute. Antenna MRN-56P is located at the bottom right between frames 30 and 31A.

The ventral fin passes along the bottom of the fuselagefrom frame 28A to the end, along the axis of symmetry.

The front part of the fin is radiotransparent; at the rear of the fin, behind frame 36, is the drogue chute lock.

The engine cowling is inside the fuselage from frame 29 to frame 34.

The stabilizer is attached to an axle that rotates in bearings mounted on frames 35A and 36.

The engine afterburner is attached to frame 36.

R. p. 44 The fuselage terminates in the tail nacelle, made with no inner plating.

There are special air-inlet ducts at frame 31A for engine blow-off.

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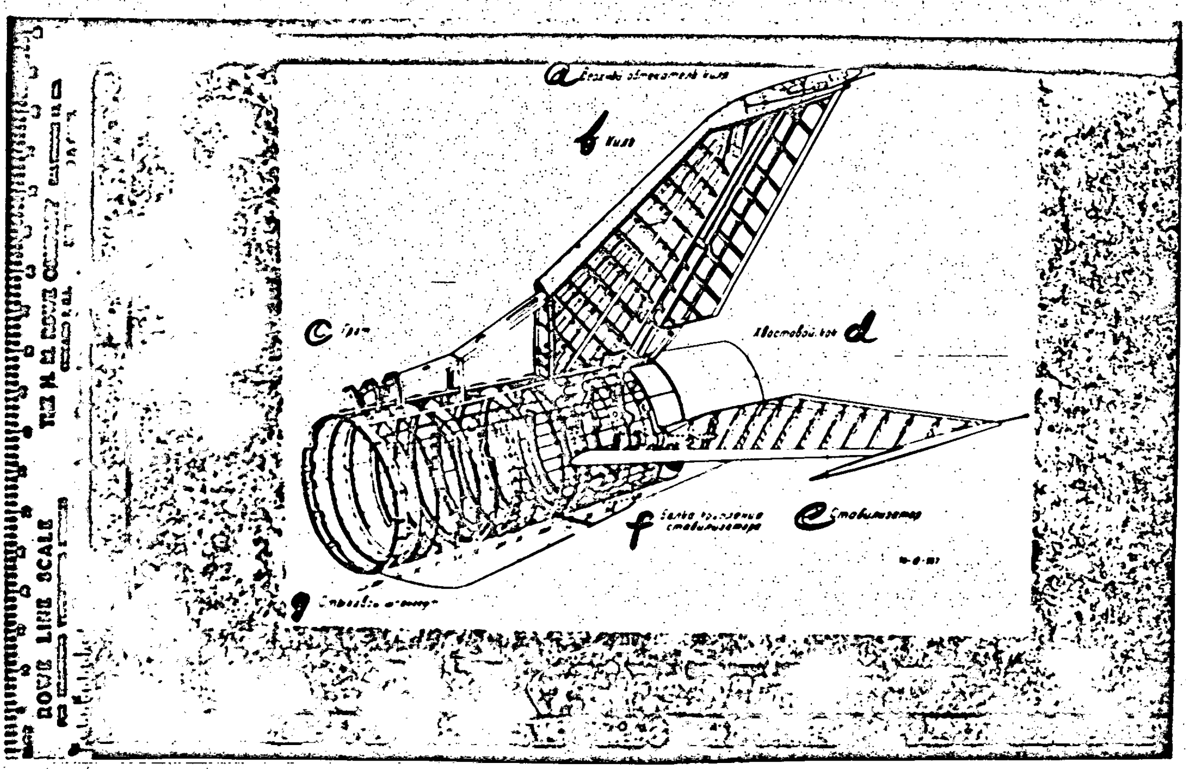

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Fig. 10. Framework of tail section of the fuselage and the tail.

a) Upper rudder fairing; b) rudder; c) back-fairing; d) tail nacelle; e) stabilizer; f) stabiliser attachment truss; g) joining frame.

2. Canopy and Ejection Seat

The canopy and the ejection seat form the system "SK" designed to save the pilot when he leaves the plane at speeds up to 1100 km/hr, by instrument.

A. Canopy

1. General Information

The canopy of the Ye-6T is designed to cover the pressurized cockpit, protect the pilot from the air stream, and assure normal vision during flight and when landing the craft. In addition, the canopy is used to protect the pilot from the incoming air stream during ejection.

The canopy (Fig.11) is a streamlined transparent secondary structure on the upper part of the fuselage between frames 6 and 13. The rear of the canopy forms a smooth junction with the back-fairing.

The canopy consists f the following basic parts:

--the hinged part,

--the rear section,

--a heat baffle;

--a transparent screen;

--side flaps.

The canopy has the following systems to fulfill its functions:

--pressurization and control systems;
--emergency ejection system;
--seat-retention system;
--de-icing system

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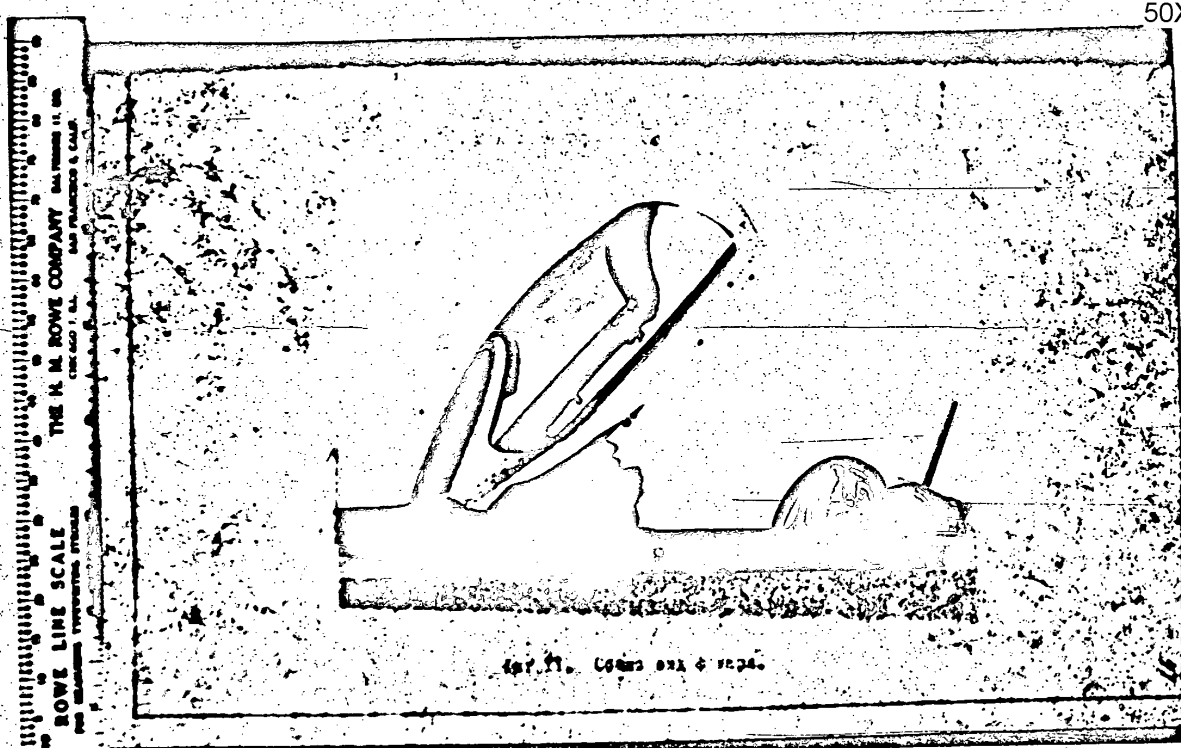

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Fig. 11. General view of the canopy.

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When the cockpit is opened, the hinged part of the canopy lifts out and up, on an axle on frame No. 6. The hinged part of the canopy is lifted by an air cylinder.

The canopy* is pressurized after it is lowered and locked in place. The canopy is depressurized either automatically, when the locks are removed, or autonomously, using the pressurization thumb button. The pressurization hose is located in the fuselage.

The air pressure in the pressurization hose is 1.7-2.55 kg/cm^2. The pressure in the hose is less than that behind the reducer due to the pressure drop because of resistance in the check valve.

The canopy can be released, in an emergency, by means of the emergency release handle on the right side of the fuselage. The emergency locks are released by means of a pyrotechnic system. The canopy is raised by lift cylinders to which xxx air at a pressure of 130 kg/cm^2 is fed.

During ejection with canopy shielding, the canopy separates from the fuselage and is held to the seat; the emergency canopy locks in this case are released by seat pins.

The canopy emergency ejection system is interlinked with the seat firing mechanism; if necessary to eject after emergency ejection of the canopy, part of

* Henceforth, in such expressions we will use the word "canopy" to mean its hinged part.

the gases are bled off from the firing mechanism. This prevents the occurrence of great overloads due to a decrease in the mass of the ejected system.

2. Design of the Canopy (Fig. 12)

Hinged Part of the Canopy

The hinged part of the canopy (I) is designed in the form of a rigid structure, bearing the convex main glass (1) and the flat front glass (17).

The frame consists of two longitudinal side trusses (18), attached together in the front by a cast bracket made of magnesium alloy (32) and in the back by an arc (2). The longitudinal trusses consist of Elektron profile (26), duralumin profiles and plating (27) riveted together. Rear arc (2) is of rigid rivited design and has a cutout covered by special cover (3) made of magnesium alloy. During ejection with the canopy used for protection, the cover of the hatch is dislodged by the pyromechanism of the seat-stabilizing parachute.

The main glass (1) is heat-resistant organic glass, brand ST-1, 10 mm thick. The glass is affixed in the side profiles by means of/Capron tape (20) glued to the glass. One edge of the tape is glued to the glass, the other is inserted into a special groove in the profile (26) and held in place by a rod (21).

Along the rear arc and the frame of the forward glass the main glass is held in place by rubber gaskets between the outside covering and the inside brace plates; these are tightened by bolts.

In the longitudinal direction, between the ends of the glass and the parts of the frame there is a gap to prevent contact stresses in the glass.

The front glass is silicate laminated safety glass 14.5 mm thick in a special frame (16) which is bolted to the frames of the front glass.

The moving part of the canopy at the joints is pressurized by means of an U-30M-2 pressurizer (19).

If there is no air in the plane's hydraulic system, the canopy can be lifted manually by means of handle (5) on left truss (18); when not in use this handle is in a socket in the truss, held in place by knob (6).

The Rear Section of the Canopy

The rear part of the canopy (II) is not pressurized and is removable. It is attached to the fuselage by anchor nuts. It is designed in the form of a framework whichcontains the glass. Glass (30), brand CO, 5 mm thick, is fastened along the perimeter between the outside covering of the framework and the inside brace plate; these are drawn together with bolts.

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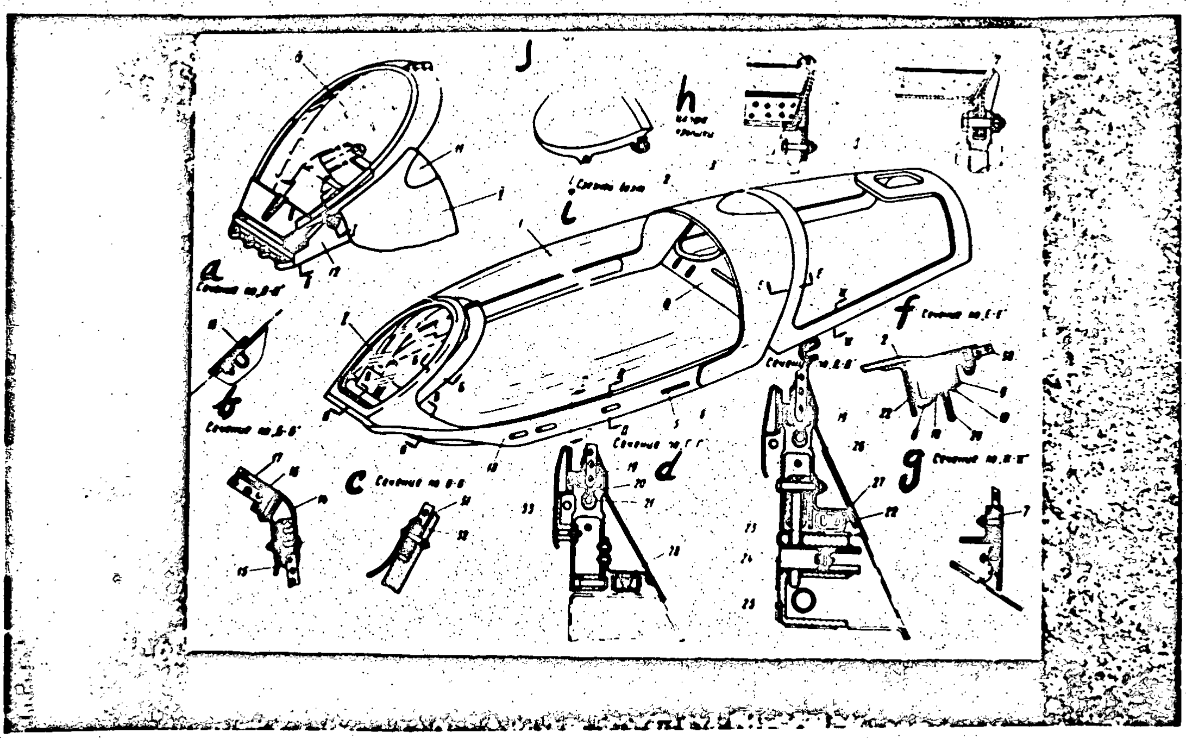

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Fig. 12. Canopy design. a) cross section at "A-A"; b) cross section at "Б-Б"; c) cross section at "B-B"; d) cross section at "Г-Г"; e) cross section at "Д-Д"; f) cross section at "E-E"; g) cross section at "Ж-Ж"; h) cover pin; i) shear bolt; j) ~~[illegible]~~ sealing the cover (......)

Fig. 12. Canopy design.

I. Hingdd section; II. rear section of canopy; III. Heat baffle; IV. Transparent screen; V. Side flap; 1. Main glass; 2. rear arc; 3. Cover; 4. frame for trans-parent screen; 5. handle to manually open canopy; 6. knob; 7. rubber grommet; 8. groove for pressurization hose; 9. framework of rear section of canopy; 10. Dural [?] pressurized bulkhead sheet; 11. glass of side flap; 12. gun-sight bracket; 13. de-icer collector plate; 14. outside frame; 15. inside brace plate; 16. front-glass frame ; 17. front glass; 18. side truss; 19. U-30M-2 pressuriser; 20. capron tape;

21. rod; 22. pressurization hose; 23. canopy loop; 24. pintle for operating frame; 25. operating frame; 26. Molded mk Elektron profile; 27. covering; 28. Dural profile; 29. glass of heat bulkhead; 30. glass; 31. rubber grommet; 32. bracket; 33. blow-off tube.

To prevent contact xmzaxm stresses in the glass, between the covering and the glass there is "UPL-0.4" packing take, while the openings in the glass for the bolts to pass through are made larger than the bolt diameter, and rubber bushings (7) are put in them.

Pressure Bulkhead

The pressure bulkhead (III) separates the pressurized cockpit from the unpressurized region behind the rear section of the canopy. It is attached to the panel beneath the canopy to framex 11. Along the outside edge it is xxxxxxx bolted to the front end of the rear section of the canopy. In the center it is attached by bolts to the armor plate.

The pressure bulkhead is of hermetically-sealed flat design made of crimped Dural sheets (10) with reinforcing ridges stamped into it, and riveted profiles.

Above and to the sides in the pressure bulkhead are small windows for examination of the rear hemisphere. The windows consist of flat glass (29), brand SO-[?], 5 [6?] mm thick.

In front, in the center of the pressure bulkhead, is attached a channeled profile (8) which contains the canopy pressurization hose (22).

Transparent Screen

The transparent screen, of bulletproof glass (IV), is located directly beneath the front glass of the movable part of the canopy. It serves three purposes: 1) it protects the pilot in front from direct hits by bullets, shells, and shrapnel; 2) the canopy rolls along it during ejection with protection by the canopy; and 3) it protects the pilot from the air stream after release of the canopy.

The transparent screen is three-sheet laminated safety glass 62 mm thick in a rigid steel frame (4) which is bolted, with 4 bolts, to sight mount (12).

Side Flaps

To the sides ofthe transparent screen are two side flaps (V) which have small windows (11) made of organic glass. The side flaps together with the transparent screen form a sort of baffle plate which protects the pilot from the air stream in the event the canopy is released in an emergency.

3. Pressurisation and Canopy Control System
(Fig. 13)

The canopy is attached to the fuselage suspension bracket (1) by means of two bolts which serve as axes of rotation when the canopy is raised and lowered.

Canopy control consists in the opening and closing of the operating locks and raising and lowering the canopy. The canopy is controlled with a special handle (7) on the left side of the panel beneath the canopy. The canopy is pressurized with hose (4); pressurization is accomplished by turning button (15) which is on the same shaft as canopy control handle (7). On the panel beneath the canopy and on the fuselage covering, near handle (7), are instructions for the correct use of the valve.

Canopy control and pressurization are possible both from inside and outside. ~~tha~~For this, the double-arm canopy control lever has two handles: one inside (16) and one outside (13). The outside handle is in a slot in the fuselage and is held in place by catches and knob (14). In this position, the outside handle is kinematically separated from the inside handle. When knob (14) is pressed, handle (13) moves out, and when it is turned down it engages the inside handle, after which the canopy can be controlled from the inside.

To retract handle (13) it must be pulled from the inside until the handle disengages from the inside handle and fits into its housing such that the catches of the handle drop into place and knob (14) can be turned, locking it in place. Pressurization from the outside is accomplished by turning shaft (17) by means of a screwdriver placed in the slot at the end of the shaft.

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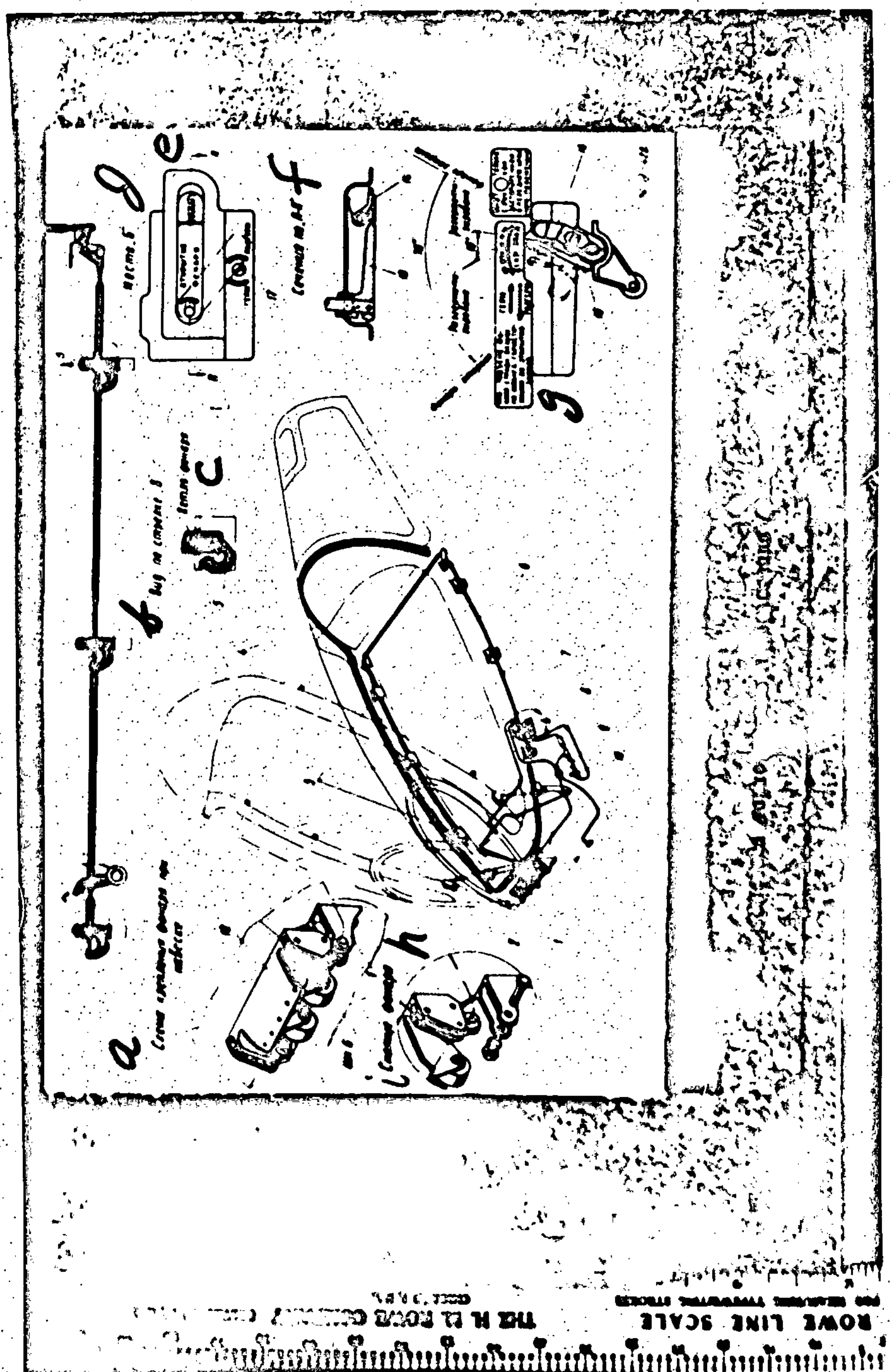

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Fig. 13. Pressurization system an d canopy control.

a. diagram of canopy attachment when suspended; b. view at "B"; c. canopy loop; d. point "B"; e. [see below]; f. cross section at "A-A"; g. [see below]; h. removal of canopy; i. frame 6.

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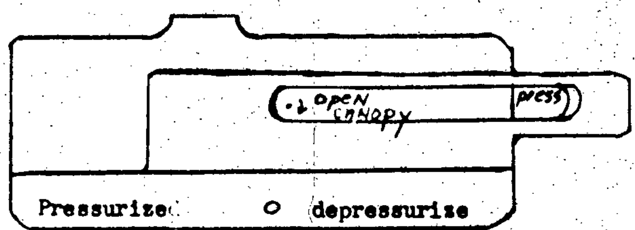

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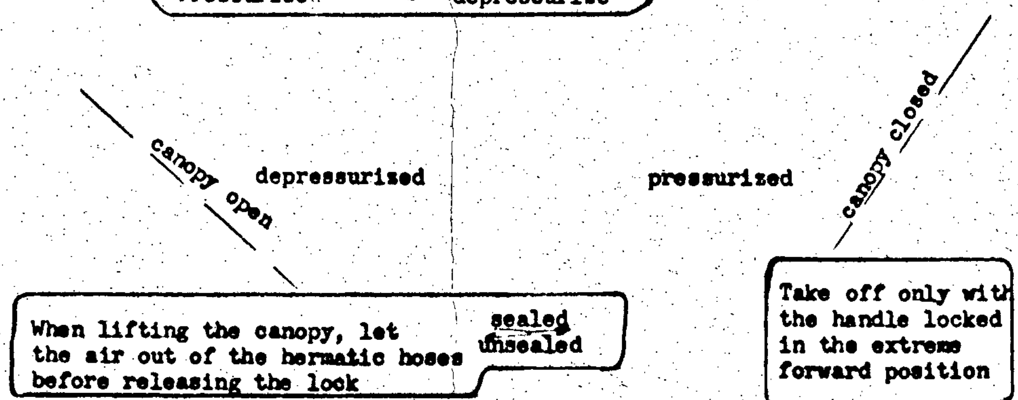

Fig. 13. Pressurization and canopy control system.

1. canopy suspension bracket; 2. canopy lift cylinder; 3. canopy operational lock; 4. pressurization hose; 5. catch 6. push-pull rod; 7. double arm handle for canopy control; 8. check valve; 9. RV-1.5 reducer; 10. air valve; 11. actuating arm; 12. pintle; 13. outside handle; 14. knob; 15. pressurization push button; 16. inside handle; 17. slotted shaft ~~with~~ spline for pressurizing the ~~xmhm~~ canopy from the outside; 18. swivel lock.

The canopyis affixed in the lowered position by six locks (3) located in the ~~pakei~~ panel beneath the canopy. Lock 3 is a cast bracket with a groove into which the canopy loop fits. Pintle (12), moved by actuating arm (11) crosses this groove. The actuating arms of all the locks areconnected by connecting rods to the canopy-control handle guide. To prevent the locks from opening before the canopy is released, the rear left lock has a catch (5) which covers the groove at the point where pintle (12) emerges.

When the canopy is released the loop compresses catch (5) and frees pintle (12).

The canopy is lowered by means of cylinders (2) which get their air from the hydraulic system by means of canopy-control valve. The canopy is lowered by its own weight, displacing the air from cylinders (2) into the atmosphere.

The double-arm canopy control handle (Fig. 14) is attached to panel (16) and housing (1). It consists of rod (4) which has on it inside handle (9), pressurization button (8), and guide (7). Inside rod (4) is shaft (3) containing outside handle (2). Shaft (3) is pressed outward by spring (6) and in this position engages shaft (4) by means of two screws (5). Screws (5) and the grooves in the head of shaft (3) are positioned asymmetrically, so that the outside handle engages the inside one only in the down position.

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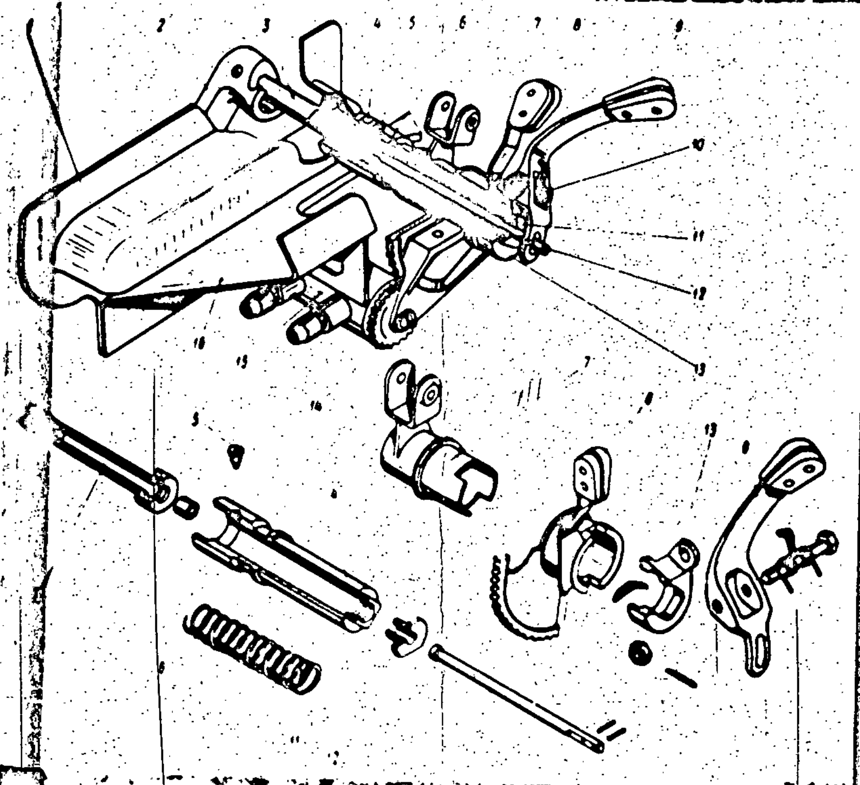

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Fig. 14. Two-position canopy-control handle.

1. housing for outside handle; 2. outside handle; 3. shaft; 4. rod; 5. screw; 6. spring; 7. guide; 8. pressurisation push button; 9. inside handle; 10. spring; 11. nut; 12. connecting rod; 13. bracket; 14. gears; 15. pressurization and canopy control valve; 16. panel.

[redacted]

The prevents disturbing the handle when the canopy is closed from the outside.

Guide (7)and button (8) have clearance relative to handle (9) and rod (4) of 30° and 15° respectively. By means of the clearance of pressurization button (8) the canopy can be pressurized and depressurized when handle (9) is locked in the extreme forward position. The toothed sect on of button (8) is connected with canopy control valve (15), which is also on panel (16). The projections of shaft (3) and the xx stem of the valve are hermetically sealed by means of gland packing and a rubber ring. When the outside handle is operated, shaft (3), by means of connecting rod (12), deflects the inside handle and does not permit it to be locked in the forward position.

Canopy Air System (Fig. 15)

The canopy air system is divided into the operating and emergency systems. The operational air system is designed for pressurization and raising of the canopy. It includes canopy lift cylinders (5), pressurization hose (8), canopy control valve (11), air valve (12), reducer RV-1.5 (13), and check valve (14).

The canopy lift cylinders (5) are located on the sides of the panel beneath the canopy near frame No. 7[?]. Canopy control valve itx (11) is attached to the panel of the canopy control handle.

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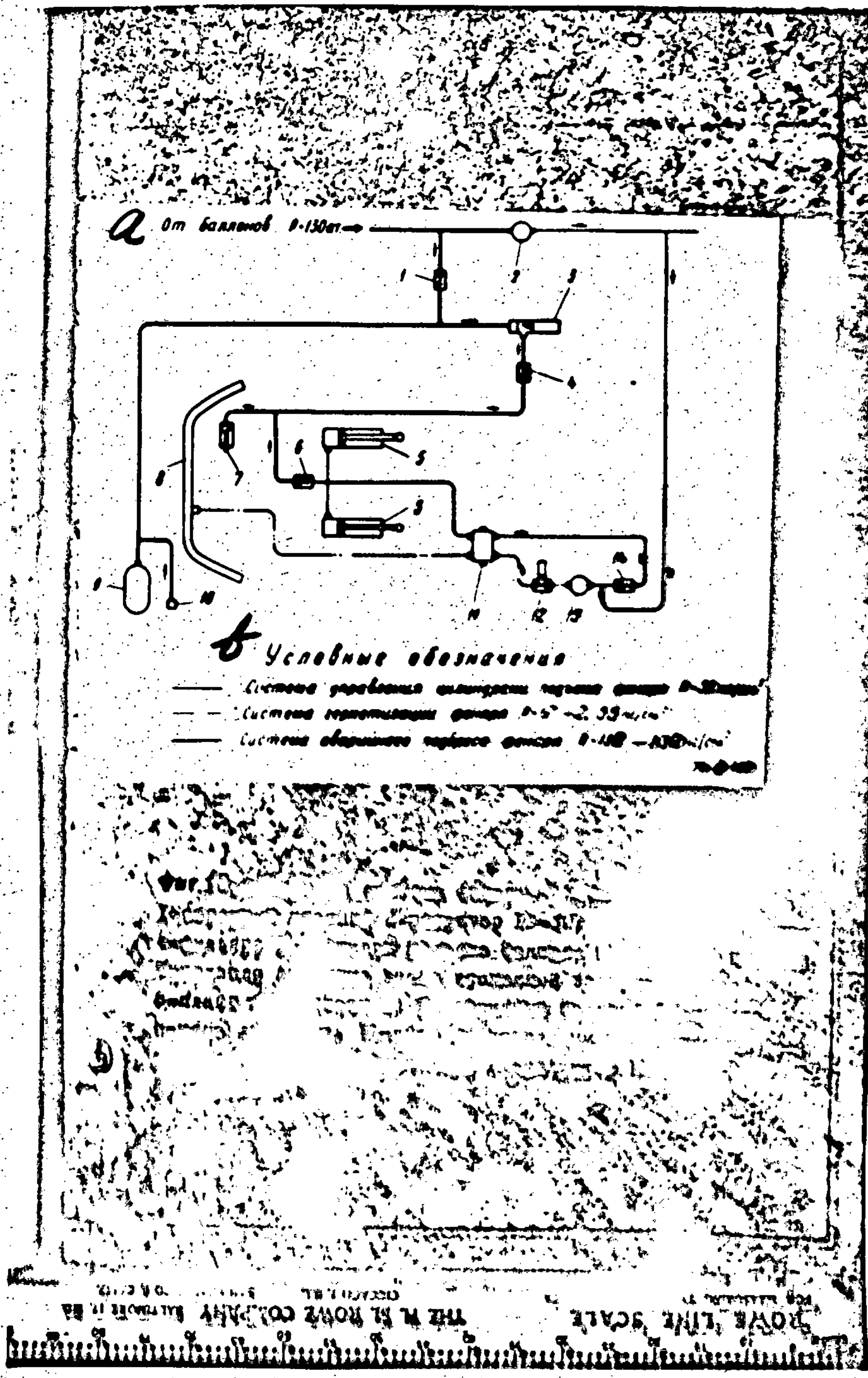

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Fig. 15. Canopy ~~hydraulic~~ air system. a. from cylinders, p = 130 atm; b. designations: ——— - system for control using canopy-lift cylinders, p = 50 kg/cm^2; —·— - canopy pressurization system, p = 1.7-2.55 kg/cm^2; ——— - canopy emergency removal system, p = 110-130 kh/cm^2.

1. check valve; 2. reducer RV-???; 3. emergency valve; 4. filter; 5. air cylinders; 6. check valve; 7. air cylinder; 8. pressurization hose; 9. emergency tank; 10. pipe; 11. canopy control valve; 12. air valve; 13. reducer RV-1.5; 14. check valve.

The pressurization hose is in a special groove in the panel beneath the canopy. Air valve (12), connected into a single unit with RV-1.5 reducer (13), and check valve (14) are on the left side of the cockpit near frames 7 and 7b[?].

Using the emergency air system, the canopy is cast off when it is released in an emergency. This air system consist of:check valve (1), located on the right side of the cockpit, which separates the canopy emergency hydraulic system from the 130-atm aircraft pressure system; emergency tank (9), in the forward equipment compartment; emergency valve (3) on the bracket that holds the right-hand canopy-lift cylinder; filter (4); air cylinder (7), attached to the canopy suspension bracket and used to open the time-delay lock during emergency canopy release; check valve (6) which separates the emergency air system from the operating system; and air cylinders (5), which during emergency release of the canopy serve as ejection cylinders. Pipe (10)is used to measure the pressure in the emergency canopy air system, and to bleed off the air.

Hydraulic System Units

Pressurisation and Canopy Control Valve

(Fig. 16)

The pressurization and canopy control valve has two cavities, similar in design. The valve consists of body (3) and a shaft with cams (1) and valves (6) and (7). On a shaft (1) is a gear (see Fig. 14) which turns the tuuthed sector of the pressurization button.

The gear ratio of the coupling is 3, i.e., when the toothed sector is turned 75° the gear and the valve stem turn 225°. The other end of the shaft passes to the outsi e through the covering of the cockpit and has a slot so that the cockpit can be pressurized from the outside using a screwdriver.

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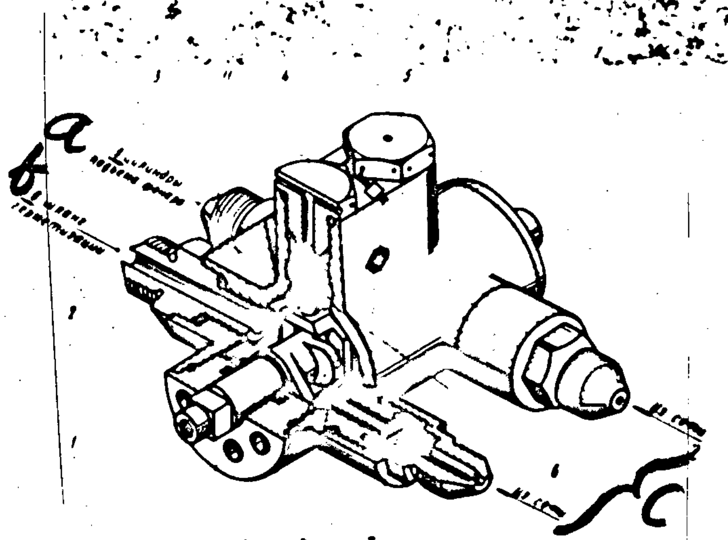

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Fig. 16. Pressurization and canopy control valve.

1. shaft with cams; 2. connecting pipe; 3. body; 4. connecting pipe; 5. connecting pipe; 6. valve; 7. valve; 8. guide; 9. cap; 10. cam; 11. connecting pipe.

a. To canopy lift cylinder.

b. To pressurization hose.

c. From supply.

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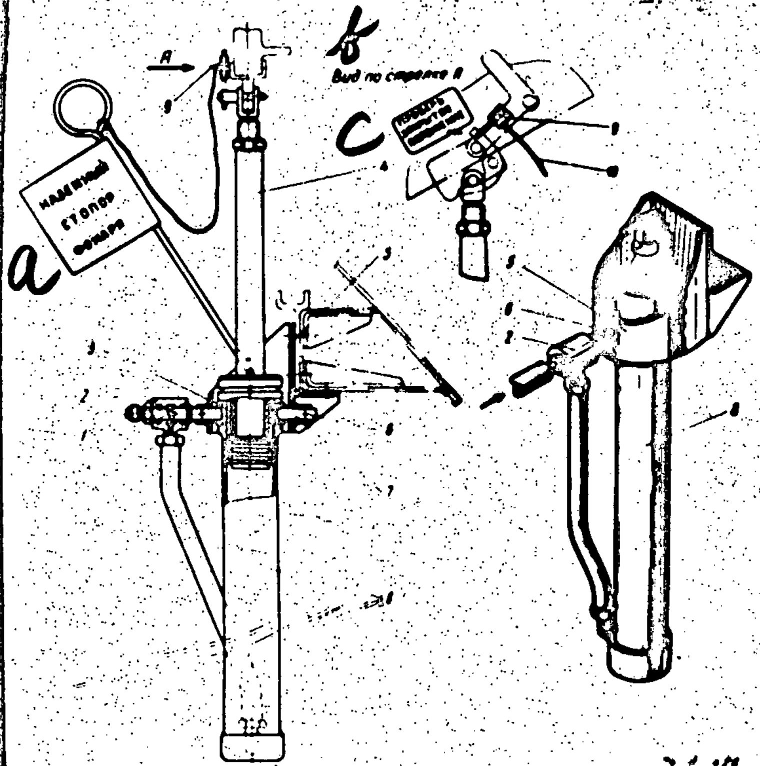

Фиг. 17. Цилиндр подъема фонаря.
1 - штуцер; 2 - поворотный штуцер; 3 - [illegible];
4 - шток; 5 - кронштейн подвески цилиндра; 6 - шплинт;
7 - штифт; 8 - цилиндр; 9 - стопор аварийной системы;
10 - шнур.

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Fig. 17. Canopy lift cylinder.

1. connecting pipe; 2. swivel connector; 3. holder; 4. rod; 5. cylinder support bracket; 6. split pin; 7. pin; 8/ cylinder; 9. emergency system lock; 10. cord.

a. ground canopy lock.

b. view at "A"

c. check closed position.

.... The inlet connecting pipes of both cavities have throttle openings 0.5 mm in diameter.

Canopy Lift Cylinder

Figure 17 shows the design of the canopy lift cylinder and the method of attaching it to the panel beneath the canopy. Cylinder (8) is attached to support bracket (5) by means of connecting pipe (1) and pin (7) in holder (3). Pipe (1) and pin (7) are kept from shifting longitudinally by split pins (6). When the canopy is raised or lowered, the cylinders move in the longitudinal plane, rotating on pipe 1 and pin (7). Air is fed to the cylinders by means of swivel pressurized connection (2). Air is fed to the left cylinder from ~~the~~ the covering side; it is fed to the right cylinder from within the cockpit.

To prevent the ~~xxxxx~~ raised canopy from lowering due to absence of pressure in the plane's hydraulic system, ground stoppers are placed in rod (4); these are removed before lowering the canopy.

Air valve

(Fig. 18)

The air valve is a set of check and safety valves in one body. It consists of body (1), two slide~~xxxxx~~ valves (3) with rubber washers, springs (4), cover (5), and plug (7).

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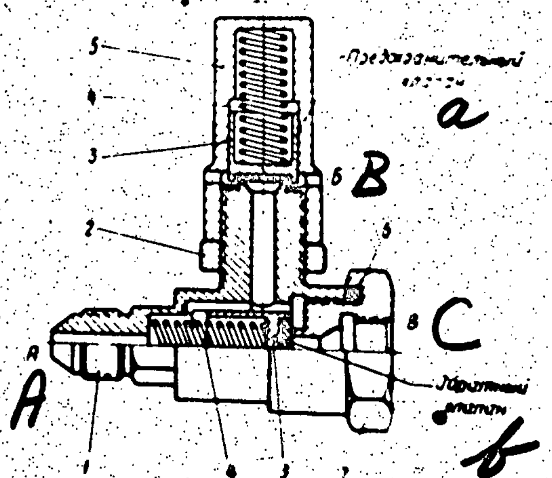

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Fig. 18. Air valve.

1. body; 2. retainer nut; 3. slide valve; 4. spring; 5. cover; 6. rubber auxiliary ring; 7. plug.

a. safety valve.

b. check valve.

When air is fed to pipe "C," slide valve (3) of the check valve is opened and the air passes through pipe "A" to the pressurization valve.

When air moves from pipe "A" to pipe "C," spring (4) of the check valve seats slide valve (3) against plug (6) and blocks the air path.

When the pressure in the hose rises above 2.8 atm, slide (3) of the safety valve opens and xxx the air escapes intothe atmosphere through pipe xx "B."

Emergency Valve
(Fig. 19)

The emergency valve serves to pass air from the emergency xxxxxx hydraulic system to the canopy release cylinders and to the cylinder that closes the xxxxx of time-delay lock. It consists of body (6) with two pipes, separated by membrane (7) made of stainless steel 0.1 mm thick.

Membrane (7) is hermetically compressed by pipe (8) between the body seat and bushing (9) to which it is attached. To change the membrane it is necessary to unscrewxpipe (8). The air is fed to pipe "A."

When pin (3) is pulled out, pin (5) moves forward, actuated by spring (1), and begins to rupture membrane (7). The weakened membrane is ruptured by the air pressure, and pin (5) is thrown backward and seals the cavity of the body, pressing with its conical section against the rubber washer.

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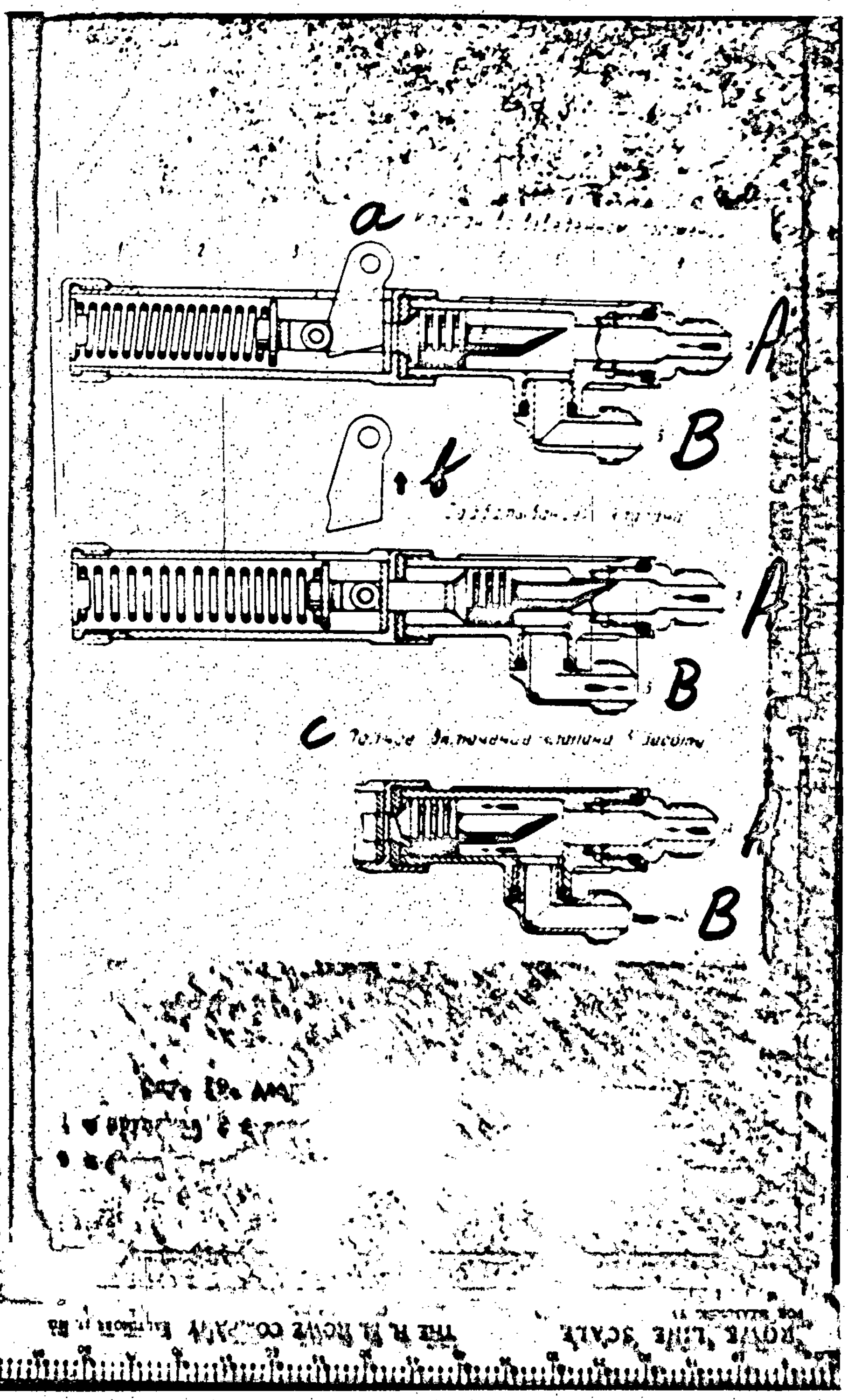

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Fig. 19. Emergency valve (membrane valve).

1. spring; 2. tube; 3. pin; 4. rubber washer; 5. pin; 6. body; 7. membrane; 8. pipe; 9. bushing.

a. valve in the cocked position.

b. operation of valve.

c. valve completely engaged.

The air enters the working units through pipe B.

Filter
(Fig. 20)

The filter serves to trap the fragments from the ruptured membrane of the emergency valve; it consists of body (1), mesh (2), and cover (3).

If the emergency valve is actuated aboard the plane, the filter is removed and the membrane fragments removed from it.

Operation of the Canopy Control Handle and Valve
(Fig. 22)

Opening the Canopy

To open the canopy the canopy control handle must be moved from the extreme forward position to the extreme rear. If the canopy is pressurised, during the first 15° which the handle turns the canopy becomes depressurized. If the canopy is not pressurized, only the handle moves in the first 15°. Then the handle begins to turn the pressurization button and, by means of this button, the shaft of the canopy control valve. When the handle turns 30° the guides connected to the connecting rods of the operational locks begin to turn. When the handle

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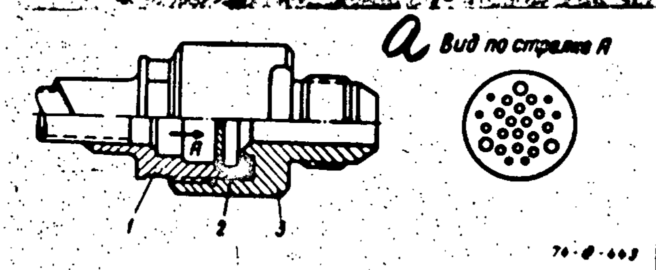

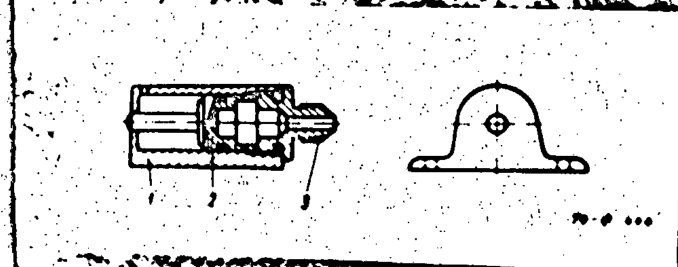

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Fig. 20. Filter. 1. body; 2. mesh; 3. cover. a) view at A

Fig. 21. Cylinder for opening time-delay locks.

1. body; 2. rod; 3. cover.

turns 60-63° the pintles of the operational locks completely clear the canopy loops and come out of the grooves in the brackets; during the next 3° air begins to be admitted to the canopy lift cylinders.

PRECAUTION: The canopy should lift smoothly 3-5 seconds after air is fed to the lift cylinders. Forced retention of the canopy in the down position might result in a sudden upward snap of the canopy, damaging the lift-cylinder-rod fittings.

Closing the Canopy

To close the canopy the handle must be moved from the extreme rear position to the extreme forward position. First only one handle moves. After 15° the clearance in the pressurization button is taken up, and it begins to turn and rotate thestem of the canopy control valve. When the handle has turned 30-40° the bleeder valve for the cylinder cavity opens, air from the canopy lift cylinders escapes into the atmosphere, and the canopy begins to lower. After the handle has turned 45° it is restrained, since the locking pintle of the rear left lock is held by the arresting device (see Fig. 13). After the canopy has lowered completely into place, the handle can be turned some more and the canopy locks are closed.

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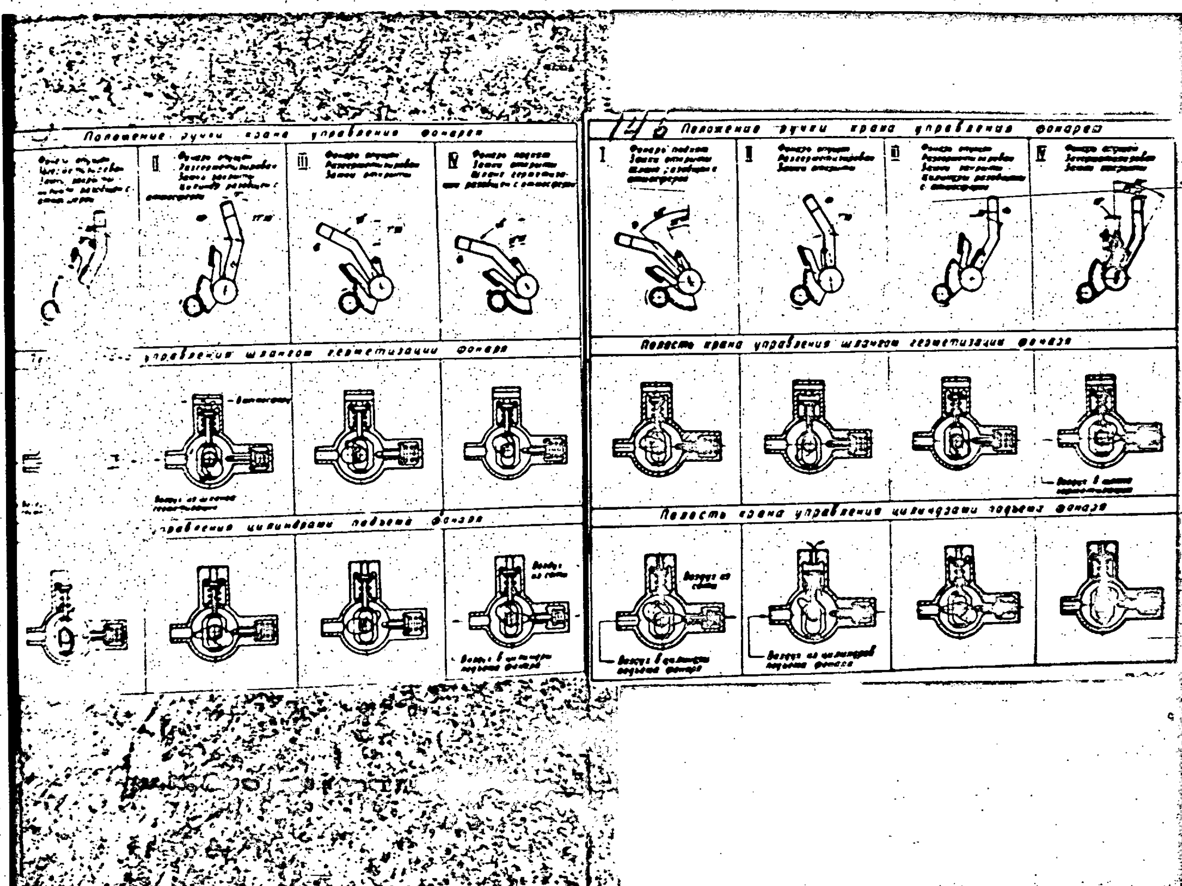

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Position of the canopy control handle			
I Canopy is closed Pressurized Locked Cylinder disconnected from the atmosphere	II Canopy is closed Depressurized Locked Cylinder disconnected from the atmosphere	III Canopy is closed Depressurized Unlocked	IV Canopy is raising Unlocked Pressurizing hose ~~is disconnected~~ from the atmosphere
Cylinder control cavity of the hermatic hose of the canopy			
[Illegible]	to the atmosphere air from the hermatic hose		
Cylinder control cavity of the canopy lift cylinder			
			air from the system air to the canopy lift cylinder

S-E-C-R-E-T

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Position of the canopy control handle			
I Canopy is open Unlocked Hose is disconnected from the atmosphere	II Canopy is closed Depressurized Unlocked	III Canopy is closed Depressurized Locked Cylinder is disconnected from the atmosphere	IV Canopy closed Pressurized Locked
Cylinder control cavity of the hermatic hose of the canopy			
			air to hermatic hose
Cylinder control cavity of the canopy lift cylinder			
air from the system air to the canopy lift cylinder	air out of the canopy lift cylinder		

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After 1-3° of turning the handle until it occupies the extreme forward position and is recessed into the panel, the canopy control valve closes the bleeder valve of the cylinder contr·l cavity. This is done so that with emergency canopy release the air from the aircraft system will not pass through the ejection cylinders and the canopy control valve.

To pressurize the canopy the pressurisation button must be pushed 15° forward.

PRECAUTION: The canopy should lower smoothly in 5-8 seconds after air begins to be bled from the ejection cylinders. Forced retention of the canopy in the up position may result in an abrupt drop onto the panel beneath the canopy.

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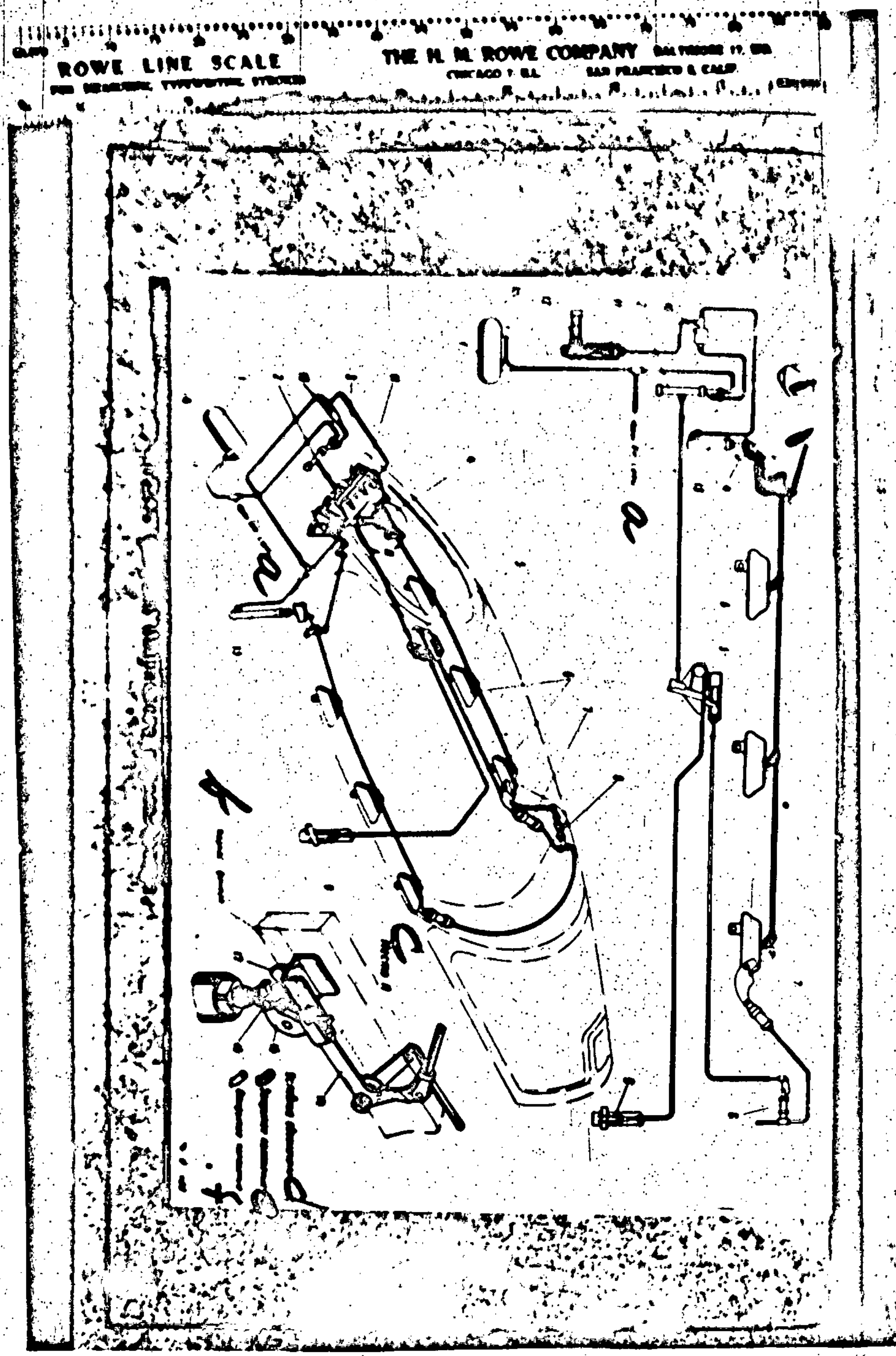

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Fig. 23. Emergency canopy ejection system.

a. from network; b. canopy framework; c. point A; d. arbitrary designations; e. closed position; f. open position.

Fig. 23. Emergency canopy release system.

1. emergency tank; 2. emergency valve; 3. swivel lock; 4. cylinder rod attachment lock; 5. handle for emergency canopy release; 6. side emergency locks; 7. pyrotechnic cylinder; 8. pyrotechnic pistol; 9. pin of bleeder valve of pyromechanism TSM-2500-38. 10. filter; 11. time-delay lock opening cylinder; 12. canopy time-delay lock; 13. canopy ejection cylinder; 14. actuating arm; 15. arresting device; 16. shaft; 17. bracket; 18. pipe for measuring pressure in tank of canopy emergency system and for filling when checking the system.

[redacted]

4. Emergency Canopy Release System
(Fig. 23)

To open the cockpit in an emergency, there is emergency canopy release which is accomplished by means of a special system, by turning the canopy emergency release handle(5).

The emergency canopy release system has the following systems and units:

--emergency canopy locks;

--a pybotechnic system for opening the emergepcy locks [pyrotechnic pistol (8), pyrotechnic cylinder (7), and pyrotechnic controls];

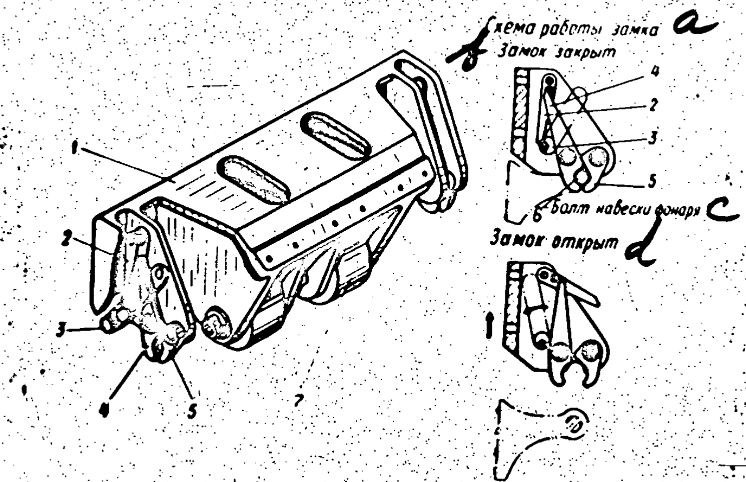
--an ejection system (emergency canopy hydraulic system);

--handle for emergency canopy release.

The canopy emergency locks--a swivel lock (3), six emergency locks (6), and two cylinder-lift-rod coupling locks (4), are coupled by connection rods.

The emergency locks are opened, when the canopy is released, by pyrocylinders (7) whose shafts turn the locking handles of the rear emergency locks (6); by means of a connecting rod all locks are opened.

[redacted]



Фиг. [illegible]. Замок-шарнир.
1 – корпус; 2 – собачка; 3 – валик; 4,5 – захваты.

Fig. 24. Swivel lock. 1. body; 2. arresting device; 3. shaft; 4, 5. retainers.

a. Diagram of lock operation.

b. lock closed.

c. canopy retention bolt.

d. lock open.

Units of the Emergency Canopy Release System

Swivel Lock (Fig. 24)

The swivel lock is fastened to the front bracket of the canopy frame and has two identical sections. It consists of a housing (1), retainers (4) and (5), arresting device (2), and a sectioned shaft with an actuating arm (3). The lock housing is a cast Elektron bracket. The shafts (3) of both sections are rigidly fastened to one another. As shaft (3) turns, arresting device (2) is released and retainers (4) and (5) separate.

Side Emergency Lock
(Fig. 25)

The side emergency locks are mounted on the Elektron profiles of the side trusses of the canopy framework. The lock mechanism is housed in a removable housing (5), and consists of levers (2) and (4) and actuating arm (3) on a sectored shaft. Loop (1) is held in the lock by means of a shaft xxx on lever (2).

As actuating arm (3) turns, levers (2) and (4) are thrown free and loop (1) is released.

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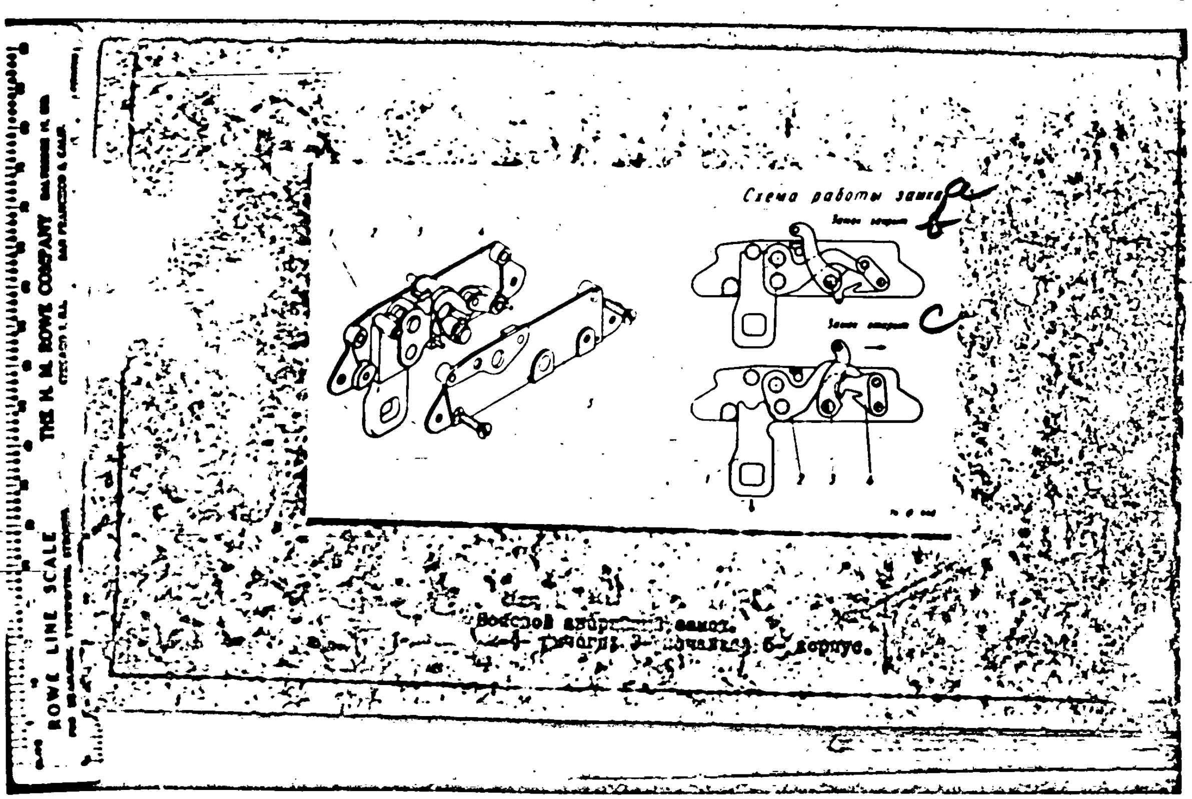

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Fig. 25. Side emergency lock. 1. loop; 2, 4. levers; 3. actuating arm; 5. housing.

a. Diagram of lock operation.

b. lock closed.

c. lock open.

Lift-Cylinder-Rod Attachment Lock (Fig. 23, point A)

The lift cylinder rod is attached to the canopy framework by means of bbacket (17) in whose groove goes the shaft of the rod (16). With downward motion theshaft is retained by the arresting device (15) which is fixedin the operating position by actuating arm (14) which is coupled with the lock control wires. When actuating arm (14) is released, arresting device (15) turns and frees shaft (16).

Emergency Canopy Release Handle
(Fig. 26)

The emergency canopy release handle is located on the right side of the panel beneath the canopy. It accomplishes three operations: it turns on the emergency valve, actuates the pyrotechnic pistol, and pulls out the pin in the bleeder valve of pyromechanism TSM-2500-38.

The handle is a double-arm lever (6), at the end of which is hinged handle (8) connected by cable to the pin on the emergency valve. The pin on the emrgency valve is pulled out when handle (8) is pulled.

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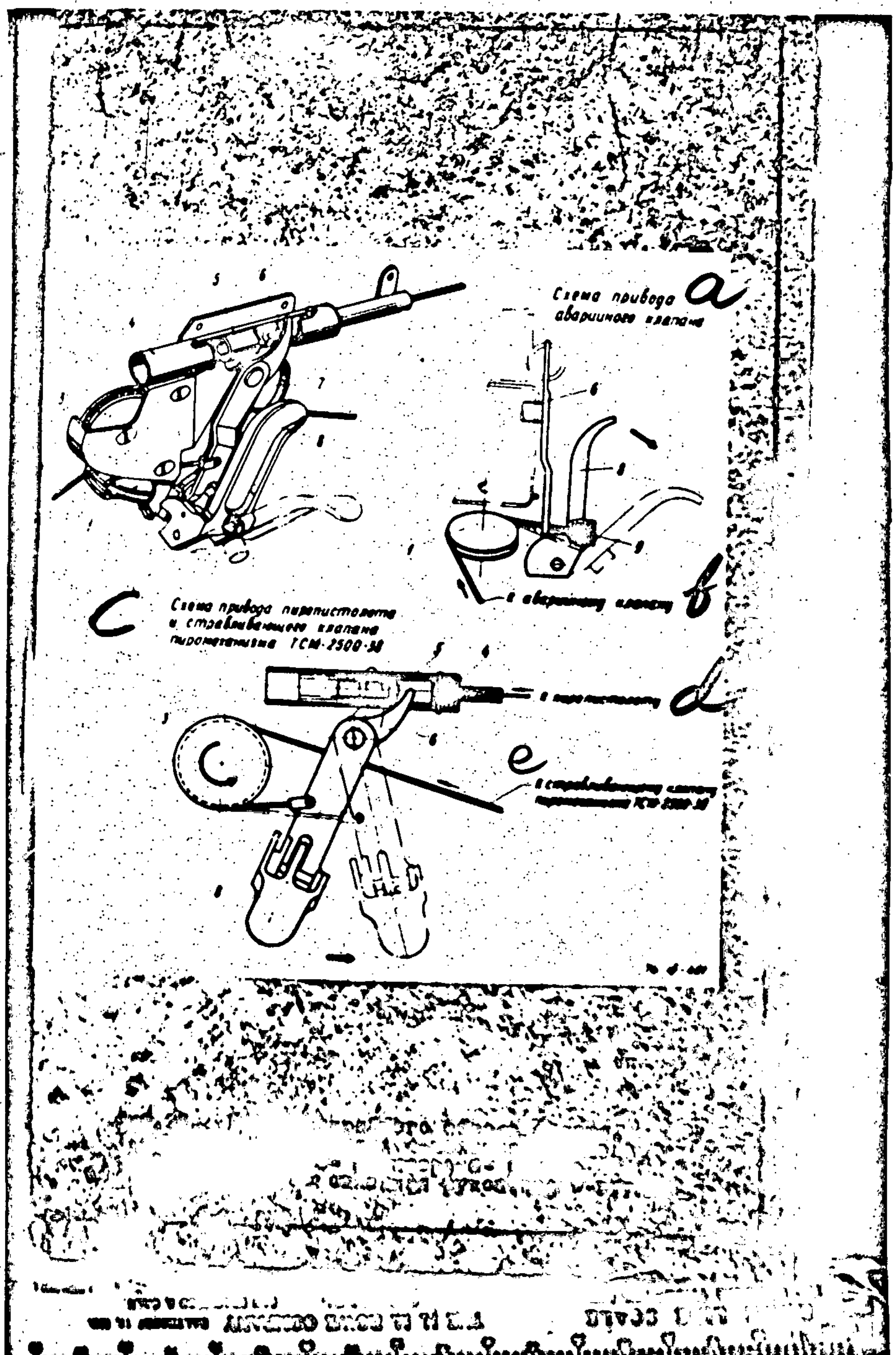

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Fig. 26. Emergency Canopy Release Handle. 1, 3. rollers; 2. cover; 4. pyropistol drive mechanism; 5. plunger; 6. lever; 7. bracket; 8. hinged handle; 9. bushing. a. diagram of emergency valve gear; b. to emergency valve; c. diagram of the pyrotechnic pistol ~~[illegible]~~ and bleeder valve gear of pyromechanism TSM-2500-38; d. to pyropistol; e. to bleeder valve of pyromechanism TSM-2500-38.

[redacted]

The other end of lever (6) is in the pyrotechnic pistol drive mechanism (4). When the handle is pulled back, lever (6) pushes plunger (5) ahead; the plunger is attached by cable with the pytotechnic pistol trigger lever.

Lever (6) is locked in the forward position and can be drawn back only after turning handle (8) to the horizontal position.

The cable from the pin of the bleeder valve of pyromechanism TMS-2500-38 [should probably be TSM-2500-38] passes across roller (3) and is attached to lever (6).

Pyrotechnic Pistol
(Fig. 27)

The pyropistol is constructed as follows:

Two PV-1 "Roks" pyrocartridges (2) are placed in housing (1) and are covered by the housing of seal (4) into which firing pin (6), propelled by spring (5), passes.

Firing pin (6) is held in the cocked position by trigger lever (10). When lever (10) is turned, firing pin (6) is released and strikes the percussion caps of pyrocartridge (2).

[redacted]

Fig. 27. Pyrotechnic pistol. 1. housing; 2. pyrocartridge PV-1 "Roks"; 3. nut; 4. seal; 5. spring; 6. firing pin; 7. nut; 8. barrel; 9. roller; 10. trigger lever. a. cross section at A-A

Fig. 28. Pyrocylinder. 1. rod; 2. housing; 3. cover.

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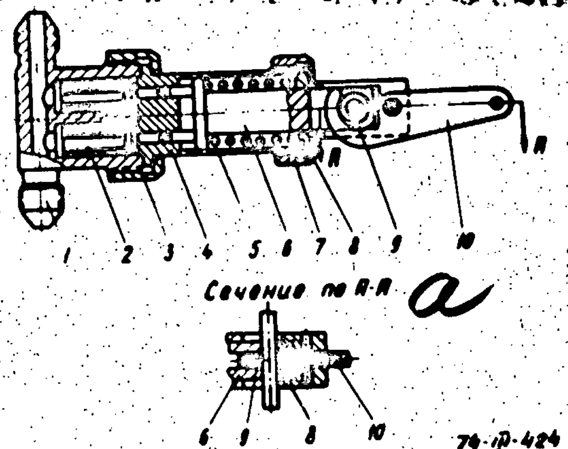

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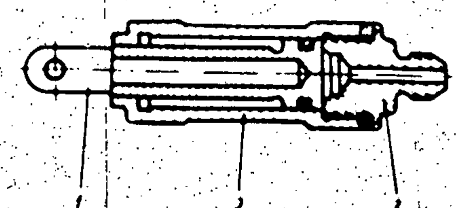
Фиг.27. Пиродетонатор.
1-корпус; 2- пиропатрон ПП-1 "Рокс"; 3- гайка; 4- [illegible]; 5- [illegible]; 6-боек; 7- [illegible]; 8-стакан; 9-ролик; 10-спусковой рычаг.



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Фиг.28. [illegible]
[illegible] 2- [illegible] 3- пружина

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Emergency Canopy Release Process
(Fig. 29)

When the hinged handle of the emergency release handle is moved (1), the pin of the emergency valve is pulled out (2). Air from the emergency hydraulic system enters the canopy time-delay lock opening cylinder (3) (the canopy time-delay lock is described in the section "System for Locking the Canopy to the Seat") and ~~xx~~ the ejection cylinders (4), creating an ejection force before the emergency locks open.

When emergency canopy release handle (4) is turned, pyrotechnic pistol (7) is activated. The gases formed in the pistol from the explosion of the two "Roks" pyrotechnic cartridges enter pyrocylinders (8), and the emergency locks open. The canopy is ejected upward and carried away by the oncoming air stream.

At the same time as pyropistol (7) operates, the motion of the emergency release handle (5) withdraws the pin of the bleeder valve of pyromechanism TSM-2500-38.

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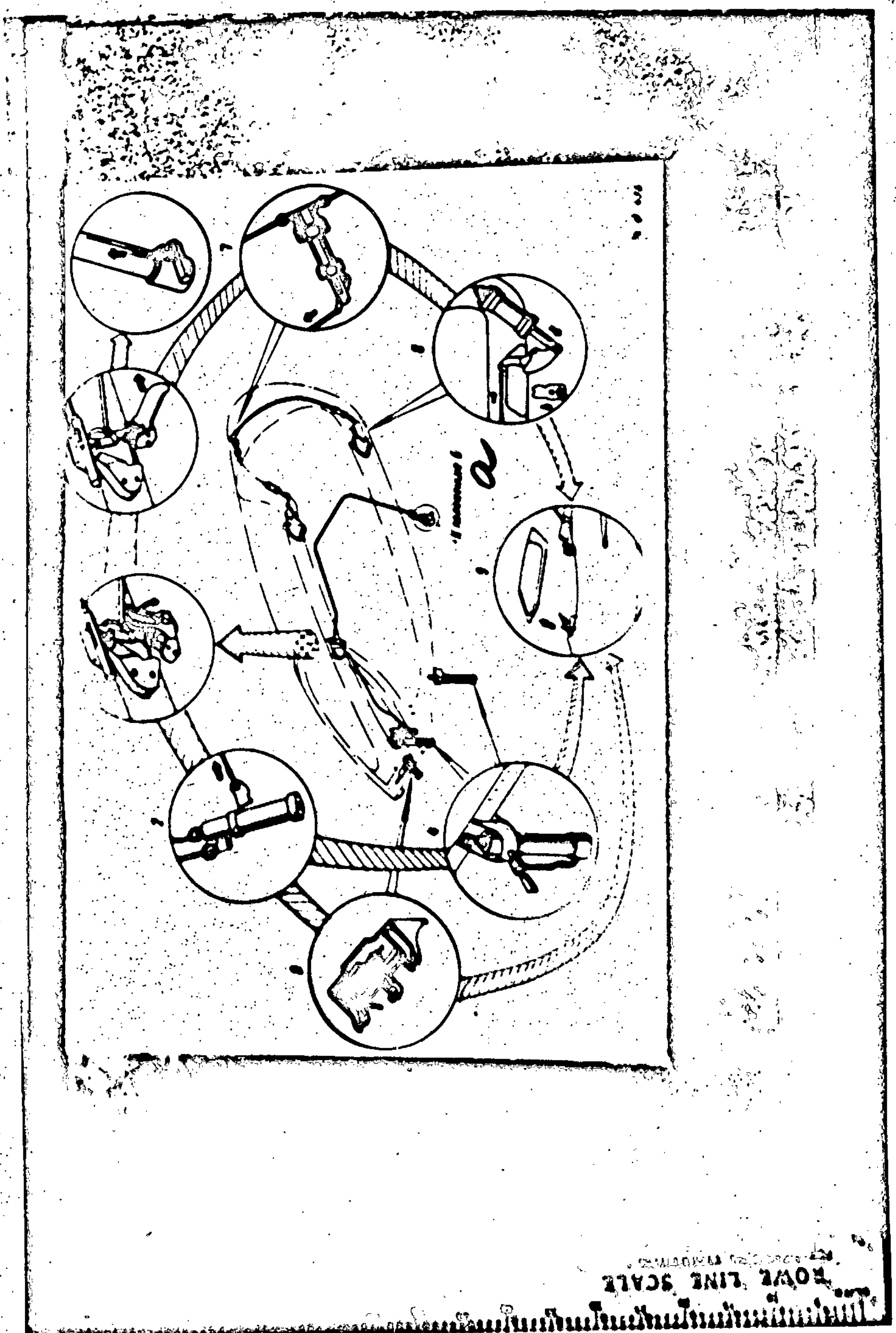

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Fig. 29. Emergency canopy release process. a. to position 6.

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5. System of Canopy Retention by the Seat
(Fig. 80)

In the case of ejection with protection by the canopy, the canopy separates from the fuselage and is held by the seat. For this purpose, on thecanopy is mounted a system for canopy retention by the seat; this contains the following units:

--emergency canopy locks (described in the section "Emergency Canopy Release System);

--locks to retain the seat [front (5) and rear (7)];

--canopy time-delay lock (1).

During ejection, the bearing pins of the seat enter thexnotches in the rear locks (7); ~~thrumix~~ turning their handles they close, and open the emergency canopy locks by means of ~~x~~ connection rods(10) and actuating arms (11). The time-delay lock keeps the nose of the canopy from rising after the emergency locks have been opened. When the canopy, whose rear section moves together with the seat, occupies a position such that the air stream will press it against the fuselage, lock (1) opens. The bushings of the forward seat-retention locks (5) fall into the hinged bearings of the seat and are lock into them.

To separate the canopy from the seat buttons(9) is pushed; these are mounted on the rear locks (7). Button (9) is on a shaft with actuating arms (8), whichare connected by connecting rods to the locking levers of the forward locks (5).

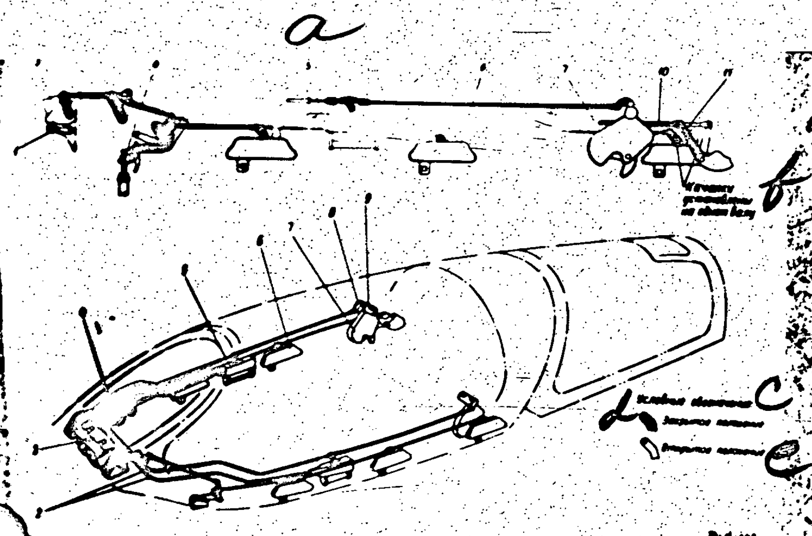

Рис. [illegible] Система [illegible] фонаря [illegible].
1-[illegible] [illegible] трубки тросовой проводки; [illegible] 5- [illegible] [illegible] 7-задний замок [illegible] 9-[illegible] передних [illegible] 11-[illegible]

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Fig. 30. System for Canopy Retention by the Seat.

1. canopy time-delay lock; 2. cable conduits; 3. swivel lock; 4. cylinder rod attachment lock; 5. front retention lock; 6. side emergency lock; 7. rear retention lock; 8. actuating arm for opening front retention locks; 9. button for opening front locks; 10. connecting rod; 11. actuating arm.

a. main diagram; b. actuating arms on one shaft; c. arbitrary designations; d. closed position; e. open position.

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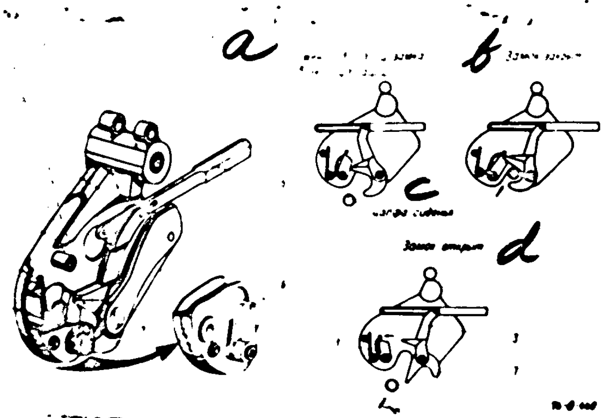

[illegible]

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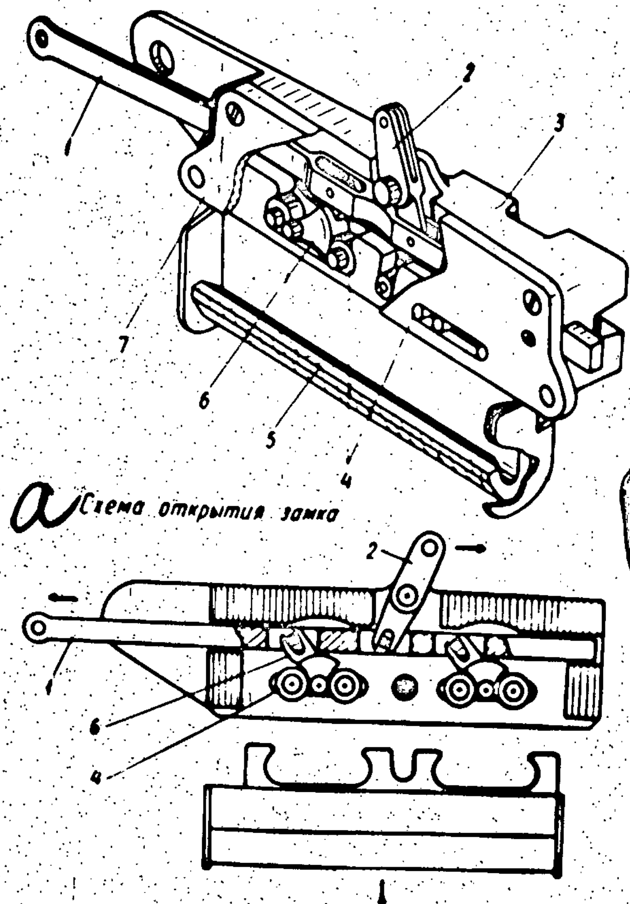
Fig. 31. Rear retention lock. 1. stop; 2. spring; 3. lever; 4. housing; 5. connecting rod; 6. arresting device; 7. retainer.

a. position of parts of lock in operation; b. lock closed; c. seat ~~pin~~ bearing pin; d. lock open.



[illegible] 52. [illegible] захвата.

1 – тяга; 2 – рычаг; 3 – [illegible]; 4 – [illegible]; 5 – [illegible]; 6 – [illegible]; 7 – [illegible]

Fig. 32. Front retention lock. 1. connecting rod; 2. lever; 3. housing; 4. roller; 5. bushing; 6. actuating arm; 7. housing cover.

a. diagram for opening the lock.

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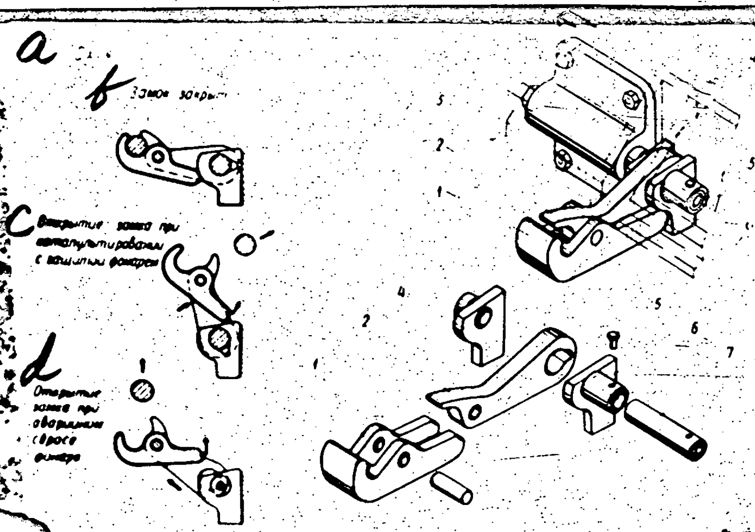

Фиг. 85. Замок [illegible] запорный фонаря.
1—упор; 2—[illegible] 4—втулка; [illegible]

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Fig. 33. Canopy time-delay lock. 1. lever; 2. connecting link; 3. air cylinder; 4. bushing; 5. shear rivet; 6. ~~bearing~~ bushing; 7. axle.

a. operating diagram; b. lock closed; c. opening of lock during ejection with protection by canopy; d. opening of lock during emergency canopy release.

.... arresting device (6) is loosened by pulling the pin, and stop (1) is moved from beneath retainer (7), and the bearing pin is freed.

Front Retention Locks (Fig. 32)

The front locks are also located on the side trusses of the canopy frame inside the cockpit. Bushing (5) is placed in housing (3) and held in place by four rollers (4) moved by ~~[illegible]~~ actuating arms (6). Whenhandle (2) is turned the actuating arms (6) are turned by means of connecting rods (1). The released rollers leave their slots in the bushing, which is then free.

A dual cable line connects lever (2) of ~~[illegible]~~ one lock with the connecting rod (1) of the other, and vice versa.

Canopy Time-Delay Lock (Fig. 33)

The time-delay lock is mounted on the canopy support frame and cons'sts of connecting link (2) and lever (1).

When the canopy moves together with the seat the lock begins to turn. The ends of lever (1) slide along bushings (4) and (6) and when they reach the filed part of the ~~[illegible]~~ bushings the lock ~~[illegible]~~ opens.

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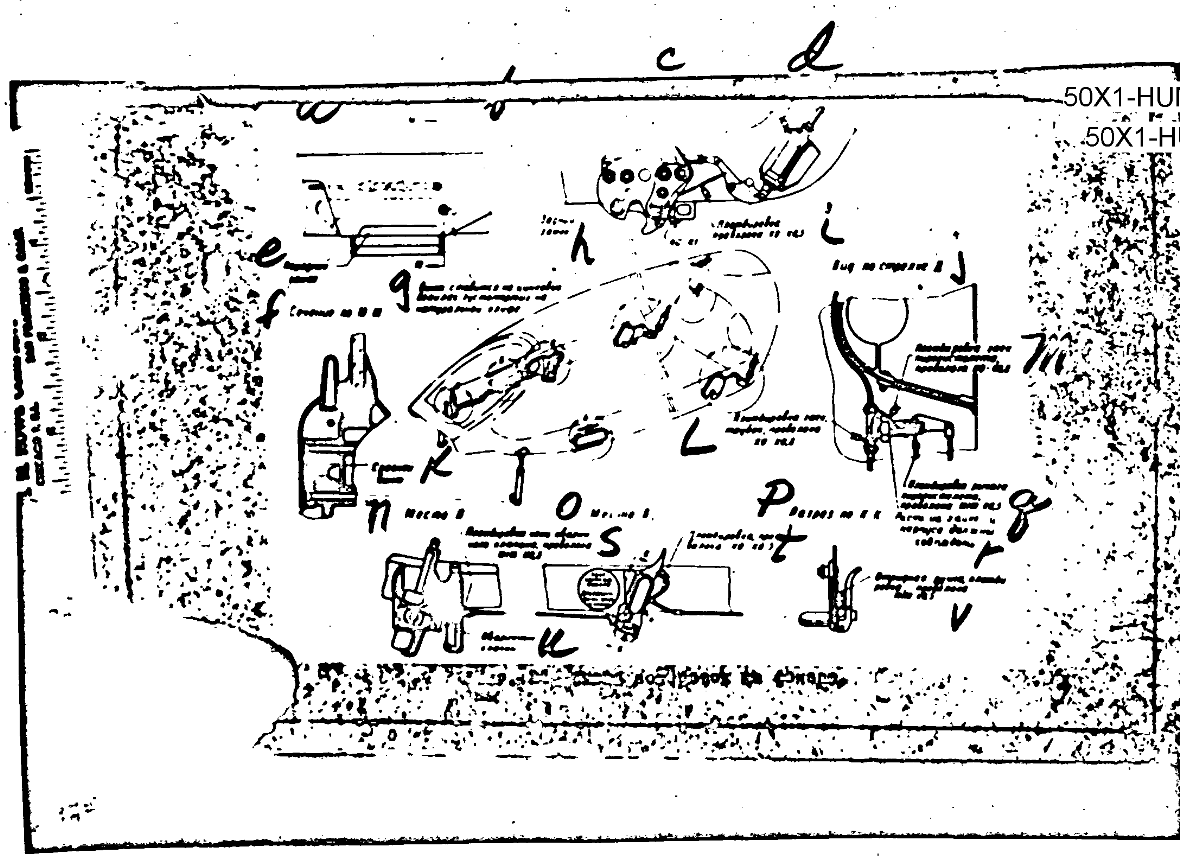

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Fig. 34. Diagram of locking pieces on thecanopy.

a. point Б ; b. shear bolt ____________; c. point Г ; d. illegible; e. front lock; f. cross section at M-M; g. screw in white lead (drying oil pastes); g. rear lock; i. sealing, KO-KO.5 wire; j. view at arror Д ; k. shear bolt; l. sealing of nuts, tubes, wire KO-KO.8; m. sealing of nuts of the pyrotechnic pistol, wire KO-KO.8; n. point A; o. point B; p. cross section at K-K; q. sealing of pyropistol handle, wire M1M-KO.5; r. the tic marks on the nut and the housing should coincide; s. sealing of emergency valve pin, wire M1M-KO.5; t. sealing, wire KO-KO.5; u. emergency valve; v. hinged handle, sealing, wire M1M-KO.5.

[redacted]

In the event of emergency canopy release, air enters the air cylinder (3), the cylinder rod drives out the axle (7) and remains in its place. Connecting link (2) moves forward, after which the lock opens in any position.

6. De-icing System (Fig. 35)

The de-icing system is designed to prevent icing of the front glass of the canopy by spraying ethyl alcohol on its surface.

Pressing button (4) located at the upper left on the instrument panel activates electro-pheumatic valve 695000 M [?] (6) which feeds air from the plane's pheumatic system at a pressure of 50 [kg/cm^2?] to reducer RV-3 (5), calibrated into 3±3.2 kg/cm^2, and then to the small alcohol tank (1). Alcohol from tank (1) is fed to collector (3) where it flows under plate (17). The oncoming air stream passes under plate (17) and sprays the alcohol onto the surface of the glass.

When the system is turned off, the air is no longer fed to the tank and the bleeder valve is opened. Air from the tank is fed to valve (6) through 96 | 97 check valve (7) and is bled off into the atmosphere.

Alcohol tank (1), with a capacity of 5 liters, is attached to the front nacelle of the fuselage by clamp bands (12). Felt padding is placed between the tank and the bands.

Fill head (11), inside of which is filter (16), is hermetically sealed by cover (15), screwed into place by screw (14).

The alcohol is drained by turning drain plug (10).

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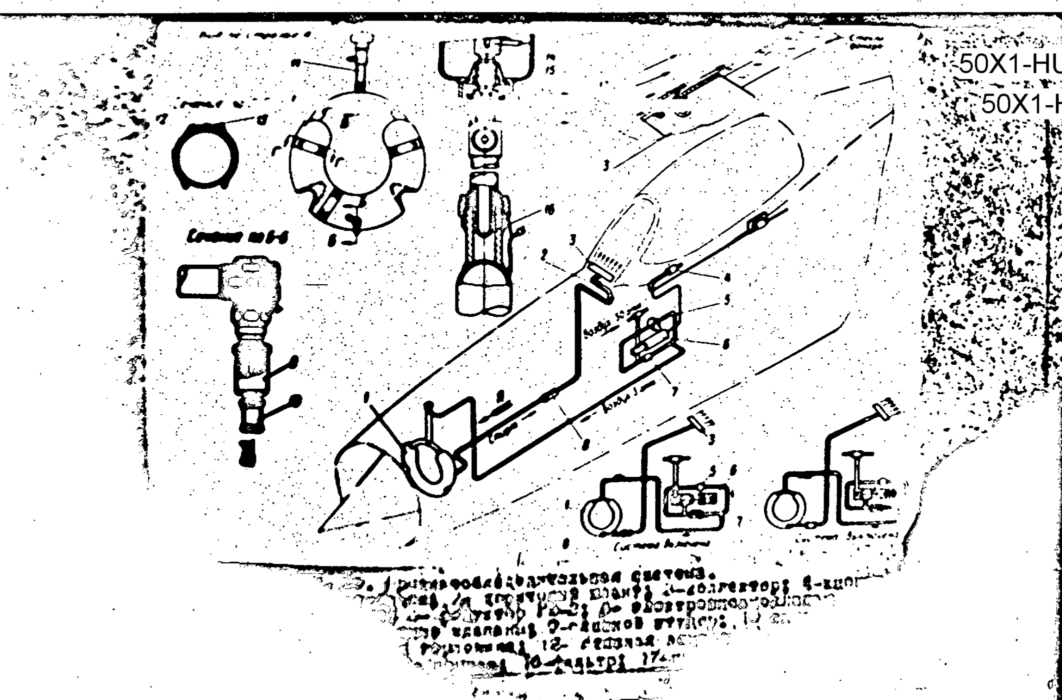

Fig. 35. De-icing system.

1. small alcohol tank; 2. _____ hose; 3. collector; 4. button; 5. reducer RV-3;
6. xalxa electro-pneumatic valve 695000 M; ', 8. check valves;
9. [illegible]; 10. fuel plug 11. fill head; 12. clamp bands; 13. tightening ..../...bolt;
14. screw; 15. cover; 16. filter; 17. plate.

[most of these were taken from the text rather than from the figure caption itself TR]

B. ~~XX~~ EJECTION SEAT "SK"

1. General Information

The "SK" ejection seat (Fig. 36) is designed for the pilot in the cockpit and to immobilise him during various operational g-forces, and also to assure his safe exit from the plane in an emergency ~~xx~~ up to an instrument speed of 1100 km/hr. The pilot is protected from the air stream by the hinged part of the canopy which, during ejection, is retained by the seat and covers the pilot.

The "SK" seat has the following basic advanbages: the pilot is protected from the air stream (during ejection with canopy retention) regardless of his flight equipment[?];

the braking g-forces occurring after the seat has leftthe cockpit are reduced, due to the increased total weight of the ejection system (seat, pilot, canopy);

for ejection, the pilot needs make only one motion (pulling the handle), which is easily done under any flight conditions;

[remainder blurred]

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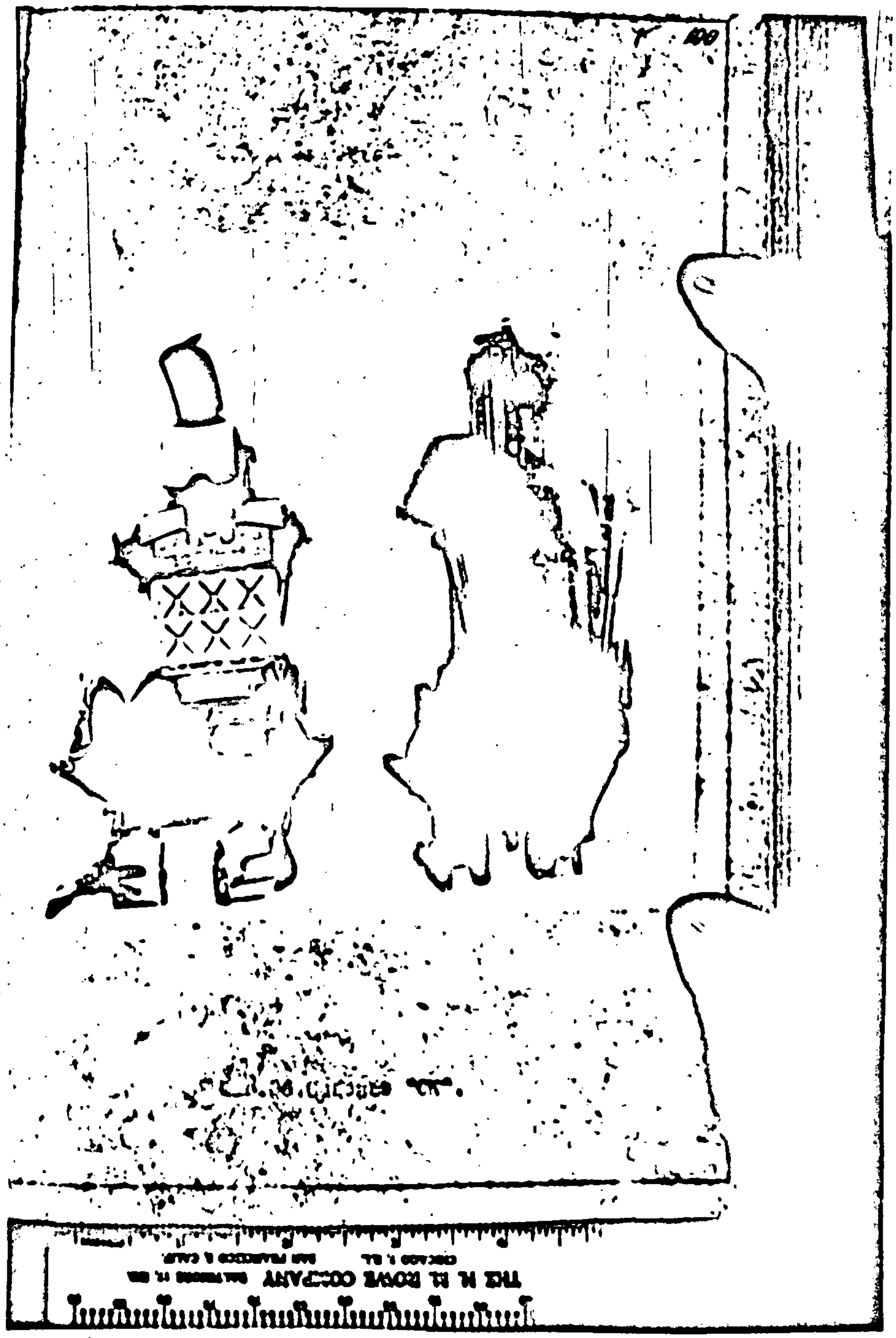

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Fig. 36. Seat "SK."

--guarantees that the pilot will assume the position necessary for ejection, by using restrainers;

--decreases the minimum safe ejection height during descending flight regimes, by cutting down the time necessary to perform the preliminary operations.

The seat is of rigid design, consisting of a framework with a bucket; these have the following operating and emergency systems mounted on them:

--control of the bucket;

--safety-belt system;

--harness of the shoulder safety-belt system;

--fire control;

--stabilization of the seat during free flight;

--retention and immobilization of legs;

--retention and separation of canopy;

--system to open harness and leg-retention locks;

--emergency pyromechanism firing device 215F [?] and system to open harness locks.

The seat is affixed to the cockpit (see Fig. 37) by means of three pairs of rollers mounted on the rear armor plate. The rollers ride on the seat rails and prevent longitudinal and transverse shifting. The seat is retained in the vertical position by means of TSM-2500-38 pyromechanism.

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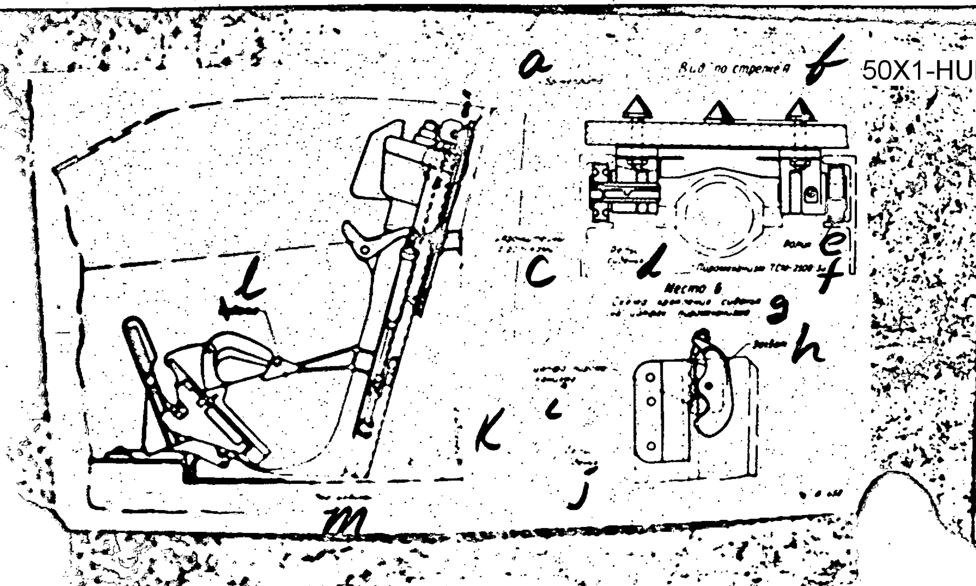

Рис. 7. Установка сиденья в кабине.

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Fig. 37. Placement of seat in cockpit.

a. armor plating; b. view at arrow A; c. brackets with rollers; d. seat rails; e. roller; f. TSM-2500-38 pyromechanism; g. Point B -diagram of attachment of seat to pyromechanism bearing pins; h. retainer; i. pyromechanism bearing pin; j. seat rails; k. frame 11 [?]; l. illegible; m. illegible.

On the inner cylinder of the TSM-2500-38 pyromechanism there is a coller with two bearing pins that go into the retainers on the seat and are locked in place by two catches. The retainers are pressed and locked by screws which press against the brackets when screwed in.

In flight, the pilot sits on the parachute which is stored in the bucket of the seat (this bucket can be raised or lowered by the pilot during flight). The bucket is electrically operated.

The pilot is harnessed to the seat by the safety-belt system at three points (two at the waist and one at the shoulders). The tension on the safety belts can be changed by means of a handle on the right side of the bucket.

Tension on the shoulder belt is accomplished by means of a spring, during operation, and by powder gases during ejection. In flight, the pilot can move his shoulders forward by 14^{+5}_{-10} mm and be held in this position. The catches for the tightened and deflected positions are controlled by a handle on the left side of the seat bucket.

There may be three ways of ejection, with and without protection by the canopy. Ejection without protection by the canopy occurs after the canopy has been first released. Pyromechanism TSM-2500-38 is activated by pressing the handles on the sides of the seat bucket.

Because of the fact that when ejecting with protection by the canopy the gap between the pressurised helmet and the canopy glass decreases, the gap must always be at least 50 mm.

Basic Data on the "SK" System

--maximum instrument speed at which ejection can be carried out safely	1100 km/sec hr
--ejection g-forces Pu	15-18
--braking g-forces Px at an instrument speed of 1100 km/hr	35-36
--maximum altitude of horizontal flight at which the pilot can be safely ejected	[blurred]
--maxmxa total design weight of the ejection seat	[blurred]
--weight of seat with inner ____ of the pyromechanism	[blurred]
--weight of hinged part of canopy	33 kg (?)
--weight of pilot and parachute, fully equipped	100 kg (?)

--useable pyrotechnic cartridges:

for TSM-2500-38 pyromechanism PK7-7M

for 215P pyromechanism ~~215Rx~~ 215R
for PK-3M-1 pyromechanism 215F

--parachute with capron belt system S-3

The design of the TSM-2500-38, 215F, 215P, and 215R pyromechanisms is similar to that examined in Book II of this description.

The Ejection Processes, with the Pilot Protected by the Canopy

(see Fig. 38)

Having decided to eject, the pilot presses the release levers [remainder illegible]

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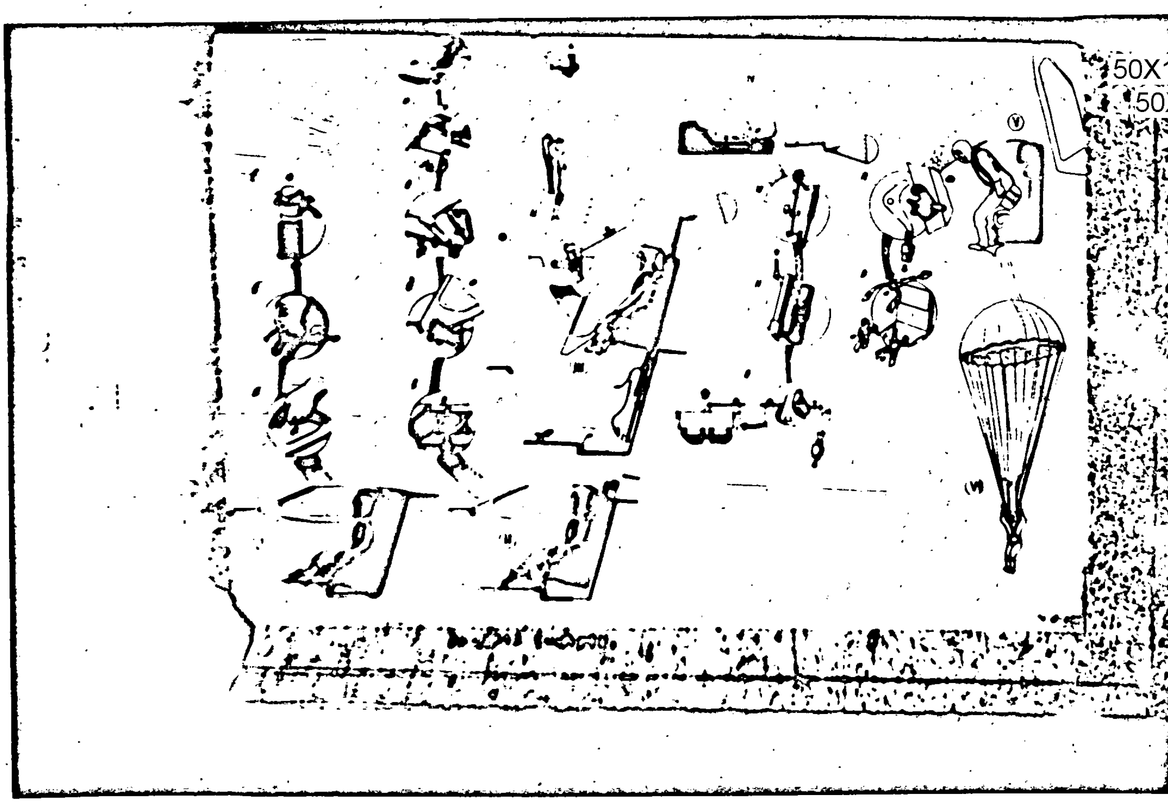

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[redacted]

Fig. 38. Ejection process, with pilot protected by canopy.

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2. Seat Framework (Fig. 39)

The framework of the seat is a rigid frame consisting of two steel vertical profiles--rails (3)--and two cast Elektron transverse trusses--the lower and upper ones (5).

Bucket (7), into which the parachute fits, is attached to the rails by means of guides (6). The lower truss is the housing for the reducer of the bucket-control system. Above the upper truss is armor-plated head rest (4) with a light porous plastic [illegible] pillow (cushion). It has a flap (1) which protects the pilot's head. When the canopy separates from the seat after ejection, the glass slides along this flap. To prevent flap (1) from scratching the glass it has a protective piece of [illegible] synthetic chamois (2) glued to it. On the canopy glass, at the point of contact with flap (1), there is a protective adhesive film.

3. Bucket-Control System (Fig. 40)

To improve piloting conditions, visibility during landing, and use of the instrument panel, the pilot can change, in flight, the position

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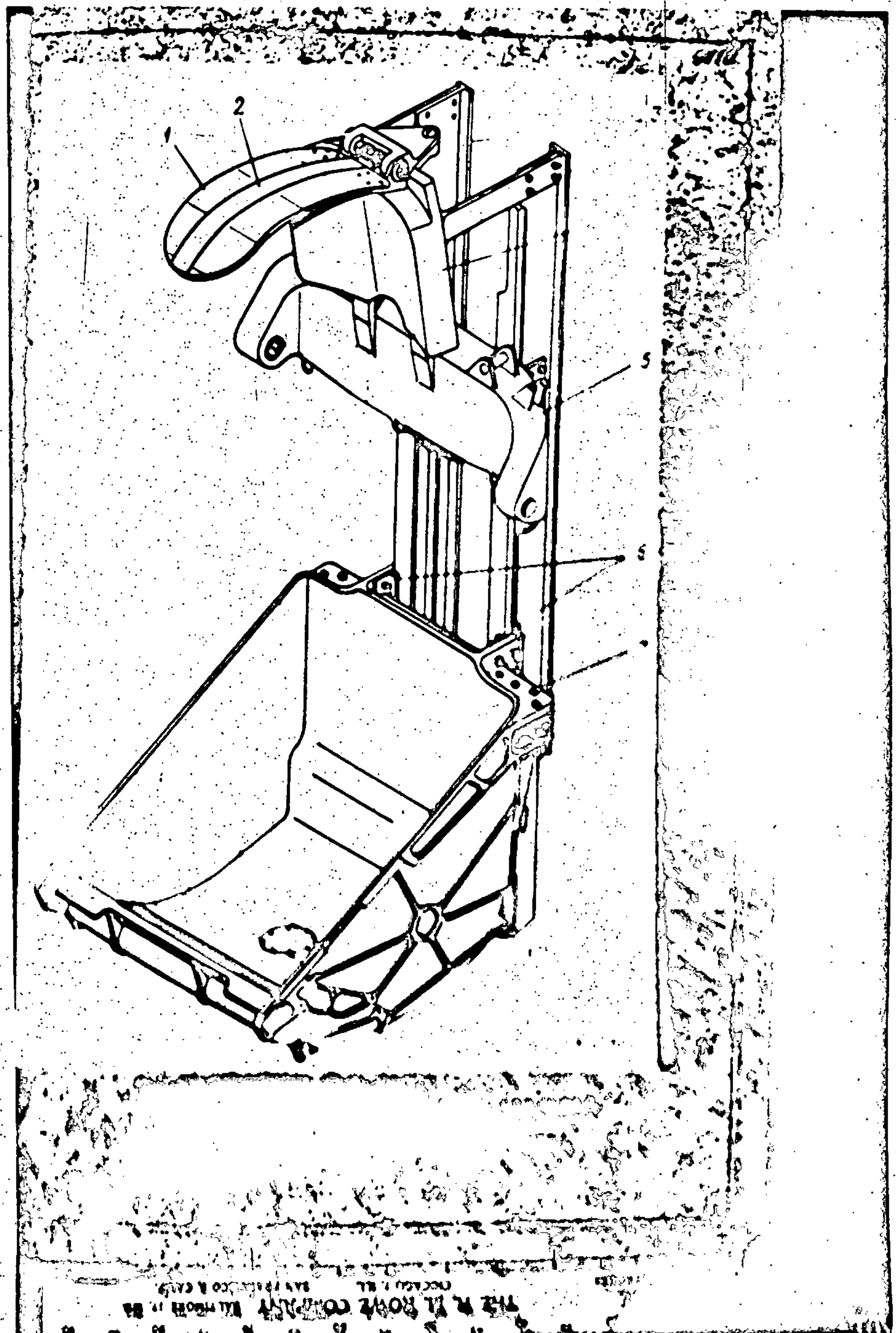

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Fig. 39. Seat framework. 1. flap; 2. synthetic chamois strip; 3. vertical profiles; 4. armor-plated head rest; 5. upper truss; 6. bucket guides; 7. bucket.

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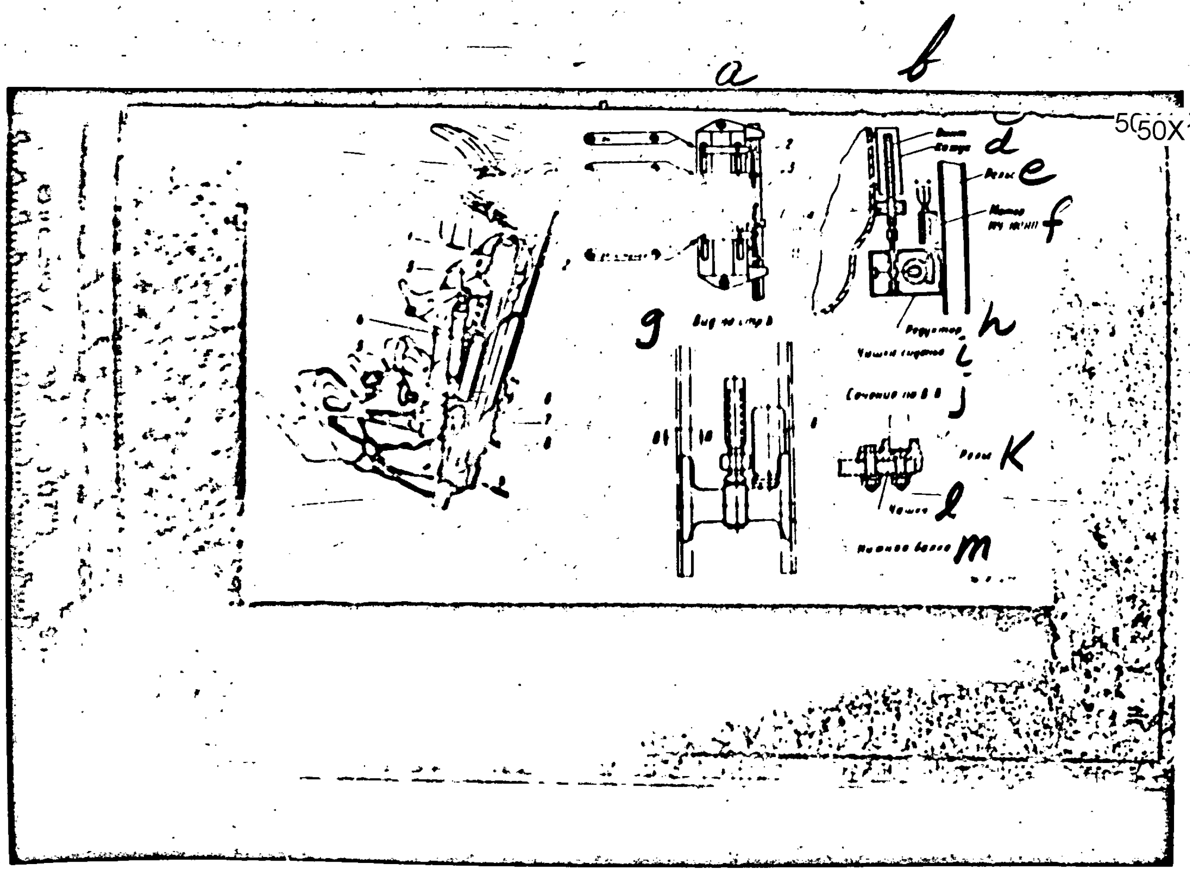

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Fig. 40. (caption illegible)

a. point A ; b. basic diagram of seat drive mechanism; c. screw; d. casing; e. rails; f. MU-100AP motor; g. view at arrow Б; h. reducer; i. bucket of seat; j. cross section at B-B; k. rails; l. bucket; m. lower truss.

of the bucket of the seat up or down, depending on his height. The maximum travel of the bucket is 90 mm.

The bucket is raised and lowered by means of motor (8) which, through a reducer, turns vertical screw (6) which passes through nut (7) which is rigidly attached to the bucket. Electric motor (8) and screw (6) are mounted on the lower transverse truss of the framework, which simultaneously serves at the reducer housing.

The reducer consists of two worm gears with a ratio of 1:144 (?).

[Remainder illegible]

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When adjusting the seat for theheight of the pilot, the minimum possible clearance between the canopy glass and the pilot's pressurized helmet is 50 mm.

Mechanism (1) is a housing in which are mounted two [remainder illegible]

The seat is height-adjusted as follows. The pilot, fully equipped, sits in the seat and moves the bucket up or down until his helmet is at least 50 mm from the canopy glass. Then the upper ring is set opposite the arrow which shows the pilot's height, and is fixed in this position by locking screw (10).

The mechanism has four indicator arrows (3) which show the maximum height of the pilots in the sitting position, which makes it possible to ..... adjust the seat for any pilot.

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4. Harness System

/Fig. 41/

Immobilization of the pilot is required during catapulting and during flight, when the inertial forces acting on the pilot are directed forward, sideways, or upward. This happens when the plane goes into a dive, during sudden deceleration, during flight in turbulent air, during a spin, etc.

The forces tearing the pilot forward from the seat may be especially great during a forced landing outside the airfield.

The immobilization of the pilot is achieved with the aid of the harness system

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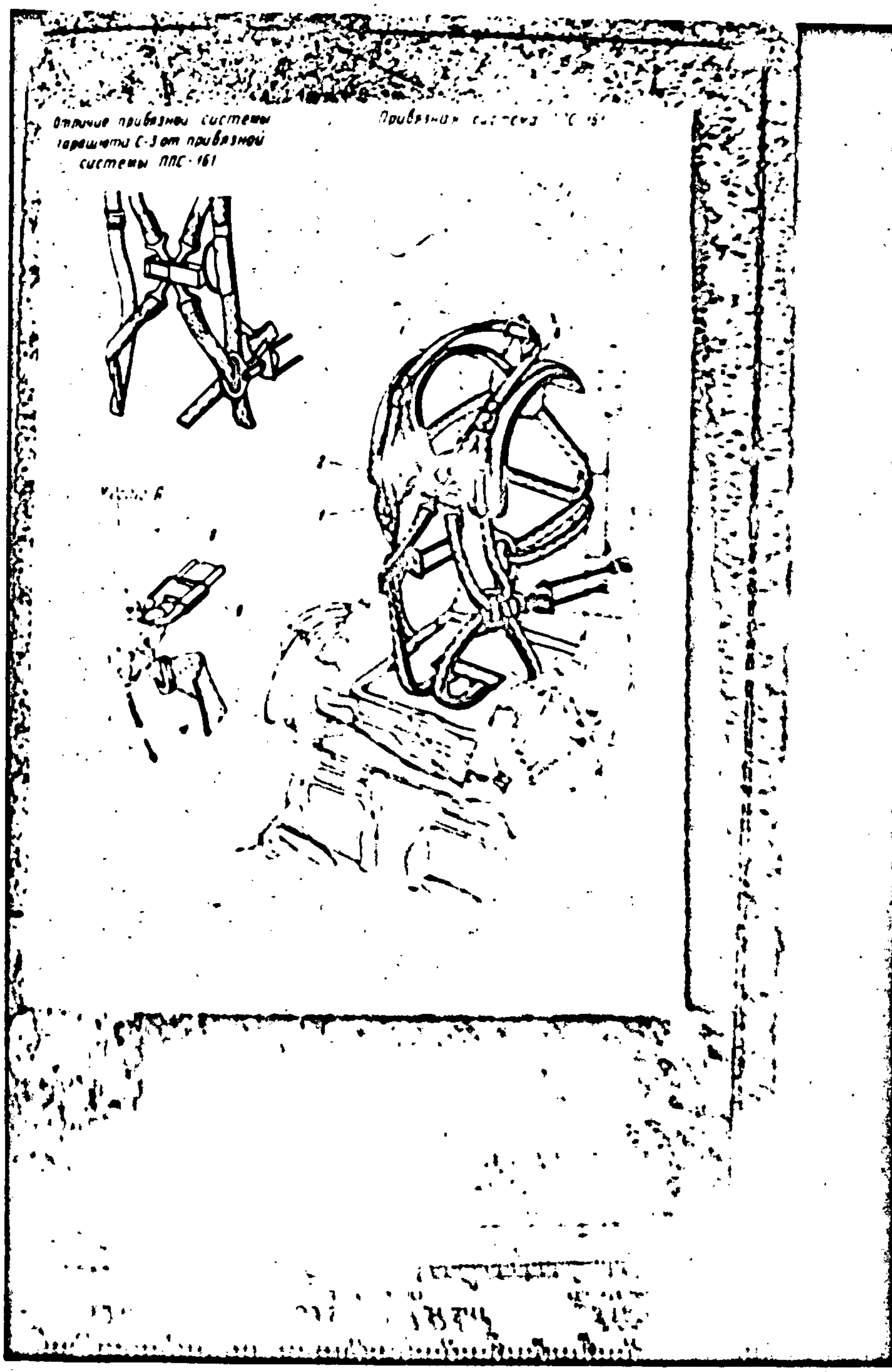

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Fig. 41

Difference between the harness system of the S-3 parachute and the harness system of the PPS-161

Harness of the PPS-161

Position A

(remainder illegible)

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The harness system is attached in the zone around the waist through leg straps with the aid of pulleys /5/. The leg straps of circular cross section are first passed through the side buckles before being locked in the central lock /1/.

The harness system

(remainder illegible)

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case the stress of the spring does not act on the pilot. During catapulting, if the pilot is in the deflected position, he is forceably pulled to the back of the seat and is ~~immobilized~~ kept in this position.

The shoulder attachment includes; shoulder-attachment lock /11/ with strap /14/; pyromechanism 215R with power spring /17/; deflected-position arresting mechanism /20/; handle of shoulder attachment /23/ and cable line /7/.

The system operates as follows. In the pulled position the pilot's shoulders are prevented from moving forward by lock /11/. ~~[illegible]~~

(remainder illegible)

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When handle /23/ is pushed down, drum /9/ stops, and the pilot is kept in the pulled position.

The shoulder-attachment lock consists of drum /9/, on one face of which ratchet /8/ is rigidly attached. Catch /33/ stops the drum and does not allow it to turn when strap /14/ tightens. On the other face of the drum (illegible) .

Strap /14/ is attached to the drum by hinged detainer /34/, which is kept in the operating position by rod /12/. When rod /12/ is pulled out, detainer /34/ folds inside the drum and releases the strap.

Cable /13/ bends roller /18/ of pyromechanism 215R and is secured on the seat housing.

Pyromechanism 216R consists of two cables: inner /16/ and outer /15/.

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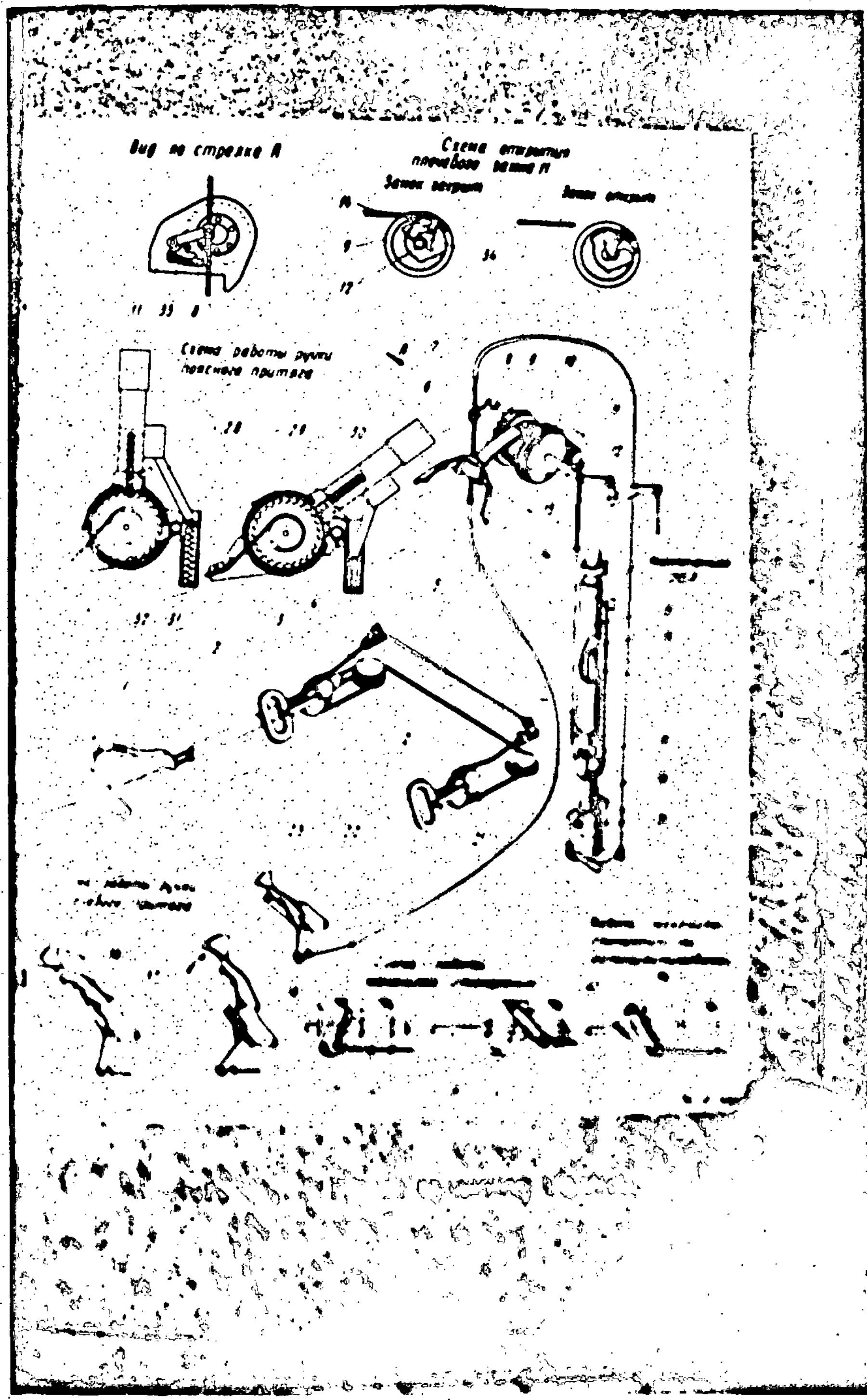

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View along arrow A

Method of opening shoulder lock 11

Lock closed

Lock open

Method of operating the handle of the waist attachment

(remainder illegible)

Method of operating the handle of the shoulder attachment

Fig. 42. Attachment of harness system.

1 - handle of waist attachment;

2 - pulley with clasp;

3 - guide roller;

4 - waist-attachment lock;

5 - connecting rod;

6 - rocker;

7 - xxxxx cable;

8 - ratchet;

9 - drum;

10 - roller;

11 - shoulder-attachment lock;

12 - locking rod;

13 - attachment cable;

14 - strap;

15 - outer tube of pyromechanism 215R;

16 - inner tube of pyromechanism 215R;

17 - spring;

18 - roller;

19 - rod;

20 - deflected-position arresting device;

21,22 - waist-attachment cable;

23 - handle of shoulder attachment;

24 - handle ring;

25 - casing ring;

26,31,33 - catches;

27 - spring;

20 - plunger;

29 - xxxxx detainer;

30 - handle;

32 - roller;

34 - hinged detainer;

35 - trigger-stop;

36 - actuating arm;

37 - cantilever;

38 - folding part;

39 - detainer;

40 - cantilever; 41 - actuating arms;

42 - screw.

The arresting mechanism /20/ is constructed as follows. The casing of the mechanism consists of two parts, i.e., a stationary cantilever /40/ and a folding part /38/, which is hinged onto the cantilever and is immobilized by a screw /42/. Inside the casing is a rod /19/ connected with an outer tube by pyromechanism 215R. On the folding part /38/ is a rotating detainer /39/ and ~~a rocker~~ actuating arm /41/ sitting on the same shaft with the detainer /39/. The ~~rocker~~ actuating arm /41/ is connected with a handle /21/ by a cable line. When the rod /19/ moves upwards, detainer /39/ turns under the action of the spring and stops the rod from moving downward.

In the case of catapulting

(remainder illegible)

In order to deflect the handle, it is necessary to unlock it by pressing the upper end of the trigger toward the seat cord, and then pull the handle toward oneself.

Attachment of Waist Belts

The system of attachment of the waist belts makes it possible to control the force pressing the pilot toward the seat.

The system includes: shoulder-attachment handle /1/, two pulleys with buckles /2/ located on the harness system, two waist-attachment locks /4/, in which the ends of cables /21 and 22/ are secured, and the elements of the wiring cables - ~~that~~ guide rollers /3/, etc.

The tension of the cables of the waist harness may be increased by rocking movements of lever /30/.

To attenuate the tension it is necessary to press lever /30/ forward up to the stop, after which cables /27/ can be

(remainder illegible)

Catch /31/, pressed by the spring, enters the casing from above and stops roller /32/. Handle /30/ sits with its ring /24/ on the casing ring /25/ and can be rotated forward. Inside the handle is detainer /29/, which is squeezed out by spring /27/ and meshes with the teeth of the ratchet. With the aid of catch /26/ the detainer can be pressed upward. In this case the lever will rotate, without causing the ratchet wheel to rotate.

When lever /30/ is moved forward, roller /32/ turns and winds up the cables.

(remainder illegible)

For automatic return of the handle (30) to the initial position there is on the casing a special spring, which with the aid of plunger (28) deflects the handle backward. /26

A description of the shoulder-attachment locks is given in the section "System of Opening the Attachment Locks and the Leg Clamps".

6. System for Controlling the Firing of Pyromechanism TSM-2500-38 (Fig. 43)

Pyromechanism TSM-2500-38 is actuated by pulling out pin (4), which is connected by a cable line to the handrails of the seat (1). The firing can be actuated by one or both handrails.

The handrail of the seat (Fig. 44) is constructed in the following way. Hinged onto casing (7) are starting lever (4), safety lever (2), and safety clip (3). The fire-control line is led to the starting lever (4).

In the normal position the starting lever is prevented from being accidently actuated with the aid of bolt (5), the head of which enters the groove of the safety lever. When only the starting lever is pressed down, the head of the bolt strikes against catch (2) and stops the starting lever. When only the safety lever is pressed down, plate (8) strikes against the head of bolt (5) and stops the safety lever. Firing is possible only when both levers, the starting [illegible] pressed down

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closed position of the firing levers is accomplished in accordance with the superimposed positions of the white lines drawn on the handrails.

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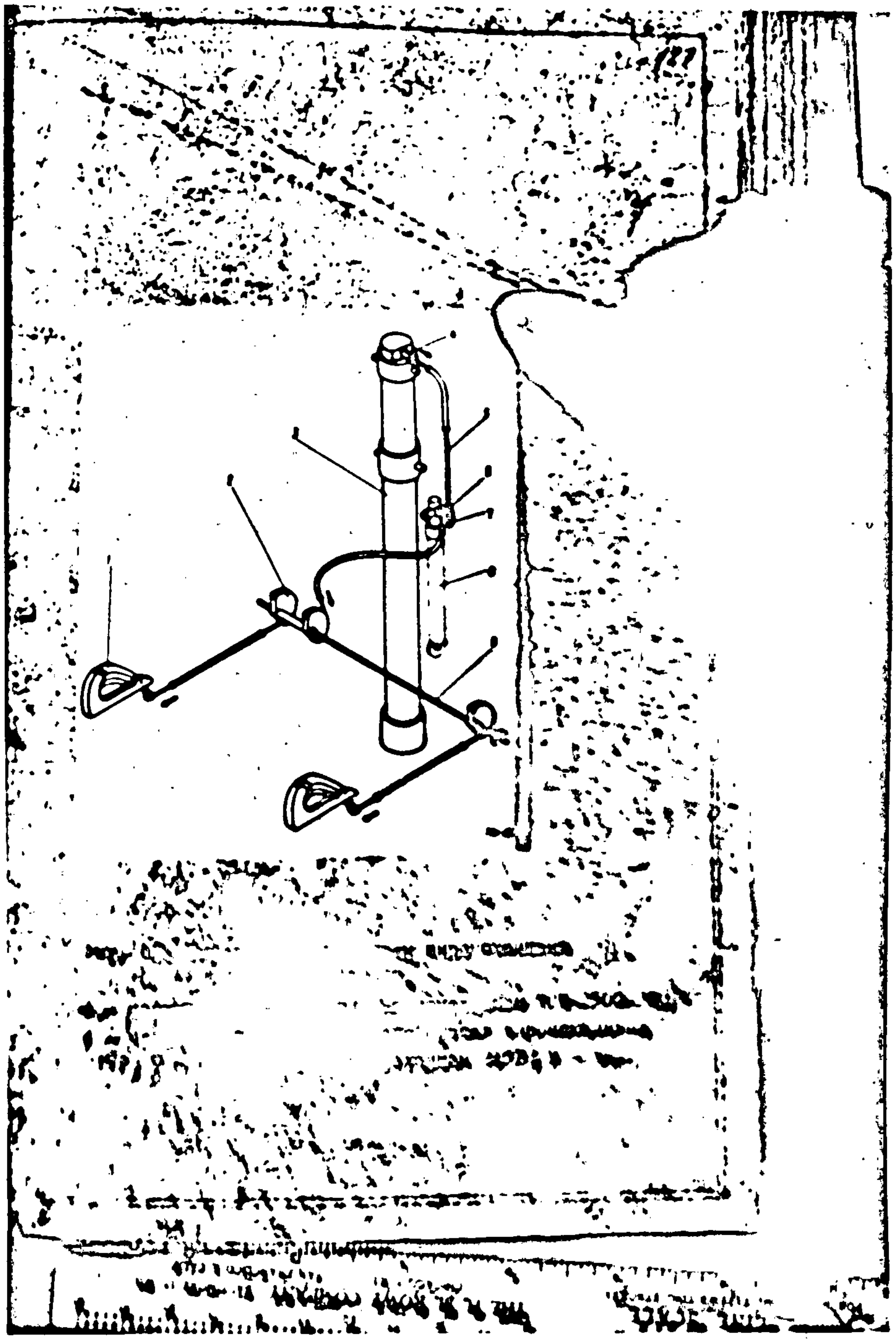

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Fig. 43. (illegible)

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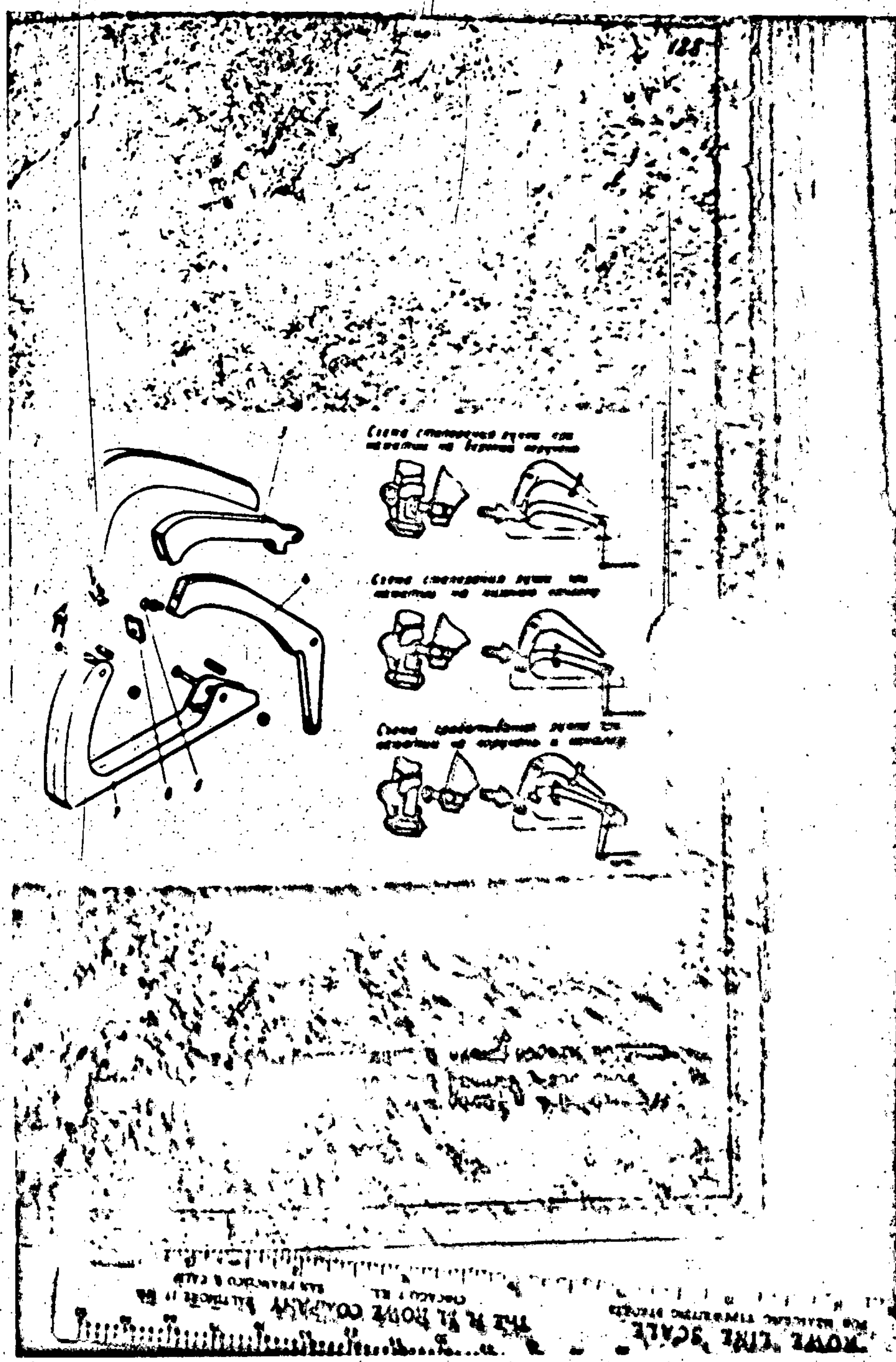

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Fig. 44.

Schematic Drawing of the Armrest Mechanism

1-catch; 2-safty lever; 3-checking device; 4-trigger lever; 5-bolt; 6-plate; 7-base.

In this case bolt /5/ moves upward and emerges from the groove of the safety lever.

Safety clip /3/ closes the gap between the starting and safety levers and protects the hand from being pinched when pressing the handrail.

A cable line leads from the starting levers (see Fig. 43) to a common shaft /9/ with the sectors /2/, and from the shaft goes off the right-hand sector to the starting lever /6/ of pyromechanism 215R. From lever /6/ the line is led with the aid of a ring /7/ with an opening, connecting rod /5/, and a cable to the pin /4/ of the pyromechanism.

When the handrails are pressed, first pyromechanism 215R is actuated, and the pilot is pulled back.

Then lever /5/

(remainder illegible)

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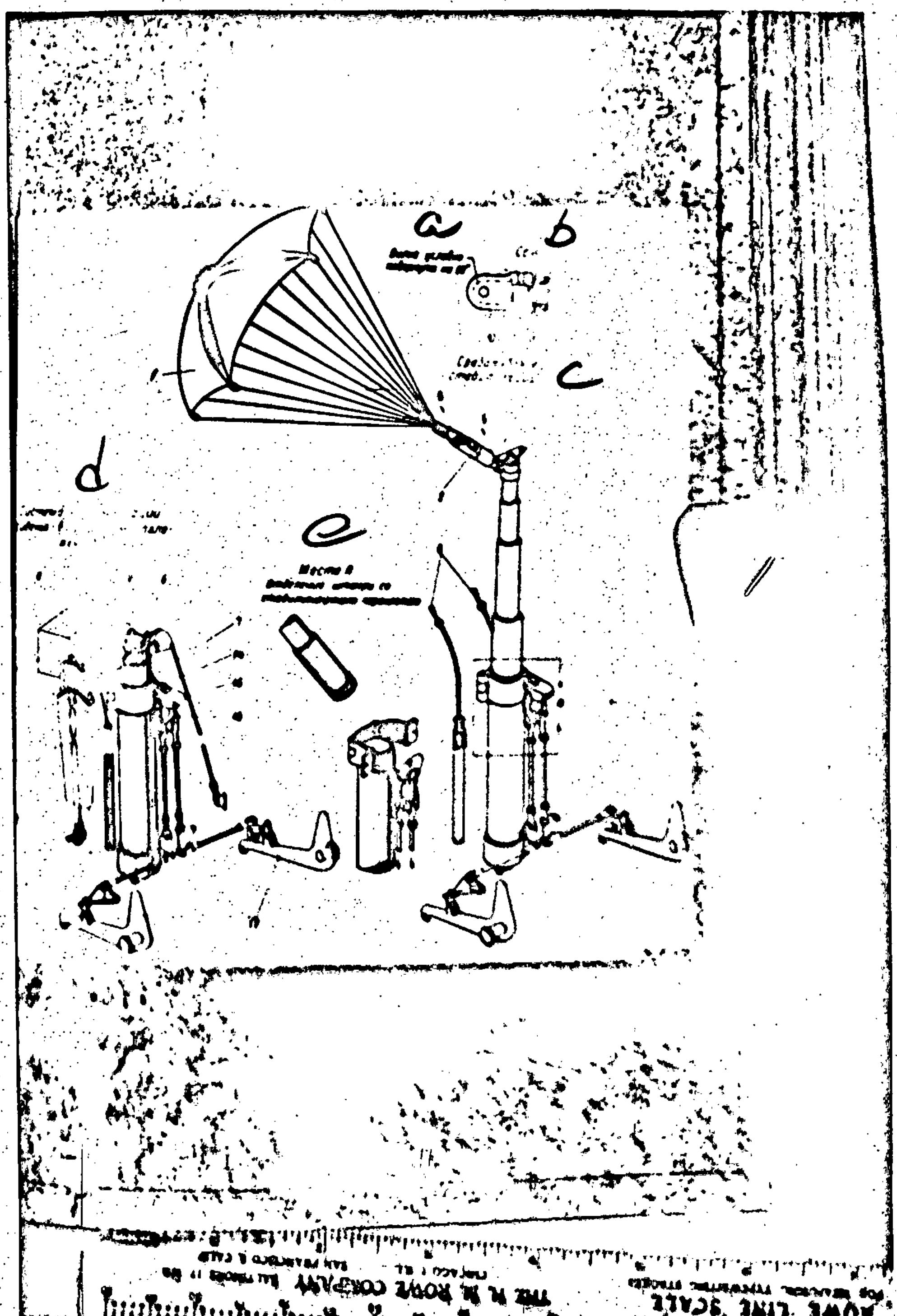

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Fig. 45. Stabilization system of seat.

a) Prong ~~xxxx~~ rotated arbitrarily through 90^0

b) Cross section

c) Stabilization triggering

d) Stabilization system of ~~xxxx~~ seat in initial position

e) Position A
Separation of bar from stabilizing parachute

Fig. 45. Stabilization system of seat.

1 - stabilizing parachute;

2 - adapter;

3 - parachute container;

4 - cover of parachute top cords;

5 - clip;

6 - pin of pyromechanism 215P;

7 - cable;

8 - clip;

9 - pin;

10 - prong;

11 - shaft;

12 - holder;

13 - lug;

14 - collar;

15 - clip;

16 - prong;

17 - canopy-separation levers.

For assured and reliable opening of the parachute before the seat runs off the rollers the parachute is introduced into a jet in the container at the very beginning of the catapulting with the aid of pyromechanism 215P, the pin /6/ of which is connected by cable /7/ to the aircraft structure and is pulled out when the seat moves 30-50 mm.

The pyromechanism, ~~moving~~ drawing apart, knocks off the ~~lid~~ hatch cover on the rear arc of the canopy, withdraws the top cords from the cover, and introduces the container with the parachute into a jet. The parachute container is secured to the head of pyromechanism 215P with the aid of a special clip /8/ and two pins /9/ connected by cables to the seat structure. When pyromechanism 215P moves 200 mm, the cables tighten and withdraw pins /9/. The container is pulled off the parachute by the air jet; the parachute canopy is filled and begins to rotate.

~~The~~ Adapter /2/ is a radial thrust ball bearing and consists of shaft /11/, which carries prong /10/, and clamp /12/ in which lug /13/ is embedded. Shaft /11/ rotates in clamp /12/ on bearings.

Fifteen seconds after catapulting, immediately before the separation of the canopy, the bar of pyromechanism 215P is released together with the parachute. For this purpose the upper part of the outer ~~pipe~~ tube of pyromechanism 215P is removable and is attached with the aid of collar /14/, which con[illegible]

Collar /14/ is closed on the tube by clamp /15/, which is suspended by hinges from the seat frame. Connected to clamp /15/ is prong /16/, which with the aid of connecting rods and actuating arms is connected to xxx canopy-separation levers /17/. When levers /17/ are turned, clamp /15/ releases the collar, which under the action of the load coming from the stabilizing parachute, opens, and the upper part of the outer tube together with the inner tube, the piston, and the stabilizing parachute is separated from the seat.

8. <u>Leg-clamp system</u> /Fig. 46/

The leg-clamp system is intended to prevent the pilot's legs from being spread apart by the air jet or by inertial forces during the catapulting. The system is mounted on leg supports and is actuated automatically by sharply dropping the legs on the supports. The system consists of clamp /1/ and lever /2/, which are connected to each other by connecting rod /13/. During catapulting the pilot's legs press on levers /2/, rotate them, and close the outlet from the support by means of a clamp /1/. The system is kept in the closed position by stop /12/, with the aid of a toothed sector mounted on lever /2/.

In order to open the leg-clamps after catapulting, stop /12/ is hinged. In the working position it is held back by lever /10/, the second end of which abuts against actuating arm /9/. Both actuating arms /8/

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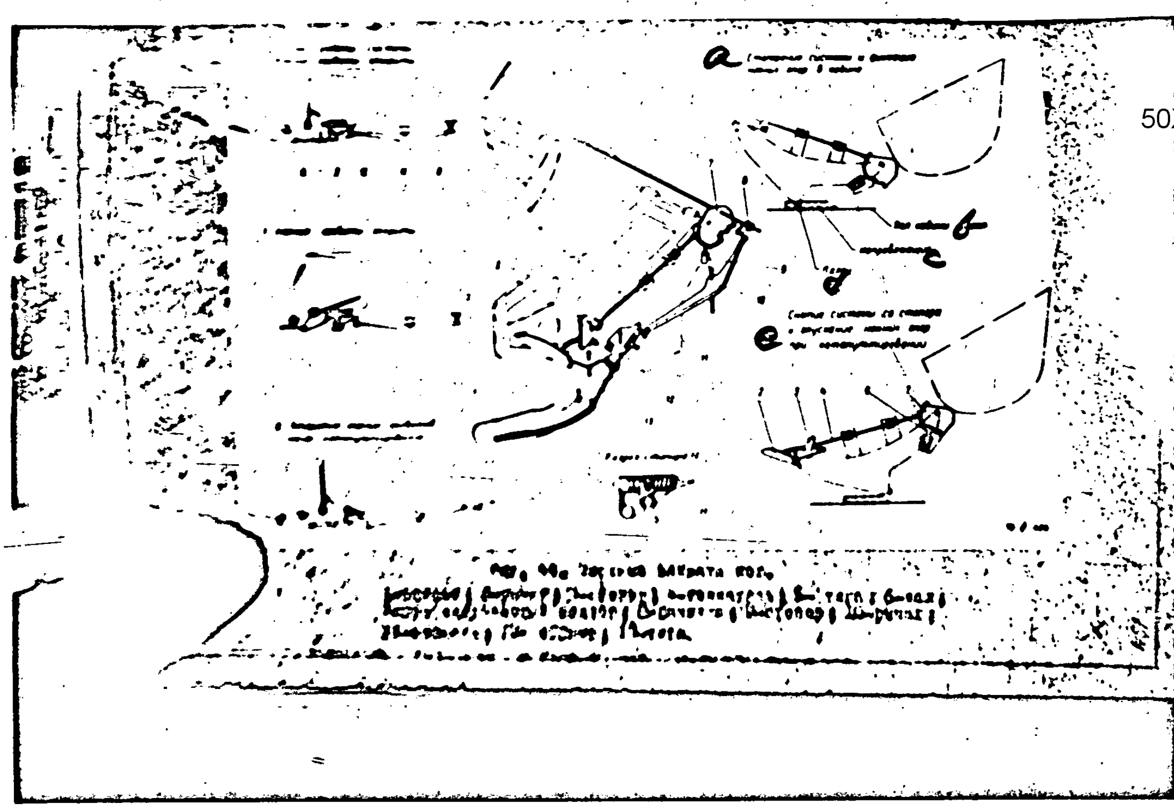

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Fig. 46. Leg-clamp system.

1. Clamp; 2. lever; 3. lever stop; 4. push rod; 5. connecting rod; 6. /illegible/; 7. profiled sector; 8. /illegible/; 9. stop

10. lever; 11. catch; 12, stop; 13. connecting rod.

a) securing of the system and the fixing of the foot rests in the cockpit

b) cabin floor

c) guide

d) cam

e) releasing the system from the locked system and lowering the foot rests when ejecting.

/remainder illegible/

by ~~plunger~~ push rod /4/, the second end of which abuts against profiled sector /7/ located on the rotational axis of the support.

During operation, when the seat is in the cabin, the leg supports are raised upwards. Moreover, the end of push rod /4/ abuts against the cavity of sector /7/, and stop /3/ keeps lever /2/ in the open position. During catapulting the leg supports drop down under the action of the pins, ~~sliding~~ both sliding and guiding, which are located on the floor of the cabin. Push rod /4/ is pressed out by the projection of sector /7/ and withdraws stop /3/ from the groove in the toothed sector.

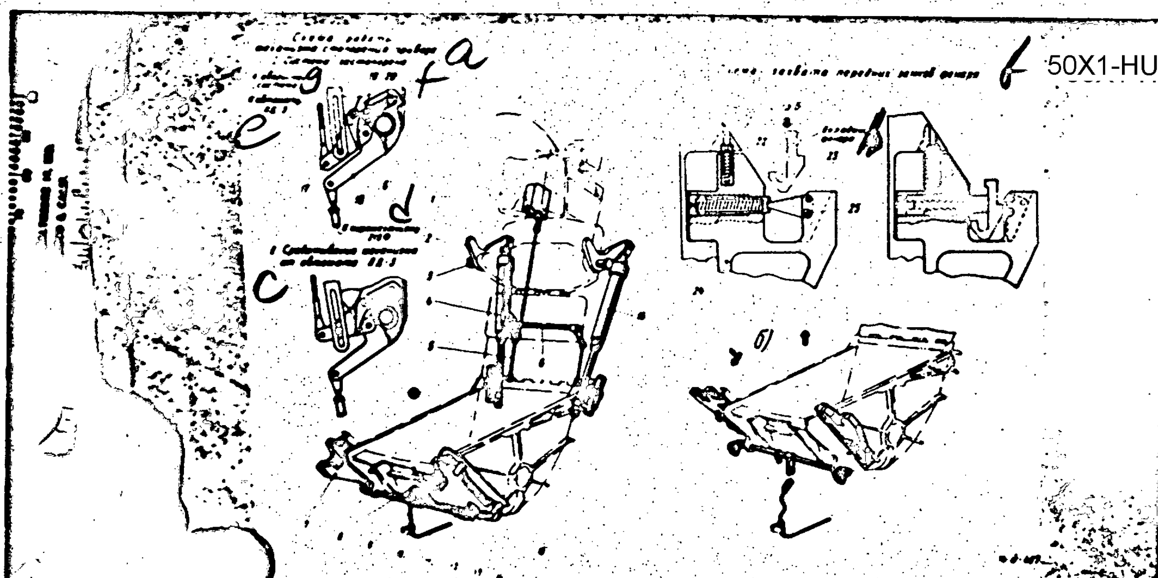
In the descended position the supports are immobilized by stop /9/. If the clamps should close accidently, they can be opened by pressing catch /11/ against the pin of stop /12/.

9. <u>System of Clamping and Seperating Canopy</u>

/Fig. 47/

The clamping of the canopy during catapulting is accomplished with the aid of pins /3/ and hinged supports /7/.

Supports /7/ are rigid brackets, which are hinged onto the seat fastening.



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Canopy clamping and separation system.

Fig. 47.

a) Operation of drive stopping mechanism

b) Clamping system of forward locks of canopy

c) Triggering of mechanism by automatic machine AD-3

d) To pyromechanism 2159

e) To automatic machine AD-3

f) Arresting system

g) To emergency system

h) canopy bearing

Fig. 47. Canopy clamping and separation system.

1 - automatic time machine AD-3;

2 - canopy separation levers;

3 - pins;

4 - drive stopping mechanism;

5 - connecting rod;

6 - shaft;

7 - hinged support;

8 - xxxkxxx actuating arm;

9 - cable;

10 - bracket;

11 - tube;

12 - shaft;

13 - detainer;

14 - screw;

15 - spring;

16 - pyromechanism 215F;

17 - lever;

18 - actuating arm;

19 - push rod;

20 - spring;

21 - bracket;

22 - catch;

23 - detainer;

24 - pivot;

25 - screw.

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In the upper parts of the supports there are grooves into which the bushings of the forward clamp locks enter during clamping of the canopy.

The bushings strike against detainer (23) and turn it downward, cutting screw (25) and freeing pivot (24), which under the action of a spring emerges and closes the bushing.

During operation the supports are pressed against the seat fastening and are held fast with the aid of detainers (23), which sit on shaft (12).

Shaft (12) through actuating arm (8)

(remainder illegible)

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The separation of the canopy from the seat after catapulting is realized by levers /2/, which are rotated by pyromechanisms 215F /16/. Levers /2/ at the beginning of their motion ~~xxxxxxx~~ strike against the triggers ~~which open~~ [illegible] the forward locks-clamps /see Fig. 30/ and open them. At the same time the bar of the stabilizing parachute is released. After moving further, levers /2/ press on the ~~xxxxx~~ detainers of the rear canopy clamp lock~~x~~ and rotates it on the seat pivots. When the canopy ~~xxxxx~~ rotates through ~ 100-120^0, the catches of the rear locks of the clamp strike against the bosses of the pins and open the locks. The canopy is separated from the seat.

Pyromechanism 215F is actuated by the rotation of automatic machine AD-3 /1/ through the arresting mechanism of drive /4/, transverse shaft /6/, and connecting rods /5/. A description of pyromechanism 215F is given in the second book of the technical description.

The arresting mechanism of the drive is a device which ~~xxxxx~~ prevents shaft /6/ from accidentally turning. It consists of actuating arm /18/ and lever /17/ which sits on it. Lever /17/ is pressed loose by spring /20/ through push rod /19/ and its stopping pin enters the [illegible] socket. When automatic machine AD-3 is actuated, lever /17/ is deflected, the pin emerges from the ~~frame~~ [illegible] socket, and actuating arm /18/ rotates.

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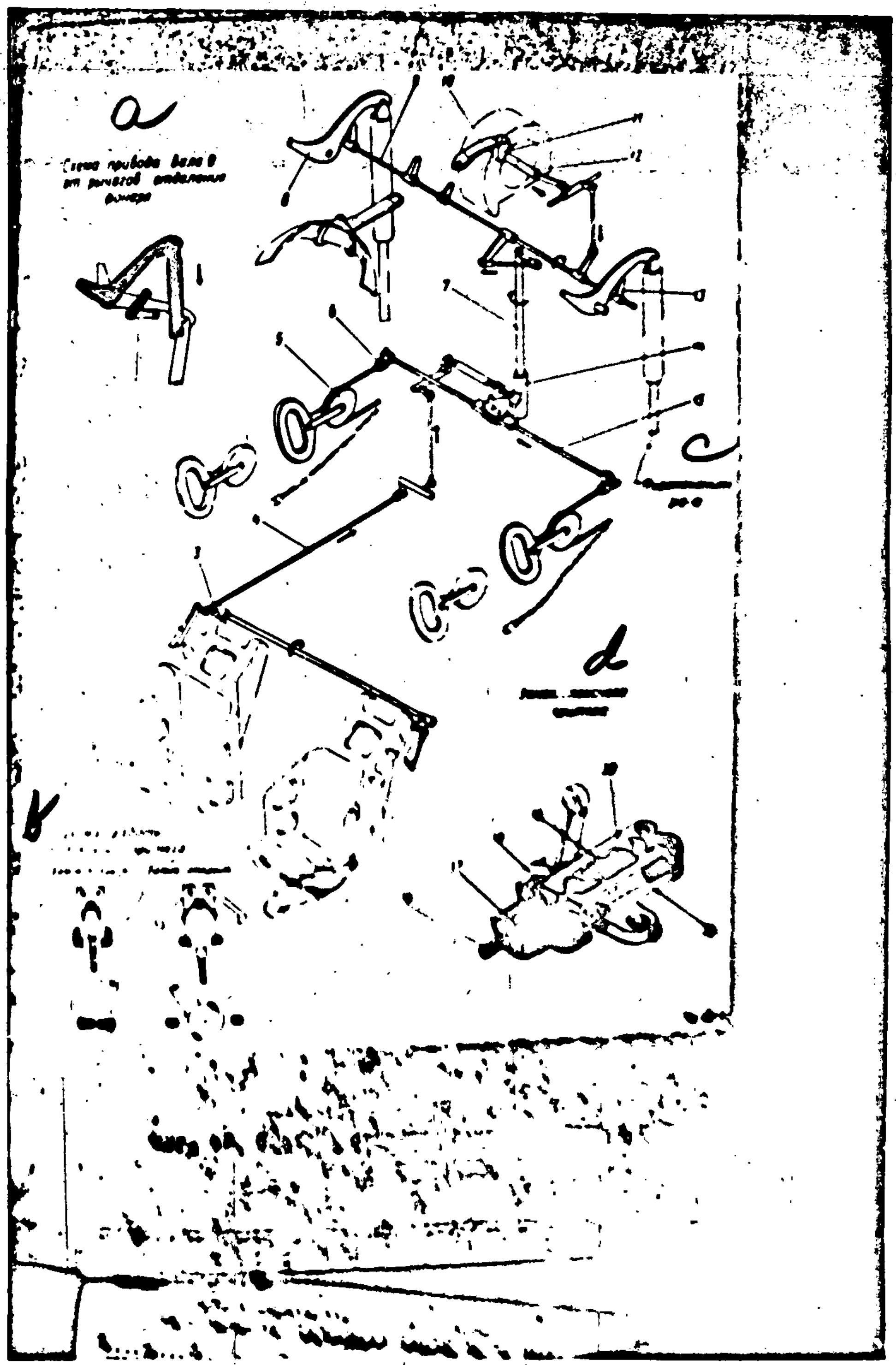

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10. System for Opening the Harness Locks and the Leg Clamps

/Fig. 48/

After separation of the canopy from the seat during catapulting the harness locks and leg clamps open. The shoulder lock is opened by ~~the~~ pulling out locking rod /12/. ~~Ex~~ Waist locks /6/ are opened by rotating actuating arms /18/. The leg clamps are opened by rotating actuating arms /3/.

The system for opening the locks consists of a drive shaft /9/, a vertical shaft /7/, and a set of rods and pins. When pyromechanisms 215F are actuated, shaft /9/ is rotated by the canopy-separation levers /8/ with the aid of actuating arms /13/. Levers /8/, rotating, come to rest on actuating arms /13/ and, pressing them downward, turn shaft /9/.

Actuating arm /14/, sitting on vertical shaft /7/, slides upward or downward along the shaft together with the seat fastening, thus ensuring normal operation of the system in any position of the fastening.

The waist-harness lock is constructed and operates as follows. Hinged in casing /21/ are two clamps /20/, which are drawn apart by spring /19/.

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Fig. 48. System for opening the harness locks and leg clamps.

a) System for driving shaft 9 from canopy separation levers

b) System of operation of waist harness

Lock closed   Lock opened

c) Pyromechanism

d) Waist-harness lock

Fig. 48. System for opening harness locks and leg clamps.

1 - leg support;

2 - lever for opening leg clamps;

3 - actuating arm;

4 - connecting rod;

5 - pulley with harness;

6 - waist-harness lock;

7 - vertical shaft;

8 - canopy-separation levers;

9 - drive shaft;

10 - shoulder-harness strap;

11 - hinged detainer;

12 - locking-rod;

13 - actuating arm of system;

14 - sliding actuating arm;

15 - connecting rod for opening the waist-harness locks;

16 - waist-harness cable;

17 - nut;

18 - actuating arm;

19 - spring;

20 - clamp;

21 - casing.

The end of the waist-harness cable /16/, when pressed on by a bushing, enters the casing and is locked by clamps /20/, which are held in the closed position by the projections of actuating arm /18/. When actuating arm /18/ rotates, clamps /20/ are released, and the cables are withdrawn from the lock.

For proper separation of the pilot from the seat the opening of the locks occurs in a definite sequence. At first the leg clamps open, then the shoulder lock, and finally the waist locks.

II. Emergency system for driving pyromechanisms 215F and opening harness locks. /Fig. 49/

The emergency system serves to drive pyromechanisms 215F in case of failure of automatic machine ~~(illegible)~~ AD-3 and to open the harness locks and leg clamps

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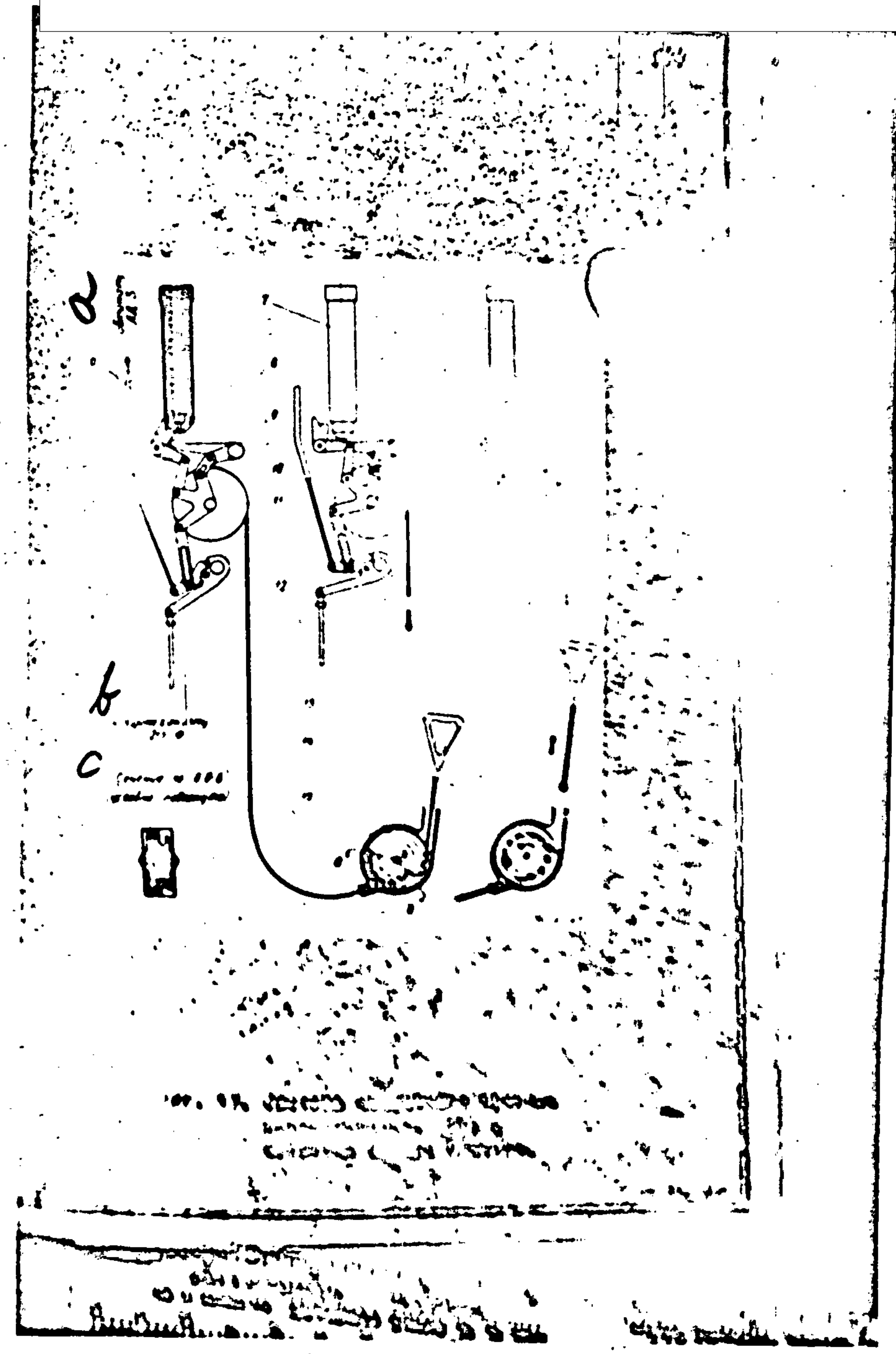

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Fig. 45. Emergency system for driving pyromechanisms 215F and opening harness locks.

a) automatic machine AD-3

b) to pyromechanism 215 F

c) cross section at A-0-5

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Fig. 49. Emergency system for driving pyromechanisms 215F and opening harness locks.

1 - locking drive mechanism;

2 - stirrup;

3 - three-arm lever;

4 - actuating arm;

5 - detainer;

6 - rod;

7 - spring amplifier;

8 - lever;

9 - drive shaft of system for opening harness locks;

10 - stirrup;

11 - roller;

12 - cable;

13 - emergency holder;

14 - roller;

15 - casing.

When holder (13) is pulled out "toward itself", roller (11) rotates together with lever (3), and the following operations occur in succession: pyromechanisms 215F and spring amplifier (7) are switched on, ~~xxxxxxxx~~ and shaft (9), which drives the lock-opening system, rotates.

The system for opening the harness locks in this case is analogous to the one described in the section "System for Opening Harness Locks and Leg Clamps". The difference lies in the method of rotation of the drive shaft (9).

Spring amplifier (7) consists of a casing, in which there is a rod (6) pushed by the spring. The rod is kept in the withdrawn position by detainer (5).

When roller (11) rotates together with lever (3), detainer (5) turns with the aid of actuating arm (4) and releases rod (6), which strikes against lever (8), which sits on ~~thx~~ shaft (9), and aids in turning it.

Holder (13) is connected with cable line (12) with the aid of roller (14) mounted in casing (25). After the locks open holder (13) is pulled out of the roller and remains in the pilot's hand.

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12. Stop system (Figs. 50, 51)

In order to prevent ~~xxx~~ accidental starting of the mechanisms, there are two stop systems: an operational system, for stopping the seat mechanisms in the cabin, and a ground mechanism used when the seat is outside the cabin.

The operational system stops (in sequential order)

pyromechanism TSM-2500-38	(stop No. 1)
pyromechanism 215P	(stop No. 4)
handrails	(stop No. 7)
emergency release handle	(stop No. 8)
membrane valve	(stop No. (illegible))
safety housings	(No. 9)

The ground system stops (in sequential order)

pyromechanism TMS-2500-38	(stop No. 1)
pyromechanism 215R	(stop No. 2)
pyromechanism 215F	(stop No. 3)
pyromechanism 215P	(stop No. 4)
hinged supports	(stop No. 5)
leg supports in the upper position	(stop No. 6)

For convenience of use the stops and the mechanisms which are to be stopped have the same numbers stamped on them; these number determine the sequence in which each stop is arranged.

In Fig. 51 the numbers of the ~~stopping-places~~ stopping locations are given in accordance with the stop marking.

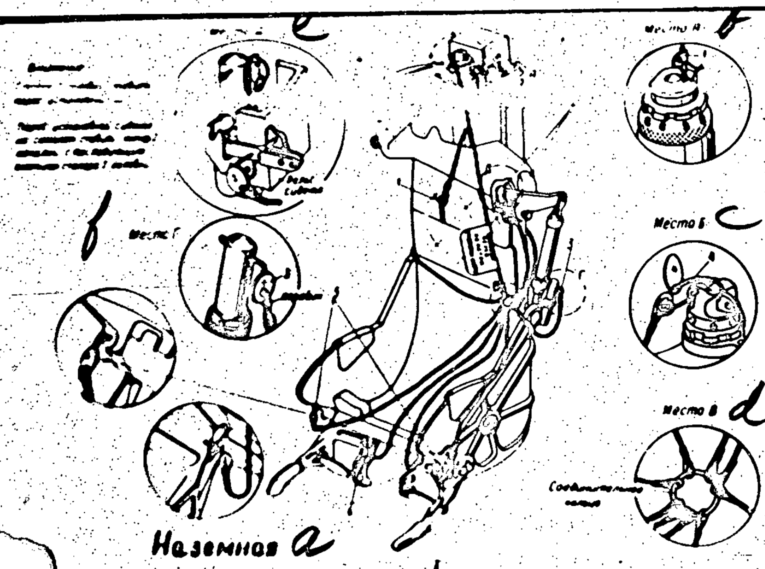

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Fig. 50. Ground system of stops

a) Ground b) location A c) location B d) location C e) location D

f) location E

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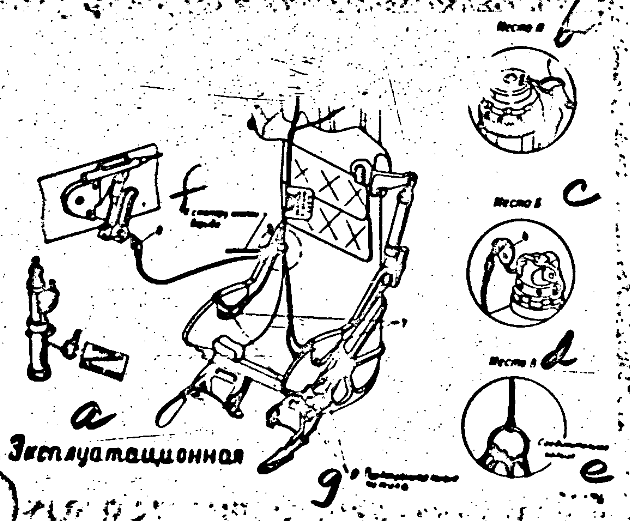

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Fig. 51. Operational stop system.

a) Operational b) location A c) location B d) location C

e) joint ring f) to the explosion-button ~~xxx~~ stop

g) safety housings

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III. THE WING

I. General Information

(Fig. 52)

The wing of the plane is delta-shaped with a sweepback angle of 57^0 along the leading edge. The trailing edge makes an angle of 90^0 with the axis of the fuselage.

The wing profile is made out of a high-speed symmetrical profile.

Basic Geometrical Data on the Wing

Area	23 m^2
Span including the part beneath the fuselage	7.154 m
Chord along the axis of the plane	5.97 m
Setting angle	0^0
Dihedral angle	2^0

On the wing are flaps with a sliding rotational axis and an area of 2 x 0.935 m^2 and ailerons with an axial aerodynamic compensation with an area of 2 x 0.44 m^2 (on the rotational axis).

There is one wing fence on the upper surface of each wing cantilever. The presence of fences improves the longitudinal stability of the plane at large angles of attack.

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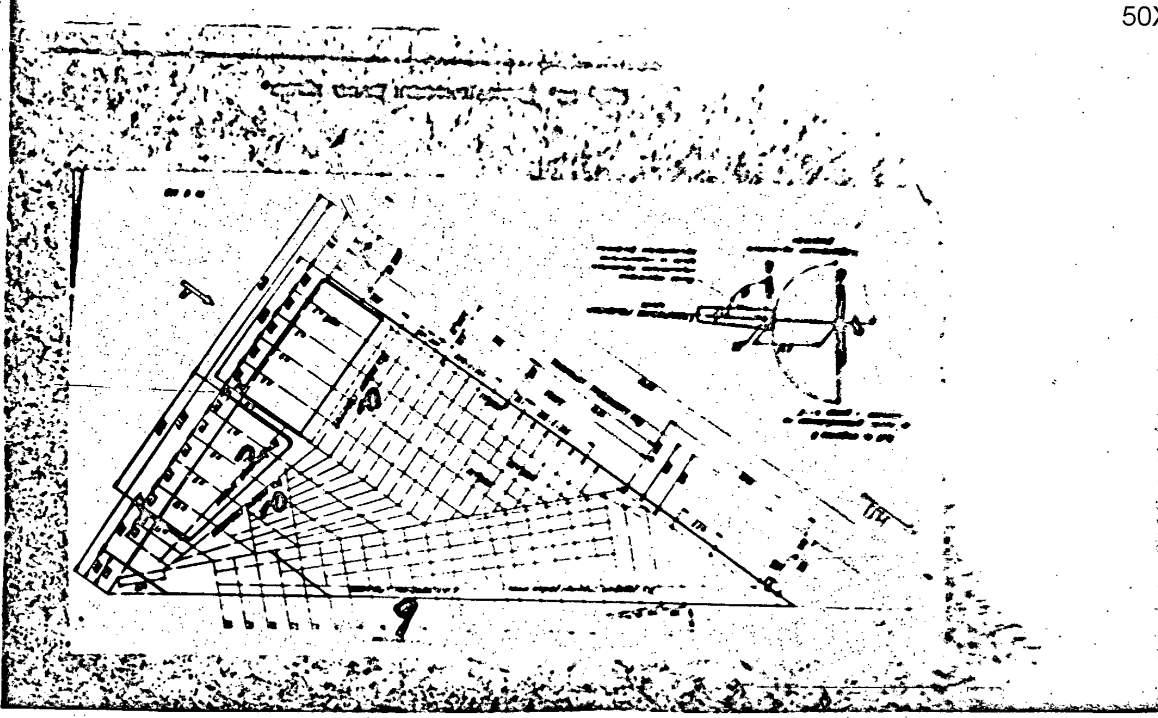

Fig. 52. /illegible

a. axis of rear stringer

b. axis of front stringer

c. axis of gyration of aileron

The projecting parts on the wing are covered by fairings: on the upper surface the fairing of the aileron actuating arm, on the lower surface the fairing of the flap rail.

Wing Design

(Fig. 53)

The wing consists of two cantilevers. The framework of each ~~xxxxxxx~~ cantilever consists of: one spar, two ~~xxxxxxx~~ wall stringers (front and rear), the main beam, two stringers, the rear ~~stress~~ main brace plate, a set of ribs, ~~xxxxxxxxx~~ the covering and stringers reinforcing the covering.

The main materials ~~xxxxxxx~~ used in the construction of the wing are: dural D16, alloy V95, steel 30KhGSNA and 30KhGSA, alloy F15-T4 and VT65-1.

Between the spar and the main beam in each cantilever

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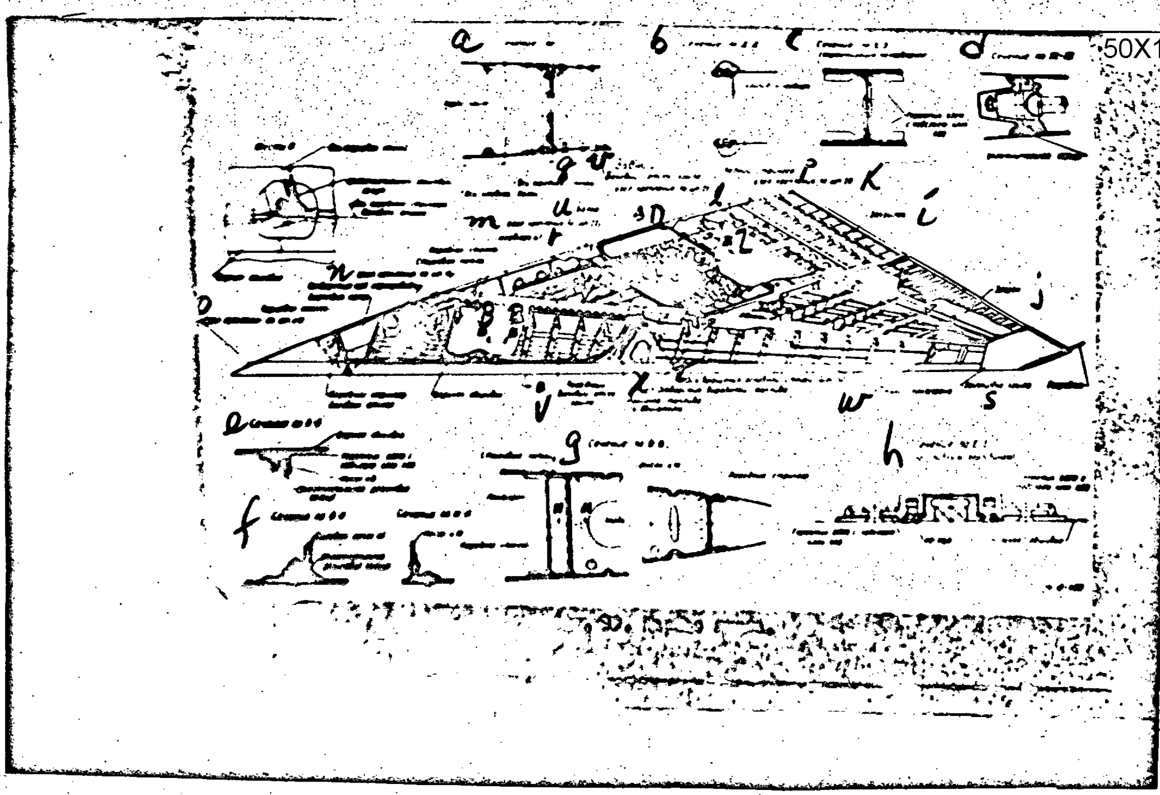

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Fig. 59. Wigg framework.

a- cross section at points G - G

b- " " D - D

c- " " X- X

d- " " Z - Z

e- " " B - B

f- " " A - A

g- " " V - V

h- " " E - E

i- wing flap

j- aileron

k- attachment assembly at frame 28

l- " " 25

m- " " 22

n- " " 16

o- " " 13

p- rear stringer

q- axis of rear partition

r- rib number 1.

s- wing tip

t- axis of the rotation of the main landing gear strut

u- truss

v- rear side chamber of the wing

w- main spar

x- fuel outlet

/other captions illegible/

On the left- and right-hand wing cantilevers, ahead of the main beam, between ribs 1 and 2 are small landing lights.

The landing light on the right-hand wing cantilever can be replaced by a camera, in which case the hatch cover is replaced by a special cover.

On the left- and right-hand cantilevers in front of the spar at the nose /19/ is a shipping fitting, which serves at the same time as an arresting device for the chock.

In the wing noses along ribs 13 and 15 are two fittings for the suspension of rockets.

The wing is attached to the fuselage at five points.

The wing spar is made of three parts: root part, central part, and tail part.

The root part is drop-forged out of material V-95; the ~~middle~~ central part is drop-forged out of steel 30KhGSA; the tail part is cold-forged out of steel 30KhGSA-K1.5.

In the root part of the spar is a socket for the journal bearing of the axis of rotation of the main landing-gear strut.

In the ~~middle~~ central part of the spar on top and beneath are brace plates made of V-95.

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__The forward stringer__ of the channel section. In the side-compartment zone the stringer is made out of a special D20 profile and, further on, from nose 12 to nose 26 of the channel section is made out of D-16 sheet.

__The rear main stringer__ consists of two parts stamped out of 30KhGSA-I2 sheet steel. The parts are joined together by a steel insert on rib 5.

From rib 4 to the wing tip above and below the stringer is reinforced with steel plates made of 30KhGSA-I2 and I2.5 material.

The main beam is made by drop forging out of 30KhGSNA steel with subsequent mechanical treatment and heat treatment to $\sigma_{b} = 170$ kg/cm^2.

In order to obtain the outer contour, strips of D16 and MA8 are run above and below the beam and protrude from the wing contour.

Located on the main beam is a second socket for the journal bearing of the axis of rotation of the main landing-gear strut.

The ribs are made mainly by drop-forging out of sheets of D16.

The ribs located in the central and tail parts are aligned with the flow. They are made out of materials D16T, AK-8, V-95, MI5-T4 by cold-forging, hot-forging, and casting.

The ribs have grooves for the stringer.

In the central part of the wing along rib 6 the stringers are cut and joined together with joining tape and festoons.

The noses of the ribs are arranged perpendicular to the wing spar and also have grooves for the stringers.

The wing covering is made of material (illegible) with a thickness of from 1.5 mm to 2.5 mm. The covering on the nose fuel-tank section both above and below is made, together with the rigidity ribs, out of D15T sheet metal by chemical milling.

Wing Fuel Tanks

In each wing cantilever there are two fuel tanks.

Tank 1 is in the nose zone of ribs 1-13.

Tank 2 is in the zone of the main beam and ribs 1-6. The rear wall of the tank passes from the extension of the axis of frame 25 of the fuselage.

Each fuel tank is a pressurized compartment formed by elements of the wing structure.

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Tank 2 consists of: a front wall cast out of ML5-T4 material, a rear wall stamped out of V95T material, ribs, stringers, and two panels, upper and lower. The panels are made ~~mf~~ out of sheet duralumin with a 3 mm cross section by chemical milling.

The securing of leaktightness and the anti-corrosion ~~xxxxx~~ shielding of the inner part of the tanks is achieved by means of U30cw sealer with a sublayer of ~~gxxxx~~ K-5S glue.

Before riveting and setting the bolts, the lugs and the flanges of the elements of the tank framework joined to each other and adjoining the covering are smeared with sealing and a sublayer of glue.

In the groove for the upper covering (panel) is a rubber cord.

After final assembly the side compartments are tested for leaktightness of kerosene with an excess pressure of 0.8 kg/cm^2 for 20 minutes and ~~xxxx~~ for resistance to a kerosene pressure of 0.9 kg/cm^2 in the case of tank No. 2 and 1 kg/cm^2 in the case of tank No. 1 for 3-5 minutes.

Wing Fittings

(Fig. 54)

The the wing cantilevers are attached to the fuselage on frames 13, 16, 22, 25, and 28. The fittings for attaching the wing cantilevers are the forward main stringer, the spar, the main beam, the rear ...

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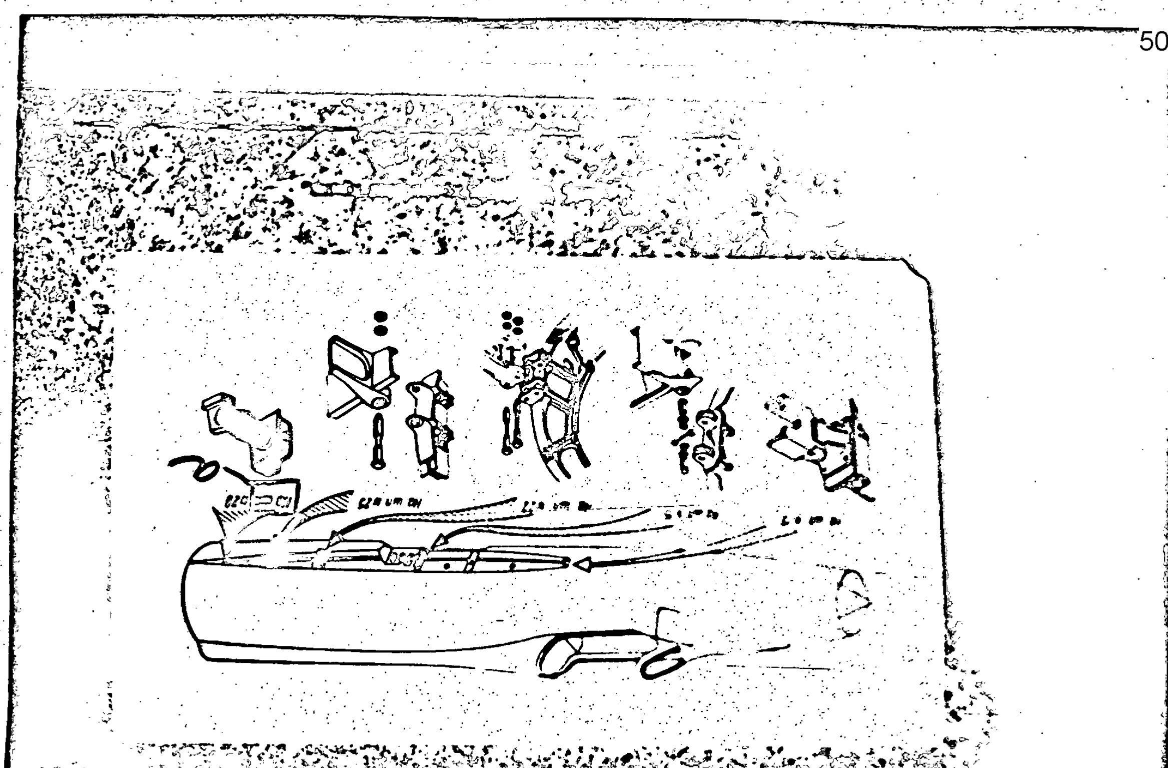

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Fig. 54. Fittings for attaching the wings.

a) on frame No.

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The forward main stringer is attached to frame 13 by one bolt with a diameter of 8 mm.

The spar is attached to frame 16 by two vertical bolts with a diameter of 22 mm and one horizontal bolt with a diameter of 16 mm.

The main attachment of the wing to the fuselage ~~xxxxxx~~ is achieved at frame 22 along the main beam by two bolts with a diameter of 30 mm.

The aircraft rib is attached to frame 25 by one bolt with a diameter of 18 mm.

The flap rail is attached on frame 28 by a bolt with a diameter of 12 mm.

The bolts for attaching along the spar and the main beam are made out of S30KhGSNA with ~~xxxxxxx~~ heat treatment σ_B = 170 kg/mm^2; the other bolts are made out of 30KhGSA with the heat treatment σ_B = 120 kg/mm^2.

The Aileron.

(Fig. 55)

The aileron is located in the rear end portion of the wing bounded by the rear stringer, rib 6, and the wing tip.

The aileron is of riveted construction. Its frame consists of the forward and the rear spars.

(remainder illegible)

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In the nose of the aileron is an antiflutter load made of steel casting and inscribed in the contour of the aileron.

The spars and ribs are stamped out of D16AM sheet material.

The aileron coverings, the upper and the lower, are of one-piece construction of variable cross section: 1.5 mm in the front section up to the rear spar and 0.8 mm in the tail section behind the rear spar. The coverings are made of D16AT-1.5 material by the method of chemical milling.

The end profile or knife is made of MA8 material.

The aileron is suspended at three points: the first - an end point - a support point located on rib 6 (the control rod goes up to it); the second - the central point - on rib 9; the third - an end point - on the wing tip.

The area of the aileron is 2 x 935 m^2; the angles of deflection are ± 20^0; axial compensation over approximately 24% of the length of the chord.

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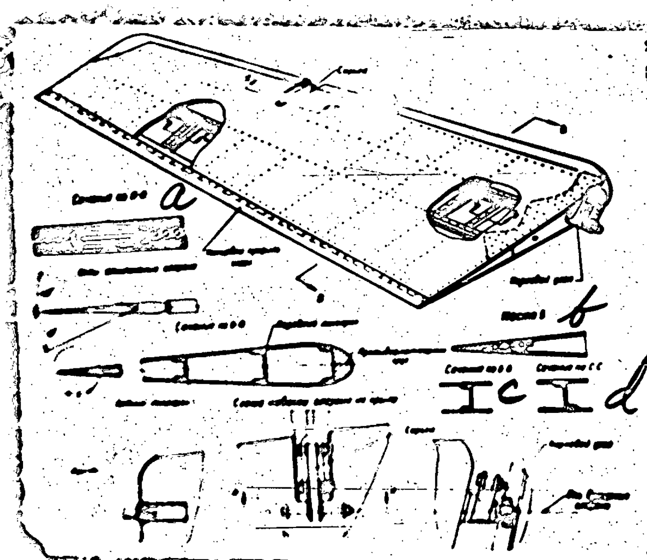

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Fig. 55. The aileron.

a) cross section along A-A . b) location 5

c) cross section along (illegible) d) cross section along C-C

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IV. Empennage.

(Fig. 56)

General Information

The empennage is cantilevered and sweptback,xxx consists of a horizontal and a vertical empennage, and has a symmetrical profile.

The horizontal empennage has a sweepback angle of 55^0.

The area of the suspended part is 3.94 m^2; the setting angle of the stabilizer is 0^0; the dihedral angle V= 0.

Deflection angles of the stabilizer:

a) along the flow: nose upward $+7^030'$

nose downward $-16^030'$

b) perpendicular to the rotational axis with the booster switched on:

nose upward $+13^0$

nose downward -28^0

The setting of the vertical empennage is made with the idea of ensuring transverse stability of the plane at high flight speeds. This is achieved by (illegible) and tapering the nose of the fin.

The vertical empennage has an area of 4.37 m^2.

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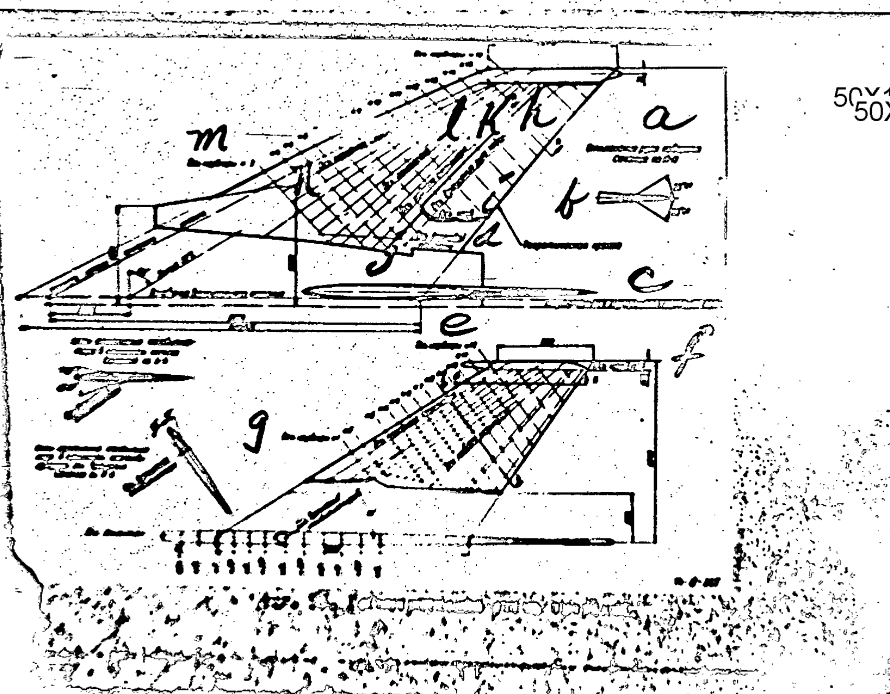

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Fig. 56. Geometrical layout of empennage.

a) Deflection of rudder
Cross section along A-A

b) Theoretical edge

c) Datum line of the fuselage

d) Axis of side rib

e) Axis of rib 12

f) Axis of rib 16

g) Axis of rib 1

h) Axis of rotation of rudder

i) Axis of rib 8

j) Axis of side rib

k) Axis of rear stringer

l) Spar axis

m) Axis of rib 3

n) Axis of forward stringer

(remainder illegible)

The profile of the vertical empennage is symmetrical. The sweepback angle is 60^0.

The rudder with an area of 0.965 m^2 has axial aerodynamic compensation.

The maximum deflection anglex of the rudder is 25^0 right and left.

Empennage Design

(Fig. 10)

1. Horizontal Empennage

The horizontal empennage consists of a controlled stabilizer without an elevator.

The stabilizer consists of two halves.

Each half contains: a forward wall stringer consisting of two parts (forward of D16AM-D1.2 and rear of variable cross section), the main beam, a set of ribs, a rear stringer of variable cross section, two forward coverings, covering of nose and tip, two fairings, two main brace plate, and a tail section.

Beam Attaching Stabilizer

(Fig. 57)

Each half of the stabilizer is attached to a steel beam of circular cross section by four vertical and one horizontal bolt.

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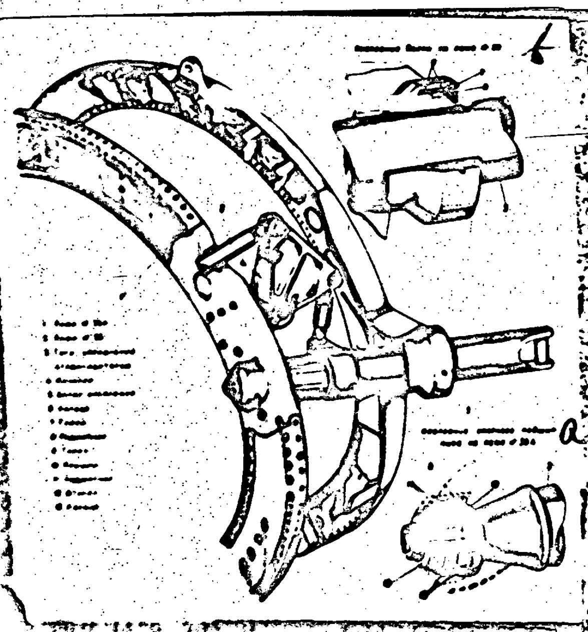

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Fig. 57. /Caption illegible/

a. attachment of the support frame on bearing No. 35A

b. attachment of the beam at bearing 36.

1. bearing No. 35A

2. bearing No. 36

/remainder illegible/

The rotation of the stabilizer shafts is realized in two radial thrust bearings located on frame 35A with left and right sides and two needle bearings located on frame 36 with left and right sides.

In order to eliminate radial play, each needle bearing is mounted on a slit conical bushing.

The longitudinal and radial clearances of each beam are chosen by tightening the nuts of the bearings.

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2. Vertical Empennage

The vertical empennage consists of the rudder fin and the rudder.

Rudder Fin

Structurally the rudder fin consists of a transverse set of drop-forged sheet ribs, two main wall stringers (forward and rear), a longitudinal set of ~~xxxxxxx~~ molded stringers, the end rib, a beam, and the covering.

The fin is attached in the upper panel of the tail part of the fuselage by fittings located on frames 34 and 36 and by rivets along the contour

(remainder illegible)

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The rear stringer consists of two parts: the root part (joint fitting) made by drop forging out of L-95, and the end section made out of D16 sheet of variable thickness.

The end rib of the rudder fin is drop forged out of AP4-1.

The beam of the rudder fin is drop forged out of material 30KhGSNA and is attached along the root part to frame 34. A stabilization control booster is mounted on the beam.

The covering of the rudder fin is made out of sheet material D-16 of variable thickness.

The tip of the rudder fin is riveted out of sheet material D-16. Mounted in the tip are

(remainder illegible)

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50X1-HUM

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Rudder

The rudder is of riveted construction and consists of ~~xxxxxx~~ the spars, the stringer, a set of ribs, the covering, ~~x~~ three suspension fittings.

The rudder spar of channel cross section is drop forged out of sheet material V-95.

The ribs of z-shaped cross section are drop forged out of sheet material D-16. The main covering of the rudder is made out of D16-L0.8; the nose covering is made out of D16-L1.2.

Antiflutter loads are mounted in the nose between ribs 11 and 17.

A "knife" profile is mounted ~~xxxxxx~~ on the tips of the ribs, in order to control the ~~flight~~ stability of the plane in flight.

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CHAPTER III

POWER PLANT

1. General Information.

A 37F turbojet engine with an afterburner and an adjustable nozzle (Fig. 58) is mounted in the plane. The engine is mounted in the fuselage.

Air is taken in through a nose air intake with an adjustable three-position cone and is fed to the engine through two ducts, which beyond the pilot's cabin merge into one air-intake duct connected hermetically with the engine. In the air-intake duct in the nose of the fuselage are: antisurge, automatically controlled bleeders, while between frames 9 and 10 are noncontrolled bleeders for decreasing the rarefaction in the air-intake duct (for additional air intake into the engine when operating on the ground and in flight).

In order to prevent the structure of the aircraft and the engine units from being overloaded, the engine and afterburner compartment is ventilated by air entering during flight - from the air-intake duct through holes in the air-air radiator; during ground runs -

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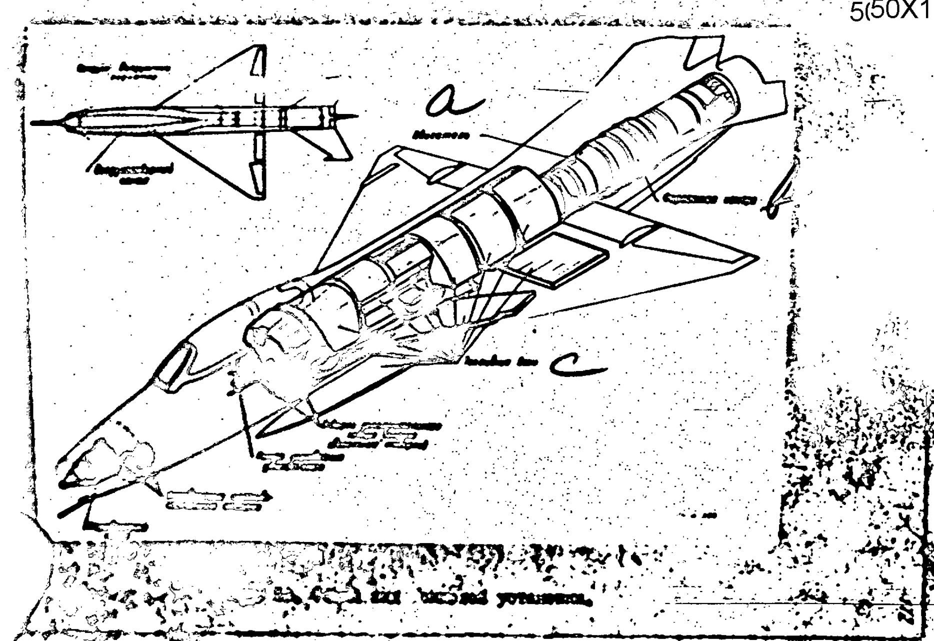

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Fig. 58. Over-all view of power plant.

a) engine b) afterburner c) fuel tanks

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of the gas jet at the outlet of the nozzle.

The engine fuel is kerosene.

The fuel is stowed:

- in six fuselage tanks;
- in two foward wing tank compartments;
- in two rear wing tank compartments;
- in a suspended tank mounted in the fuselage on a pylon.

In order to maintain the required centering during flight and to ensure a complete delivery of fuel from the tanks, the delivery occurs in a definite sequence, which is automatically ensured by the use of special and float-type valves.

In order to ensure reliable feeding of the engine during ~~flight~~ high-altitude flights, the system has tank pressurization from the engine compressor, and also a drainage system with an impact-pressure intake for quick generation of pressure in the tanks during nose dives.

The lower part of the third tank is a compartment which ensures the feeding of fuel to the engine during short flights with negative overloads or during short inverted flights.

The fuel system and the system of

(remainder illegible)

The engine is controlled by the engine-control lever (ECL) located in the pilot's cabin and connected to the engine-control panel by a system of rods and actuating arms.

An engine-drainage system — ensuring storage and jettisoning of fuel from the drainage cavities of the engine is provided.

The surge control equipment installed in the plane is intended to signal and extinguish fire in the engine zone.

Hatches are provided in the fuselage for access to the engine units and the working joints when the plane is taken apart and when the engine is moved.

2. Engine

The 37F engine is a two-shaft engine with an axial, six-stage, two-rotor compressor, a tubular-annular combustion chamber, and a two-stage turbine.

The first three compressor stages are on one shaft with the second turbine stage (a low-pressure rotor); the next three stages are on one shaft with the first turbine stage (a high-pressure rotor).

The jet nozzle

...

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The engine is equipped with:

1. An electrical autonomous and automatic starting system which makes it possible to start the engine by pressing one button.

2. A system of automatic oxygen feeding of igniters for starting the engine during flight.

3. A fuel pump control unit NR-21F, which automatically controls the engine and ensures a constant given number of rotations of the engine at all altitudes and flight speeds.

4. A fuel pump control unit NR-22F, which ensures feeding of fuel to the afterburner in boost regimes.

5. An engine control mechanism PURT-10, which, together with fuel pumps NR-21F and NR-22F, ensures engine control from the position "stop" to the total boost regime by moving only the engine-control lever.

6. An automatic system of electro-hydraulic control of the jet nozzle.

7. An autonomous oil system consisting of an oil tank, which contains a device for feeding oil during inverted flight, a fuel-oil flowmeter, and also a force pump, a booster pump, filters, an air separator, and a centrifugal blower.

8. An ignition system and electrical equipment.

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The following aircraft units are located on the engine drive box:

Generator-starter RSR-ST-12000nt

Two hydraulic pumps NI-34-2T

Booster fuel pump .... (illegible)

Rpm meter DTE-1

Beyond the last stage of the compressor are flanges on the engine for bleeding off air for pressurizing the pilot's cabin and for pressurizing the fuel tanks, the hydraulic tank, and the ~~[illegible]~~ fuel tank.

3. Installation of the Engine and the Afterburner in the Plane

The engine, together with the afterburner, is installed in the fuselage from frame 22 to the rear edge of the fuselage (Fig. 59).

When viewed from above, the engine axis coincides with the axis of symmetry of the plane, while when viewed from the side it passes below the datum line of the plane at a distance of 90 mm from frame 28 and 65 mm from frame 32A.

The afterburner axis, when viewed from above, makes a small angle with the engine axis, owing to the fact that the rear part of the afterburner is mounted with the roller axis shifted 5 mm to the left of the axis of symmetry of the plane. During the operation of the engine the afterburner axis shifts to the right as a result of temperature expansions and coincides with the engine axis.

The afterburner axis, when viewed from the side, at first moves with a small downward slope, while from frame (illegible) to the outlet of the nozzle it moves with a small upward slope.

Attachment of Engine

The engine has two attachments:

the first - the main, forward attachment on frame 25;

the second - the rear attachment on frame 28.

The forward attachment is located in a plane close to the center of gravity of the engine and consists of an upper fitting and two side rods. The upper fitting

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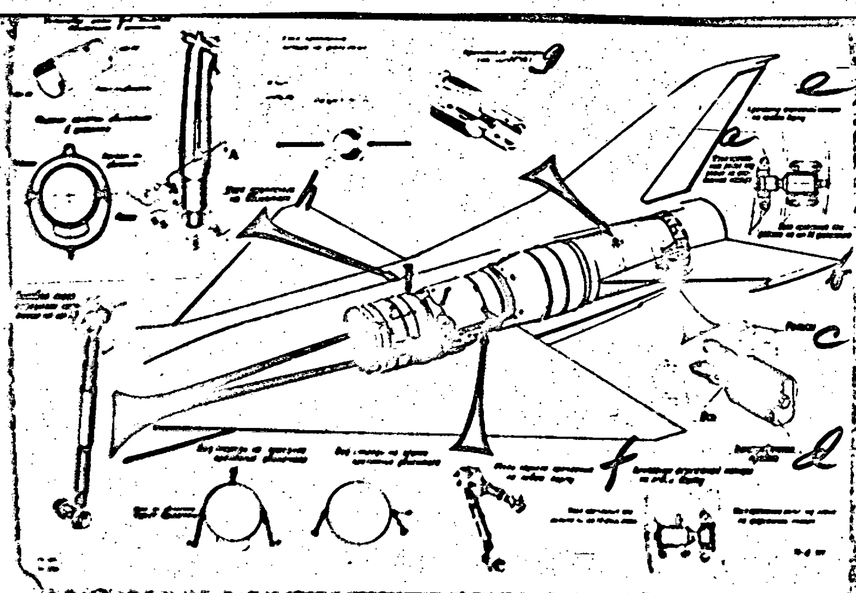

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Fig. 59. Attachment of engine and afterburner.

a) fitting of rail for roller on afterburner

b) fitting of roller axis on frame 35 of the fuselage

c) rails   d) safety plug

e) attachment of afterburner on ~~right~~ starboard side

f) attachment of afterburner on port side

g) attachment on starboard side

h) attachment to the engine

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thrust force of the engine and is loaded to completion by lateral forces.

The power element of the upper fitting is a dowel terminating in a pin, which during assembly enters a ring with a spherical surface mounted on the engine.

The dowel is attached to the upper beam of the fuselage at two points: to the upper flange of the beam by a chromansil bolt with a diameter of 10 mm; it is pressed against the lower flange by a steel wedge.

The design of the joining of the dowel pin to the engine ensures free movement of the engine in the vertical direction and rotation relative to the steam surface during heat expansion or during leveling of the engine.

The side rods of the forward attachment are designed for compression and tension and absorb the vertical loads. The rods are made out of chromansil steel and are attached by bolts:

in the upper part to the engine brackets; in the lower part to brackets on frame 25 of the fuselage.

The ends of the rods, attached to the fuselage, have eye bolts connected to the rod on a threading, thereby making it possible to vary the length of the rods when adjusting them. (remainder illegible) and one side horizontal turnbuckle rod on the left side. The turnbuckle rods are attached at one end to the engine brackets and are attached at the other end to brackets on frame 28 of the fuselage.

The turnbuckle rods of the rear attachment permit changes in their length during installation of the engine on the plane and during leveling.

During operation changes in the length of the engine rods are not made.

The engine is mounted with the aid of a special carriage when the tail section is dismantled. In order to facilitate the mounting of the engine on the plane, brackets with steel rollers are installed on the compressor casing, while guide rails (profiles) are installed on the fuselage between frames 22 and 28. The engine in the carriage is led by the rollers onto the guide rails and is rolled along them to a detainer located on the carriage, after which the engine fitting are assembled.

Attachment of Afterburner.

The forward part of the afterburner is attached to the engine by a telescoped joint /Fig. 59/.

The rear part of the afterburner is attached to the fuselage with the aid of longitudinal guide rails mounted on the chamber and resting on special rollers. The rollers are fitted and secured on bushings screwed into sockets on frame 36 on the right- and left-hand sides.

The roller on the left-hand side has flanges which prevent the chamber from moving in the lateral direction; the roller on the right-hand side has no flanges, as a result of which the chamber moves to the right during heating.

Thus the afterburner

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air-intake duct /Fig. 58/. During flight part of the air is bled out from the air-intake duct through special holes in the air-air radiator for the purpose of cooling the engine compartment.

The air-intake duct consists of an annular air intake with an extensible cone in the nose of the fuselage, two ducts located along the sides of the fuselage, and which, beyond the pilot's cabin in the region of frame 16, combine into one common duct, the extension of which is the air-air radiator of the cabin's ventilation and heating system.

On the rear flange of the air-air radiator is a special rubber profile, against which the flange of the engine compressor is tightly pressed and by means of which leaktightness of the joint is achieved.

The purpose of the leaktightness in the construction of the joint is described in detail in the section "Cooling of the Engine Compartment".

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The cone control system (1) (Fig. 60) consists of two Mach number sensors (19) and (20), electrostatic precipitators (18), relay for controlling the extension (retraction) of the cone into the first extended position (16) and into the second position (17), two electro-hydraulic valves (22) and (23), two hydraulic locks (24) and (25), and a three-position cylinder (26) for extending and retracting the cone.

Up to M ≈ 1.5 cone (1) is in the retracted position, contacts 3-4 in end switch (2) open, and signal tube (10) "cone extended" does not light up.

In order to attain a flight speed corresponding to M ≈ 1.9 or more, relay-sensor (19) is actuated, an electric current is fed through electric filter (16) to switch on relay (16),

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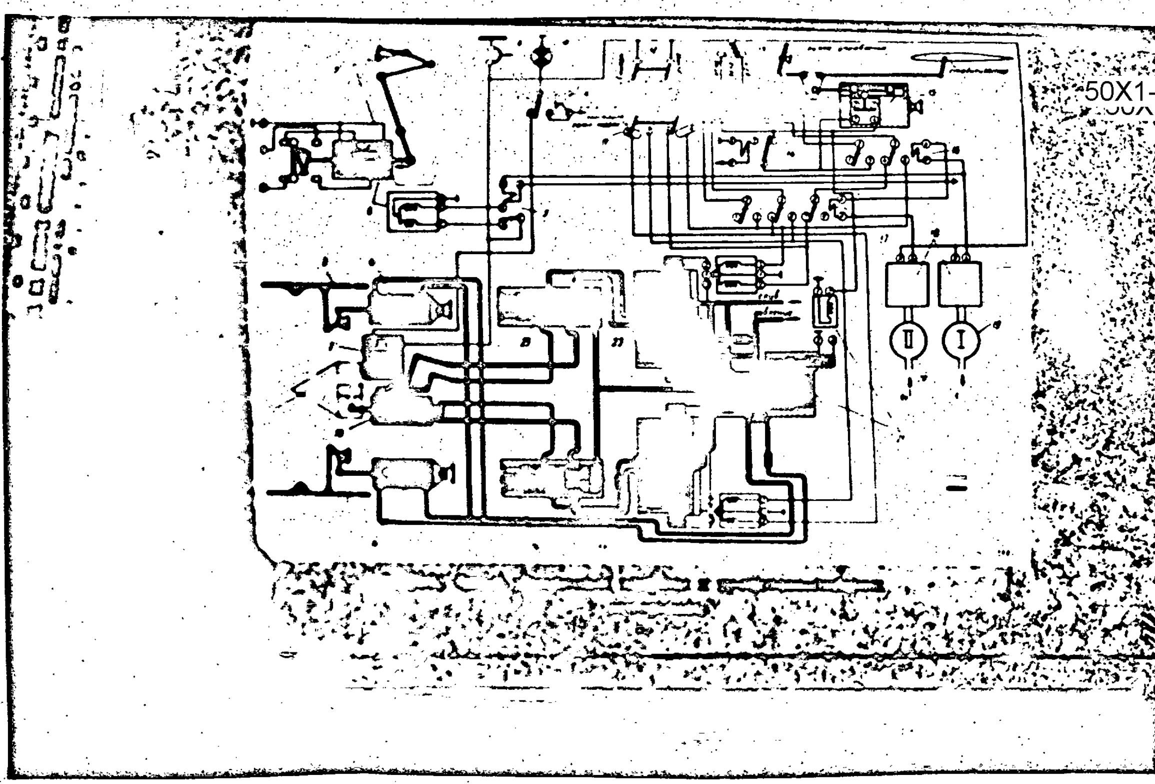

Fig. 60. System for controlling cone and surge-control valves.

a) drainage b) pressure

Fig. 60. System for controlling cone and surge-control valves.

1. Cone control.
2. Microswitch in the circuit signaling the extended position of the cone KV-9A (pos. 105M)
3. Surge control valves
4. Hydraulic cylinder
5. Relay for switching on the blocking of the gas sector TKYe-52PD (pos. 116M)
6. Electromagnet for blocking the gas sector ZKO-2/2 (pos. 75M)
7. Mach number limiter in the gas sector
8. Automatic cut-out "Cone-blocking of gas sector" A8S-1D (pos. 33M)
9. Relay for controlling the signal-panel tubes and the signaling tubes of the hydraulic system TKYe-56PD (pos. 86M)
10. Tube for signaling the extended position of the cone (pos. 104M)
11. Switch for manual control of the cone VT3602020SI (pos. 57M)
12. Switch for controlling cone 2NP-45 (pos. 34M)
13. Switch for controlling the by-pass valves PPN-45 (pos. 120M)
14. Relay for blocking the by-pass valves (illegible) TKYe-21PD (pos. 141M)
15. Microswitch in the circuit controlling the by-pass valves KD-9A (pos. 114M)

16. Relay for controlling cone TKYe-53PD (pos. 126M)

17. Relay for controlling cone TKYe-53PD (pos. 127M)

18. Filters in the circuit of the Mach number setters MP-1.5 (pos. 50M) and MP-1.9 (pos. (pos. 125M)

19. Mach number sensor MP-1.5 (pos. 66M)

20. Mach number sensor MP-1.9 (pos. 124M)

21. ~~Simpxxxk~~ Valve controlling air by-pass valves GA-184 (pos. 121M)

22. Hydroelectric valve GA-185 for extending the cone into the first position (pos. 128M)

23. Hydroelectric valve GA-185 for extending the cone into the second position (pos. 72M)

24. Hydraulic lock

25. Hydraulic lock

26. Three-position cylinder for controlling the cone

In the case of a prolonged acceleration of the plane, when Mach numbers of 1.9 and higher are reached, relay-sensor (20) is actuated, thereby switching on relay (17), through the contacts (5 and 6) of which an electric current enters hydroelectric valve (22).

Valve (22) feeds the pressure of the hydraulic system through hydraulic lock (24) into the appropriate cavity of three-position cylinder (26), and the cone moves out into the second extended position.

The design and operation of the three-position cylinder, the hydraulic locks, and hydroelectric valves (22) and (23) are described in more detail in Chapter V - "The Hydraulic System".

When the flight speed decreases the system operates in reverse order. When the speed decreases down to M < 1.9, sensor (20) of the second extended position is switched off, in relay (17) contacts 4 and 5 close, and hydroelectric valve (22) switches over to retraction of the cone, as a result of which the cone is retracted into the first extended position.

When the flight speed continues to decrease down to M < 1.5, relay-sensor (19) of the first extended position of the cone is switched off, in relay (16) contacts 4 and 5 close, and hydroelectric valve (23) switches over to total retraction of the cone, and the tube "cone extended" lights up.

In case of failure of (remainder illegible)

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and the cone will remain in the same position in which the failure of the hydraulic system occurs.

In order to eliminate unstable operating regimes of the air intake, the cone control system is blocked together with the engine control lever and does not allow the handle to be retracted more than ≈ 0.93 at the maximum when the cone is extended (flight speed corresponds to M = 1.5 or more). This is accomplished in the following way: during flights at speeds ~~exceeding~~ corresponding to M = 1.9 or more, in relay-sensor (19) contacts A and B close, as a result of which relay (5) is switched on, through contacts 6-6 of which an electric current is fed to electromagnet (6) mounted on the gas sector. Electromagnet (6), with the aid of a system of rods, pulls out a special Mach number limiter, which prevents the engine control lever from being retracted more than is intended by the design, i.e., up to ≈ 0.93 at the maximum.

When the speed decreases down to M < 1.5, relay (5) is switched off, contacts 4-5 close, and the Mach number limiter is retracted by the electromagnet (illegible).

The Mach number limiter may also be retracted manually

(remainder illegible)

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Manual control of the cone is provided in case the automatic apparatus goes out of order. For this purpose switch (12) on the ~~xxxxxxx~~ left panel must be set in the position "manual", while the ~~xx~~ extension and retraction of the cone must be done with the aid of the switch "cone" (11), which has three positions: "retraction" (as shown in Fig. 60), "extension 1.5", and "extension 1.9". After setting switch (6) in the required position manually, an electric current is fed to valves (22) and (23), and the cone will occupy the appropriate position.

6. Surge-control Valves

In order to ~~xxxxx~~ prevent the occurrence of surge in the air intake during high-altitude flights, automatically controlled surge-control valves are installed in the forward part of the air-intake duct on both sides of the fuselage on frames 2 and 3 / Fig. 60/.

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the strength of the structure of the duct.

Moreover, pressure pulsations may occur in the duct and may move along it, thereby impairing the operation of the duct.

In order to eliminate this phenomenon, at the moment the engine rpm is decreased during high-altitude flights ($M \geq 1.5$ or more) the surge-control valves are opened automatically and the excess air escapes from the air-intake duct into the atmosphere, while the engine control lever moves to the Mach number limiter, thus preventing the lever from being retracted to a position less than ≈ 0.93 at the maximum, as was mentioned in section B of this chapter.

The system of controlling the opening and closing of the surge-control valves (3) (Fig. 60) consists of ~~[illegible]~~ hydraulic cylinders (4), with the aid of which the opening and closing of the valves occurs; hydroelectric valve (2), which controls the feeding of the pressure of the hydraulic mixture to the appropriate cavity of the hydraulic cylinders

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When the "by-pass valve" switch (13), which is in the pilot's cabin on the left-hand panel, is in the position "automatic", the opening and closing of the valves occurs automatically.

In this case the valves are always closed up to flight speeds corresponding to M < 1.5.

At speeds corresponding to M equals exactly or more than 1.5, in relay-sensor (19) of the cone control system contact A-B are closed and in relay (16) contacts 2-8 are closed. If, moreover, the engine control lever is in the range from "minimum afterburner" to "total afterburner", the valves do not open, since in afterburner-blocking relay /14/ contacts 1-4 are open and the electric circuit controlling the opening of valve /21/ is open.

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at an angle to the axis of the cone and the air intake in the nose of the fuselage. The greater this angle, the sooner, all other conditions being equal, air pressure pulsations arise in the air-intake duct. Blocking of the deflection angle of the stabilizer is also intended to open the surge-control valves when the stabilizer is deflected downward at an angle of more than 20°. The electric current in this case enters hydroelectric valve (21) through contacts 2-8 of relay (16) $M \geqslant 1.5$ and relay (19) switched on through contacts 3-4 of microswitch (15) located in the region of frame 12 and switched on by the actuating arm of the stabilizer control system; hydroelectric valve (21) feeds the pressure of the hydraulic mixture to hydraulic cylinders (4), and the bleeders open regardless of the position of the engine control lever.

Thus the automatic system ensures the opening of the surge-control valves at flight speeds corresponding to $M \geqslant 1.5$, if:

1. the engine control lever is in the range from "stop" to the limiter "minimum afterburner".

2. the nose of the stabilizer is deflected downward by angles greater than 20°.

Naturally the surge-control valves

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"by-pass valve" switch must be set from the position "automatic" to "closed" or "open", depending on the flight regime.

In case of manual control the electric power supplied to electric valve (21) enters directly from switch (19), by-passing all the blocking relays.

7. Additional-air-intake Valves

The additional-air-intake valves or "take-off valves" (Fig. 58) are located on both sides of the fuselage in the region of frames 9 and 10.

The purpose of these valves is to decrease the rarefaction in the air-intake duct occurring during the operation of the engine on the ground and in flight, i.e., when the impact pressure is low or completely absent.

The bleeders are mounted on frame 9 on hinges and open into the air-intake duct, as a result of the difference between the pressure in the chamber and atmospheric pressure.

When the bleeders are open, air from the atmosphere is sucked into the air-intake duct.

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8. Cooling of the Engine Compartment

In order to avoid overheating the aircraft structure and the engine assemblies during flight and also during ground runs, the engine compartment, starting from frame 22, has air blown through it /Fig. 61/.

During flight the air for blowing and cooling is bled from the air-intake duct through special holes /2/ with grids in the air-air radiator /1/. The air xxxxxxx comes from the outside of the radiator and xxxxxx through plate valves xxxxxxx /3/ in the radiator rushes into the engine compartment.

In the engine compartment the air, passing into the space between the fuselage and engine structures and then between the aircraft covering and the afterburner, cools them and escapes into the atmosphere through the fuselage outlet. Moreover, part of the air flow is bled off through annular gap 6 in the wall of frame 29 for the purpose of cooling the outer part of the structure of the aircraft casing of the afterburner.

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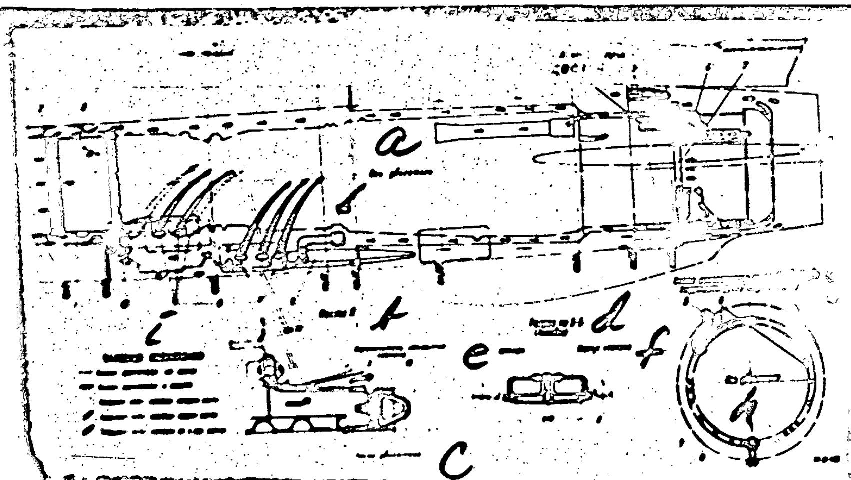

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Fig. 61. Design for blowing air through the engine compartment.

1) air-air radiator 2) windows with grids 3) plate valves

4) xxxxxxxxx pipe 5) xxxxxxxxx pipes 6) casing 7) illegible

8) xxxxxxxxx pipe 9) disk valves 10) profile

a) engine axis b) location A c) engine compartment

d) cross section along 5-5 (typical) e) dowel f) valve body

g) location of pipes for blowing air through hydraulic cylinders /view along arrow A/

h) engine axis

i) legend

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2. Afterburner - by air entering through pipes /4/ at frame 21a.

3. Hydraulic cylinder controlling the valves of the jet nozzle - by air from pipes /5/ in the region of frame 36. The two upper pipes are located above the engine axis to the right and left of the rudder fin; the lower pipe is double-walled and is located on both sides of the comb; the pipe runs along the combs, then merges into one common duct joining with the casing of the lower hydraulic cylinder controlling the valves of the jet nozzle.

The air from the impact-pressure intake ducts /5/ passes through connecting pipes into casings /6/ of the hydraulic cylinders, cools them, and escapes into the atmosphere. Moreover, part of the air is bled out through slits in the bulkheads of the casings for the purpose of cooling the hydraulic pipes and the armature located to one side of the hydraulic cylinders, then the main ring for the purpose of cooling the hydraulic pipes supplying the hydraulic mixture and escapes into the atmosphere through openings in the main ring.

During ground runs the engine compartment is cooled by air sucked in from the surrounding atmosphere as a result of the rarefaction in the engine compartment created by the energy of the gas jet. The cooling air enters the engine compartment through 12 apertures 70 mm in diameter with disk valves /9/ (these apertures open as a result of the excess pressure of the surrounding atmosphere), and also through the individual additional-cooling tubes of the assemblies. In this case ~~thx~~ plate valves (3) on the air-air radiator are closed, since the rarefaction in the air-intake valve is greater than in the engine compartment.

In order to avoid disruption of the cooling regimes, the engine compartment is pressurized:

1. Along frame 22 at the place where the engine is joined to the air-air radiator (1) by means of a special rubber profile (10) attached to the ~~fxxxxx~~ radiator. The sealing of the joint is created by the pressure of the flange of the engine-compressor housing against this profile.

2. The openings for ~~thx~~ laying the ~~pipxx~~ pipelines in frame 22 are closed by special plugs.

3. The openings through which the drainage tubes of the fuel system emerge into the back fairing in the region of frame 29 and also the openings for laying the ~~pipxx~~ pipelines in frame 29 are closed by ~~xpxxixt~~ cover plates.

9. ~~Venxxlxxxxx~~ ~~Airxblowing~~ Ventilation and Drainage of Engine

The ~~xxxxxxxxxx~~ ~~airxblowing~~ ventilation of the centrifuge of the oil system of the engine is accomplished by piping which goes out into the atmosphere through the engine-inspection hatch cover in the region of frames 26 and 27.

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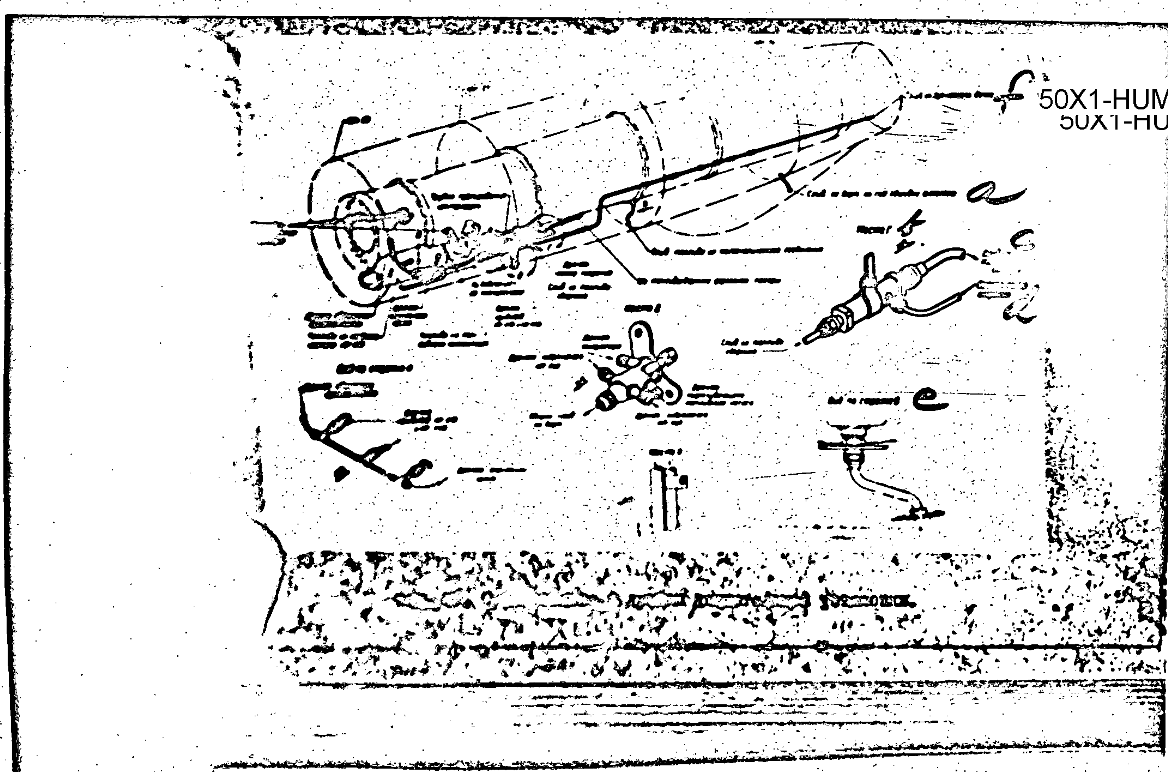

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Fig. 62. Air blowing and drainage of engine.

a) jettisoning from under the fuselage covering

b) location D

c) jettisoning from fuel collector

d) illegible

e) view along arrow C

f) discharge from drainage tank

(remainder illegible)

The joint between the pipe and the hatch is telescoped and is sealed by a rubber collar. It should be born in mind that during pressurization of the joint (owing to incorrect setting of the pipe or the outlet from the sides of the rubber collar) a dark deposit may appear near the joint and the insulation of the generator wires may be burned.

In the region of frames 25 and 26 are two pipes for removing gases from the labyrinth sealing of the turbine shaft and from the unloading cavities of the engine. The pipes are mounted on the hatch covers to the right and left of the fuselage.

The drainage piping of the engine is combined in groups and led out of the fuselage at five places.

The first in-flight outlet is made at frame 27 and combines eight drainage points of the engine, namely: drainage of the afterburner valve, the drives of pumps NP-21F and NP-22F, the automatic engine pick-up, the generator, hydraulic pumps NP34-21, and the booster fuel pump.

The second outlet, located immediately beyond the first outlet,

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The fourth outlet serves to drain fuel from under the fuselage covering.

The fifth outlet is made below the outlet of the jet nozzle. It connects the drainage tank mounted on the engine with the atmosphere. In case of unsuccessful starts or when the engine stops, the fuel from the fuel collector and drainage valve of the NP-21F is ~~xxxxxxxxxx~~ gathered into this tank and is extruded into the atmosphere by the air.

In addition to the above-mentioned drainage outlets there are drainage openings in the fuselage covering (not shown in Figs. 62). Beyond frame 36 there are two 5 mm openings for ~~xxxxx~~ each rigidity of the tail nacelle. ~~xxx~~ Through these openings in the nacelle covering the fuel flowing out of the afterburner during deinhibiting of the engine on the plane is drained off.

10. Operational Hatches

In order to have access to the assemblies, individual units, and engine-feeding systems, ~~xx~~ several operational hatches are provided on the fuselage (cf. Chapter I, Fig. 6).

In the lower part of the fuselage between frames 5 and 25-28 are four operational hatches on the right- and left-hand sides which provide access to the engine assemblies and systems. These hatches are used (remainder illegible)

The hatches of the fuel fillers are located above and to the left of the back fairing as follows: for access to the forward fuel filler - between frames 15 and 16A, for access to the fuel filler of the gas tank - between frames 20 and 21, for access to the rear fuel filler - between frames 21 and 22.

The locations of the other hatches are given in the description of the fuselage and the wing.

II. FUEL SYSTEM

Skeleton and Assembly Diagrams of the Fuel System

The plane's fuel system (Figs. 63 and 64) is intended to supply the engine with fuel both during flight and during runs.

The plane's fuel system ensures normal operation of the engine at all altitudes and for all flight regimes, as well as for all airplane maneuvers, and consists of:

1. Seven fuselage tanks.
2. Four wing tank - compartments.
3. One tank suspended under the fuselage.
4. Four main ducts: feed, booster pump, drainage, and booster pressure.
5. A command-pressure system controlled by the order of output of fuel from the tanks.

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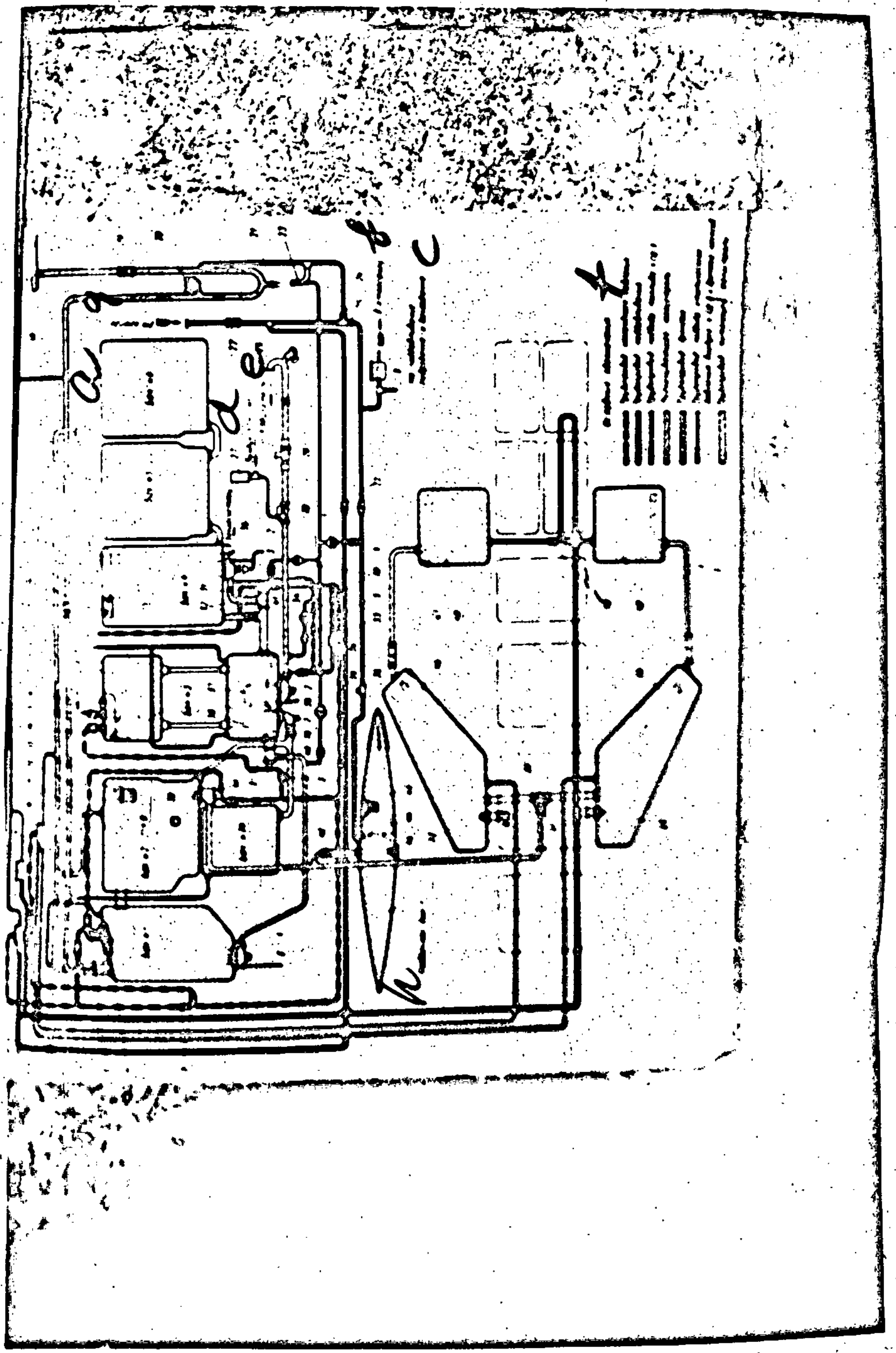

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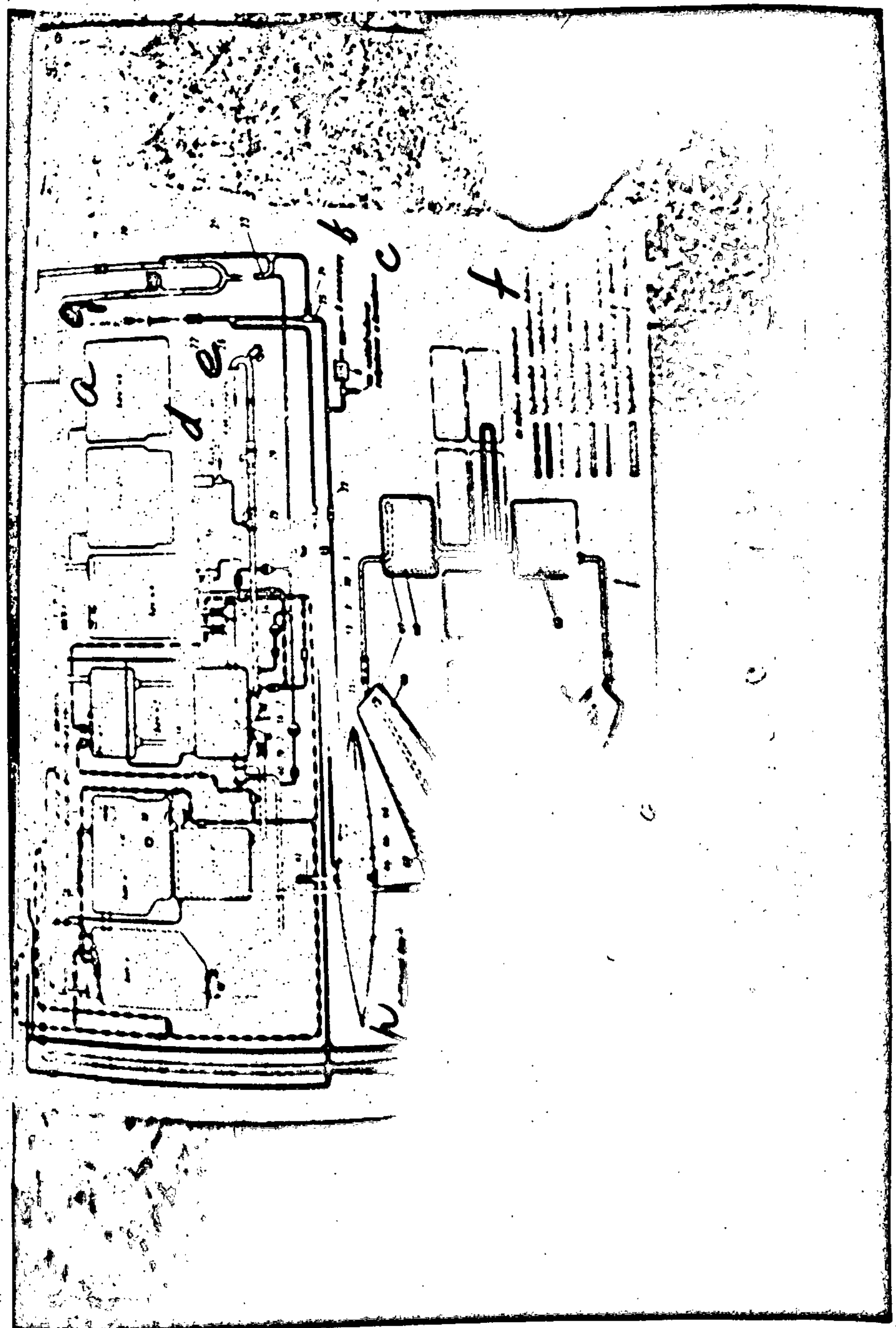

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Fig. 63. Title illegible

a) tank b) to the atmosphere c) to boost the pressure in the hydraulic tank and the gas tank

d) air 50 kg/cm^2 e) to the engine

f) legend g) from the compressor

h) suspended tank

(remainder illegible)

Fig. 63. Skeleton diagram of fuel system

1 - booster pump 422A;

2 - drainage valves;

3 - throttles, diameter 0.8 mm;

4 - float valves on the 1st and 3rd tanks;

5 - filters of float valves;

6 - throttle, diameter 2.1 mm ± 0.1;

7 - pressure indicator SVU2-0.35;

8 - drainage valve controlling output of wing tanks;

9 - safety-valve box;

10 - drainage valve controlling refueling of wing tanks;

11 - pipe connecting 1st and 2nd tanks;

12 - pipes for refueling of wing tanks;

13 - refueling fillers;

14 - sensor of emergency fuel supply indicator S3-1637;

15 - return valve;

16 - balloon filler of gas tank;

17 - gas tank;

18 - impact-pressure intake valve;

19 - return valve with 3 mm opening;

20 - safety valves;

21 - throttle, diameter 3 mm;

22 - return valve;

23 - (illegible)

24 - throttle, diameter 8 mm;

25 - throttle, diameter 2 mm;

26 - drainage valve;

27 - electropneumatic valve 695000 m;

28 - flowmeter sensor RTB-16A;

29 - shut-off valve;

30 - pressure indicators;

31 - throttle, diameter 25 mm;

32 - non-return valves;

33 - command-pressure filter;

34 - non-return valves;

35 - vacuum valve;

36 - booster pump 495A2;

37 - negative-overload valve;

38 - non-return valves;

39 - pipelines with return valve;

40 - throttle, diameter 17 mm;

41 - special valve;

42 - non-return valve;

43 - balloon → filler of suspended tank;

44 - pipe with return valve;

45 - grid filter;

46 - forward wing tanks - compartments;

47 - drainage plugs;

48 - rear wing tanks - compartments;

49 - throttle, diameter 7 mm;

50 - non-return valves;

51 - barrier grid;

52 - non-return valves for refueling the wing tanks;

53 - throttle, diameter 1 mm.

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S-E-C-R-E-T

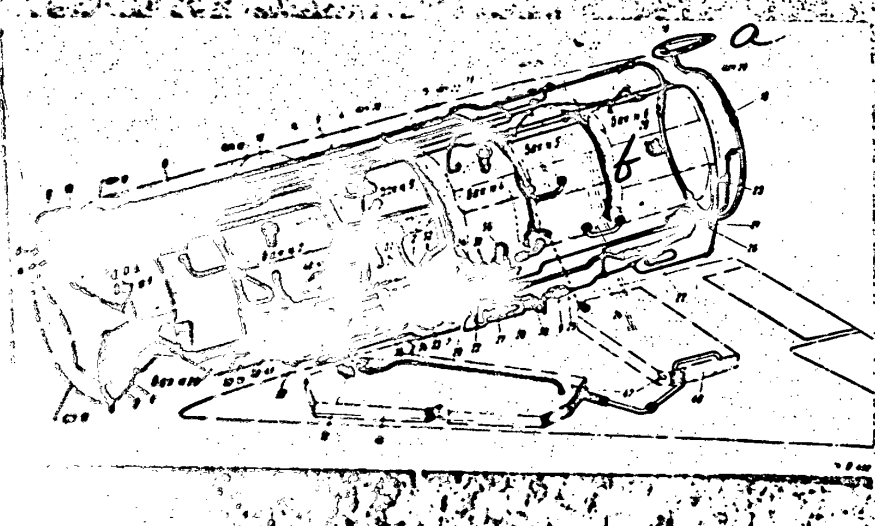

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Fig. 64. Assembly diagram of fuel system.
((illegible) the same as in Fig. 63)

a) frame b) tank

The fuselage fuel tanks are divided into three groups according to their output and signaling sequence: first, second, and third.

First group of tanks - tank No. 1 and the upper part of tank No. 2 to the lower edge of connecting pipe (11).

Second group of tanks - supply. It includes: tank No. 3, the lower part of tank No. 2, and tank No. 2a.

Third group of tanks - tanks 4, 5, and 6.

The tanks of each group are connected to each other, while the lower part of tanks 2 and 2a are connected to tank 3 (supply tank) by a pipeline containing ~~xxxxxxx~~ non-return valve (39), which prevents reverse flow of the fuel from the third tank, which detracts from the reliability of the system.

The output of fuel from each group of tanks is achieved with the aid of pumps through booster ~~lines~~ mains.

From booster pump (1) of the first group of tanks(mounted in tank 1) the first ~~line~~ main duct departs toward the supply tank through special (11) and non-return valve (38) located in the tank directly ~~xxxxxx~~ behind the special valve.

The opening and closing of all special valves (41) is done with the aid of a command-pressure system.

Non-return valve (38) serves to prevent fuel from flowing back from the supply tank.

In this booster line ahead of the special valve is throttle (40) with a [illegible] of 17 mm. Ahead of the throttle is a pipe for connecting the [illegible] [illegible] is to create a high fuel pressure in the main duct, this being necessary for accurate operation of the indicator. When the throttle is installed, the pumping rate decreases insignificantly, while the fuel pressure in the main duct ahead of the throttle increases. If this throttle is absent, the fuel consumption increases, while the pressure differential created by the pump decreases. Moreover, the difference between the fuel pressure in the booster main and the pressure at which the pressure indicator is actuated will be small. This may actuate the indicator and cause the signal tube in the pilot's cabin to flash on prematurely or blink. The installation of the throttle prevents this from occurring.

The second booster main goes from pump (36) of the third group of tanks (this pump is located in tank No. 4) through non-return valve (32) containing throttle (31) with a diameter of 25 mm through special valve (41) to the lower wall of the supply tank. The purpose of throttle (31), non-return valve (32), and special valve (41) is the same as that of the booster main coming from the first group of tanks.

Ahead of throttle (31) on the pipeline is a pipe connecting the pipe coming from the pressure indicator of the pump of the third group of tanks and the command-pressure pump.

In order to ensure the fuel output from tanks 4, 5, and 6 when the pump of the third group of tanks is not operating, an additional main duct is introduced from the fourth tank to the third through non-return valve (32). As a result the terminates at the lower wall of the supply tank, in order to prevent the fuel from flowing backwards out of the supply tank during inverted flight, when valve (32) is open.

The next pumping duct goes from the wing tanks - compartments to the second tank. The output of fuel from the wing tanks is achieved without pumps; the excess-air pressure is 0.2 kg/cm^2 greater than the booster pressure in the afterburner tanks. Air from the booster-pressure system enters

(remainder illegible)

The joint between the pylon and the pipeline for the fuel output from the suspended tank, as well as the joint between the pipeline from the pylon to the fuel intake on the fuselage, is of telescope type; a rubber collar serves as the seal.

Thus the fuel is pumped from all the tanks into supply tank No. 3, in the lower part of which pump (36) remainder illegible is located

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The ____ joining of the tanks to the drainage ~~pipeline~~ duct, as well as the location of the duct itself, is such as to prevent fuel from over-flowing ~~fuel~~ through the drainage into the atmosphere and from one group of tanks into another in flight during various airplane maneuvers. In order to ensure this condition, in the drainage duct there are always sections which are higher than the level of the fuel in the corresponding tank or group of tanks during all airplane maneuvers. In order to prevent fuel from being ejected from the drainage duct into the atmosphere through impact-pressure intake (16) during ~~flight~~ banked flight, inverted flight, or during flight with negative overloads, the drainage duct makes a loop in the region of frame 29. The loop of the drainage pipe

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with common drainage of the fuselage tanks through drainage valves (10) and (8) controlled by the command-pressure system.

The drainage of the suspended tank is served by a pipeline in the main duct boosting the pressure in this tank, as well as by a special pipe located in the tank and connecting the tank with the atmosphere when the tank filler is opened.

In order to ensure normal operation of the fuel system, especially at high altitudes, a constant excess pressure in relation to the surrounding atmosphere is maintained in all the fuel tanks by the booster-pressure duct.

The air for boosting the pressure in all the tanks is taken from the engine compressor under a pressure of up to 10 kg/cm^2 through non-return valve (22) and is then distributed to all the systems. For the pressurization of the fuel tanks the air enters the ring of the drainage duct through throttle (24) 3 mm in diameter, which limits the flow of air to a certain value and reduces the air pressure.

At one end of this duct connecting with the impact-pressure intake pipe is non-return valve (19), which prevents complete bleeding of the air into the atmosphere. In this valve there is an opening 3 mm in diameter, for the purpose of

(remainder illegible)

For the pressurization of the tank suspended under the fuselage the air is also taken from the engine compressor through throttle (25), but with a diameter of 2 mm. Then the air goes through non-return valve (22) for the pressurization of the tank, thereby extruding fuel from it into the second tank. On the pipeline ahead of non-return valve (22) is a box containing safety valves (9), which bleed off the excess air into the atmosphere and, together with throttle (25), ensure the additional pressure in the suspended tank 0.81 + 0.83 atm (gage) during the output of the fuel from the tank. In order to avoid rarefaction in the suspended tank, vacuum valve (55) is installed in the main duct boosting the pressure in the tank.

Upon completion of the output of fuel from the suspended tank the air pressure in it decreases, pressure indicator (7)

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air pressure 0.2 kg/cm^2 higher than the booster-pumping pressure in the fuselage tanks. This differential is kept constant by safety valves located in box (9), which is similar to the box in the main duct boosting the pressure in the suspended tank.

If the output of fuel from the wing tanks is irregular, i.e., if the fuel is generated from the right-hand tanks sooner than from the left (or vice versa). In the main duct pressurizing the wing tanks are throttles (49) 7 mm in diameter, which decelerate the bleeding of air through the evacuated tanks and ensure the output of fuel from all the wing tanks.

Thus the output of fuel from the wing tanks and the suspended tank is achieved without pumps by the excess-air pressure, and the fuel-output sequence is controlled with the aid of a command-pressure system, which includes special valves (41).

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All the fuel pumps are turned on before starting the engine. In the booster-pumping ducts a fuel pressure is created; moreover, part of the fuel under pressure is taken into the command-pressure system through non-return valves (12) out of the booster-pumping ducts from a pump of the 2nd and 3rd groups of tanks. Then it is distributed through filter (13) to special valves (7) and drainage valves (14) and (15).

Special valves (7) have a cavity which is separated by a rubber membrane (8) from the cavity to which the booster-pumping duct leads. The command fuel pressure is fed into this cavity through non-return ball valve (10), shield washer (9), and a throttle 0.8 mm in diameter. Then the fuel goes along the duct through filters (2) to the connecting pipes of float valves 3a, 2b, and 1c.

Float valves (1) are adjusted so that when the tanks are completely filled the command fuel pressure entering the float valves is bled off into the tank through non-return valves (4), which at that moment are opened by rods (5).

As a result,

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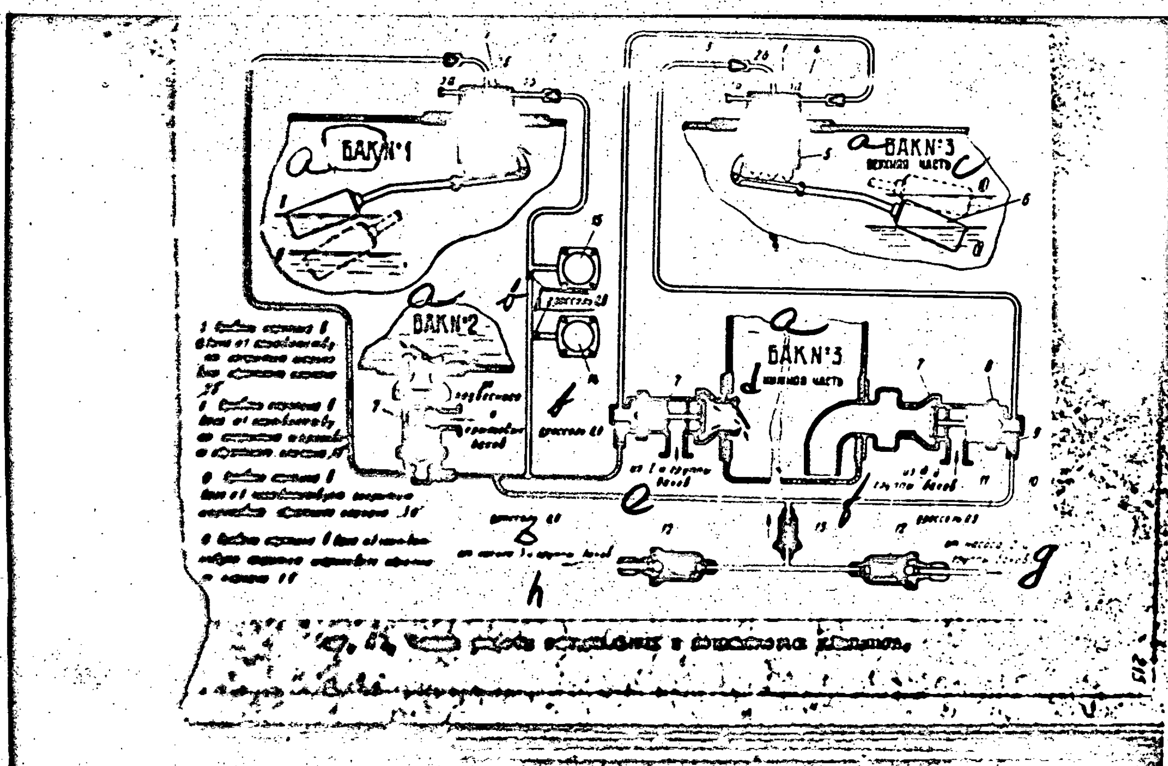

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Fig. 65. Operation of special and float valves.

a) tank b) throttle c) upper part d) lower part

e) from 1st group of tanks f) from 3rd group of tanks

g) from pump of 2nd group of tanks

h) from pump of 3rd group of tanks

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Fig. 65. Operation of special and float valves

1 - float valves;

2 - filtor of float valves;

3 - plug;

4 - non-return ball valve;

5 - floating rods;

6 - float;

7 - special valve;

8 - membrane;

9 - shielding washer;

10 - non-return ball valve;

11 - spring of special valve;

12 - non-return valves;

13 - filter of (illegible) pressure;

14 - drainage valve for filling wing tanks;

15 - drainage valve for output of fuel from wing tanks.

During the output of fuel from the tanks float (6) descends, enabling rods (5) to move downward. Under the action of the spring non-return ball valve (4) overlaps the opening through which the command fuel pressure was bled off. The fuel pressure in the main duct connected to this ~~pipe~~ connecting pipe of the float valve will increase, membrane (8) in the ~~expanding~~ appropriate special valve will sag and press spring (11), and the special valve will open, thereby connecting the tank to the booster-pumping duct. Starting from this moment, the fuel will be pumped ~~from~~ out of the appropriate group of tanks.

The throttles with 0.8 mm diameter ahead of the special valve and ahead of the drainage valves are ~~xxxxxx~~ intended to ensure independent operation of each special valve connected to the appropriate connecting pipe of the float valve. In the absence of a throttle the command pressure will be bled out of the entire system, if only one non-return ball valve (4) in one of the float valves is open.

(remainder illegible)

21P

sequence of opening this special valve (Fig. 65).

The order of output of fuel (Fig. 65) from the tanks when the plane is in a horizontal position will be as follows. First a small quantity of fuel is delivered from the completely filled fuselage tanks; in this case the level of the fuel descends somewhat more in tank No. 3, owing to the delay in the overflow of fuel from the other groups of tanks.

The release of the command pressure in the float valve on the third tank through connecting pipe 3a stops, as a result of which the special valve of the first group of tanks, located on the front wall of the tank, will open, and pumping of the fuel from the first group of tanks to the supply tank will begin.

Delivery of fuel from the first group of tanks will take place until the fuel level in tanks 1 and 2 descends, so that the non-return valve of connecting pipe 3b of the float valve on the first tank closes. The fuel pressure in the duct connected to this connecting pipe will increase, thereby causing the special valve on tank No. 2 to open, and pumping of the fuel from the suspended tank to the second tank will begin.

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а Схема выработки топлива

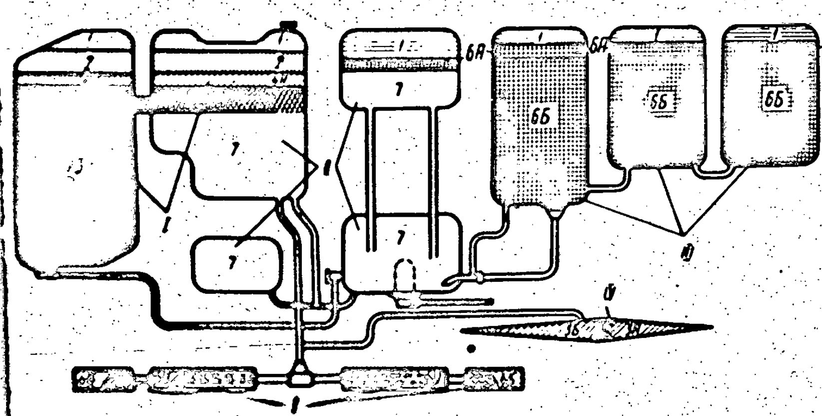

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Fig. 66. (Title illegible)

a) fuel-delivery system

will increase, the float will rise, non-return valve (4), connected to connecting pipe 2b of the float valve will open, the pressure from the command main duct will be bled into the tank, and the special valve on tank No. 2 will close.

Upon completion of the fuel delivery from the suspended tank the fuel level in the first and second tanks will descend still more, the bleeding of the command pressure through connecting pipe 1b of the float valve on the first tank will stop, the fuel pressure in the main duct will increase, drainage valve (14) controlling the pressurization of the wing tanks will overlap the duct connecting the rear wing tank compartments with the drainage, the air pressure in the wing tanks will increase, and the pumping of fuel from the wing tanks into the second tank through the previously opened special valve will begin. If during the delivery process the fuel level in the 1st tank exceeds the level at which the non-return ball valve of connecting pipe 1b closes, the air pressure on the wing tanks is bled off into the drainage through the drainage valve controlling the pressurization, this valve being open in such a case. The delivery of fuel from the wing tanks to the second tank will take place until

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and No. 2 will continue further, so that tank No. 1 will be completely evacuated, while tank No. 2 will be evacuated down to the lower edge of the connecting pipe. Starting from this moment, the fuel level in tank No. 3 will begin to descend, and the non-return valve of connecting pipe 2b in the float valve of this tank will close, as a result of which the special valve of the 1st group of tanks on frame 20 will open under the action of the command fuel pressure, and pumping of the fuel from tanks 4, 5, and 6 to the supply tank and from the connecting pipe to the engine will take place.

The last step will be the delivery of fuel from the supply tank, the fuel residue from tanks 2 and 3a. Figure 56 shows the fuel-delivery system and order of delivery.

Continuous control over the consumption of fuel by the engine is achieved by the pilot from the indicator of a flowmeter located on the right-hand side of the instrument panel, to which a signal is sent from flowmeter sensor RTO-16A located in the main duct feding fuel to the engine.

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tanks, and the suspended tank, and also at the moment when 500±50 liters of fuel remain in the system. In this case a signal tube labeled "500 liters remaining" flashes on in the pilot's cabin.

The delivery of fuel from each group of tanks and from the suspended tank is indicated by special tubes located in the pilot's cabin, which flash on when the pressure sensor-indicators (33) and (7) are actuated (cf. Fig. 63).

Pressure indicators (33) and (7) are connected to the main duct for pumping fuel from the 1st, 2nd, and 3rd groups of tanks and from the suspended tank. The pressure indicators have two cavities: dynamic and static. The dynamic cavity is connected through a damping throttle with a diameter of 0.8 mm (in the case of the suspended tank a diameter of 1 mm) to the pumping ducts. The static cavity of all the sensors is combined into one main duct through fuel trap (29), which connects with the drainage-system tank.

Fuel trap (23) is the static cavity : of the pressure indicators

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SECRET

AIRCRAFT Ye-6T
Technical Description
Book III

Construction
Parts 1 and 2

Pages 223 - 453

SECRET

GROUP 1

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The indicators contain an elastic membrane, on one side of which the fuel presses, while on the other side there is a system of electrical contacts, which close in the absence of fuel pressure on the membrane. Therefore the indicator, incorporated into the main duct of one of the groups of tanks, closes the contacts of the signal tube at the moment when the pumping of fuel from a given group of tanks ends.

The signal indicates that the fuel from the group being controlled has been used up and that it is necessary to evacuate the pump of this group.

The emergency fuel-supply tube lights up when the electrical circuit in the float-type emergency supply sensor (13) located in the upper part of tank No. 3 closes.

For uninterrupted feeding of fuel to the engine during short (maximum regime 15 sec, afterburner 5 sec) inverted flights or during flights with negative g-forces, part of tank No. 3 is equipped like a negative g compartment.

The system is fueled through two fuel fillers (12) in the upper part of the fuselage: one in the region of frames 15-16A, through which tanks 1, 2, 2A, 3, and the wing tanks are fueled; the other in the region of frames 21-22, through which the third group of tanks is fueled.

The suspended tank is fueled through filler (44) within the tank itself.

The fuel residue is drained out of the lower points of the fuel system through valves (2), which are located:

1. In the lower part of all three fuel pumps;

2. On the pipeline connecting tank No. 2a with the third tank;

3. In the lower part of the pipe connecting the right and left halves of tank No. 4.

The fuel is drained out of the lower part of the pump on the 1st tank into a funnel, from which the pipeline is led outside. A pipe connecting with the drainage vent of the pump is welded to this pipeline. The drainages of the other pumps are led outside the fuselage by means of a special pipeline.

S-E-C-R-E-T

Float Valves and Special Valves

The float valves of the fuel system are located in the command-pressure duct and are designed, together with the special valves, for the automatic delivery of fuel from the tanks in a given sequence.

The float valves (Fig. 67) are located in the upper part of tanks 1 and 3 and are attached to them with the aid of plate (2), on which all the parts of the valve are mounted.

The valve consists of casing (3), which is introduced into plate (2) through an opening and is fastened to the plate by nut (6). Rotation of the casing relative to the plate is prevented by two projections on the casing which enter grooves on the plate. Leaktightness of the joint between the casing and the plate is ensured by a rubber washer (5).

In casing (3) from vents 3a, 2c, and 1a there are openings into which springs (4) of return ball valves (7) are introduced. Ball (7) rests on a seat in bushing (11) connected with casing (3) of the float valve by a connector nut (8). In the bushing are 3 openings, the upper ends of which are the seats of return ball valves (7). Floating rods (10) are inserted into these openings.

Outside, behind bushing (11) is bracket (9), on which the axis of rotation of lever (1) with the float on the end is located. The movement of the float is limited as a result of the presence of stops on the lever and on bracket (9).

S-E-C-R-E-T

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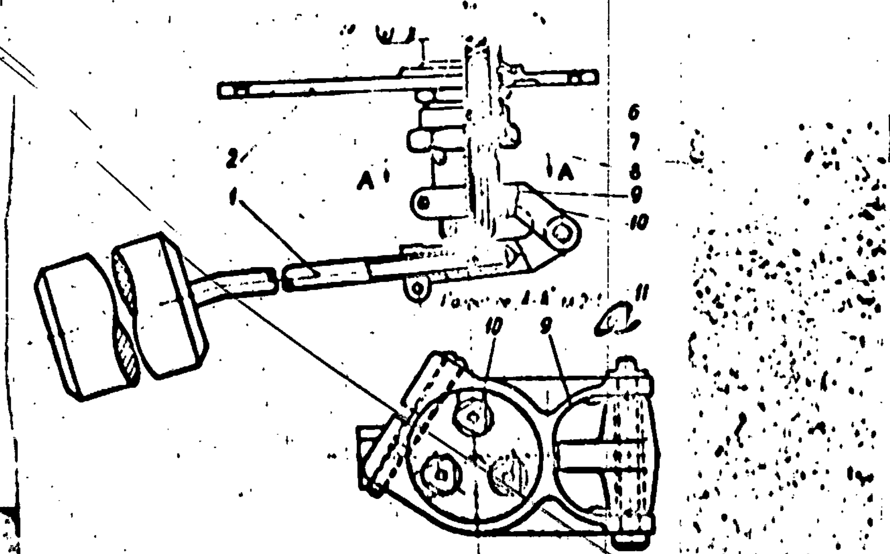

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S E C R E T

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Fig. 67. Float valve.

1 - lever of float;

2 - plate;

3 - casing;

4 - spring;

5 - rubber washer;

6 - nut;

7 - ball;

8 - connector nut;

9 - bracket;

10 - floating rods;

11 - bushing.

a) cross section along A-A

S E C R E T

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The float valve commences operation the moment the booster pumps are turned on. The float in the kerosene is acted upon by an ejecting force, as a result of which the float is lifted upward. At the same time lever (1) presses alternately on floating rods (10), the rods press the return ball valves out of the seat, and the command pressure in the main duct is bled off, thereby stopping the pumping of fuel from the respective group of tanks until the fuel level in the tank, together with the float valve, descends.

In this case the float will descend and the lever will not prevent the descent of rods (10) and the closing of the return ball valves. As soon as one of the return ball valves closes, the command pressure in the main duct connected to this valve will increase and the corresponding special valve will open.

As the float moves downward, the return ball valve communicating with vent 3a opens first, then the valves communicating with vents 2a and 1a. The bleeding of the command pressure from these ducts ceases accordingly.

Special valve (Fig. 68) is installed in the booster-pump duct in such a way that vent B is attached with the aid of an adapter to the flange of the tank, while the booster-pump duct is connected to vent A.

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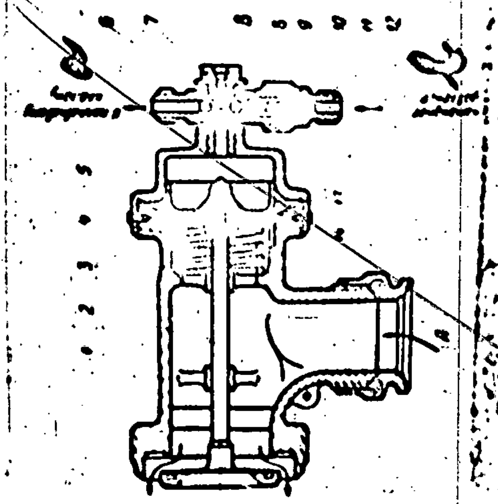

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Fig. 68. Special valve.

a) to float valve b) command pressure

Fig. 68. Special valve.

A. From the booster-pump duct;

B. To the tank;

C. Throttle opening, diameter 0.8 mm;

1. Casing;
2. Valve;
3. Spring;
4. Sliding protective washer;
5. Rubber membrane;
6. Seal;
7. Clamp;
8. Protective washer;
9. Spring;
10. Casing;
11. Ball;
12. Vent;
13. Cover;
14. Screw.

In the casing of special valve (1) in a cavity communicating with the booster-pump duct are valve (2) and spring (3), which rests on sliding washers (4), between which is clamped leaktight rubber membrane (5) separating the cavity of the booster-pump duct from the cavity of the fuel command pressure, which is fed through return ball valve (11), protective washer (8) with openings 0.7 mm in diameter, through throttle opening C 0.8 mm in diameter in the casing of return valve (10). The latter is secured to the cover of special valve (13) by means of clamp bolt (7) with an annular groove. The leaktightness of the joint is ensured by rubber washers (6). The locking of cover (13) on casing (1) is ensured by screws (14).

In the absence of a command fuel pressure valve (2) is pressed against casing (1) by spring (3), and the fuel outlet into the tank from the special valve is closed. With an increase in the command pressure membrane (5), sagging, overcomes the resistance of spring (3), and valve (2) moves in the guide rails in a direction opposite to that of the tank, thus opening the fuel outlet from the special valve into the tank. In this position fuel is pumped through the open special valve. The special valve begins to open at a command fuel pressure of $0.3^{+0.1}$ atm.

The fuel pressure in the cavity of the booster-pump duct of the special valve varies, depending on the pumping rate, but has no effect on the beginning of the opening of the special valve and on its operation.

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since the total forces resulting from the fuel pressure on valve (2) and washer (4) are identical in magnitude, as a result of the fact that the areas of valve (2) and washer (4) are the same, but have different directions, thus counterbalancing each other.

Bleeder Valve

A bleeder valve (Fig. 69) is installed in the wing-tank pressurization system. The bleeder valve serves to control the air pressure fed into the wing tanks. On casing (5) of the bleeder valve are four vents, with the three lower vents connected directly to each other, as shown in the cross section C-C.

Air from the engine compressor is fed to one of the lower vents and is distributed through the other two vents to the wing tanks and to the safety-valve box.

The fourth vent A is connected to the drainage system.

Casing (5) is connected by four bolts to cover (1) containing vent D, to which the command fuel pressure is fed.

The command-pressure cavity is separated from the air cavity by rubber membrane (2) together with cap (3).

When there is no command pressure, spring (4) opens valve (3), and air is bled from the engine compressor into a common drainage, as a result of which there will be no delivery from the wing tanks.

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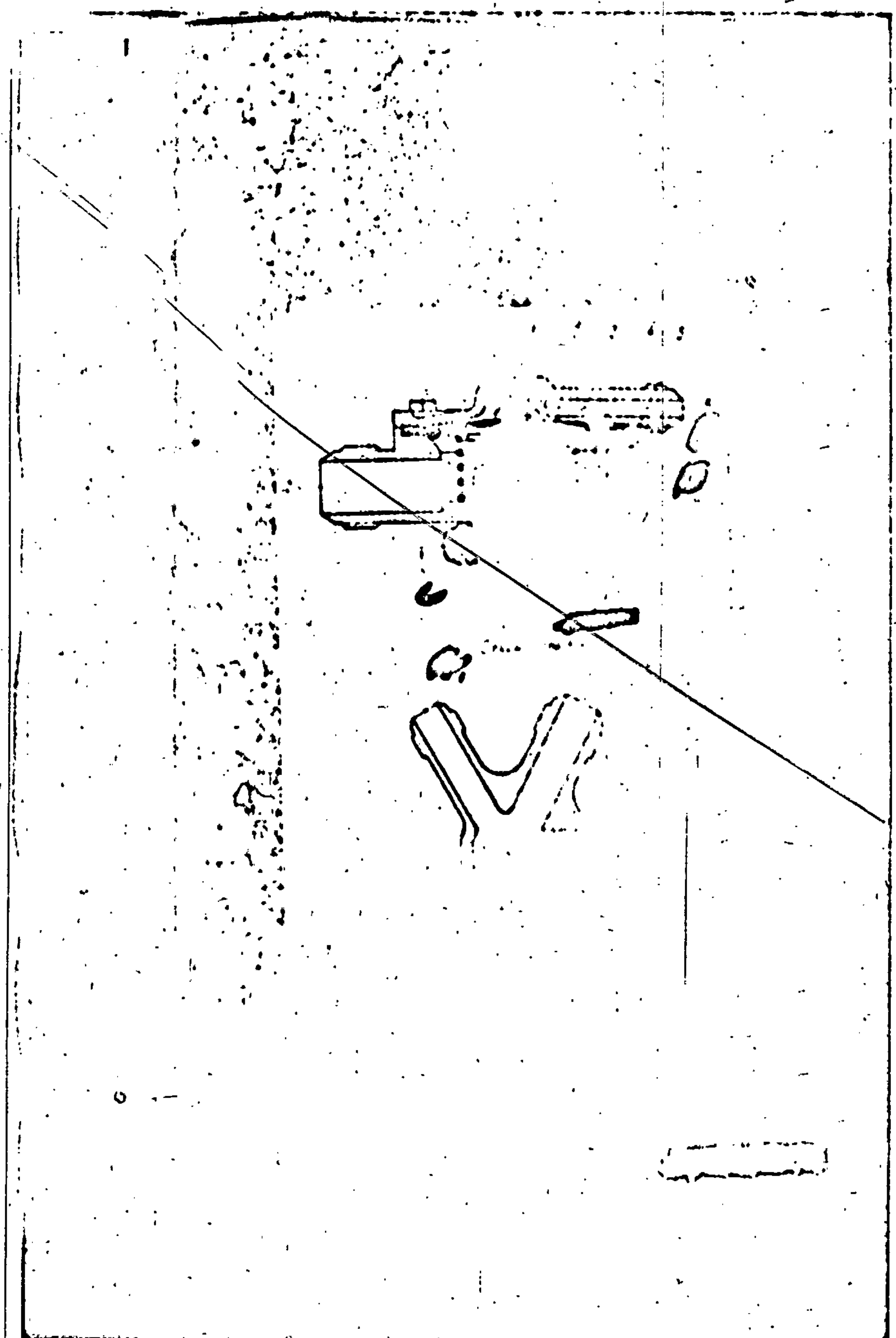

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Fig. 69. Bleeder ~~[illegible]~~ valve.

a) cross section along C-C

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When the float valve connected to vent B is actuated, the fuel pressure in the cavity above membrane (2) increases, the valve presses spring (4), overlaps the opening through which air was bled into the drainage, the air pressure in the wing tanks rises, and the delivery of fuel from them begins.

Figure 69 shows the bleeder valve controlling the pressurization of the wing tanks.

Another bleeder valve of similar construction is located in the main drainage main of the forward wing tanks. This valve is intended to discharge air into the drainage system from the forward wing tanks during the fueling of the latter. From the moment the booster pumps are turned on this bleeder valve is closed and overlaps the pipeline connecting the tanks to each other and to the drainage tank.

Command-pressure Filters

In the command-pressure main are gauze filters. The filter located below in the region of frame 19 and called the command-pressure filter is intended to purify the fuel taken from the booster mains into the system.

The filters located immediately before the float valves and called the float-valve filters are intended to purify the fuel pumped through the float valves.

<u>Command-pressure filter</u> (Fig. 70) of gauze type. Gauze (3) No. 004 V GOST 3584-53 is soldered to framework (4) embedded in casing (5), onto which nut (1) is screwed. The joint is sealed by a rubber washer (2).

<u>Float-valve filters</u> (Fig. 71) also of gauze type. Gauze (3) No. 01 V GOST 3584-53 is soldered to the base and is embedded, together with it, in casing (4). Vent (1) is screwed into casing (4). The joint is sealed by rubber washer (2).

<u>Safety-valve Box</u>

The excess pressure in the pressurization mains of the suspended tank and the wing tanks is kept constant during the fuel-delivery process with the aid of safety valves (Fig. 72), which are mounted in a locktight box (6).

The safety-valve box in the pressurization main of the suspended tank is installed on the port side of the fuselage on frame 23, while the safety-valve box in the pressurization main of the wing tanks is installed in the back-fairing in the region of frame 12.

The safety valves

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S-E-C-R-E-T

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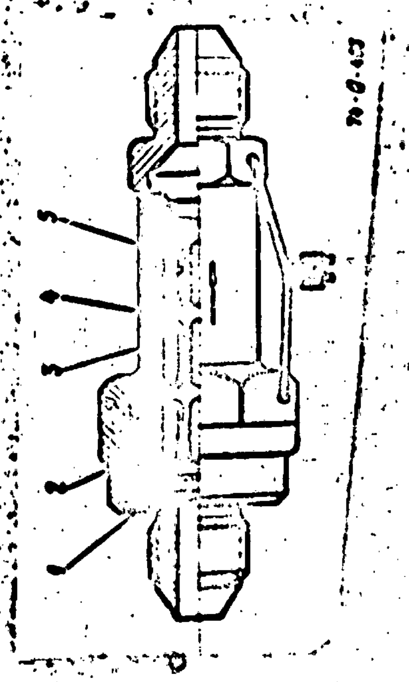

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Fig. 70. Commnd-pressure filter

1 - nut;

2 - rubber washer;

3 - gauze;

4 - framework;

5 - casing;

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Fig. 71. Float-valve filter.

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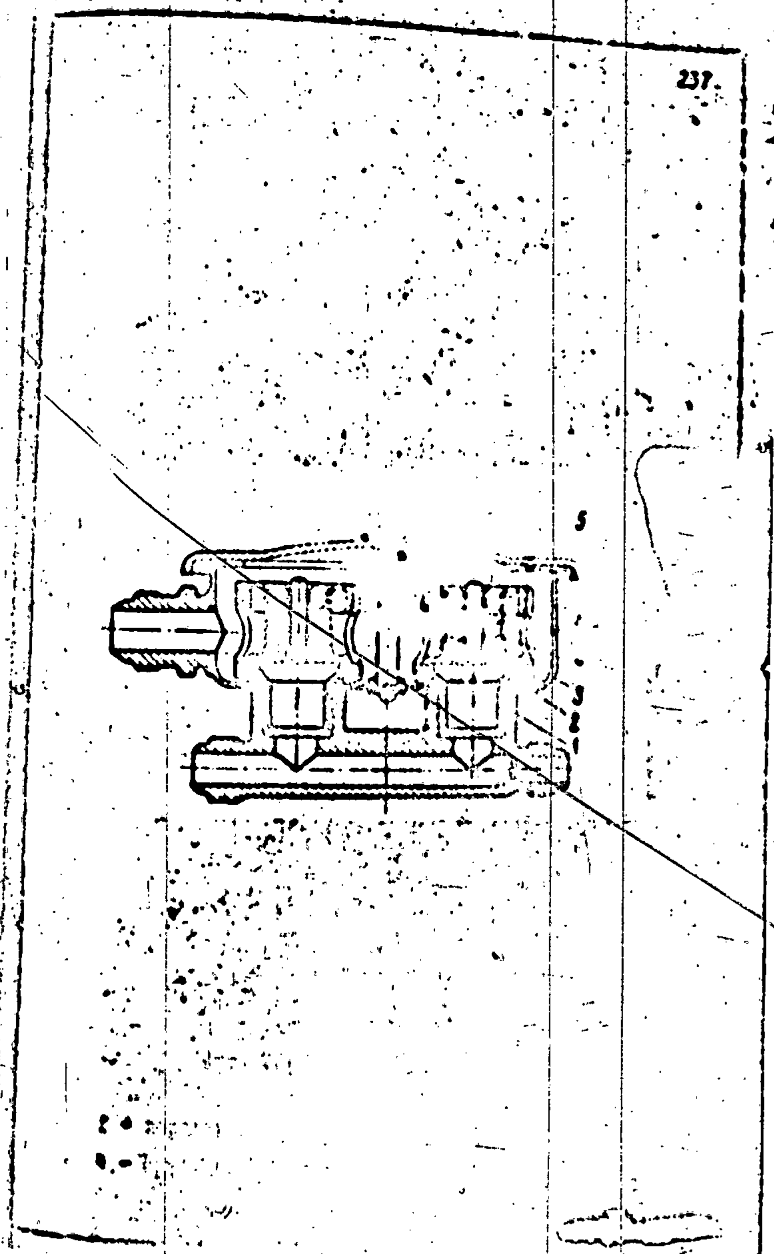

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Fig. 72. Safety-valve box.

1 - casing;

2 - valve casing;

3 - valve;

4 - spring;

5 - cover;

6 - box.

Cover (5) is ...ed into casing (2) and makes it possible to adjust the spring pressure up to a certain magnitude during assembly. The cover is locked by a wire passing through an opening in the cover and the casing.

The safety valves of the pressurization system of the wing tanks begin to open at 0.19 ±0.01 atm, while the safety valves of the suspended tank begin to open at 600-610 mm Hg.

The outlet from the locktight boxes is connected: from the box in the pressurization main of the wing tanks - to the over-all drainage; from the box in in the pressurization main of the suspended tank - to the atmosphere.

Shut-off Valve

The shut-off valve (Fig. 73) is intended for emergency shut-off of the main feeding fuel to the engine or for shutting off the main during assembly operations.

A valve of straight-way type with immobilization of the extreme positions consists of casing (2), vent (1) hermetically connected to the casing, valve (3), lever (4), spring (5), which immobilizes valve (3) in the position "open" or "closed". Lever (4), connected to valve (3), is mounted on axle (7), which is rotated by guide (6) controlling the valve; as a result, spring (5) is pressed and offers resistance to the motion of the guide. When passing through the central position

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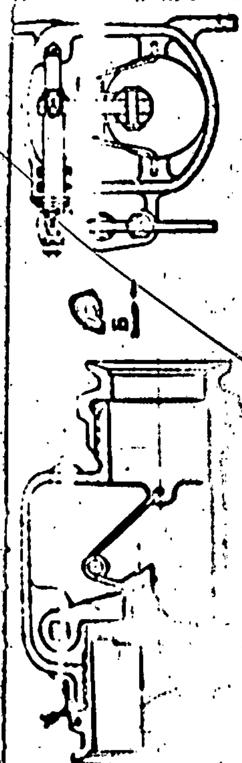

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Fig. 73. Shut-off valve.

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a) view along arrow B

b) guide shown in valve position "open"

c) illegible

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The outlet of axle (7) from the inner cavity of the valve is hermetically sealed by two rubber washers.

The closing of the valve is remote-controlled from the pilot's cabin. On the left panel is a button "fire valve", closed by a safety cap.

When it is pressed for 3-4 sec, an electric current is fed to the windings of electropneumatic valve 695000/M located below in the region of frame 21 near the valve.

The electropneumatic valve is actuated and allows air under a pressure of 50 atm to pass through the pipe into cylinder (6). Piston (9) moves out, breaks the lock of guide (6), moves it, thereby closing the valve.

Electropneumatic valve 695000/M is in the open state only when the button on the panel is pressed.

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Bleeder Valve

A bleeder valve (Fig. 74) is installed in the region of frame 28 on the pipe feeding fuel to the engine.

The valve serves to drain fuel from the tanks and the system, and also to inhibit the engine. The valve consists of casing (4), which is welded to the pipe feeding fuel to the engine. Rod (3) is screwed into casing (4), together with valve (5), which is made out of polyfluoroethylene resin. Nut (1), together with rubber gasket (2), vulcanized on a glue base, is also screwed into the casing and serves to limit the movement of the rod. Drainage vent (6) is welded to the casing and is closed by plug (7).

The valve opens when rod (3) is screwed out and closes when it is screwed in. In order to open the valve completely, it is necessary to screw out the rod until it is stopped by nut (1) and rubber gasket (2), which is simultaneously the seal of the valve rod. The rod has faces for a 24 mm wrench.

The flow area of the valve is 30 mm. In order to drain off fuel, it is necessary to remove the plug from the drainage vent and turn it in such a way as to make two projections on the vent move out of grooves in the plug, then connect

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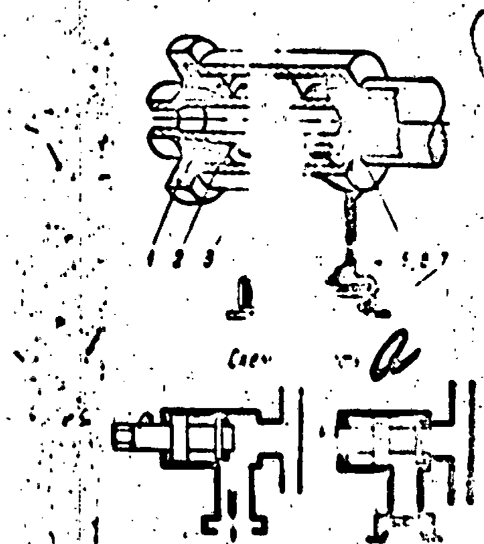

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Fig. 74. Bleeder valve.

1 - nut;

2 - rubber gasket;

3 - rod;

4 - casing;

5 - valve;

6 - drainage vent;

7 - plug.

a) diagram of operation

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When the engine is inhibited without removing it from the plane, it is necessary to install on the vent an adapter, which is part of the complex of ground equipment.

Safety Valves

Safety valves (Fig. 75) are installed in the system boosting the pressure in the fuselage tanks and serve to maintain a constant excess pressure of 0.21-0.23 atm (gage) in the tanks.

The valve consists of casing (2), the valve itself (3), cover (5), screwed into the casing and making it possible to adjust the compression of spring (4) during assembly and calibration of the valve.

The valve begins to open at an air pressure of 160-170 mm Hg. The leaktightness of the valve should be as follows: at air pressures ranging from 0 to 40 mm Hg bleeding is allowed at a rate of up to 15 bubbles per minute, while at pressures higher than 40 mm Hg it is allowed without restriction.

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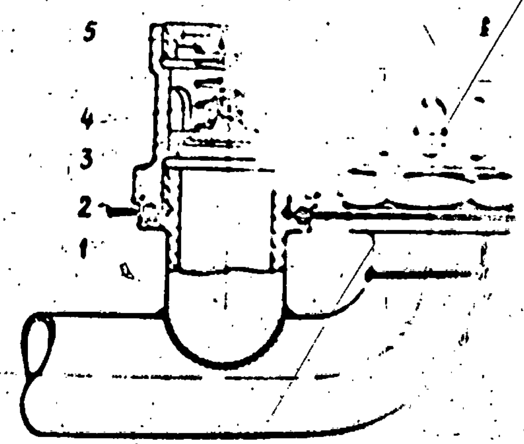

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Fig. 75. ~~[illegible]~~ Safety valves.

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Return Valves

All the return valves of the fuel system, with the exception of the valves in the command-pressure main, are of petal type and close under the action of their own weight, while the two valves located in the drainage pipeline, in the back fairing between tanks 2 and 3, and in the collar of the drainage pipeline are under spring pressure and open at a certain pressure differential. These valves are shown in Fig. 75.

The return valve (Fig. 76) consists of casing (5) and vent (1), together with valve (4), joined by bolts. The flange joint is hermetically sealed by a rubber gasket. Valve (4) of petal type closes under the action of its own weight and spring (3); the valve rotates on an axle inserted in lug (2), which is pressed into vent (1); the lug is secured in the vent by a pin.

The leaktightness of the return valve is achieved by gripping the contiguous surfaces. (illegible)

The return valves under spring pressure open at the following pressure differentials.

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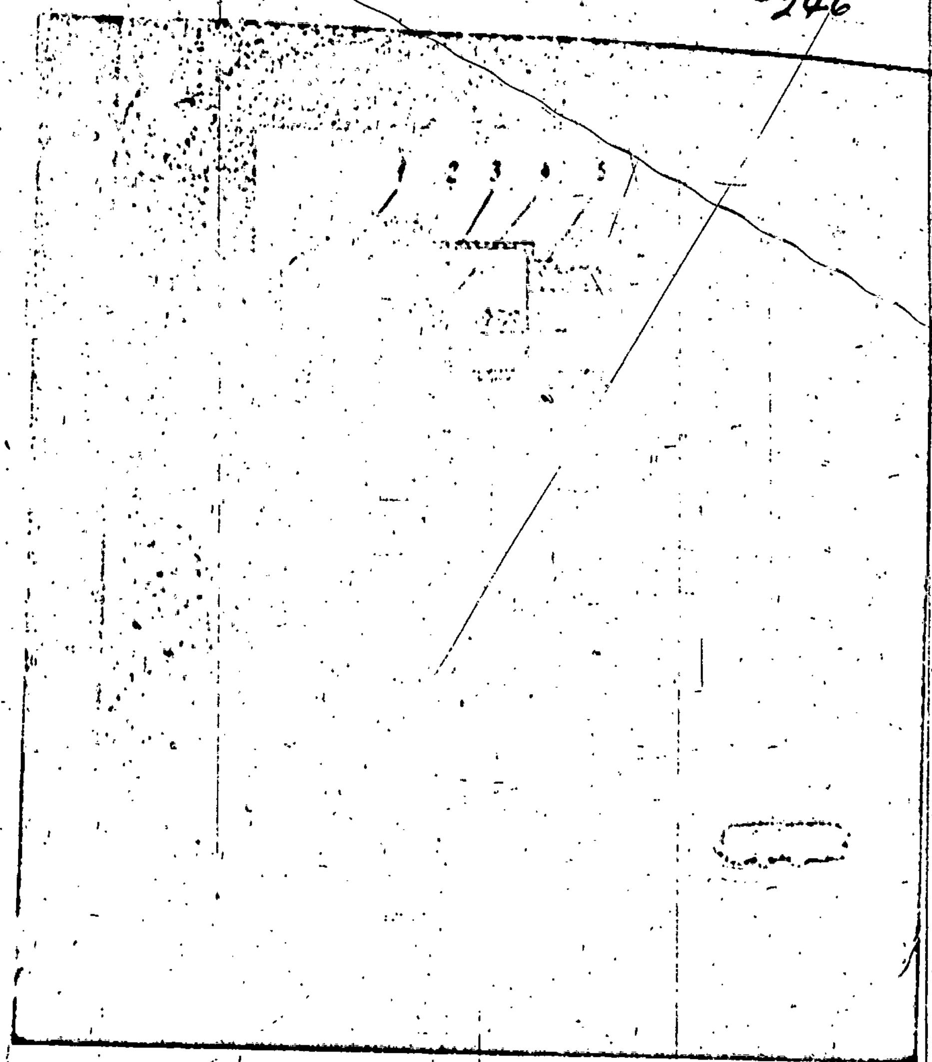

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Fig. 76. Return valve.

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In the command-pressure system are [illegible]-return valves of ball type and two [illegible]-return valves of disk type (cf. Fig. 65).

Unit 495A2

Unit 495A2 is a centrifugal pump driven by an individual electric motor of type MDP-700 and is installed in the fuel system to boost the fuel pressure and create a pressure head at the inlet to the engine fuel pump, and also to increase the high-altitude performance of the fuel system. A skeleton diagram of the operation of the pump is shown in Fig. 77.

Electric motor (1) is attached to the flange of casing (2) of the pump and is an integral part of it. The motor is cooled by the fuel surrounding the casing of the motor, as well as by atmospheric air coming through special ducts in the casing of pump (6) with discharge of exhaust air through the drainage vent into the atmosphere.

(The cooling scheme is shown in Fig. 79).

The electric motor is a compound quadripole engine designed for operation in a single-wire aircraft network. The normal technical characteristics of the MDO-700 electric motor are as follows:

feed voltage	27 volts
current consumption	not more than 37 amp
rpm of shaft	6100^{+300} rpm

Unit 495A2 is attached to the bottom of the third tank in the negative G compartment and on the bottom of the fourth tank. The inlet duct of the pump casing is always filled with fuel.

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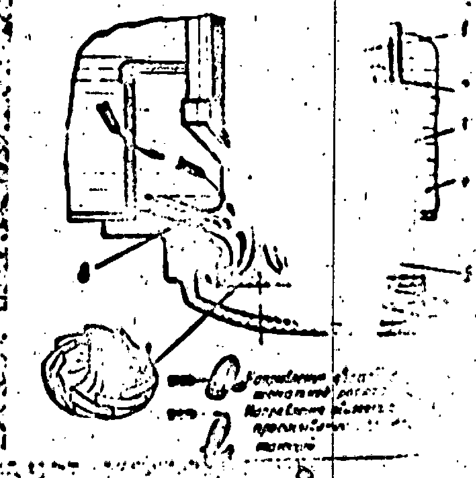

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Fig. 77. (illegible)

6 - casing (other captions beneath title illegible)

a) direction of movement of fuel during normal operation of the motor

b) direction of movement of fuel during suction ~~xxxxxxx~~ of (illegible) through nonoperating (illegible)

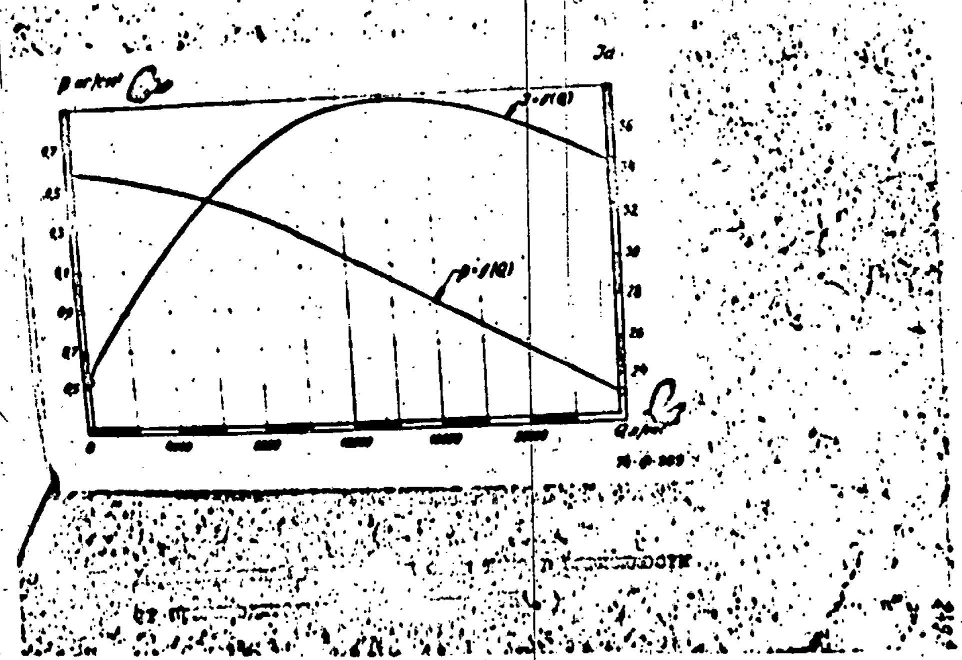

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Fig. 78. Pressure and current characteristics as functions of the ~~xxxxxxxxx~~ output of the unit 495A.

a) kg/cm^2 b) liter/hr

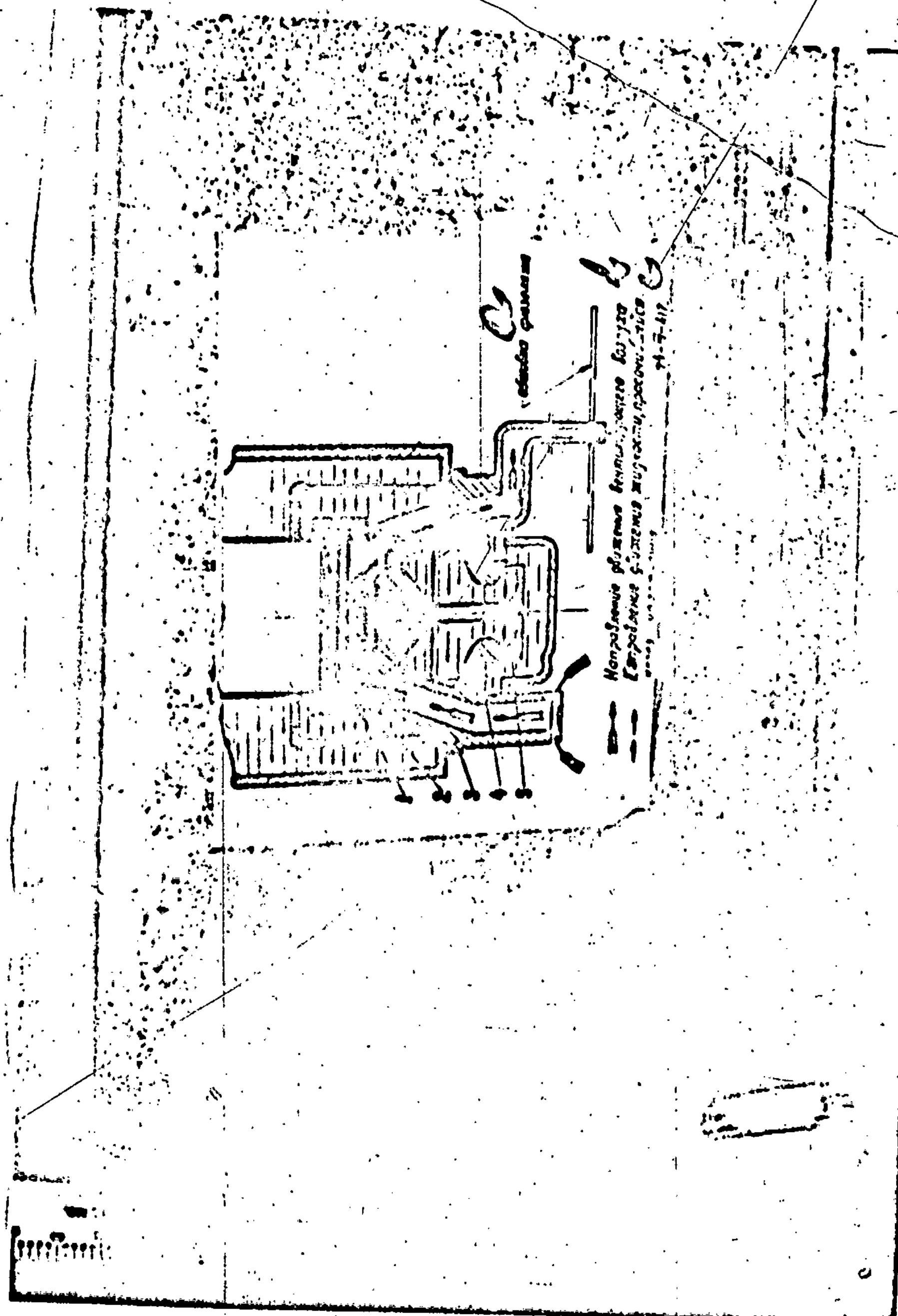

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Fig. 79. Air-cooling system of the electric motor of the unit 495A2.

1 - electric motor;

2 - gauze filter;

3 - casing;

4 - valve;

5 - impeller.

a) fuselage cover

b) direction of motion of ventilating air

c) direction of motion of fluid seeping through seal

The fuel passes through gauze filter (3) onto the central part of impeller (7). When the pump is turned on, the impeller rotates and creates a translational and rotational movement of the fuel, thereby increasing its speed and pressure. The fuel is ejected from the impeller channels along the outer diameter of the impeller and enters a spiral collector, from which the fuel rushes into the channel of the pressure tube, which is an extension of the spiral.

The spiral collector is connected by overflow pipe (4) to the tank cavity, thereby improving the operating stability of the unit and decreasing the fuel-pressure pulsations.

In the lower part of the spiral is a bleeder valve to drain off the water condensate (not shown in Fig. 77).

The main approximate characteristics of unit 495A2 (the dependence of the pressure differential P created by the pump and the dependence of the current consumption J on the flow rate Q) are given in Fig. 78.

When the electric motor is not in operation, the fuel flows out of the tank into the main duct either through impeller (7) or through return valves (5), which open in this case and reduce the hydraulic resistance of the pump.

Unit 422A

Unit 422A, like 495A, is a centrifugal pump driven by an individual electric motor of type MDP-500A (1) and is installed in the fuel system to pump fuel from the first group of tanks into the supply tank.

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The electric motor is attached to the flange of the casing of pump (3) and is an integral part of it. The motor is cooled in the same way as unit 495A2 (cf. Fig. 79).

The design of the electric motor and the attachment of the motor to the pump casing are such as to prevent fuel from getting into the interior of the motor. The nominal basic technical characteristics of the electric motor in the basic regime are:

Feed voltage .... 27 volts
Current consumption .... not more than 29 amp
Rpm of shaft .... 7900 rpm

The method of operation of the unit and its installation in the tank are similar to those of unit 495A. In contrast to the latter, in unit 422A there is no overflow pipe (4) (Fig. 77) and deflector (8), indicated by a broken line in the diagram, is installed in front of impeller (7). During the operation of the unit part of the fluid with the bubbles, being the lighter part, is pressed upwards along the wall of the filler under the deflector without preventing the counter flow of fuel.

The main approximate characteristics of unit 422A (the dependence of the pressure differential P created by the pump and the dependence of the current consumption I on the flow rate Q) are given in Fig. 80.

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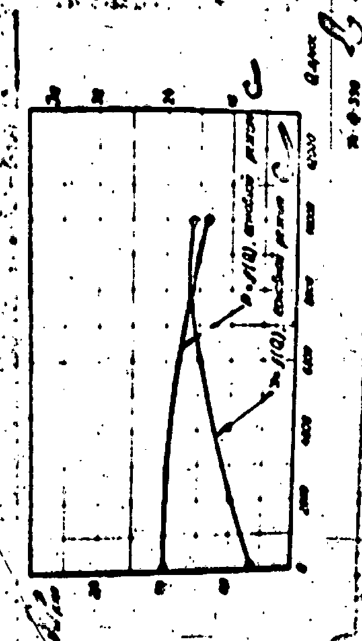

Fig. 80. Pressure and current characteristics as functions of the output of unit 422A.

a) kg/cm^2 b) liter/hr c) basic regime

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FUSELAGE TANKS

General Information

All the fuselage tanks are of soft construction. As a result, they are placed in special containers for the purpose of ~~xxxxxxxxxxx~~ removing tensile stresses from the walls of the tank.

The walls of the tanks consist of two layers:

- an inner layer, made of kerosene-resistant rubber 3826 MRPTU 1551-51 with a thickness of 0.8 mm;

- an outer layer vulcanized on a glue base and made out of ~~xxxxxxx~~ fabric AFHKR TU 1597-53.

The total thickness of the walls of the tank amounts to as much as 1.3 mm. The butt welds of the inner rubber layer overlap by 25-30 mm; ~~xxxxxxxxxx xxxx~~ in this case the edge of the inner layer is mitered. The butt welds of the outer layer made out of fabric are sealed with strips of light-weight, two-way-stretch fabric AKhKR opened at an angle of 45° to the (illegible) of the fabric.

At the points of installation of the framework

(remainder illegible)

In order to remove the detachable ingot, when the available openings on the tank are small, technological cuts are made; then the sites of the cuts are sealed, for which purpose (cf. Fig. 80, cross section along), at the site of a cut the outer layer of fabric AKhKR is stripped off over a width of 40 mm in both directions from the cut, and two layers of rubber with a width of 30 mm and 80 mm are pasted on symmetrically in place of the fabric; a layer of fabric AKhKR is placed above those two layers.

In order to prevent them from being scratched, the edges of the fabric are glued together by a layer of rubber ~ 20 mm wide. Then, depending on the size of the cut repeated local or overall vulcanization is carried out.

Tank No. 1

Tank No. 1 (Fig. 81) is located between frames 11 and 13 above and between the side air-intake valves.

The tank is attached to the fuselage structure.

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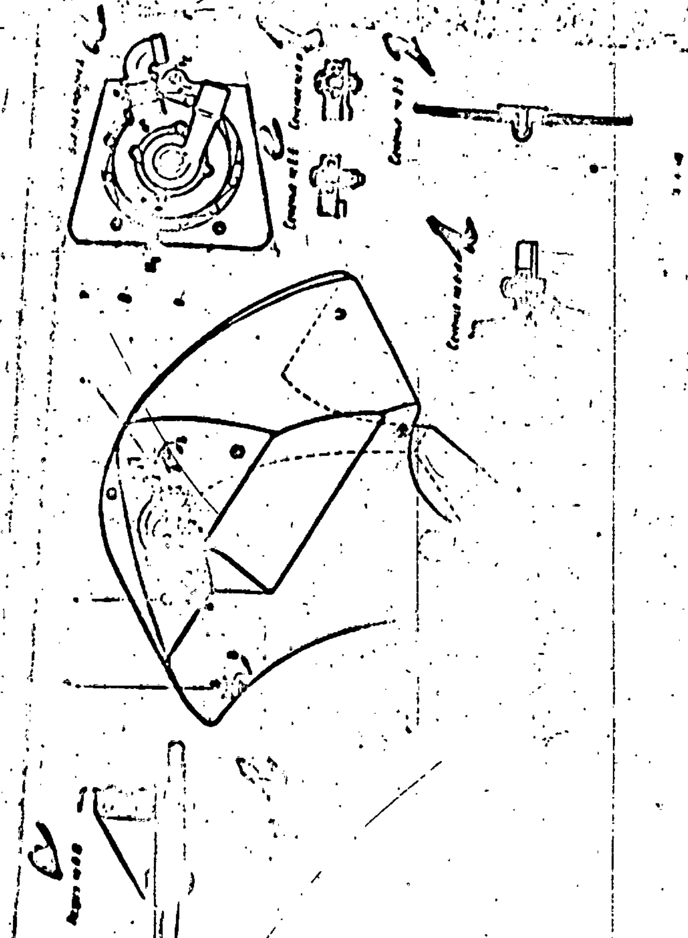

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Fig. 81. ~~xxxxxxxx~~ Tank No. 1 (captions beneath title ~~xxxxxxxx~~ illegible except: 6) flange; ~~xxxxx~~ 7) unit 412A

a) cross section along A-A

b) " " " B-B

c) " " " C-C

d) ~~xxxxx~~ view along arrow E E

e) cross section along ~~xxx~~ F-F

f) " " " ~~xxxxx~~ G-G

g) " " " ~~xxx~~ H-H

h) " " " I-I

bolted [redacted] the tank along the perimeter; the heads of the bolts are retained by a wire.

In the upper part of the tank is soft nipple (5), which connects with the drainage pipe.

On the rear wall of the tank flange (5) with a vulcanized plate sealed onto it serves to attach the connecting pipe of the 1st and 2nd tanks.

Crosspiece (8) serves to bond the plate of unit 422A with frame 16.

Tank No. 2

Fuselage tank No. 2 is located above the air-intake duct between frames 13 and 16.

Its cross section is in the shape of a semicircle (Fig. 82).

The tank is installed and removed by removing the right upper panel of the fuselage; the tank is attached to the fuselage structure by means of pins (2), of which there are 12 above and 4 below; of these two pins in the region of frame 35 are not attached directly to the container, but are attached in a region more accessible for assembling the tips of the cables (cf. location C) connecting with the pins.

There are three soft nipples on the tank: one nipple (4) above is used for the drainage of the tank; the other two (7) below near the rear wall of the tank are used to install the pipe connecting both parts of the tank.

Flanges with rubberized metal plates are located on the tank for the following purposes:

25-8

Fig. 82. Tank No. 2.

(captions beneath title illegible)

a) cross section along A-A

b) location B

c) location C

d) cross section along D-D

e) location E

f) cross section along F-F

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Fig. 82. Tank No. 2

1 - flange;

2 - pin;

3 - wing-tank fueling pipe;

4 - drainage vent;

5 - fuel filler;

6 - ~~[illegible]~~ inertia valves;

7 - ~~[illegible]~~ soft nipples;

8 - ~~[illegible]~~-return valve;

9 - side flanges;

10 - casing of fuel filler;

11 - crosspiece;

12 - hatch;

13 - screw;

14 - small slat;

15 - disk;

16 - stop ring;

17 - cover;

18 - stop washer;

19 - gauze filter.

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- flange (1) on the forward wall of the tank, to attach the pipe connecting the first and second tanks;

- flanges (9), located on the side part of the tank, to attach the wing-tank fueling pipes (3);

- the flange of fuel filler (5), located above, for installing the fuel filler, as shown in the cross section along D-D;

- a flange located below, to attach the casing of return valve (8), to which the special valve for pumping fuel from the suspended tank to the wing tanks is connected.

Fuel filler (5) (cf. cross section along D-D), together with the tank flange, is attached by screws to the fuselage panel. The opening for the fuel filler is closed by easily removable hatch (12). Through the fuel filler

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This cover hermetically seals ~~xxx~~ off the tank cavity from the atmosphere by means of a rubber gasket vulcanized onto the cover.

In order to close the fuel filler, it is necessary to insert the cover (during assembly) into the casing in such a way that

(remainder illegible)

Tank No. 2a

Tank No. 2a (Fig. 83) is located in the region of frames 14 to 15A under tank No. 2 on the left (with respect to the direction of flight) side of the fuselage.

Tank No. 2a is installed in a container when the lower left hatch is removed. It is attached to the fuselage at nine points:

- with the aid of five countersunk screws (2) screwed into the cup nuts of the tank on the upper surface of the tank;
- by two pins (3) on the lateral surface of the tank;
- by two pins (3) on the lower surface of the tank.

Drainage vent (1) is located in the upper part of the tank, in the region of frame 14; flange (4), which connects the fueling pipe ~~xxxxxxx~~ used for fueling and delivering fuel from the tank, is located below in the region of frame 16A.

Tank No. 3

Tank No. 3 (Fig. 84)

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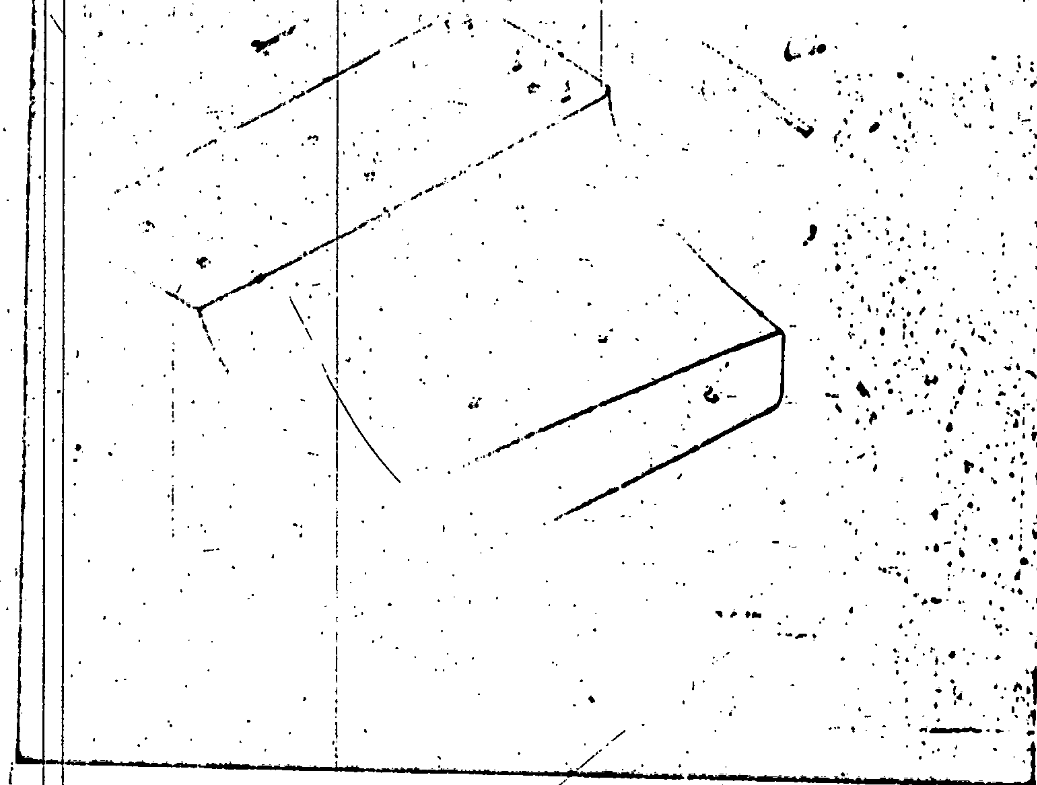

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Fig. 83. Tank No. 2A

1 - ~~[illegible]~~ soft nipple;

2 - screw;

3 - pin;

4 - flange.

a) cross section along B-B

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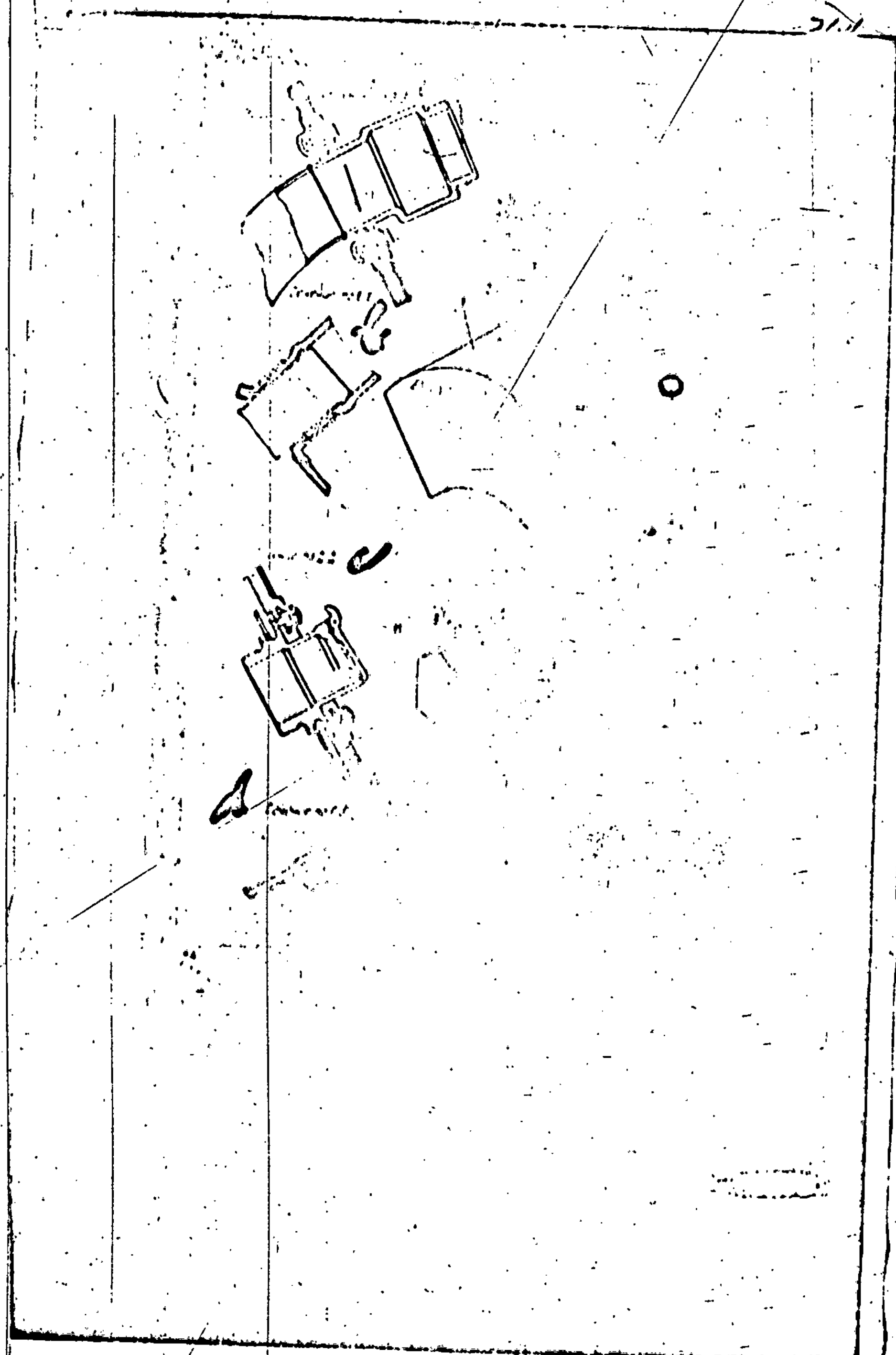

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Fig. 84. Tank No. 3

1 - upper part of tank;

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a) cross section along H-H

b) cross section along F-F

c) cross section along E-E

d) cross section along D-D

e) cross section along C-C

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The lateral surfaces of the tank - by four pins, two on each side.

On the upper part of the tank are emergency fuel-supply indicator (3), float valve (5), and drainage pipe (5). All these units are attached to tank flanges with rubberized metal plates. Below, to the left and right, are two soft nipples (7) in which connecting pipes (9) are installed and secured.

The lower part of the tank occupies the volume under the air-intake duct and is attached to the fuselage at six points:

by two side pins, on the left and right;

below, by four pins.

The lower part of the tank is installed and removed through a removable panel on the left-hand side (with respect to the direction of flight). In this case all the units should be removed from the tank.

On the lower part of the tank are pump 495A2 (12), return valve (13), connected to which is the special valve of the 1st group of tanks, and pipe (10), connected to which is the special valve of the third group of tanks.

On the upper surface of the lower part are four soft nipples. The soft nipples with the smaller diameter are used for draining the lower part of the tank, while the large nipples have inserted in them connecting pipes (9), through which the lower part of the tank is fueled.

During flights with negative G's and during inverted flights the lower part of the tank

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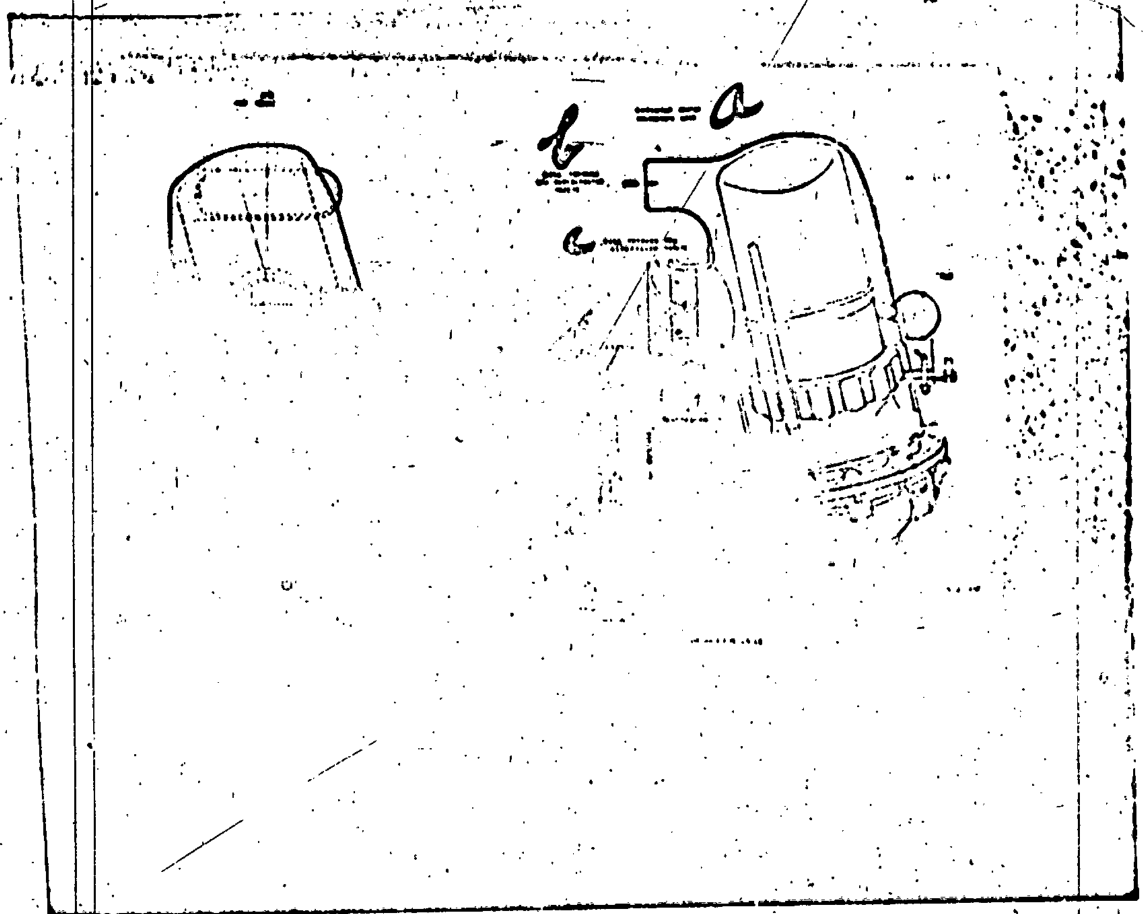

Fig. 85. Installation of negative g valve.

a) outer contour of supply tank

b) entry of fuel during inverted flight

c) entry of fuel during normal flight

d) valve

e) adapter

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negative g compartment; in this case connecting pipes (9) act as drainage pipes. The negative g compartment is constructed as follows.

On an adapter secured on a plate is pump 495A2, the entry of fuel into which during normal flight occurs through two openings in the casing of the negative g valve.

In the compartment a load is affixed to the valve casing on the lever. The other end of the lever is connected to the valve, which moves in the lower opening.

During short inverted flights or during flights with negative g's the load will move towards the air-intake duct, and the valve will close the opening. The fuel will enter the pump through the upper opening, which in this case will be in the fuel medium.

Tank No. 4

Tank No. 4 is located in the region of frames 20-22 under the air-intake duct; its cross section is in the shape of a semicircle (Fig. 86). The tank is installed in the fuselage by removing the right-hand panel, is attached to the panel by pins (4), and is additionally secured by brackets

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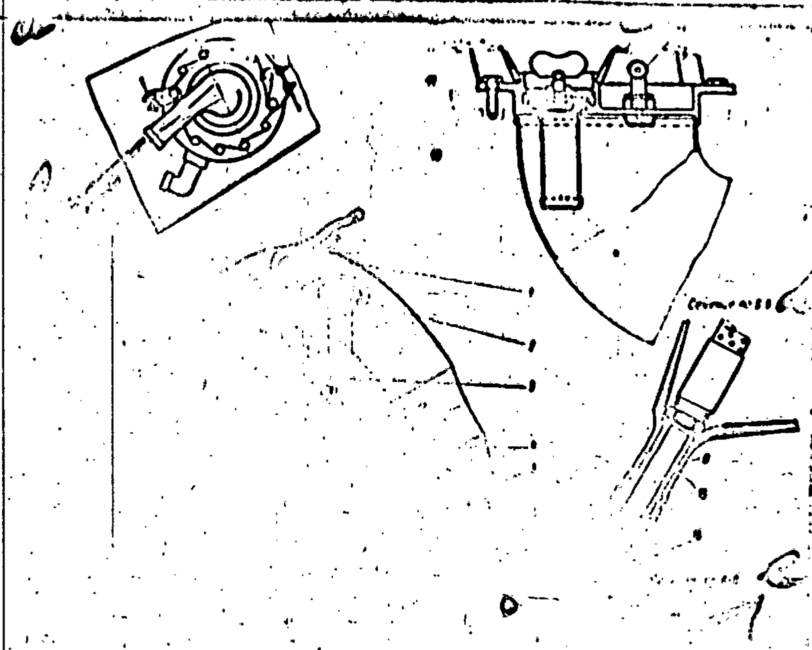

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Fig. 86. Tank No. 4
(captions beneath title illegible)

a) view along arrow A

b) axis of pressure tube

c) cross section along C-C

d) cross section along B-B

e) cross section along D-A

Fig. 86. Tank No. 4.

1 - drainage pipe;

2 - fuel filler;

3 - fuel tank;

4 - pins;

5 - flexible hose;

6 - ~~[illegible]~~ soft nipples;

7 - booster pump 495A2;

8 - ~~[illegible]~~ soft nipple;

9 - ~~[illegible]~~ soft nipples;

10 - gauze filter;

11 - plate of fuel tank;

12 - funnel;

13 - pressure-boosting pipe;

14 - tip of hose;

15 - ~~[illegible]~~ nipple;

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The tank is additionally secured at the points of installation of units and assemblies. Installed in the tank are:

- In the upper part - drainage pipe (1), the fuel filler of the third group of tanks (2), and the plate of the fuel tank (3), together with the fuel filler.

- In the lower part of the tank - booster pump (7) 495A2 and nipple (16) of the fuel system.

Drainage pipe (1) is attached to the tank by six bolts, two bolts bolting each of the supporting plates which prevent the flange of the pipe from sinking into the inside of the tank.

It should be noted that similar supporting plates are secured by bolts attaching the drainage pipe to the third tank and by bolts attaching the pipes connecting tanks 4 and 5.

Fuel filler (2) of the third of tanks is of the same construction as the filler in tank No. 2.

Fuel tank (3) is located inside the tank. The plate of fuel tank (11), together with the fuel filler and nipple (14) boosting the pressure in the fuel tank, is bolted to the top of tank No. 4. Under the bolts securing plate (11) to tank No. 4 are three brackets, which, in their turn, attach both the plate and the tank to the upper fuselage panel by means of countersunk screws.

The fuel filler of the fuel tank
(remainder illegible)

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Fitting tightly against the fuselage casing and cover is funnel (13), which prevents gasoline from getting into the tank container or directly onto the fuel tank itself.

Fuel tank (3) is of welded construction, its shell being made out of material AMTs with a thickness of 1.5 mm. On top the shell is welded to the plate of fuel tank (11), while on the bottom it is rounded and to it is welded the nipple for connecting the flexible hose (cf. cross section along A-A). Flexible hose (5) is embedded on both sides in the tips. On one side the hose is connected to the lower nipple of the fuel tank; the other tip of hose (15) is connected to the fuel system through soft nipple (8) in the tank.

Pump 495A2, which is used to pump fuel from the third group of tanks, is attached to the tank flange (cf. view along arrow A) by bolts.

Under the bolts securing the pump to the tank are two brackets, which secure both the pump and the tank to the profiles of the lower wall of the container.

Soft nipples (9) on the front wall of the tank are intended to have connecting pipes installed in them. Soft nipples (6) on the rear wall of the tank are intended to have the pipes connecting tanks 4 and 5 installed in them.

Tank No. 5

Tank No. 5 is located in a container above the engine compartment in the region of frames 22-25 (Fig. 87) and is divided

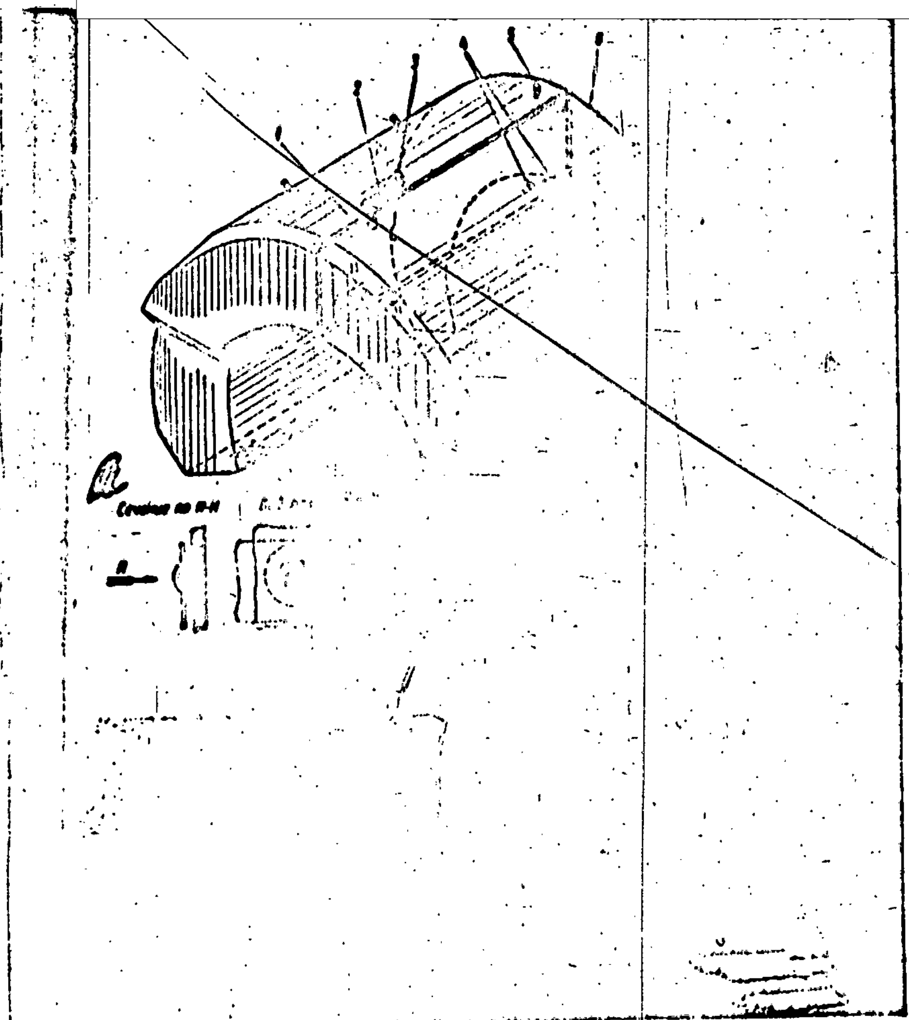

Fig. 87. Tank No. 5

1 - right-hand side of tank;

2 - drainage pipes;

3 - soft nipple;

4 - buttons;

5 - pin;

6 - left-hand side of tank;

7 - flange.

a) cross section along H-H   b) view along arrow A

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into two parts along the axis of symmetry: right (1) and left (6).

Each half of the tank is installed in the container separately. In this case both the upper right and upper left fuselage panels must be removed.

Both parts of the tank are attached to the fuselage by ten pins (5), while both parts are suspended from the fuselage beam along the axis of symmetry on buttons (4) (cf. section along A-A), there being two buttons on each half of the tank.

On top both halves of the tank are connected by drainage pipe (2) inserted into soft nipples (3).

On the bottom of the tank are flanges (7) for connecting the pipes of the fuel system.

Tank No. 6

Tank No. 6 is located in a container above the engine compartment in the region of frames 25-28 (Fig. 88).

Like tank No. 5, it consists of two halves: right (1) and left (6). Each half of the tank is installed in the container separately. In this case both upper fuselage panels must be removed.

Both halves of the tank are attached to the fuselage by six pins (5) on each half, while both parts are suspended from the fuselage beam along the axis of symmetry on buttons (4), as in the case of tank No. 5.

The drainage of both halves of the tank is ensured by pipeline (2) inserted and embedded into soft nipples (3).

On the lower wall of the tank is flange (7) for installing the pipes connecting both halves of tank No. 6 with tank No. 5.

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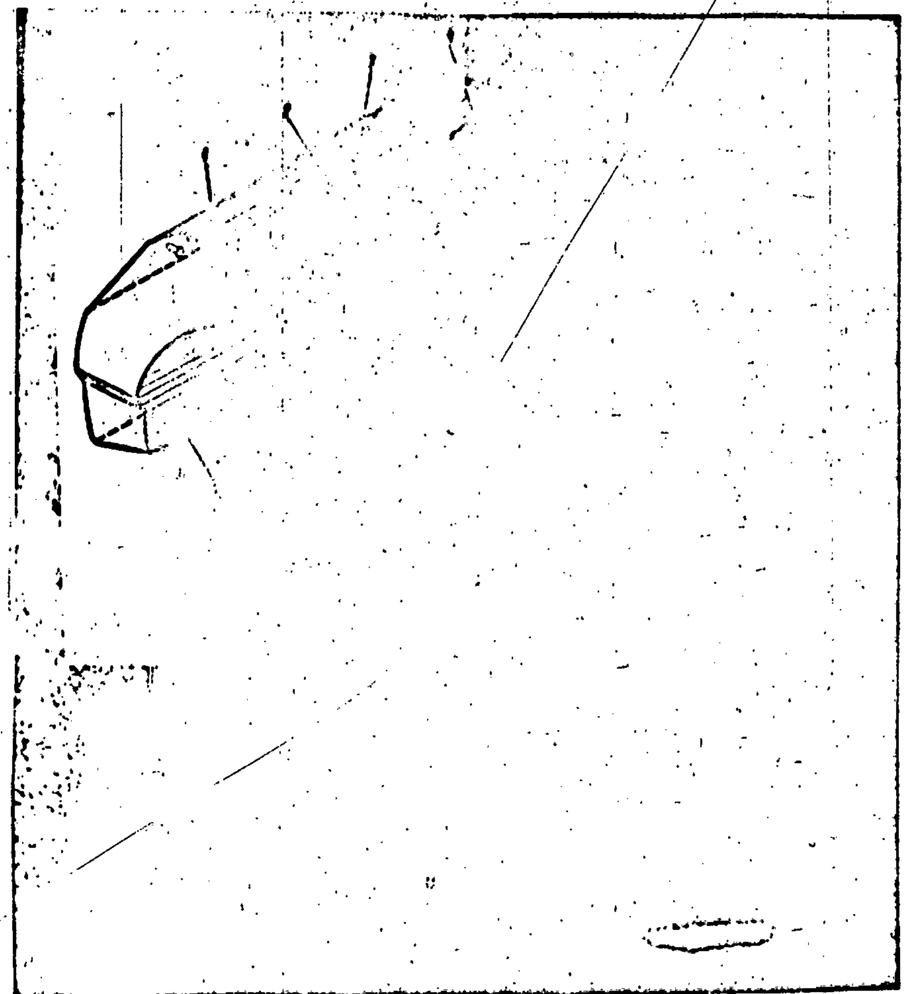

Fig. 88. Tank No. 6

1 - right-hand side of tank;

2 - drainage pipe;

3 - soft nipple;

4 - buttons;

5 - pin;

6 - left-hand side of tank;

7 - flange.

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Suspended Tank

The suspended tank (Fig. 89) is cylindrical in shape with conical tips.

The tank is suspended on a pylon under the fuselage with the aid of bomb-rack lock 369E and in case of necessity can be jettisoned in flight.

The tank is of welded construction and is made out of material AMG with a load-carrying covering. The tank consists of three parts: front (1), central (7), and rear (10), which are butt-welded to each other.

The front part of the tank (1) is a conical tip with three internal rigidities made out of profiles welded to the covering of the rollers.

The central part of the tank terminates on one side in leaktight bulkhead (15) and terminates on the other side in two main profiles (20) with forward stop (4) between them.

On the central cylindrical part of the tank are the following stops: forward (4), rear (9), and eye bolt (6), with the aid of which the tank is installed and secured to the pylon, as well as vent (3) for delivering fuel from the tank, pressure-boosting vent (8), and filler (2) for emptying the fuel-filler tank.

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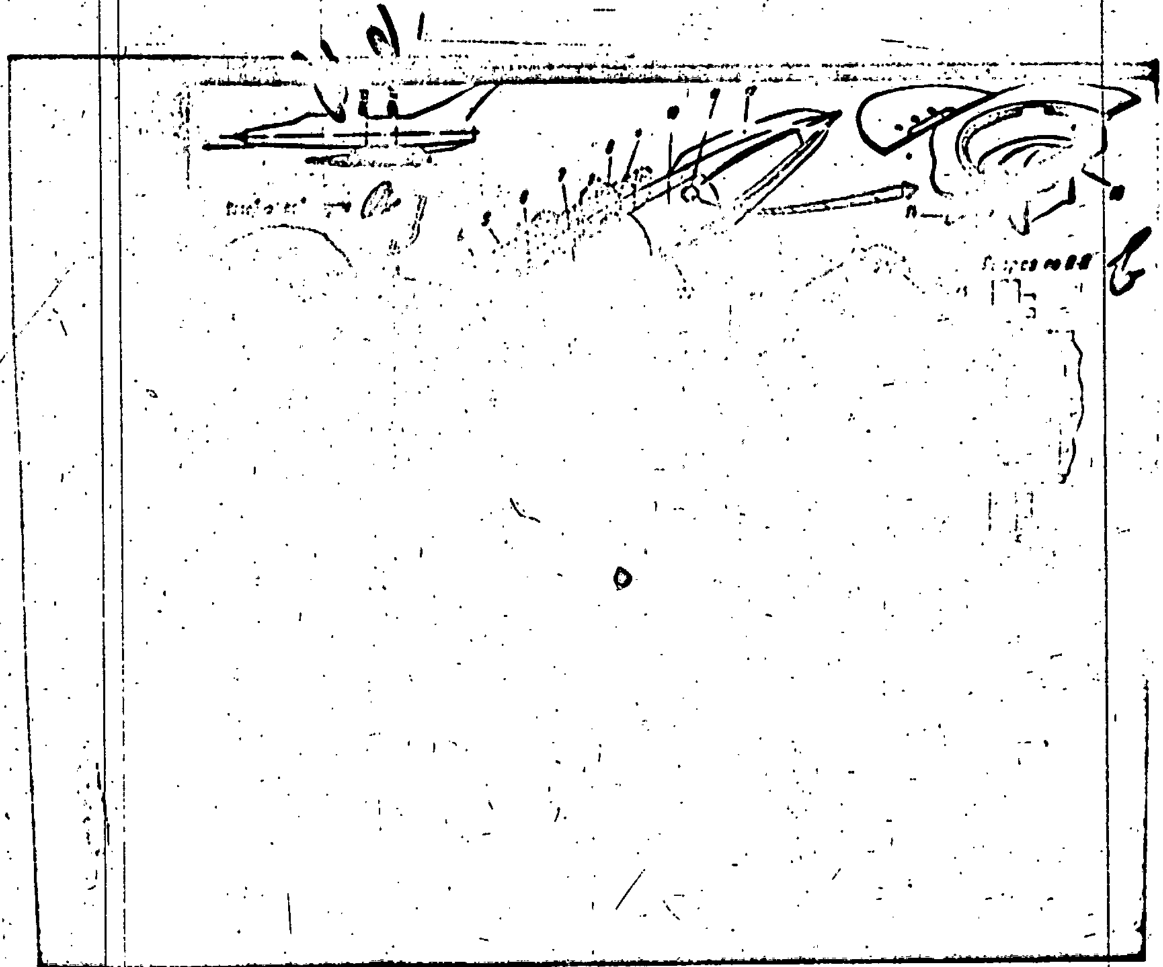

Fig. 89. Suspended tank.

a) arbitrarily turned

b) section along A-A

c) location A

d) frame 16

e) frame 20

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Fig. 89. Suspended Tank.

1 - forward part of tank;
2 - drainage filler;
3 - delivery vent;
4 - forward stop;
5 - bushing for ~~xxxxxxxxxx~~ pyroplunger;
6 - eye bolt;
7 - central part of tank;
8 - pressure-boosting vent;
9 - rear stop;
10 - rear part of tank;
11 - fuel filler;
12 - stabilizer plates;
13 - crosspiece of filler;
14 - drainage pipe;
15 - bulkhead;
16 - overflow pipe;
17 - ~~xxx~~ return valve;
18 - gauze ~~xxxxxx~~ strainer;
19 - cover of drainage plug;
20 - profiles;
21 - beam;
22 - drainage plug;
23 - pressure-boosting pipe;
24 - vacuum valve.

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Forward stop /4/ prevents the tank from moving in the horizontal plane and upwards; rear stop /9/ prevents it from moving in a lateral direction and upwards. Eye bolt /6/ prevents the tank from moving downwards. Between the forward stop and the eye bolt above the tank is main beam /21/, on which is located bushing /5/ for the pyroplunger.

The rear part of tank /10/ consists of a cylindrical and conical tip with three internal rigidities welded to the shell.

On the rear tip of the tank are fuel filler /11/, drainage plug /22/, and stabilizer plates /12/.

The fueling of the tank is done through fuel filler /11/ in the upper part of the rear tank. During fueling the fuel enters the forward tank from the rear tank through a pipe with return valve /7/ installed in the lower part of leaktight bulkhead /15/.

During fueling the air from the upper part of the forward compartment enters the fuel filler through drainage pipe /14/ inside the tank; this pipe is automatically shut off by crosspiece /13/ when the

(remainder illegible)

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The fuel from the rear part of the tank enters the forward compartment through return valve /17/ and leaves this compartment through gauze strainer /18/ via a pipeline in the tank and in the pylon to the second fuselage tank.

Overflow pipe /16/ is installed in the leaktight bulkhead parallel with the pipe containing the return valve. It is intended to decrease the saturation of fuel in the forward compartment by air coming through return valve /17/ upon completion of the fuel delivery from the rear compartment. Owing to the presence of this pipe, part of the air goes upwards through it to boost the pressure in the forward compartment, by-passing the return valve.

In the pipeline going from the suspended tank to tank No. 2 are two return valves for reliable shutting off of the fuel main when the suspended tank is jettisoned.

Gauze strainer /18/ on the delivery pipeline is attached to drainage plug /19/, which is screwed into a flange on the tank. In order to remove the strainer to clean it, it is necessary to unscrew the drainage plug together with the strainer.

Filler /2/ on the central part of the tank is intended to evacuate the fuel-filler tank and, when transporting the tank, is used for the parts of the pyroplunger, which are placed in a special chamber.

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In order to prevent rarefaction in the tank during nose dives, on the air-inlet pipe in the pylon is installed a vacuum valve, which opens when the rarefaction in the tank reaches 0.03 kg/cm^2 in comparison with the surrounding atmosphere.

The tank is jettisoned in flight by electropyromechanisms located in the pylon of the suspended tank (for more details, see technical description, book II).

When the tank is jettisoned, an electromechanism releases the hook of the bomb rack, from which the tank is suspended by an eye bolt, and then a pyromechanism, acting as a plunger, separates the tank from the pylon.

The correct position of the tank at the moment of separation from the pylon and departure from the plane is ensured by a guide in the rear stop and by stabilizers on the tail tip of the tank.

12. Fuel System

The fuel system (Fig. 90) is intended to feed fuel to the starting fuses of the combustion chambers, when the engine is started in the air, and consists of:

- fuel tank (1), capacity of 4 liters, located in the fourth fuselage fuel tank;
- pump (10) PNR10-9M for feeding fuel to the engine. The pump is mounted on brackets attached to the lower beam of the fuselage in the region of frames 20-22;

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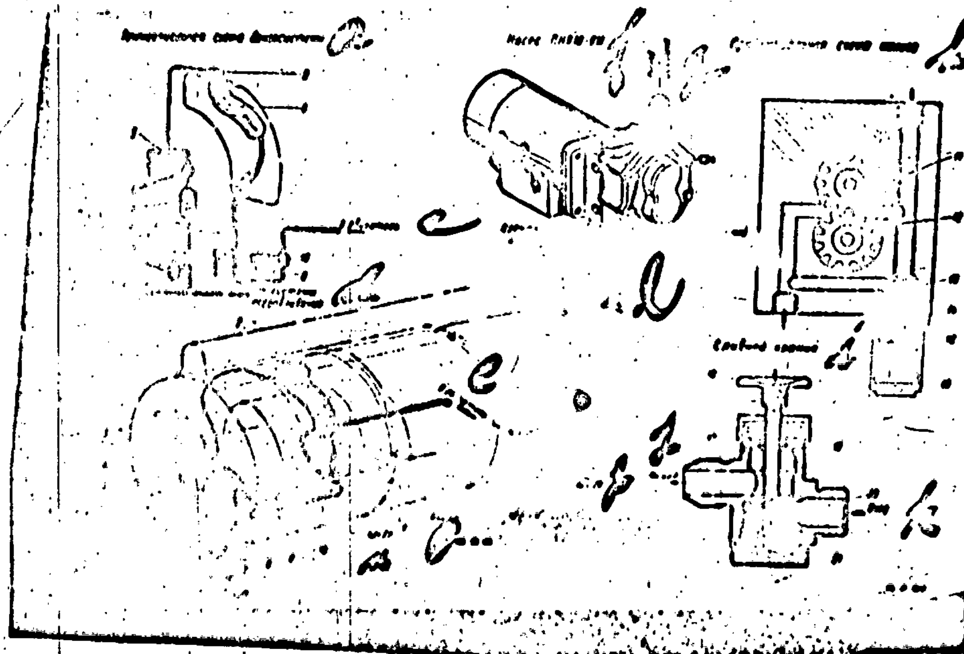

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Fig. 90. Fuel system.

a) skeleton diagram of fuel system

b) for boosting the pressure in the hydraulic tank

c) to the engine

d) from the pressure-boosting system

e) to the engine

f) pump PNR10-9M

g) fuel outlet

h) skeleton diagram of pump

i) bleeder valve

j) outlet

k) inlet

l) fuel inlet

m) frame 18

n) frame 17

o) tank No. 4

p) frame 28

(other captions illegible)

Fig. 90. Fuel System

1 – fuel tank;

2 – fuel filler;

3 – pressure-boosting unit;

4 – ~~xxxxxxxxxxxxxx~~ reduction gear RV-0.4;

5 – return valve and safety valve;

6 – gauze strainer;

7 – bleeder valve;

8 – drainage pipe;

9 – relief valve;

10 – pump;

11 – driving pinion;

12 – ~~driving~~ driven pinion;

13 – barrel;

14 – valve casing;

15 – regulating screw;

16 – cap;

17 – casing of bleeder valve;

18 – button;

19 – nut;

20 – valve;

21 – cover;

22 – sediment trap.

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- bleeder valve /7/, equipped with gauze strainer /6/ and installed on the bracket securing pump PTR10-9M;

- main duct boosting the pressure in the fuel tank, containing xxx pressure-boosting unit /3/ (receiver), ~~xxxxxxxx/xxxxx~~ reduction gear /4/ RV-0.4, and return valve with a safety valve /5/;

- a pipe for feeding fuel from the tank to the pump and then to the engine.

From the moment the engine is started on the ground an excess-air pressure of 0.4 atm (gage) is created in the fuel tank. Air from the engine compressor under a pressure of up to 10 atm (gage) is taken from the pipeline of the pressure-boosting system and goes directly into the tank through sediment trap /22/xxxx and the return valve in the pressure-boosting unit /3/. The pressure-boosting unit, ~~xxxxxxxx~~ like that installed in the hydraulic system /see Fig. 19, Chapter V/, ~~xxxxxxxxxxxxx~~ is in the form of a balloon acting as a receiver.

When the engine is stopped or in case of malfunctioning of the pipeline feeding air from the pressure-boosting system

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Reduction gear RV-C.4 is similar to reduction gear RV-1.5 installed in the hydraulic system, with the exception of the calibration. Return and safety valves /5/ are also taken from the hydraulic system, but springs with a different rigidity are installed in them.

The safety valve opens when the pressure reaches $0.5^{+0.1}$ atm (gage).

Both the pressure-boosting unit and the reduction gear RV-C.4 with the return-safety valve are installed in the right-wheel housing, above, in the region of frame 20.

When the engine is started in the air, a current is automatically fed from the electrical system

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When the pump is turned on, driving pinion (11) is made to rotate by the electric motor and makes driven pinion (12) rotate.

The gear teeth, disengaging on the suction-chamber side, free the space between the teeth, which fills up with fuel. Then the fuel is carried to the pressure chamber, where it is extruded into the pressure main by the teeth entering into gear. The delivery pressure behind the pump, when the latter is operating under normal atmospheric conditions, is 2.2-2.4 atm (gage). When this pressure is exceeded, barrel (13) of the relief valve rises slightly and admits part of the fuel from the pressure chamber into the suction chamber through an opening in the casing of the relief valve.

If the pipeline at the inlet to the engine is closed, the fuel is entirely admitted into the suction chamber.

The fuel pressure behind the pump in this case will depend on the calibration of the relief valve.

The relief valve consists of casing (14), in which barrel (13) moves back and forth.

Barrel (13)

(remainder illegible)

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The relief valve is covered on the outside by cap (16). The joints are hermetically sealed by gaskets; the valve casing is sealed by a cap nut.

Bleeder Valve

Bleeder valve /Fig. 90/ serves to drain the fuel out of the system and consists of casing /17/, valve /20/ with button /18/. The valve is pressed against the seat by a spring resting on cover /21/. The joints are sealed by rubber gaskets, while the outlet of the valve rod from the pump casing is hermetically sealed by gland seals.

When button /18/ is depressed, the spring is compressed; at this moment the valve is open. When the pressure is removed from the button, the valve, under the action of the spring, is automatically closed.

13. System for Feeding Oxygen into the Starting Fuses of the Engine

In order to increase the reliability of starting the engine in flight, especially at high altitudes, a system of automatic feeding of oxygen to the starting fuses of the balloon combustion chambers is used.

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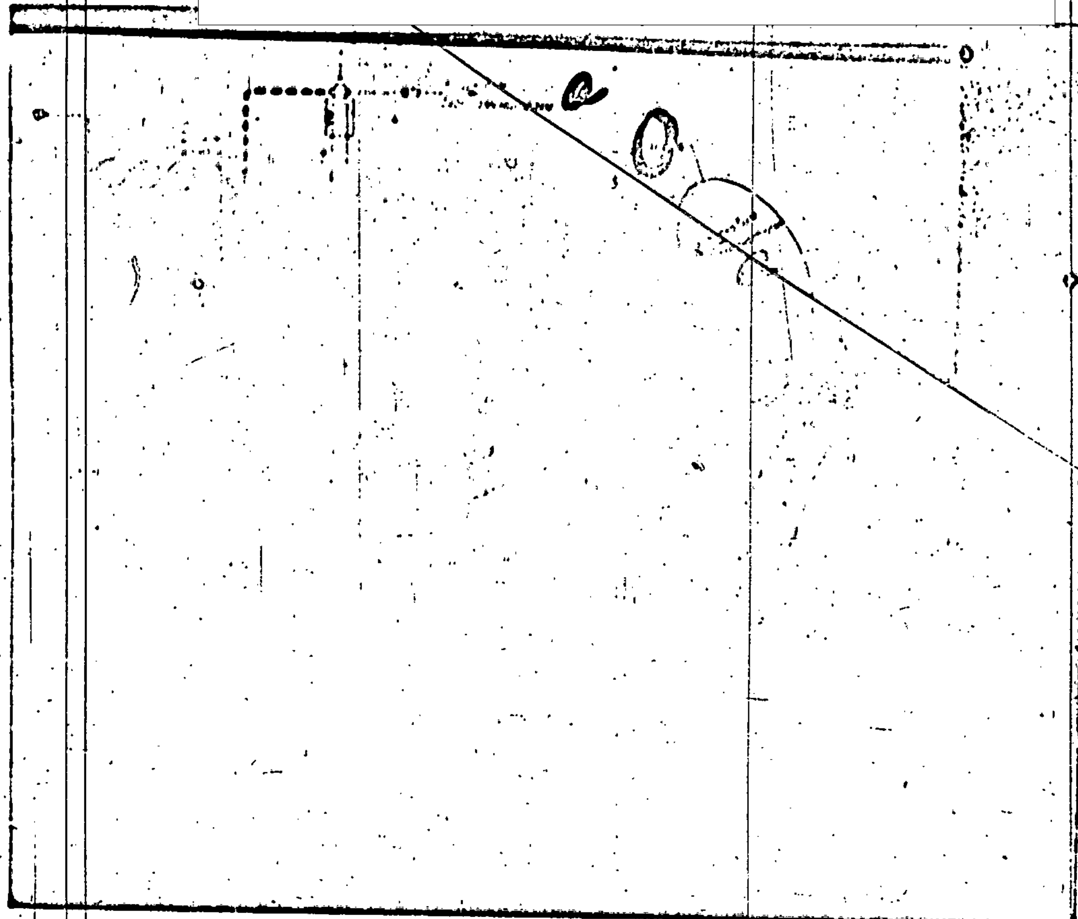

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Fig. 91. Assembly and skeleton diagram of the oxygen feed system.

a) to starting fuses

c) frame No.

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Fig. 91. Assembly and skeleton diagram of the oxygen feed system.

1 - oxygen valve KV-223;

2 - manometer MK-06;

3 - T-bend;

4 - electropneumatic valve 694400;

5 - return valve;

6 - filler pipe 11180;

7 - manometer MK-12;

8 - T-bend with return valve;

9 - oxygen balloon;

10 - oxygen reducer 2130A.

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- two-liter oxygen balloon /9/, located in the region of frames 17 and 18 in the lower part of the fuselage;
- oxygen reducer 2130A /10/, located on the port side of the fuselage in the region of frames 12 and 13;
- electropneumatic valve 694400 /4/ for feeding oxygen to the engine, located in the compartment containing the oxygen balloon;
- aircraft filler pipe 11160 /6/ and high-pressure manometer MK-2M /7/, located in the left wing in the region of rib No. 2 in the landing-gear housing (Manometer MK-2M is intended to control the pressure in the balloon when it is being filled.);
- shut-off valve /1/ for feeding oxygen from the balloon to the system;
- low-pressure manometer /2/ MK-6 for controlling the oxygen pressure behind the reducer;
- an electrical [illegible] system for controlling the feeding of oxygen to the engine.

The systems operate as follows: through filler pipe /6/

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Before take-off oxygen valve /1/ is opened, and oxygen enters the high-pressure cavity of reducer /10/, the oxygen pressure drops to $10^{\pm 0.5}$ atm (gage), and then the oxygen under this pressure arrives at electropneumatic valve /4/.

When the engine is started in the air /the switch "Start in Air" is turned on/, a current is automatically fed from the electrical system to the electromagnet windings of electropneumatic valve /4/, the valve opens, and oxygen is fed to the starting fuses through return valve /5/ located on the engine. As was already mentioned /see section "Fuel System"/, at this same moment the fuel enters the starting devices. As a result, reliable starting of the engine is ensured.

When the engine is started on the ground by the button "Start Engine", no voltage is fed to the terminals of the electropneumatic valve, and the valve does not open.

Electropneumatic valve /4/ may be opened when checking the system for nitrogen leakages, for which purpose the toggle switch "Oxygen Feeding of Engine", located on the port side of the fuselage in the region of frames (illegible) must be in the position "Check".

(remainder illegible)

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In order to check the oxygen feed system on the ground after the engine has been run, before the engine is stopped, it is counter-started, i.e., it is started by the switch with the nameplate "Start in Air". The instructions for checking the system are given in the manual of operation of the TK-021, book 1.

Oxygen Reducer

Oxygen reducer 2130A /Fig. 92/ is intended to reduce the pressure of the oxygen entering the reducer to an outlet pressure of $10^{\pm 0.5}$ atm (gage) and to keep this pressure constant.

The reducer is a single-stage reverse-action reducer. Housing /2/ has three cavities: high-pressure cavity A, working-pressure cavity B, and safety-valve cavity C. Pressed into the reducer housing are valve seat /7/ and the seat of safety valve /17/.

Ball /6/ is pressed against seat /7/ through valve /illegible/ by spring /4/. On top spring /4/ is pressed down through disk /illegible/ by plug /1/, which

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Fig. 92. Oxygen Reducer 2130A

1 - plug;
2 - housing;
3 - disk;
~~[illegible]~~
7 - seat;
11 - bellows;
15 - lug;

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The bellows is welded to bushing /10/ and flange /13/, which is attached to the housing by bolts. Inserted into bellows /11/ is spring /12/, which is pressed against by plug /14/.

In cavity C ~~xxx~~ is safety valve /20/, consisting of ball /18/, seat /17/, small bellows /19/, and springs /21/ and /16/. Lugs /15/ and /22/ serve to secure the reducer to the plane.

The reducer operates as follows: at the inlet to the reducer during its operation there is ~~xxxxxxxxxxxx~~ an oxygen pressure of

(remainder illegible)

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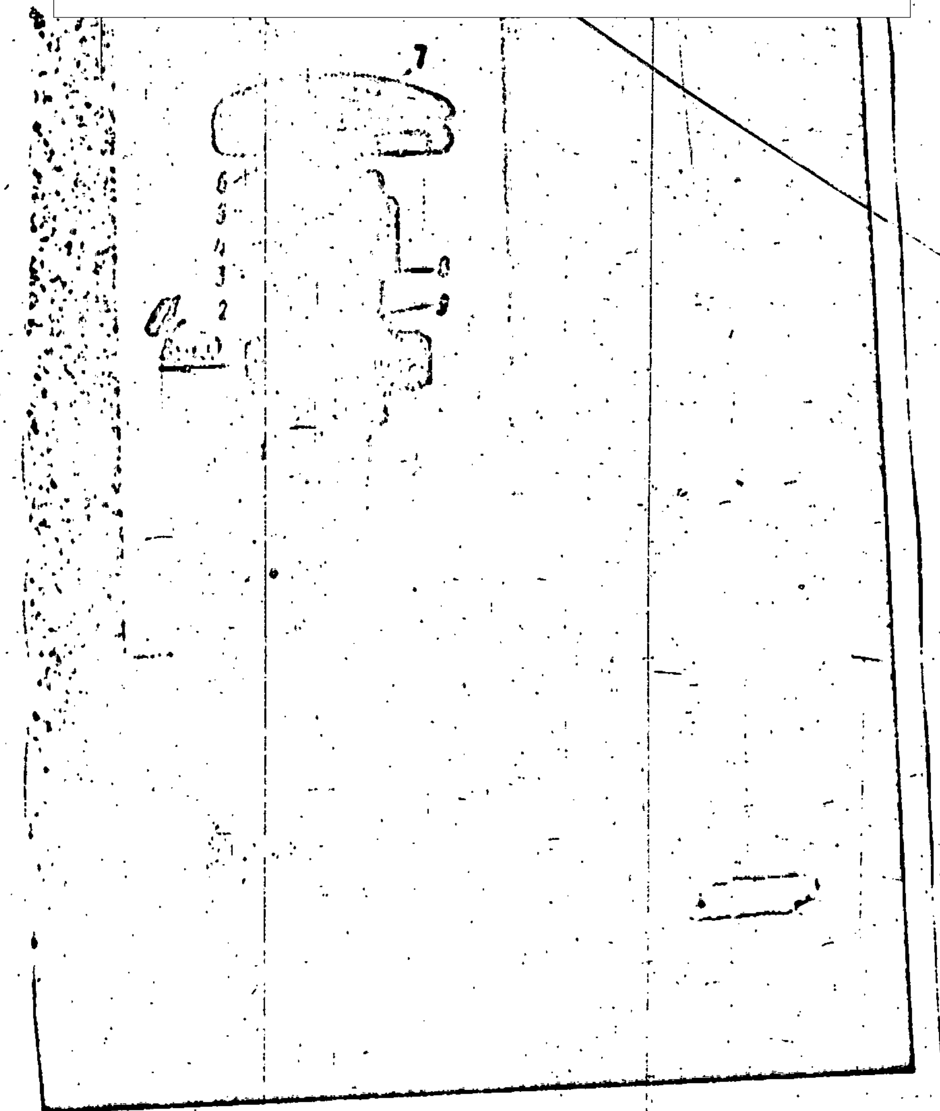

Fig. 93. Oxygen valve KV-2MC

1 - housing;

(other captions beneath title illegible)

a) outlet

b) inlet

The reducer requires no adjustments during operation.

Oxygen Valve KV-213

The oxygen valve (Fig. 93) is used to disconnect the oxygen balloon from the system.

The valve is opened before the flight and is closed after it, thereby preventing oxygen from leaking out of the balloon through the reducer and to ~~xxxxxxxx~~ eliminate possible leakages in the system.

Valve (8) with spring (9) is inserted into casing (1). On top the valve is pressed against the seat on the casing through membrane (2) by segment (3) inserted in spindle (5).

In this position the valve is closed.

In order to open the valve, it is necessary to unscrew flywheel (6) to the stop in plug (4).

14. Engine Control

The engine is controlled (Fig. 94) by the engine-control lever (RU-D)

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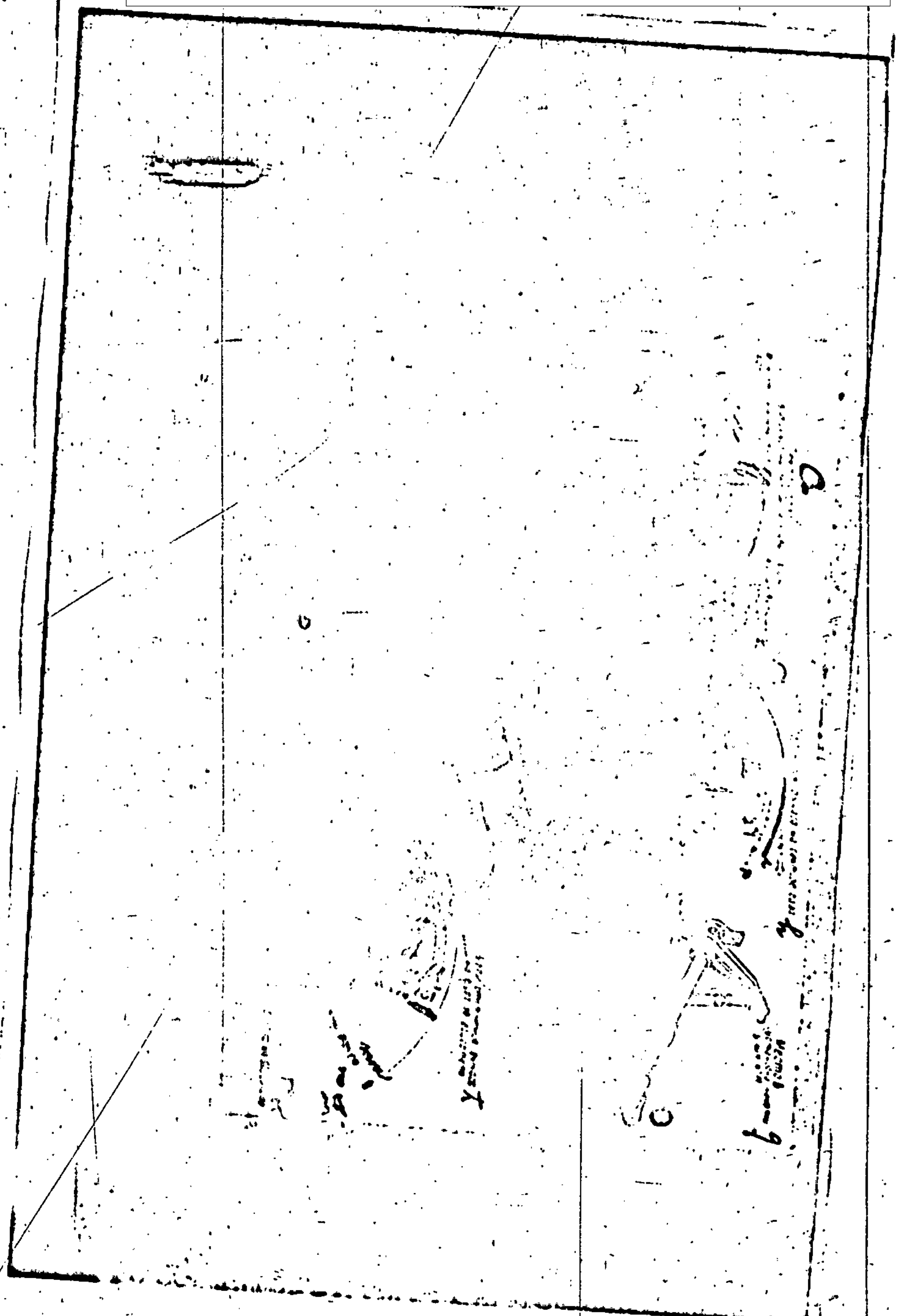

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Fig. 94. Diagram of engine control.

a) ~~gas sector~~ (view from the pilot's cabin toward port side)

b) buttons for turning on the radio transmitter

c) slider of microswitch KV-9 of brake flaps

d) button for holding the "maximum" and "afterburner" positions

e) stop of position "maximum"

f) "total afterburner" stop

g) electromagnet EMD-2/2

h) angles of deflection of the lever on the gas sector

i) flight

j) vertical

k) ball lock "nominal"

l) stop "maximum"

m) Mach number stop

n) minimum afterburner stop

o) total afterburner stop

p) electromagnet EMD-2/2

q) location B
installation of actuating arm on frame 11

r) to the engine

s) to engine-control lever.

t) angles of deflection of the lever on the PURT-1F of the engine

u) low-gas stop

v) button for emergency switching off of Mach number stop

w) tightening lever

x) total afterburner

y) minimum afterburner

z) Mach number stop and maximum

aa) nominal

bb) low

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cc) stop of position "stop"

dd) stop of position "low gas"

ee) button for holding the position "stop" together with [illegible] low [illegible]

ff) stop

gg) to engine-control lever

hh) low gas

ii) nominal

jj) vertical

kk) maximum

ll) minimum afterburner

mm) total afterburner

nn) stop

oo) PURT-1F

pp) to engine

qq) lock of sighting-range lever

(remainder illegible)

With the aid of push-pull rods and actuating arms mounted on frames 11, 13, 15, 20, 22 the control lever is connected to the lever-control mechanism on the PURT-1F of the engine.

In addition to the actuating arms in the engine-control system, there is a sighthole located near frame 15. The outlet of the control from the cabin is through the hermetic sealing unit below frame 11 (Fig. 96).

Rod (1) is hermetically sealed with the aid of bushing (2) and sealing cover (3).

Cover (3) is attached to bushing (2) by wire belt (9); the other end of the cover is attached with the aid of collar (8) to pipe (4), which is rigidly connected to frame 11.

Bushing (2) of the hermetic sealing unit is kept suspended with the aid of a hinge device consisting of stirrup (5) and clamps (6) and (7), which are hinged onto bushing (2) together with pipe (4).

Owing to this device, rod (1), can assume an inclined position, when moving vertically.

The gas sector (Fig. 95) consists of a bracket, the engine-control lever (RU-D), a tightening lever, and other parts for tightening and securing.

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Fig. 95. The Throttle control

a) button for holding the position "stop" together with the position "low gas"

b) stop, position "low gas"

c) stop, position "stop"

d) lock of sighting-range lever

e) button for switching on the radio transmitter

f) slider of microswitch KV-9 of brake flaps

g) button for holding the positions "maximum" and "afterburner"

h) stop, position "maximum"

i) stop "minimum afterburner"

j) stop "total afterburner"

k) electromagnet ED-2/2

l) button for emergency switching off of Mach nurter stop

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Mounted on the bracket are: a button for holding the positions "stop" and "low gas", a button for emergency switching off, the Mach number stop and the stops of the regimes "maximum", "minimum afterburner", and "total afterburner", and ball lock of position "nominal".

On the control lever are a button for holding the positions "maximum", "minimum afterburner", and "total afterburner", the stops "low gas" and "stop", and a washer of straight-way ball lock of the position "nominal".

Mounted in the casing of lever RUD are: the slider of the brake-flap microswitch, the lock of the sighting-range lever, a the button for switching on the radio station.

Mounted in the casing of the throttle control between sidepieces is the lever system of the Mach number stop, together with electromagnet EMO-2/2.

The tightening lever, when rotated clockwise, increasingly retards the motion of the RUD until it is completely tightened. This is necessary in order to free the left arm of the pilot during the steady-state regime of the engine.

The positions "stop" and "low gas" are maintained by a button mounted on the throttle-control bracket and by a stop on the engine-control lever.

By depressing the button maintaining the position "stop", the control lever can be brought from the position "stop" into the position "low gas", and vice versa.

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The position "nominal" is maintained by a straight-way ball stop mounted on the throttle-control bracket ~~bracket of the gas sector.~~

The positions "maximum", "minimum afterburner", and " total afterburner" are maintained by a button mounted on the control lever and by stops mounted on the throttle-control bracket ~~bracket of the gas sector.~~

The position "maximum" is maintained by pressing the button and moving the RUD forward, while "minimum afterburner" is maintained by pressing the button and moving the RUD forward.

The regime "total afterburner" is achieved by pressing on the same button, while pushing the RUD completely forward and keeping the button in the position "total afterburner".

On the throttle control ~~gas sector~~ is the engine-control locking device with an extensible cone for regulating the Mach number, for which purpose there is mounted on the throttle control ~~gas sector~~ an automatic stop actuated by velocity controller MD-1.5.

At a velocity corresponding to M$\geq$1.5 controller MD-1.5 sends a signal to the relay winding; the latter actuates and switches off electromagnet ED-2/2, which extends the stop, thereby preventing the lever from being pulled backward.

The stop does not prevent the lever from moving freely forward.

At a velocity corresponding to M $\leq$ 1.5 this locking device is compressed, and the lever can move freely in the entire range of control of the engine rollers.

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If the electrical devices controlling the Mach number stop should go out of order, the stop can be switched off mechanically by depressing the red button on the throttle control bracket.

The throttle control lever (RUD) is blocked, together with the antisurge vent control system. This blocking is achieved with the aid of the electrical system for switching on the afterburner (cf. section "Antisurge Controlled Vents").

Engine R11F-300 mounted on the plane has rods on the afterburner rollers that can be adjusted from the position of the engine-control lever "minimum afterburner" to the position "total afterburner". For this purpose the engine is equipped with servosystem EGSM-1A for controlling the vents. (A description of the device and the operation of the system EGSM-1A are given in the description of the engine).

If servosystem EGSM-1A should go out of order, there is an emergency nozzle-vent control system.

The emergency control of the vents of the jet nozzle is achieved by turning on the switch with the nameplate "Emergency Nozzle Control".

If the electrical devices controlling the Mach number stop should go out of order, the stop can be switched off mechanically by depressing the red button on the throttle-control bracket.

The throttle-control lever (RUD) is blocked, together with the antisurge-vent control system. This blocking is achieved with the aid of the electrical system for switching on the afterburner (cf. section "Antisurge Controlled Vents").

Engine R11F-30C mounted on the plane has rods on the afterburner rollers that can be adjusted from the position of the engine-control lever "minimum afterburner" to the position "total afterburner". For this purpose the engine is equipped with servosystem EGSM-1A for controlling the vents. (A description of the device and the operation of the system EGSM-1A are given in the description of the engine).

If servosystem EGSM-1A should go out of order, there is an emergency nozzle-vent control system.

The emergency control of the vents of the jet nozzle is achieved by turning on the switch with the nameplate "Emergency Nozzle Control".

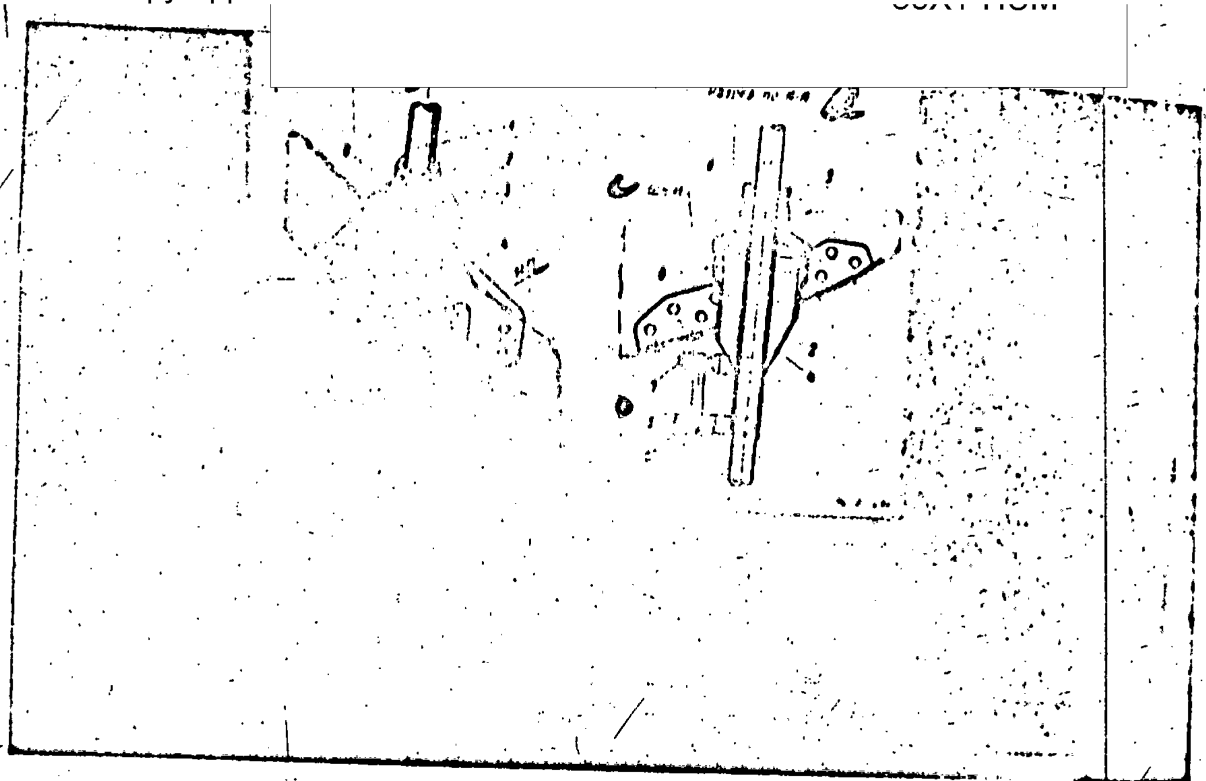

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Fig. 96. Title illegible.

2 - bushing;

6 - clamps;

7 - clamp;

8 - collar;

3 - hermetic sealing cover;

(other captions beneath title illegible)

a) section along A-A

b) frame 11

c) frame 11

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[redacted] 50X1-HUM

When the position of the gas lever is in the afterburner-control range with the switch "Emergency Nozzle Control" turned on, the vents close.

When the engine-control lever is in a position ranging from low gas to 108° /according to the PURT-1F dial/, the vents occupy a maximally covered position. When the lever is set on the stop "total afterburner", the vents will occupy an entirely open position.

Devices for Controlling the Operation of the Engine

The following devices are installed to control the operation of the engine:

1 - Two DT3-1 sensors for measuring the engine rpm: one sensor to measure the rpm of the low-pressure rotor is located to the right of and below frame 22, while the second to measure the rpm of the high-pressure rotor is located to the right of and behind frames 25-26.

The engine rpm indicator ITO-2 is located on the instrument panel in the pilot's cabin.

2 - A set of

(remainder illegible)

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CHAPTER IV

TAKE-OFF AND LANDING DEVICES

General Information

The take-off and landing devices on the plane consist of a three-wheeled retractable landing gear, the landing-gear flaps, three brake flaps, and a landing brake parachute.

The landing gear consists of two main struts of cantilever type and a lever-operated vertically supported nose strut.

The forward strut retracts into the fuselage in the direction of flight. It is equipped with a mechanism for returning the wheel to the neutral position when the load is removed from the wheel.

The main struts are installed in the wings, into which they fit during retraction, while the wheels rotate through 87° relative to the struts and retract into the fuselage.

The extension and retraction of all the landing-gear struts is accomplished by a hydraulic system, while the emergency extension is accomplished by an air system.

The automatic emergency extension of the nose strut is accomplished by a cable line.

The shock absorption of all the landing-gear struts is nitrogen hydraulic.

[redacted] 50X1-HUM

ring locks and hydraulic locks locking the mixture in the cylinder struts.

In the retracted position all the struts are held back by mechanical retracted-position locks.

Flaps controlled by the hydraulic system are installed on the wing cantilevers and serve to facilitate landing. The angle of deflection of the flaps is 24°30°. The flaps have electrical signaling. [illegible]

The brake flaps, two forward and one rear, are controlled by the hydraulic system, are located in the lower part of the fuselage, and serve to reduce the flight speed when landing. The angle of deflection of the forward flaps is 25°; that of the rear flap is 40°.

The landing brake parachute is located in the tail section of the fuselage and is intended to reduce the [illegible] plane's landing run.

The parachute is designed to be ejected during landing at the moment the main wheels touch the ground.

BASIC DATA CONCERNING THE LANDING GEAR

(Fig. 97)

	Main Struts	Forward Struts
Wheel track		
Landing-gear base		
Type and size of wheels	(remainder illegible)	
Pressure in tires		

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Fig. 97. Geometrical Diagram of Landing Gear

a) side view
b) axis of plane
c) axis of rotation of landing gear
d) path of wheel along the vertical
e) minimum radius of vibration of wheel
f) total path of shock absorber along the axis of the strut
g) retraction cylinder
h) front view
j) axis of rotation of landing gear
k) axis of frame 8

(remainder illegible)

Total path of wheel along axis of strut	280 mm	271.5 mm along the vertical
Path of shock absorber	280 mm	90 mm
Quantity of fluid in shock absorbers (AMG-10)	2400 cm^3	650 cm^3
Initial pressure of nitrogen in shock absorber	30±1 kg/cm^2	34±1 kg/cm^2

INSTALLATION OF FORWARD LANDING-GEAR STRUT

(Fig. 98)

The forward landing-gear strut is located along the axis of symmetry of the plane. The strut retracts forward in the direction of flight into a housing located between frames 2 and 7a.

After the strut has entered the housing (during retraction), the housing is covered by flaps by means of a mechanism actuated by the strut itself.

The strut installation includes a hydraulic cylinder for retracting the strut (1), the end switch of the extended position of the strut (2), a stop for keeping the strut in the extended position (3), a lever for autonomous ejection of the strut (4), the end switch for signaling the retracted position of the strut (5), the lock of the retracted position of the strut (6), a tube for signaling the extended position of the strut (7), wheel KT-38 (8), a mechanical indicator of the position of the strut (9), a mechanism for starting the nose-strut flaps (10),

.... (remainder illegible)

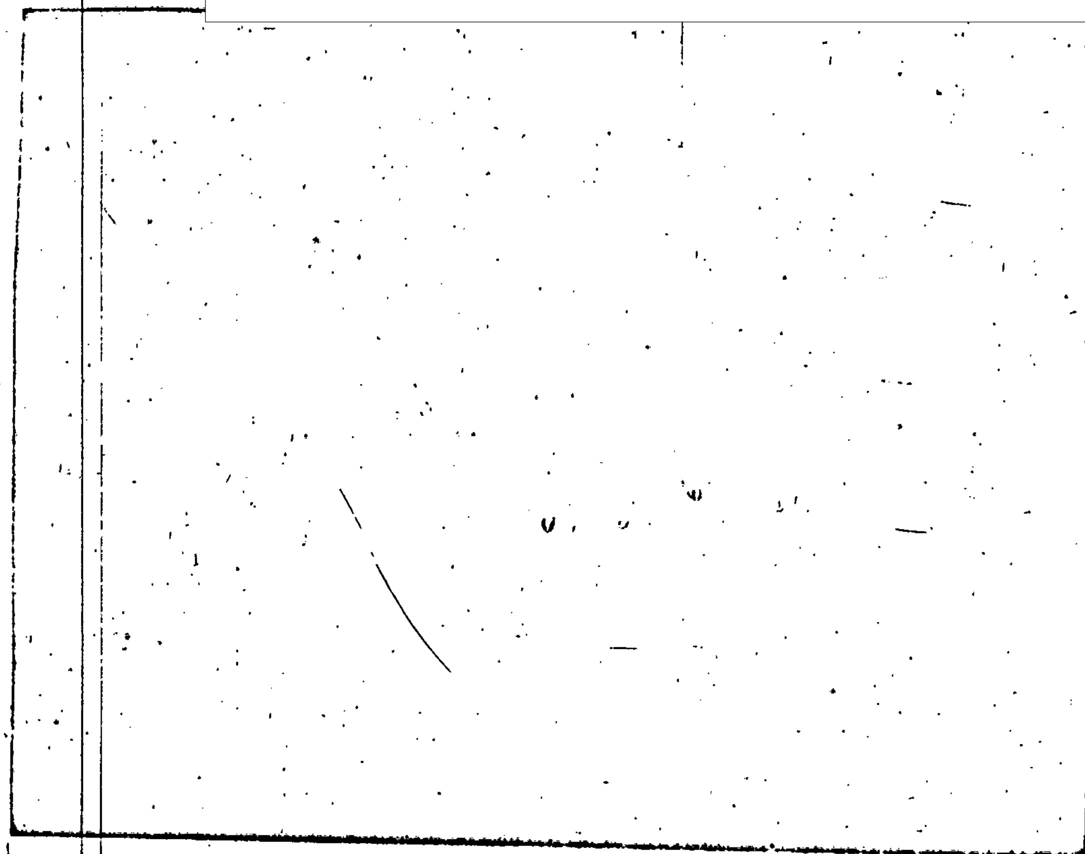

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Fig. 98. Installation of the forward strut.

a) datum line

b and c) illegible

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Fig. 90. Installation of the forward strut.

1 - hydraulic cylinder for retracting and extending the strut;

2 - end switch for signaling the extended position;

3 - strut stop;

4 - autonomous release lever;

5 - end switch;

6 - retracted-position lock;

7 - signaling tube;

8 - wheel KT-38;

9 - mechanical indicator;

10 - mechanism for extending and retracting the flaps;

11 - flaps;

12 - damper.

50X1-HUM

DESIGN OF FORWARD STRUT

(Fig. 99)

The forward strut is equipped with: a nitrogen hydraulic shock absorber, wheel KT-38 with two-chamber air brakes, a cam gear for the neutral position of the wheel during retraction and extension of the strut, and a pivot mechanism for holding the retracted and extended positions of the strut.

Mounted on the strut is a piston-type damper for damping sustained wheel oscillations occurring when the plane moves along the ground.

Mounted in the lower part of the strut is a cable for grounding the plane when parking.

The entire power portion of the strut is made out of material 30ХГСНА heat-treated to 170 kg/cm^2.

Operationally the strut is of semilever type.

Structurally it consists of the following basic power parts: barrel (1), shock-absorber rod (2), and wheel fork (3).

Barrel (1) is welded out of two parts: an upper and a lower. The upper part of the barrel is a bushing with a horn. The axle securing the strut to the fuselage passes through the bushing. Mounted in the horn is pin (11) for holding the retracted and extended positions of the strut. The horn -

(reminder illegible)

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S E C R E T

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50X1-HUM

Fig. 99. Forward landing-gear strut.

a) section along A-A

b) location A

c) the dimension ~~xxx~~ "8.5" corresponds to the normal filling of the damper with fluid AMG-10

d) red line

e) white line

f) section along B-B

g) section along D-D

h) section along [illegible] COE

i) section along F-F

j) [illegible] design of nonlinear transmission from the wheel to the damper

50X1-HUM

50X1-HUM

3/2

Fig. 99. Forward landing-gear strut.

1. upper barrel
2. rod
3. fork
4. wheel KT-38
5. [illegible] snug joint with rotary clutch
6. hydraulic cylinder for retracting and extending the strut
7. sensor UA-24/2 (of assembly UA24-200-5)
8. grounding cable
9. pipe for filling chamber
10. [illegible] brake pipe
11. holding pin
12. signaling tube
13. stirrup
14. plate springs
15. bolt joining the stirrup to pin
16. bolt joining stirrup to hoist
17. damper
18. lower hoist TsKB-1126
19. connecting rod
20. upper hoist TsKB-1126
21. balls (6 around a circumference) GOST 9722-54
22. lubricator
23. pipe for filling shock absorber
24. compensator
25. piston
26. plug
27. cover
28. valve
29. collar
30. casing
31. stirrup
32. lubricator
33. bolt
34. actuating arm
35. pin
36. guide
37. washer

50X1-HUM

The pin is connected to the rod of hydraulic cylinder (6); during retraction and extension of the strut the rod first uncouples the pin from the respective stop and then turns the strut. In the upper part of the barrel are two threaded pipes: one (a large one) for filling the valve; the other (smaller) for controlling the level of the mixture poured into the shock absorber.

The lower part of the barrel is a cylinder, mounted on which is rotary clutch (5), which is connected to the wheel fork. On the rotary clutch are stops, which restrict the movement of the clutch to the limits $17^{\circ} - 1^{\circ}$.

Mounted on the barrel is a bracket, on which damper (17) is secured by means of two bolts connected to the rotary clutch by a nonlinear-transmission mechanism consisting of collar (29), stirrup (31), and actuating arm (34).

(remainder illegible)

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When the shock absorber is squeezed, the upper cam uncouples from the lower one, thereby ensuring free rotation of the rod. The rod terminates in a lug, through which the axle securing the wheel fork. It is with respect to this axle that the fork rotates when the shock absorber is squeezed. The rod is made out of high-strength steel 30KhGSNA.

Wheel fork (3) is a lever, on one arm of which the wheel is mounted, while the other arm is connected to rotary clutch (5) through rod (19).

Structurally the fork is made out of two halves connected to each other by the axle by means of which the fork is secured to the shock-absorber rod. The semiforks are made out of steel 30KhGSNA.

During taxiing the forward wheel is made to turn by braking the main wheels; the rotation occurs on easily orienting bearings TsKB-1125 (20) and TsKB 1126 (18).

Damper

(Fig. 99, cross section COE)

The piston-type damper is intended to damp sustained lateral wheel oscillations arising when the plane moves along the ground, as a result of the unevenness of the ground or as a result of imperfect symmetry of the wheel itself.

The damper is mounted on the forward strut, while the damper piston is connected by means of its guide to the lower strut assembly through a nonlinear-transmission mechanism. The nonlinear-transmission mechanism ensures smooth damping of sustained wheel oscillations with low angles of deflection, while in the case of large wheel deflections it becomes insensitive to turns.

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314c

When the lower strut assembly is turned to the right or left, together with the fork and the wheel, collar (29), through the nonlinear mechanism, actuates piston (25) contained in casing (30). Piston (25) moves the fluid with which the casing is filled from chamber to chamber through a calibrated opening

(remainder illegible)

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SHOCK ABSORBER

(Fig. 100)

The shock absorber is intended to absorb the work of the external forces acting on the wheel during take-off, landing, and taxiing.

The shock absorption is of nitrogen hydraulic type. The working media are the mixture AMG-10 and nitrogen. The full stroke of the shock absorber amounts to 90^{+1}_{-1} mm at an initial pressure of $34^{\pm 1}$ kg/cm².

Structurally the shock absorber consists of: a cylinder with a brake valve (1), piston (2), and sealing packet (3).

Serving as cylinder (1) is the lower barrel of the strut, mounted inside of which is a valve for braking forward and reverse motion. The valve consists of: a casing, slit spring ring (4), and a nut.

Serving as the nut is the strut rod, mounted on which is sealing packet (3) made out of V-shaped rubber and leather glands.

In the upper part of the shock absorber are two pipes, one of which (the larger one) is used to fill the absorber with the mixture and to load it with commercial nitrogen (5), while the other (the smaller one) (6) is used to drain off the excess volume of AMG-10 mixture, when the shock absorber is pressed down all the way during fueling. After the excess mixture has been drained off, this cylinder is closed by a leaktight plug screwed into the pipe.

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315a

When the shock absorber is squeezed, ring (4) of the valve, under the action of the fluid pressure, is pressed against the upper shoulder of the valve casing, while the fluid flows from cavity B into cavities A and C through an opening in the piston into the xxxx joint.

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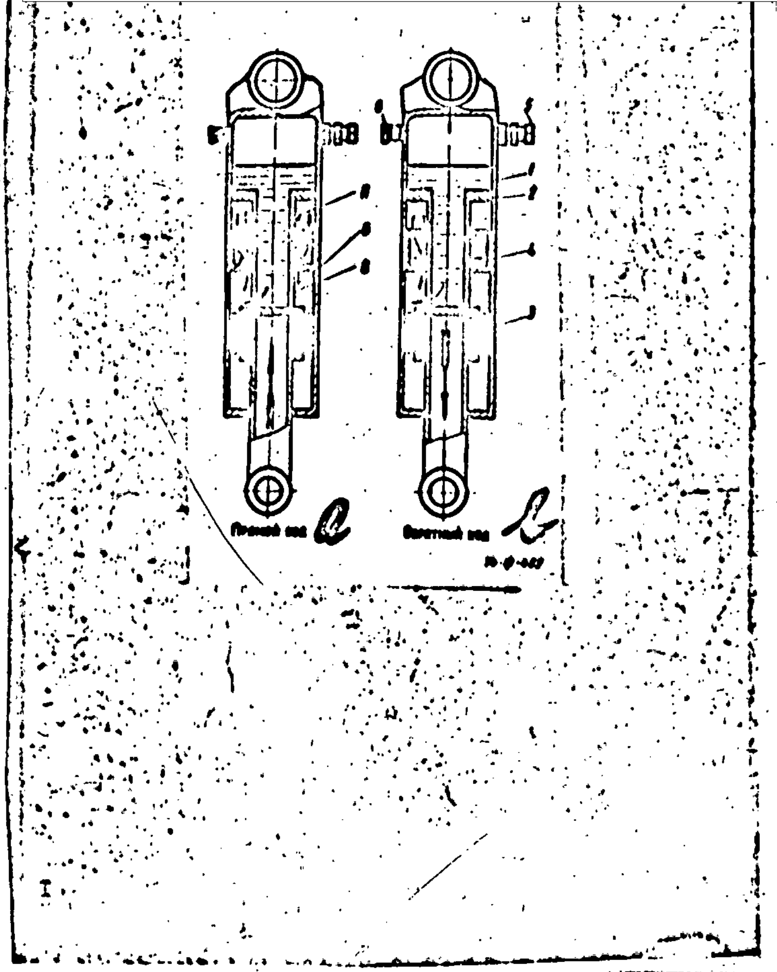

Fig. 100. Operation of Shock Absorber.

1 - cylinder;

2 - piston;

3 - sealing packet;

4 - slit spring valve ring;

5 - pipe for pouring in mixture and charging with nitrogen;

6 - pipe for draining off excess mixture.

a) forward stroke

b) reverse stroke

of the valve ring through openings in the upper valve bearing and the piston disks. The nitrogen, being under pressure in the shock absorber, is compressed further. At the beginning of the reverse stroke of the piston under the action of the compressed nitrogen the valve ring moves downward under the fluid pressure in cavity A and shuts off the gap between the valve and the piston. In this case the fluid passes from cavity A into cavity B only through the joint in the valve ring and the opening in the piston.

By decreasing the flow opening for the fluid, an intense braking of the piston speed occurs during the reverse stroke.

The kinetic energy during landing is absorbed by the shock absorber as a result of the fluid's flowing through the openings in the valve and the piston, and also as a result of the compression of the nitrogen.

The absorbed energy is dissipated in the form of heat energy.

Forward Wheel (Fig. 101)

Forward wheel KT-38 with tire dimensions 500 x 180A is of brake type with two air-chamber brakes and is equipped with inertia sensor UA-24/2 (assembly UA24-200-5), to prevent "grabbing" during braking, and with aircraft tire of arched type.

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50X1-HUM

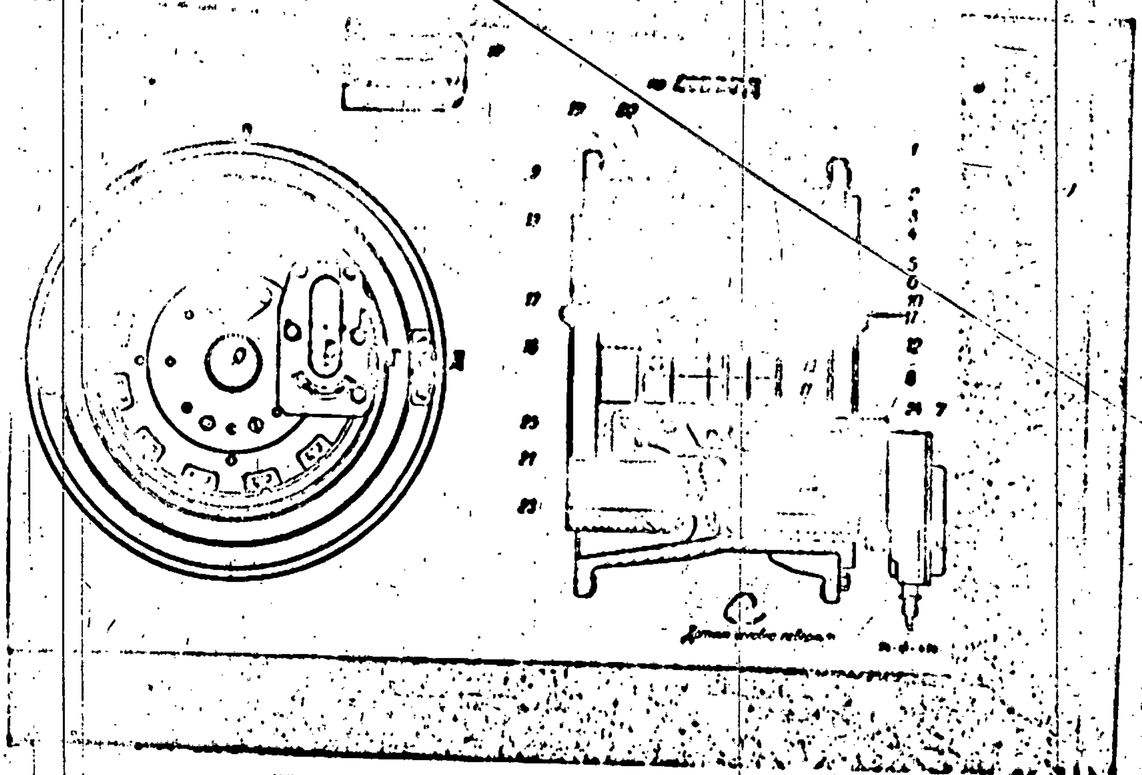

Fig. 101. Wheel KT-38

a) sensor turned arbitrarily

50X1-HUM

Fig. 101. Wheel KT-38.

1 - detachable semiflanges;
2 - drum;
3 - jacket;
4 - shoe;
5 - chamber;
6 - bucket;
7 - sensor UA-24/2 (of assembly UA24-200-5);
8 - bracket;
9 - cap;
10 - valve;
11 - driven gear;
12 - gland;
13 - drive gear;
14 - gland;
15 - roller bearing;
16 - casing;
17 - pipe;
18 - ~~xxxxx~~ nut;
19 - valve;
20 - tire;
21 - adjustable ring;
22 - gasket ring;
23 - recoil spring;
24 - shaft;
25 - gland;
26 - spreader.

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The wheel ensures the possibility of testing the engine during parking without using blocks to brake the wheel, without take-off and landing runs, and without taxiing.

The wheel is a cast magnesium-alloy drum (2) with detachable semiflanges (1) made to facilitate the assembling of tire (20). After the tire has been installed, the semiflanges are pressed against the shoulder of the drum, are prevented from turning by a dowel, and are connected to each other by two cover plates on four bolts.

Bolted to the ends of the drum are bimetallic linings (3), which are centered with respect to the axle by cylindrical perforations on the ends of the drum.

The wheel rotates on conical radial-thrust roller bearings (15). The outer races of the bearings are pressed into special hub sockets, while the inner races, together with the rollers, are mounted and tightened by nuts on the fork axle of the forward landing-gear strut. Between the inner bearing races is a spacer of adjustable length. The bearings are closed on the outside by glands (12), which prevent the bearings from being contaminated and the lubricant from flowing out.

In each bimetallic lining is a single-row chamber brake. All the parts of the brake are mounted on casing (16).

Drop-forged shaped buckets (6), together with the casing, form a groove containing ring-shaped rubber-fabric chamber (5) and shoes (4).

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Rings (21) hold chamber (5) in a central position relative to shoes (4) and do not allow the chamber to shift sideways.

Shoes (4) are reinforced (friction plastic molded together with the metal casing).

Buckets (6) are fastened by bolts on casing (16). Each bucket rim has grooved projections, which serve as guides to the shoes. The shoes are capable of moving only in a radial direction under the pressure of the compressed air fed into chamber (5) through pipe (17) and valve (10).

Recoil springs (23) pass through openings in the grooved projections on the buckets and through end grooves in the shoes.

Secured on the casing of one of the wheel brakes is bracket (8), into which sensor (7) is built. Mounted on the tail end of the sensor shaft is a gear which meshes with a gear mounted on shaft (24), which can rotate on ball bearings.

Mounted on shaft (24) is driven gear (11), which, in its turn, meshes with drive gear (13) mounted on the hub of the drum.

The gear drive between the drum hub and the sensor is protected from contamination by gland (14).

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During braking the compressed air is fed to the brakes through a pipe connected to pipes (17). Under the pressure of the compressed air brake shoes (4) are pressed against lining (3), thus braking the rotation of the wheel.

When the pressure in the chamber is drawn off, the recoil springs release the shoes from the lining and press them against the chamber.

When the wheel rotates during the landing run, the sensor shaft, connected to the wheel by the gear drive, also rotates. When "grabbing" of the brake wheel occurs, the sensor sends a pulse to the electromagnetic valve of the brake system, thereby enabling the wheel to pick up speed.

Thus, independently of the pilot, the brake pressure fluctuates around the maximum permissible value which will not cause "grabbing" of the wheel.

The basic technical characteristics of the wheel KT-38 are as follows (when installed on the plane):

Maximum parking load from take-off weight of plane	1250 kg
Initial working pressure in tire	$6^{+0.5}$ kg/cm^2
Maximum permissible load	4150 kg
Maximum brake pressure	10.5 kg/cm^2
Kinetic energy absorbed by the wheel during one braking	216,000 kg/m
Landing speed	not more than 275 km/hr

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Speed at the moment of lift-off of the wheel not more than	295 km/hr
Weight of wheel	23.8 kg
Weight of wheel rigging	31 kg

Retracted-position Lock

(Fig. 102)

The mechanical retracted-position lock of the forward strut is located in the lower part of frame 7A.

The lock consists of: ~~xxxxxxxx~~ bearing lever (4), cam (2), and lever (1), all mounted on the same ~~xxxx~~ axle, end switch (5), springs, and welding bracket (6) bolted on the frame.

During retraction the ~~xxxxxxxx~~ retainer pin located in the horn of the forward strut approaches bearing lever (4) and slides along its inclined plane.

In the maximum retracted position of the strut the pin, under the action of the springs, comes under bearing lever (4), which prevents the strut from moving backwards. Further retraction is limited by the cylinder itself (the piston strikes against the gland cover). The gap between the strut pin and the bearing lever of the lock should be 0.2-0.5 mm. Moreover, the lever for turning on the end switch is pressed away from it by a pin projecting from the "horn" of the strut and connected to the retainer pin. In this case a red signal light flashes on.

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During extension of the landing gear the retainer pin, under the action of the force coming from the hydraulic-cylinder rod sinks down and emerges from under the bearing lever of the lock. The bearing lever itself is prevented from turning by cam (2). Moreover, the elements of the lock remain stationary.

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50X1-HUM

Fig. 102. Retracted-position lock.

1 - lever;

2 - cam;

3 - spring;

4 - bearing lever;

5 - end switch (illegible);

6 - bracket;

7 - ~~[illegible]~~ signal lever;

8 - cable from the autonomous-release lever.

a) nose strut of landing gear

(remainder illegible)

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Fig. 102. Retracted-position lock.

1 - lever;

2 - cam;

3 - spring;

4 - bearing lever;

5 - end switch (illegible);

6 - bracket;

7 - ~~[illegible]~~ signal lever;

8 - cable from the autonomous-release lever.

a) nose strut of landing gear

(remainder illegible)

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In the c[redacted] extension of the forward strut by the cable line lever (1) turns together with the cam, thereby releasing the bearing lever, which turns under the action of the weight of the strut, and the strut emerges from the housing.

In this case the retainer pin does not sink ~~xxx~~ into the strut.

During extension of the strut lever (7) is released, turns under the action of the spring, and depresses the ~~xxxxxxxxxxxxxxxxxx~~ end-switch rod. At this moment the light signaling the retracted position of the forward strut goes out.

Extended-position Lock

(Fig. 103)

The strut is held in the extended position by a mechanical lock and a hydraulic lock. The mechanical lock is located on the rigidity of the cabin floor near frame 6; the hydraulic lock is mounted in the housing of the forward strut. The mechanical ~~xxxxxxx~~ lock is a stop, into which the pin located in the horn of the strut runs. As it approaches the stop, the pin sinks into the horn of the strut.

In the maximum extended position of the strut the pin, under the action of the spring, runs behind the stop and prevents the strut from moving backwards.

During retraction of the landing gear the retainer pin, under the action of the force of the hydraulic cylinder, sinks down and emerges from behind the stop.

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Fig. 103. Extended-position lock.

1 - hydraulic cylinder;

2 - hydraulic lock;

3 - pin of strut horn;

4 - forward stop;

5 - rear stop;

6 - supporting ring;

7 - stirrup;

8 - strut horn;

9 - plate springs.

a) retraction

b) extension

c) operation of hydraulic cylinder

d) crosspiece of frame 6

e) emergency extension of landing gear

f) view along arrow A

g) cradle

h) permissible gap 0.05-0.1 mm

i) given a gap of 0.05-0.1 mm, the minimum contiguity is 60% of the supporting surface of the cradle

j) opening of lock

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The hydraulic lock goes into operation when the mechanical lock fails.

Signaling System (Fig. 104)

The forward strut is equipped with mechanical and luminous signaling of the retracted and extended positions of the strut.

The mechanical signaling is achieved with the aid of a pin located on the upper part of the fuselage near frame 6 on the left side and connected to the strut by a cable line. During extension of the strut the pin emerges approximately 50 mm above the covering; when the strut is retracted the pin rises flush with the covering.

The luminous signaling is achieved by signal lights located on signal board PPS-2.

A red light corresponds to the retracted position os the strut; a green light corresponds to the extended position.

Board PPS-2 is located on the left stationary part of the instrument panel. Moreover, mounted on the strut is an electric light for external signaling of the extended position of the strut for ground control during night flights.

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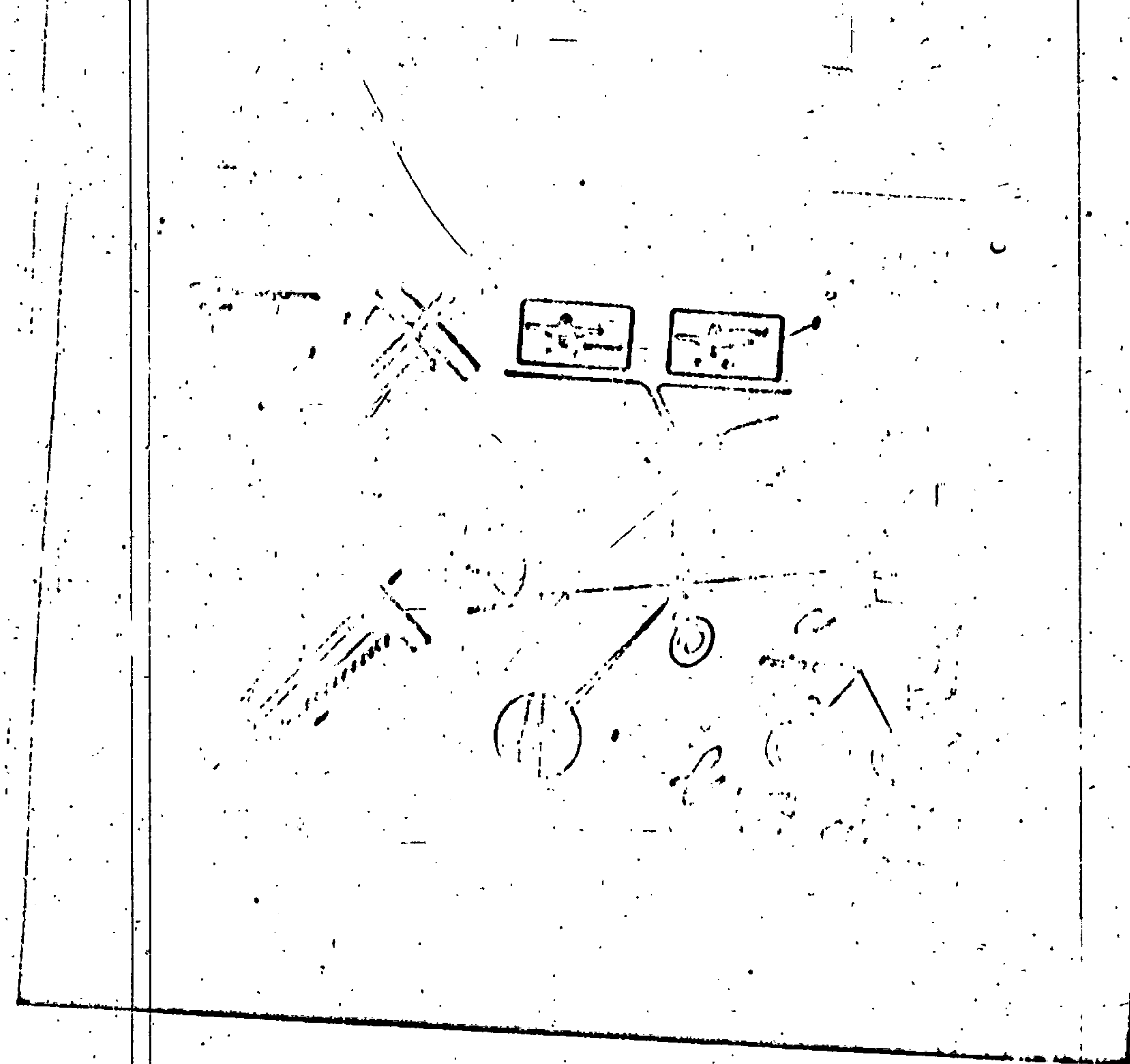

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Fig. 104. Signaling of retraction and extension of strut.

1 - illegible
2 - stationary bracket;
3 - springs;
4 - illegible
5 - adjustable turnbuckle;
6 - cable;
7 - bolt attaching (illegible)
8 - light for external signaling of landing gear;
9 - board PPS-2.

a) nose strut
b) retracted position of strut
c) extended position of strut

(remainder illegible)

50X1-HUM

Forward-strut Flaps (Fig. 105)

Flaps (5) of the strut close a groove in the fuselage during the retracted position of the strut. They consist of two symmetrical parts, each of which is hinged onto two brackets and has a mechanism for retracting and extending the flaps.

The retraction mechanism of each flap consists of rod (4), gimbal rod (3), and actuating arm (2). Actuating arms (2) are connected to each other by pipe (7).

When the strut rises, the wheel fork depresses pipe (7), and through rods (4) and (3) and link (8) the flaps are closed. When the strut is extended, the wheel fork moves away from the pipe, and the rods, together with the link, under the action of springs (1), open the flaps.

Retraction and Extension of Forward Strut

Retraction and extension of the strut occurs as follows:

When the lever of the landing-gear-valve switch is set in the position "landing gear retracted", electromagnetic valve GA-142/1 connects the landing-gear retraction line with the pressure main.

The hydraulic mixture approaches the hydraulic lock and opens it, after which it enters the strut retraction and extension hydraulic cylinder (there is no ball lock in the hydraulic cylinder).

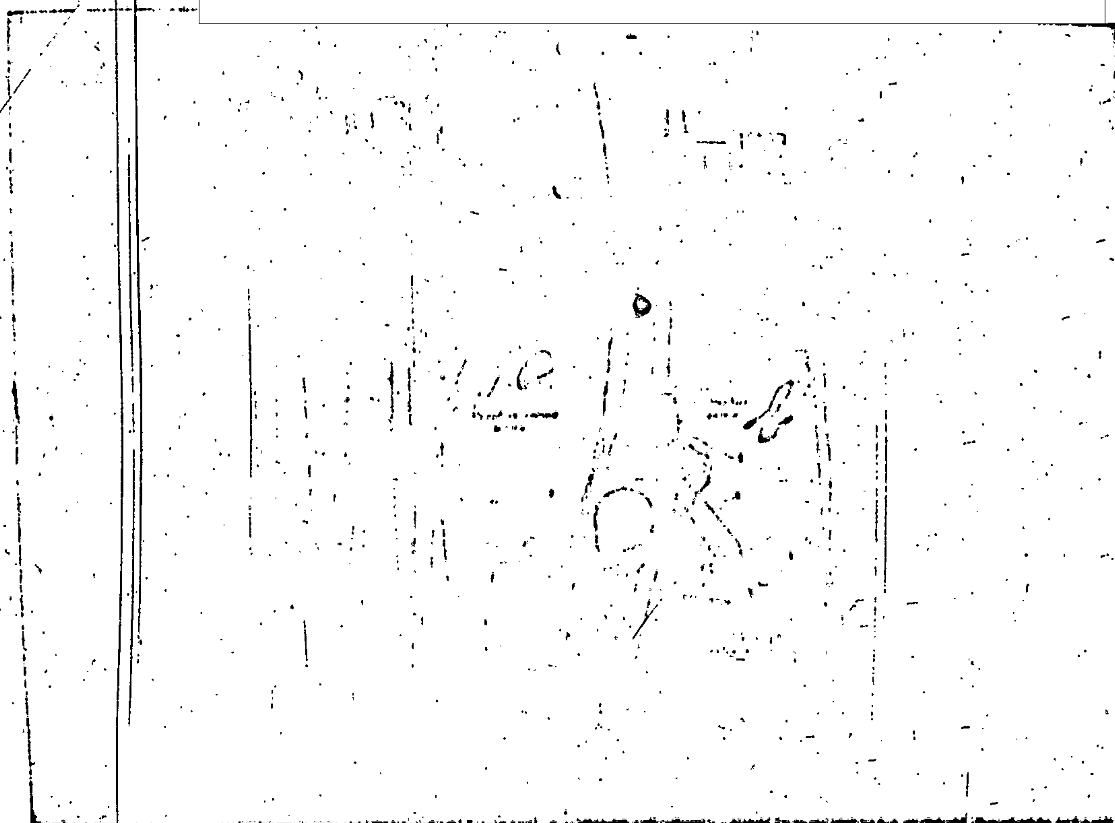

Fig. 105. Forward-strut flaps.

7 - pipe;

8 - link.

a) forward landing-gear strut

b) forward wheel

c) axis of symmetry of the plane

d) strut fork

e) bracket securing ~~[illegible]~~ rod (illegible)

(reminder illegible)

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The hydraulic-cylinder rod, moving, first disengages from the stop the pin on the upper horn of the strut and then turns the strut, as a result of which the strut is retracted.

The strut is held in the retracted position by a mechanical lock located on frame 7A.

At the moment when the strut is almost retracted the pin slides along the inclined plane of the lock located on frame 7A, sinks into the horn, runs off the edge of the surface, and, under the action of the plate springs, engages with the lock, thereby retaining the retracted position of the strut.

When the lever of the landing-gear-valve switch is set in the position "extended", the valve connects the retraction line with the drainage main, and the mixture under pressure enters the hydraulic cylinder of the strut; the pin is drawn into the horn and disengages from the bearing lever of the retracted-position lock, after which the strut begins to extend.

Under the action of a set of plate springs the pin assumes the initial position. When the strut reaches the vertical position, the pin slides along the inclined ~~plane~~ surface of the stop unit located under the floor of the cabin, sinks into the horn, runs up to the edge of the surface of the unit, and, under the action ....

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of a set of plate springs, engages with it, while the supporting cradle is pressed against the crosspiece of frame 6.

EMERGENCY EXTENSION OF FORWARD STRUT

The emergency extension of the strut is controlled, together with the main landing-gear struts, by the air system.

Air enters the hydraulic cylinder, disengages the pin from the bearing lever of the retracted-position lock, and the strut extends.

AUTONOMOUS EXTENSION OF THE FORWARD STRUT

(Fig. 106)

The system of autonomous emergency extension of the forward strut makes it possible to open the retracted-position lock with the aid of a cable line.

The cable line from the retracted-position lock enters the cabin and terminates in a lever located near the right panel.

When the lever is pulled backward, the retracted-position lock opens, while the strut, under the action of its own weight, emerges from the fuselage and is pressed completely into the extended position by a counter flow of air.

Autonomous emergency extension of the strut is used if for some reason the strut does not extend or in case of a forced landing with retracted main struts.

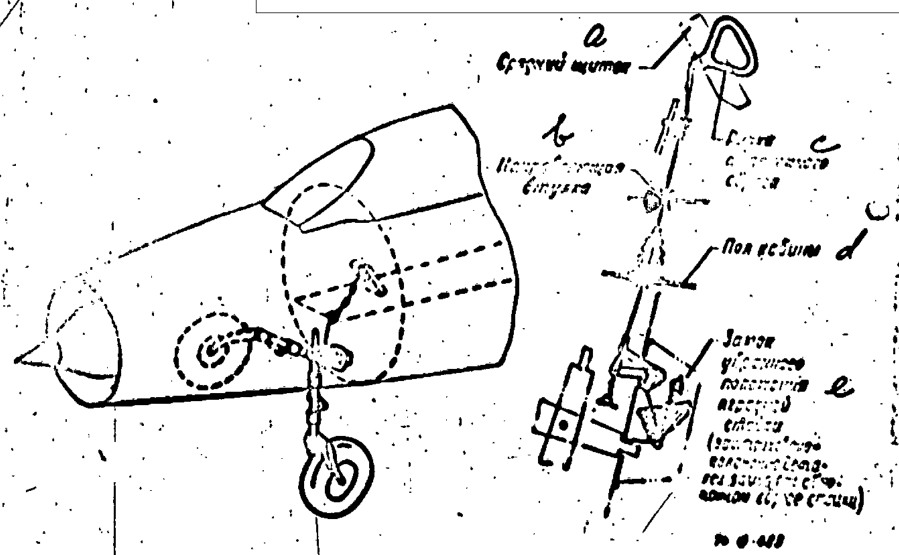

Fig. 106. Autonomous release of strut.

a) center flap

b) guide bushing

c) autonomous-release lever

d) cabin floor

e) retracted-position lock of forward strut (the shaded portion indicates the positions of the parts of the lock during autonomous release of the strut)

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MAIN LANDING-GEAR STRUTS

Mounting (Fig. 107)

The main strut is attached to the wing. When it is retracted it fits into the wing, while the wheel, which has turned 87° relative to the strut, fits into a housing in the fuselage between frames 16 and 20.

The strut is attached to bearings of the front spar and the main truss of the wing by means of a detachable axle of rotation.

The hydraulic cylinder to raise and lower the strut is at the same time the main cantilever which receives the stresses when the plane lands and transmits them to the wing structure. The hydraulic cylinder is attached to the wing by means of a power unit near the front spar of the wing; the cylinder is attached to the strut by means of a swivel bolt on the cantilever.

Design (Fig. 108)

The main strut is of the cantilever type, and consists of the following basic parts: barrel, rod, , swivel slot, shock absorber with plunger (inside the rod), and the mechanism for turning the wheel.

The barrel is the main power element, transmitting the stress from the wheels to the wing structure; it

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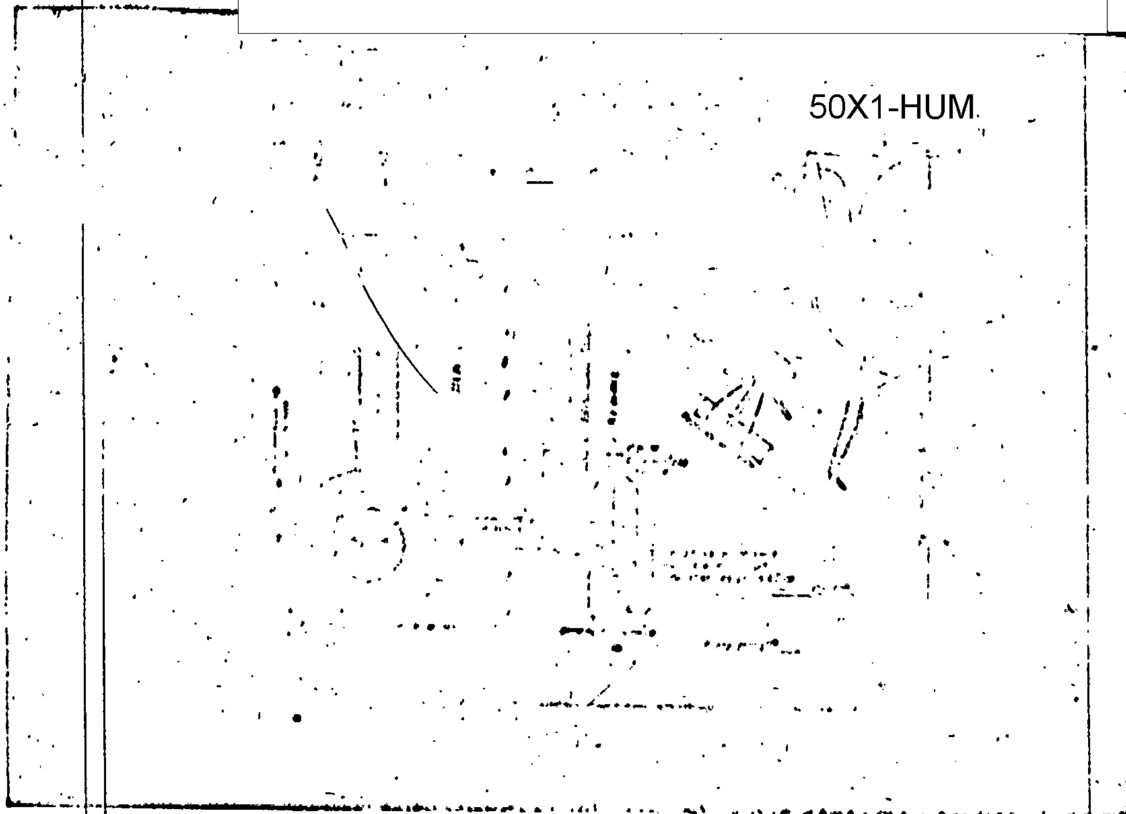

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Fig. 107. Mountings of the main landing-rear struts.

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Fig. 107. Mounting of the main landing-gear struts. 1. KT-82M wheel; 2. suspension bracket to lock landing gear; 3. parallelogram mechanism for turning the wheel; 4. cross-piece flap[?]; 5. bulb for outside signal lights; 6. connecting rod for wheel-turning mechanism; 7. flap on strut; 8. landing-gear strut; 9. axle axis of rotation of the strut; 10. end switch for electrical signalling that the landing gear is down; 12. hydraulic cylinder to raise and lower landing gear; 13. landing-gear suspension lock; 14. flap lock; 15. hydraulic cylinder to open and close flap; 16. wheel flap; 17. end switch to electrically signal that the landing gear is raised.

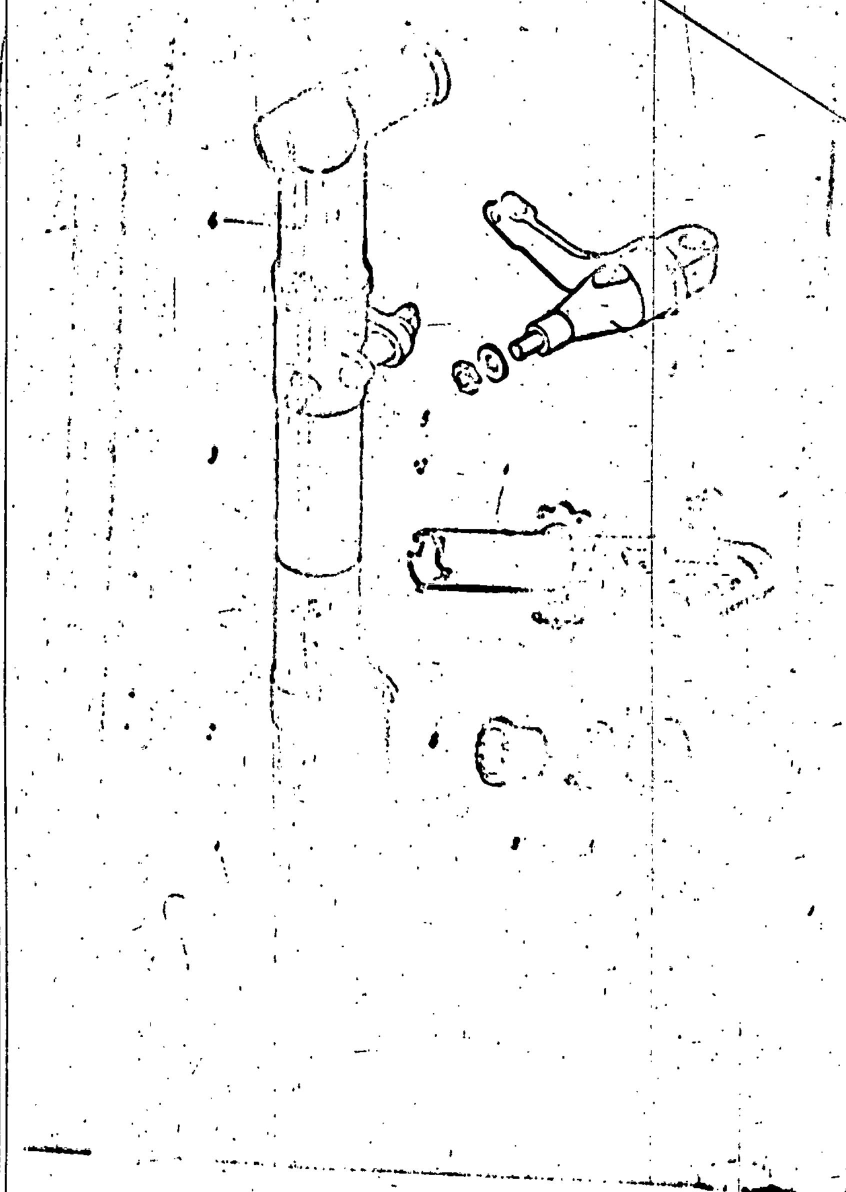

Fig. 108. Design of the main landing-gear strut. 1. wheel 2. rod; 3. inflation valve; 4. barrel; 5. bolt with actuating arm; 6. swivel slot; 7. bushing; 8. nut; 9. washer; 10. connecting rod.

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consists of upper and lower units, stamped from 20KhGSA steel and welded together.

The upper unit has two bushings of 20KhGSA steel for the rotation axle of the landing gear; the inner cavity of the unit is used as a 2-liter compressed air tank, at a pressure of 110-130 kg/cm^2.

To the barrel are attached: the hydraulic cylinder, by means of the cantilever bolt; the inflation valve; and the lug for transporting and restraining the plane when the engine is raced on the ground. Within the barrel there is a partition for rigidity; at the same time this partition is also the bottom of the air tank. The shock-absorber plunger is attached to the other side of the partition.

The barrel is the outside housing of the shock absorber; to it are attached the upper cross piece and the strut flap.

The rod consists of two parts stamped of 20KhGSNA steel, welded together. The upper part is a thick-walled tube with a header in the middle and with a thread in the upper part for the upper journal box and for the body of the brake check valve, which is also a stop during the reverse travel. To the bottom part of the rod is attached the half-axle and the lower cross piece of the swivel slot; there are also recesses for the turning mechanism and for the lock of the raised and lowered positions of the half-axle. The header of the bottom unit is a stop against which stresses from the half-axle are transmitted when the plane lands.

S E C R E T

The strut rod has two supports on the barrel: the upper and lower journal box, and operates as a truss on two supports to take up the stresses from compression and flexure.

The half-axle is made of ~~22~~30KhGSNA steel. It has a flange for attachment of the wheel brake and a lug for attachment to the rod.

The half-axle has a cantilever retractable fork to which is attached the unit of the kinematic lock which locks the half-axle in the lowered and raised positions.

Thek half-axle has a removable stop which transmits the stresses from it to the rod.

The half-axle is connected to the rod by means of an axle.

The strut torque link serves to transmit the torque from the rod to the barrel, and consists of upper and lower cross pieces stamped from 30KhGSNA steel.

The upper cross piece is connected to the bottom barrel on a pivot, which is also the pivot for the turning-mechanism actuating arm.

The cross piece has three openings to ~~attach~~ which to attach the flap that covers the opening in the wing for the strut.

The lower cross piece is connected to the rod by a pivot.

To the pivot of the lower cross piece is attached the ~~xxxxxx~~ suspension bracket for the strut to lock it in any selected position.

~~Shank~~ Shock Absorber

(Fig. 10?)

The main strut shock absorber is of the hydraulic-nitrogen, plunger type, with braking in the forward and reverse ~~strokes~~ travel, and is inside the strut.

The shock absorber, together with the pneumatic wheel, decreases the force of impact on the strut and wing when the plane lands, and smoothes the curves of the increase and decrease of this force, which protects the undercarriage and the wing frame from failure.

The maximum ~~stroke~~ travel of the shock absorber when compressed is 280 mm. The absorber is filled with 2400 cm^2 of AMG-10 mixture, and technical nitrogen to a pressure of 30^{+1} kg/cm^2.

At one end of the plunger (3) is a spherical bearing, by which it is attached to the header of the middle part of the barrel; on the other end is a header with an opening for overflow of the fluid when the absorber is compressed.

The header has a cylindrical groove into which is fitted with a cast iron expansion ring along which the inner surface of rod (7) slides when the shock absorber is compressed. The rod is centered in the barrel on two bronze ~~bearings~~ journal boxes, the upper (13) and lower (11) ones.

The upper journal box is threaded onto the rod and has an opening along the side for overflow of the fluid. The outside of the lower journal box is centered

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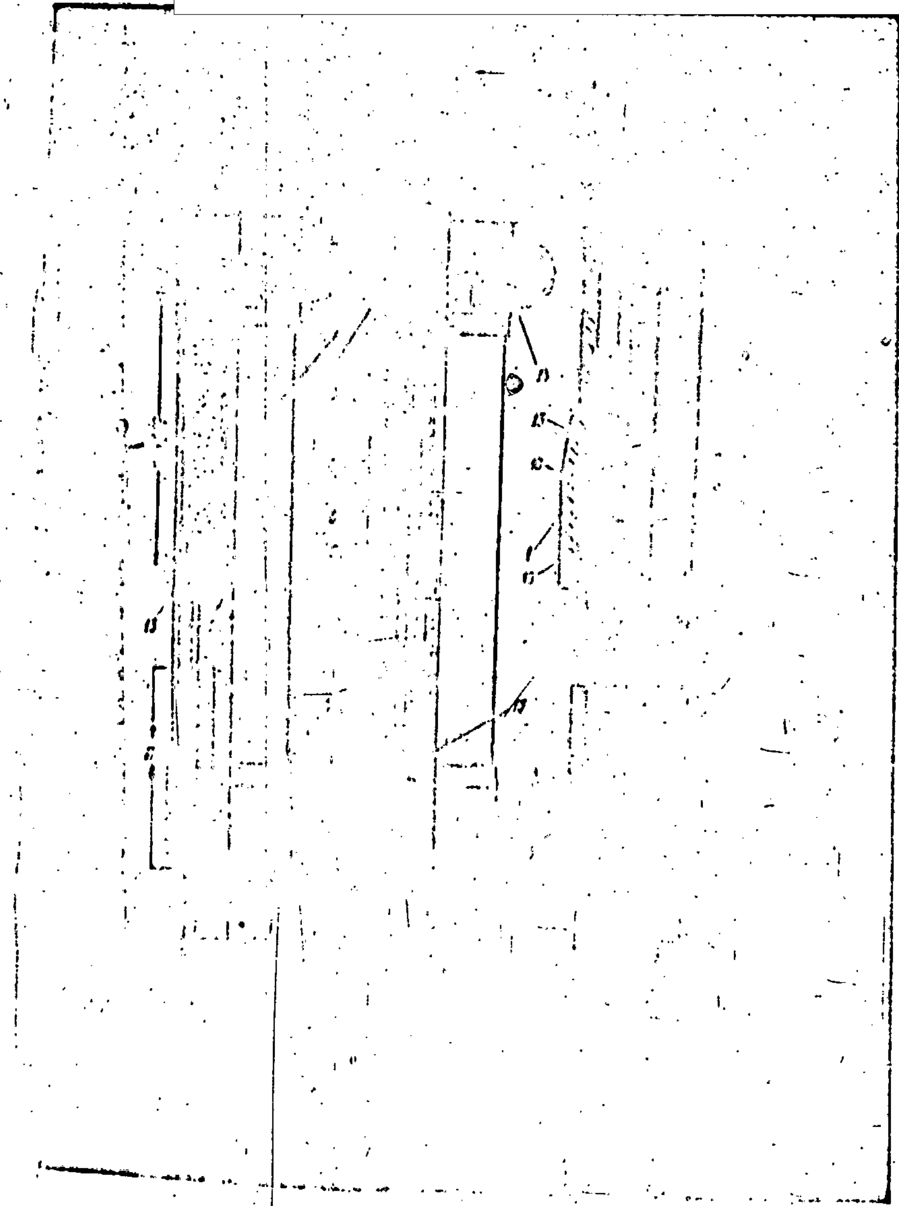

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Fig.109. Diagram of the operation of the shock absorber.

a. travel 280 [mm]; b. forward travel; c. reverse travel; d. point A; e. point

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[redacted]

Fig. 109. Diagram of the operation of the shock absorber.

1. barrel; 2. cylinder; 3. plunger; 4. screw; 5. support ring; 6. packing ring; 7. rod; 8. upper support ring; 9. Dural ring; 10. rubber sleeve; 11. lower journal box; 12. nut; 13. upper journal box; 14. inflation valve; 15. nut; 16. leather sleeve; 17. grease box.

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in the inside diameter of the barrel and, by means of nut (8), the packing is tightened.

The shock absorber operates as follows: the hydraulic mixture fills the entire lower part of the shock absorber. When the absorber is compressed, the mixture in the space formed by the inner cavity of rod (7) and the header of plunger (3) is pressed out through the openings in the header and sides of the plunger and through the openings in the upper journal box (13) into the reverse cushioning chamber which is formed by the V-shaped packing, the check brake valve, and the sides of the barrel and the rod. Then, in the reverse-travel valve (the cast iron thrust ring), during direct travel, the fluid is pressed out of the ring of the check brake valve and the mixture has free access to the reverse brake chamber. During the reverse travel the rod, acted upon by the compressed nitrogen, begins to move and expel the mixture from the reverse brake chamber. During reverse travel of the shock absorber the cast iron thrust ring presses against the seat, decreasing the area of the through-section for fluid overflow, and thus assures cushioning during reverse travel.

The Main Wheels

The KT-82M wheel (tire size 660 x 200V) on the main undercarriage has a disc brake and inertial braking sensors UA-23/2_A1 (with control $E = 450\ 1/sec^2$) or UA-23/2_A9 for the right wheel, and UA-23/2_A2 (with control $E = 450\ 1/sec^2$) or UA-23/2_A10 for the left wheel.

The wheel (Fig. 110) consists of drum (1), two removable half-rims (2), two radial-support roller bearings (5), stuffing boxes (4), and covers (6).

Drum (1) is cast of magnesium alloy. Along the outside of the rim of the drum there are 6 bosses in whose grooves are attached the guides for the splined engagement of bimetallic discs (9) with drum (1).

Tire valve (23) is in a special boss on the rim.

Half-rims (2) are detachable for mounting the tire on the wheel. The half-rims are held in place on the drum by a shoulder and are kept from turning by means of keys (21).

The outer retainers of roller bearings (5) are pressed into the nave of the drum. The outsides of the bearings are protected against contamination by stuffing box (4) and cover (6).

The wheel contains a disc brake, which consists of housing (7), cylinder unit (13), four bimetal sector discs (9), pressure disc (8), 11 pistons (11), packing ring (12), recoil springs (16), flange (27), flare (26), mounting parts, and connecting pipe (20) for attaching to the brake control system, and three cermet discs (10).

Discs (9) are made in individual sections connected by shackles. Each bimetallic disc segment is a housing made of plate

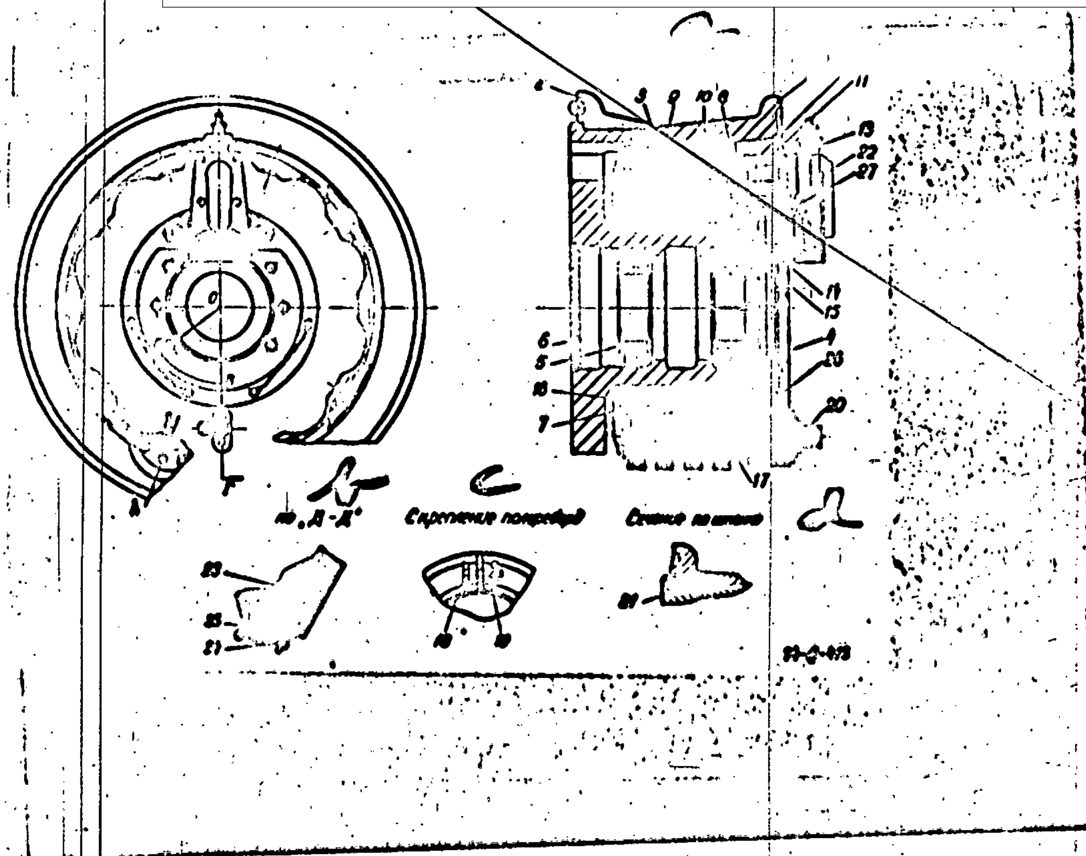

Fig. 110. Wheel KT-62M

a. view at ; b. at ; c. attachment of half-rims; d. cross section at the key.

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Fig. 110. Wheel KT-82M

1. drum; 2. half-rim; 3. guide; 4. stuffing box; 5. roller bearing; 6. cover; 7. housing; 8. pressure disc; 9. bimetallic disc; 10. cermet disc; 11. piston; 12. packing ring; 13. cylinder block; 14. gear; 15. gear; 16. recoil spring; 17. pivot bolt; 18. bolt; 19. lug; 20. connecting pipe; 21. key; 22. sensor; 23. valve; 24. [illegible] can; 25. nut; 26. flap; 27. flange.

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steel coated on both sides with a special cast iron that forms the friction surface. Discs (9) can move along the axle by means of guides (3).

Disc (10) is a steel frame faced on both sides with a cermet friction material.

The discs can move in their slots along the axle by means of guides attached to housing (7). Housing (7) has a thrust flange to which are attached the cermet segments reinforced by the steel frame.

The pressure disc consists of a frame of plate steel, with attached cermet segments.

Cylinder block (13) contains pistons (11). Rubber packing ring (12) packs the cylinder cavity.

When pressure is fed to the cylinders, pistons (11) and pressure disc (8) move along their axes, overcoming the resistance of recoil springs (16); they press against discs (9) and (10), thus braking the wheel.

When pressure is relieved in thecylinders, recoil springs (16) push away pressure disc (8) to the initial position, thus releasing the brake.

Sensor (22) is attached to brake housing (7). Gear (14), attached to the shaft of the sensor, engages gear (15) which is attached to the boss of drum (1).

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The gear drive between the boss on the drum and the sensor is protected against contamination by means of the stuffing box and the clip.

If the braking moment of the brake becomes greater than the torque of the wheel (the wheel begins to "grab"), sensor (22) sends an impulse to the electromagnetic valve of the brake system; this bleeds some of the pressure from the brake cylinders. Thus, the pressure in the brake during the braking process varies near the maximum permissible pressure, preventing the wheel from "grabbing."

The KT-82M wheel has the following basic technical characteristics (mounted on the plane):

Maximum standing load on the wheel from the take-off weight of the plane	3450 kg
Maximum standing load on the wheel from the landing weight of the plane	2590 kg
Pressure in tire at normal take-off weight	$8.0^{+0.5}$ kg/cm^2
Pressure in tire at overload weight	$16.0^{+0.5}$ kg/cm^2
Working pressure in the brake	$16^{+0.5}$ kg/cm^2
Working pressure in emergency brake system	16^{+4}_{-1} kg/cm^2
Kinetic energy absorbed by wheel in one application of brakes	454,000 kg-m
Landing speed of plane	no more than 300 km/hr
Take-off speed of plane	no more than 325 km/hr
Weight of wheel (without tire)	50 [60?] kg
Speed of plane at which brake can be applied	260 km/hr

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Wheel-Turning Mechanism (Fig. 111)

The wheel-turning mechanism on the main strut is a system of actuating arms and connecting rods connected by rod (2) with the cantilever bolt used to attach the rod of the hydraulic cylinder.

Rotation of the cylinder attachment bolt, in the form of a lever, when lowering and raising the landing gear, is used to cause the turning mechanism to rotate.

The wheel half-axle is locked in the down or up position by means of a kinematic lock which turns the half-axle with the wheel 87° relative to the strut when the wheel is retracted into the fuselage.

The kinematic lock of the turning mechanism consists of a split piece cantilevered against the eyelet of the rod, and a connecting rod bolted to the ______ and the fork of the half-axle.

[remainder illegible]

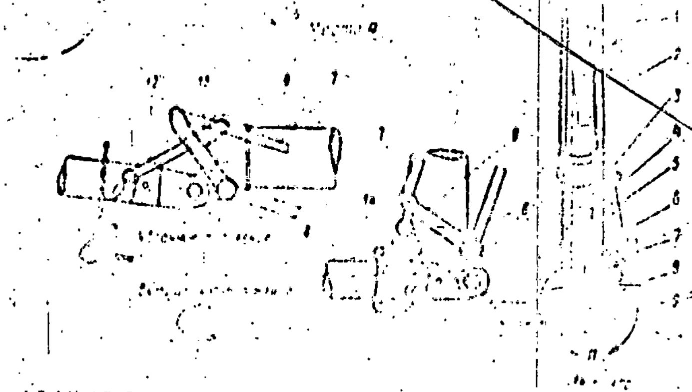

Fig. 111. Wheel-turning mechanism.

a. kinematic diagram of the turning mechanism; b. air cylinder in the raised position is not shown; c. point A; d. raised position; e. lowered position.

Fig. 111. Wheel-turning mechanism.

1. air-cylinder rod swivel attachment; 2. connecting rod; 3. actuating arm; 4. connecting rod; 5. upper cross piece; 6. actuating arm; 7. connecting rod; 8. lower cross piece; 9. actuating arm; 10. clip; 11. air cylinder; 12, 13. connecting rods of the kinematic lock; 14. small rod.

This latter, with the ~~xxxxxxxx~~ actuating arms attached to the ~~xxxxx~~ pivot of the upper cross piece and on the pivot that connects the cross pieces, together with the connecting rods parallel to the upper and lower cross pieces, form a parallelogram, which assures independent operation of the turning mechanism regardless of compression of the strut shock absorber.

To the upper actuating arm of the parallelogram is attached steel adjustable rod (2); the other end of this rod is attached to the lever by the cantilever bolt.

When raising and lowering the landing gear the air cylinder turns the cantilever bolt used to attach the air cylinder.

When the lever, which forms a single unit with the cantilever bolt, ~~is~~ rotates, ~~xxxxxxx~~ there is relative movement of the adjustable connecting rod, which actuates the turning mechanism and turns the half-axle.

The mechanism is regulated by changing the length of the adjustable connecting rod until the axes of the pairs of kinematic locks coincide.

In the lowered position, a probe (wire 3[8] mm in diameter) is used to check that the lock is closed.

When the kinematic lock is closed the probe should pass through the opening of the connecting rod and the lock element.

The Air Cylinder of the Main Strut and the Locks for the Lowered Position (Figs. 112 and 178)

The air cylinder of the main strut is used to raise and lower the strut. The strut is held in the down position by a

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ring
mechanical/lock inside the cylinder.

In addition, the air cylinder has an air lock which duplicates the operation of the ring lock.

When the locks are closed the air cylinder acts as the main cantilever.

The mechanical lock is made in the form of an expansion garter spring (1) of steel 40KhFA.

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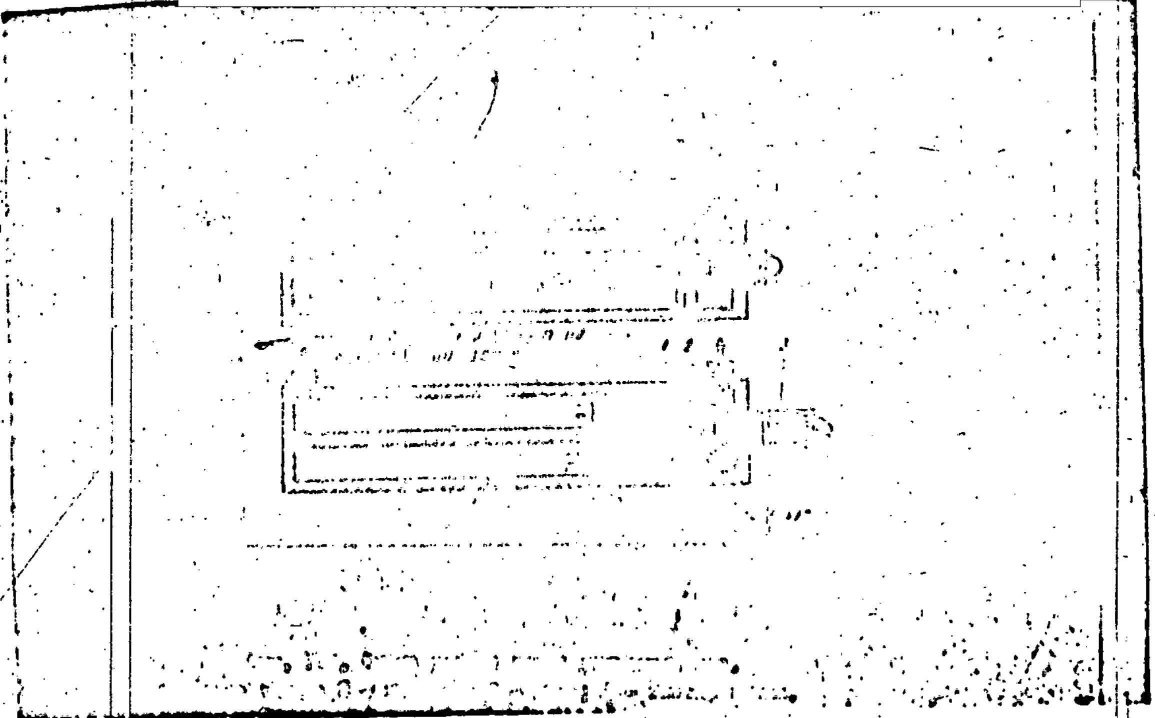

Fig. 112. Diagram of the operation of the air-cylinder lock.

1. lock starter spring; 2. cylinder; 3. rod; A. lock housing.

a. lock does not operate (rod retracted); b. rod extended and mechanically locked.

______. Heretthe mechanical lock is in a free state and is centered on the tip of the rod stop and on the conical surface of the piston.

At the moment garter spring (1) approaches housing (A) the ring, under the influence of hydraulic pressure$_x$ acting on the lock piston, is expanded and locked by the piston.

The piston is held in place, in addition, by the c llection of springs around the periphery in the bearing cage.

When the landing-gear control valve is set to the "retract" position, the hydraulic mixture enters the retraction cavity of the hydraulic cyl nder. Entering this cavity the hydraulic mixture first moves the lock piston, pressing the shrings in the bearing cage; here the garter spring of the mechanical lock, acted upon by the rod, leaves the lock housing and the lock opens. The locks having pened, the hydraulic mixture moves the rod and retracts the strut.

Lock for the Retracted Position
(Fig. 113)

The main landing-gear struts are held in the retracted position by mechanical locks mounted on the wings.

Each lockz (Fig. 113) consists of a hook (1) with spring (2), cam (10), lever (4), and air cylinder (5).

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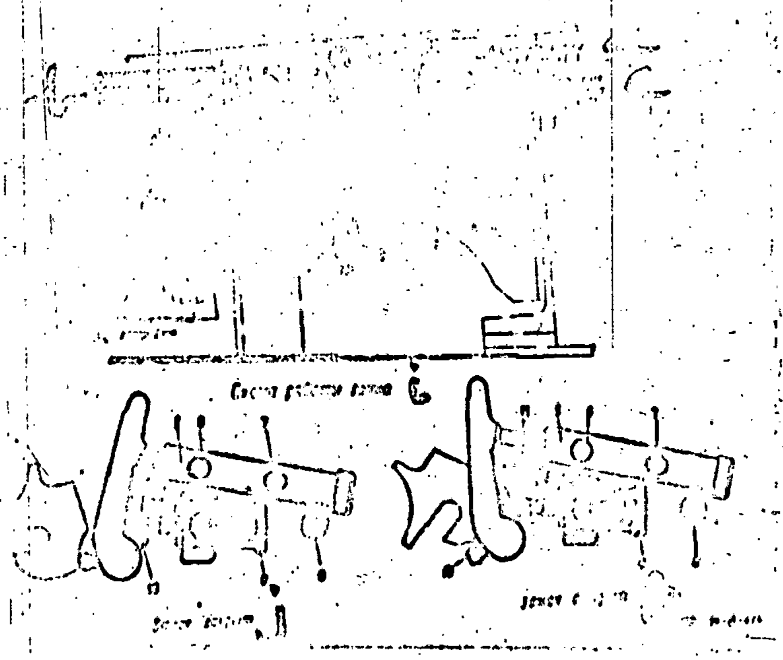

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Fig. 113. Retracted-position lock.

a. gap with lock closed - 0.5-1 mm; b. to flap locks and emergency release; c. for retraction (6); d. to landing-gear lowering cylinder (7); e. pressure from lowering system (8); f. minimum dimension - 6 mm; g. strut suspension clamp; h. minimum gap - 2 mm; i. diagram of lock operation; j. lock closed; k. lock open.

Fig. 113. Retracted-position lock;

1. hook; 2. hook spring; 3. lock housing; 4. lever; 5. lock air cylinder; 6. pipe to supply retract pressure; 7. pipe to supply lowering pressure to air cylinder; 8. pipe to supply lowering pressure; 9. end switch; 10. cam; 11. cam spring.

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Signal Lights
(Fig. 114)

The lowered and retracted positions of the main landing gear struts are checked by means of electric signal lights.

These lights consist of green and red lights on the PPS-2 signal panel in the cockpit. The lights are turned off and on by means of end switches at the following positions: on the bracket above the wing covering (for the lowered position), and on the suspension lock (for the retracted position).

In the lowered position, for each main landing gear strut, the stop on the upper part of the strut barrel presses against the rod of the end switch. On the PPS-2 signal panel a green light glows, indicating that the particular strut is in the down position.

When the strut is retracted, the rod of the end switch is pressed against by the lever of the lock at the moment the strut is locked in place, and a red light glows on the PPS-2 panel.

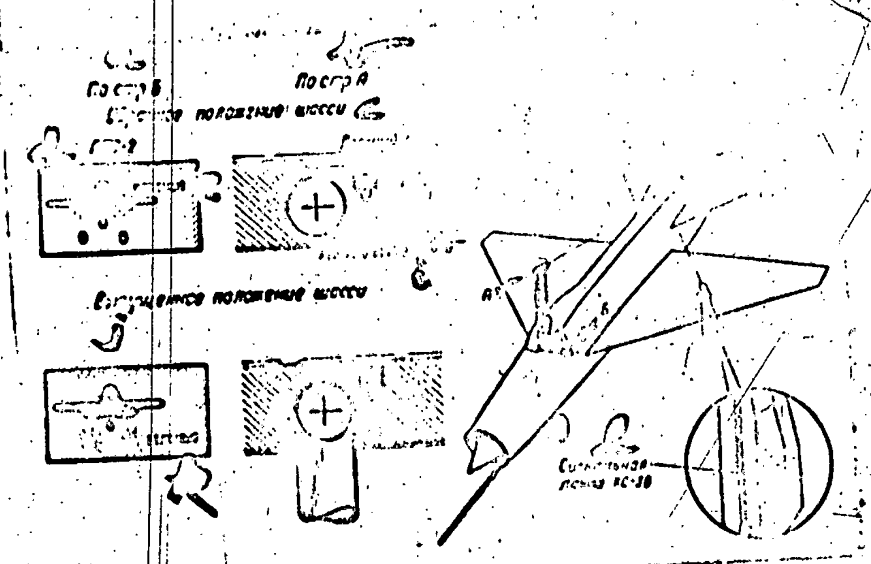

Fig. 114. Signal system for retracted and lowered positions of the main struts.

a. view at ; b. view at A; c. retracted position; d. PPG-2; e. red; f. upper side of wings; g. end switch; h. strut; i. lower side of wings; j. lowered position; k. green; l. signal light KhS-39

The end switch is installed and adjusted such that the green light goes on only when the strut is completely lowered and when the mechanical lock in the retract cylinder is closed.

When the strut is retracted, the stop is removed from the end switch and the green light corresponding to the particular strut is extinguished.

The retracted position for the strut has electrical signalization coupled with the operation of the retracted-position lock.

The lower end of the lever, when the lock closes, pushes against the rod of the end switch on the lock housing, and a red light lights in the cockpit on the PPS-2 board; this indicates that the lock for that particular strut is closed and the strut is retracted.

The rod of the end switch of the landing-gear retracted position is adjusted so that the lever presses against it at the moment the lock closes.

Main Strut Flaps (Fig. 115)

The cut-out in the fuselage for the wheel is covered with a flap which is hinged to the fuselage longeron. The flap is lowered and raised bymeans of a special cylinder with a swivel lock for the down position. ~~Exxxx~~ The wheel flap is locked in the retracted position by a lock which is mechanically coupled to the main strut lock; it opens slightly ahead of the main strut lock.

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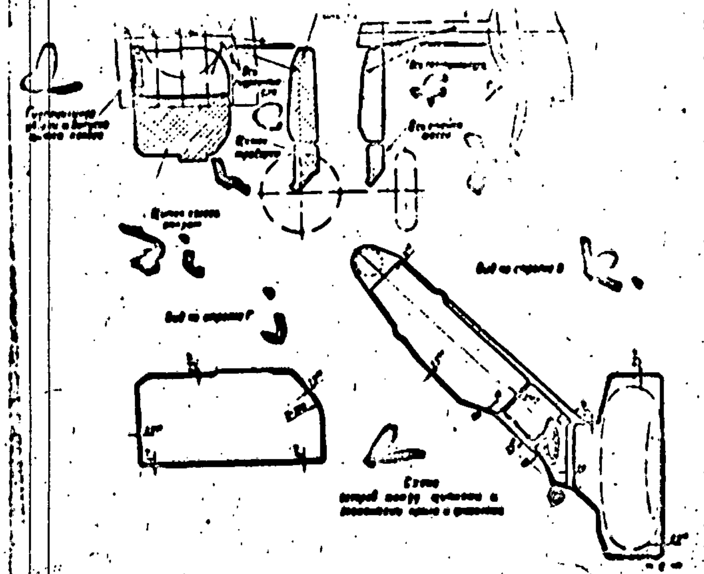

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Fig. 115. Main strut flans.

a. frames 16-20; b. flan closed; c. front view; d. air cylinder for retracting and lowering wheel flan; e. axle of air cylinder; f. axle of aircylinder; g. axis of strut; h. cross-piece flan; i. wheel flan open; j. view at arrow ; k. view at arrow B; l. diagram of clearance between flaps and the wing and fuselage elements.

The cut-out i the wing for the strut is covered w th two flaps: the flap for the after strut and the flap for the cross pieces. These flaps are rigidly attached to the strut. The after-strut fla- is attached to the barrelof the main strut, while the cross-piece flap is attached to the upper cross piece.

Wing Flaps (Fig. 116)

The wing has floating wing flaps with a maximum deflection angle of 24°30'.

The frame of the flap consists of two spars and a group of ribs.

The front spar is stamped of plate S30Kh35A material. The rear spar and the ribs are stamped of plate D-16 material. The wing-flap covering is made of D-16-11 material.

The wing flap is suspended from the wing cantilever on two tracks at the ends between ribs 1 and 6[?]; the tracks are in the form of an arc with a radius of 600 mm.

The tracks are made by hot stamping V-95 material. Inside the rails are rims made of S30KhGSA-lw 12.

Along the ends of the wing flap are carriages, two on each side; ~~then~~ these are pivots with bearings.

The front pivot of the carriage has a pin, a ball bearing, and a ball stop; the rear pivot has two ball bearings and two end balls that receive lateral forces.

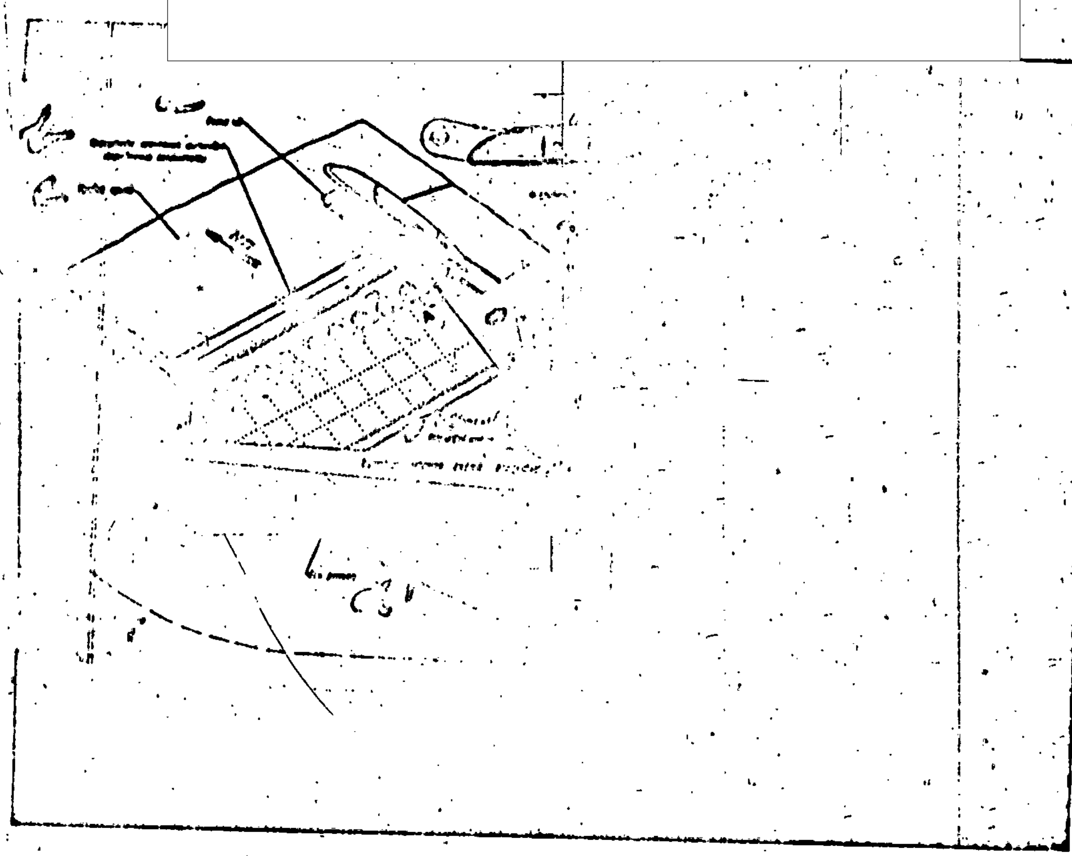

Fig. 116. Wing flap.

a. track No. 2; b. bracket for attachment of wing-flap control cylinder; c. right wing; d. front spar; e. cross section at A-A; f. ball bearings; g. wing chord; h. section at - ; i. axis of wing rib No. 6; j. ball bearings; k. end ball; l. track No. 2; m. track rim; n. front carriage; o. ball bearing; p. track rim; q. section at B-B; r. axis of wing rib No. 6; s. track No. 1; t. wing flap; u. track No. 1; v. end ball; w. axis of wing rib No. 1; x. rear carriage; y. track rim; z. ball bearing; a'. track No. 2; b'. kinematic diagram of wing flap; c'. track No. 2; d'. track axis; e'. axis of rear wing stringer.

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The wing-flap control air cylinder is attached to the center part of the wing cantilever between ribs 3 and 4.

Brake Flaps (Fig. 117)

On the plane, in the lower part of the fuselage, are attached three brake flaps controlled by the air system: two front and one rear.

The front brake flaps have a total area of 0.76 m^2 and a deflection angle of 25°.

The rear flap has an area of 0.47 m^2 and an angle of 40°.

The front brake flaps (right and left) are located between frames 11 and 13. The housing for each flap is made in the form of three main stamped channeled trusses of V-95 which are bolted to the frames.

The universal joints for the brake-flap air cylinders are on frame 13.

The fittings for attaching the flaps are on frame No. 11. Each flap is suspended on two brackets.

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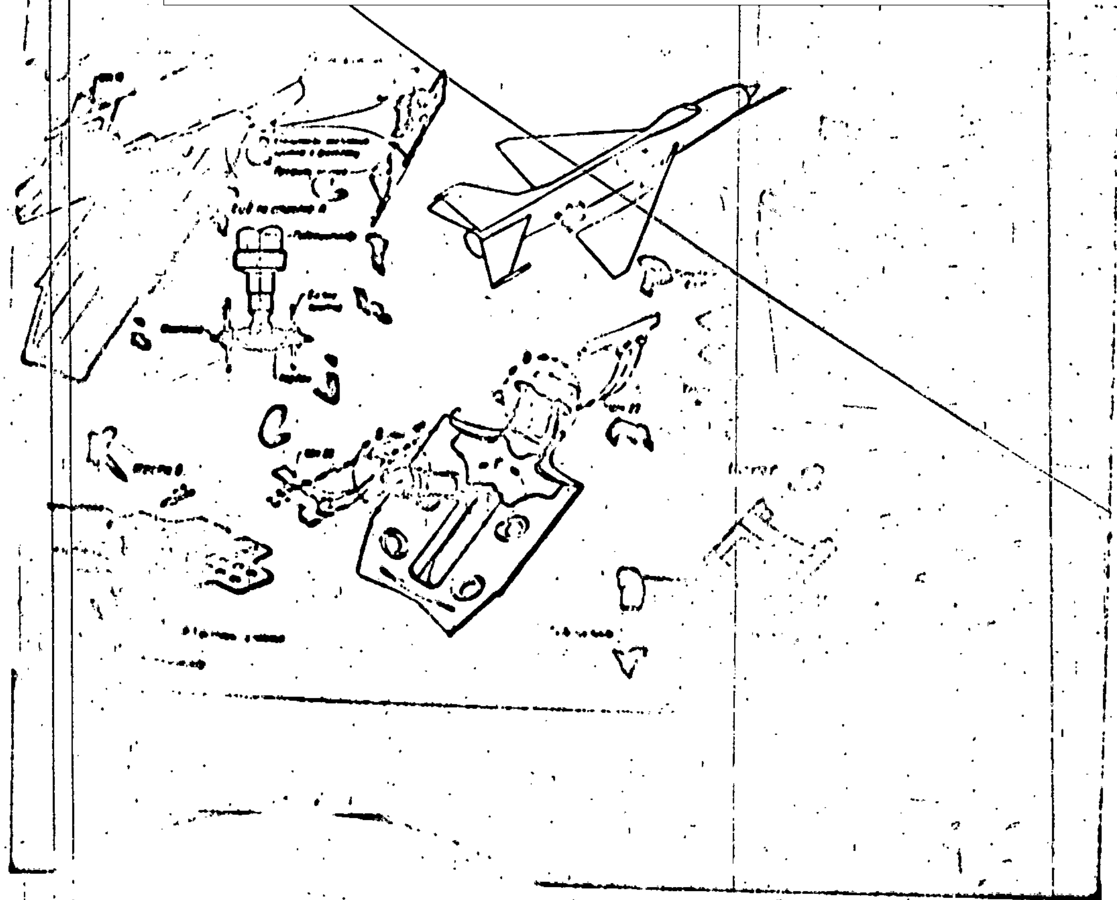

Fig. 117. Brake flaps.

a. frame 11; b. frame 13; c. fuselage truss; d. bracket for attachment of flap to fuselage; e. flap profile; f. view at arrow A; g. air cylinder; h. flap truss; i. [illegible]; j. universal joint; k. point ; l. frame 25; m. frame 22; n. point B; o. bracket; p. lower panel of fuselage; q. frame 22; r. brake flap; 2 s. point ; t. bracket; u. lever; v. air cylinder.

The rear brake flap is located between frames 22 and 23. The air cylinder for raising and lowering the flap is attached to frame 25 by means of a universal joint.

The front part of the flap contains two suspension units.

The Brake-'Chute System (Fig.118)

The brake chute system is intended to cut down the landing distance of the plane. The brake-chute control system is designed to release the chute at the moment the main wheels touch down.

As the parachute fills with air, a moment for lowering the nose wheel is created.

The brake chute, pre-packed in a special ______ container, is located in a housing in the tail section of the fuselage, on the left between frames 30 and 32.

The chute container is attached at four points: by two pivot bolts (27) and two easily removed locks ____ and ____.

The parachute is placed in the container and covered with special "aprons," and before the flight is placed on board the plane.

The chute line (5) is placed in a groove in the bottom of the fuselage and is held in place by special ______

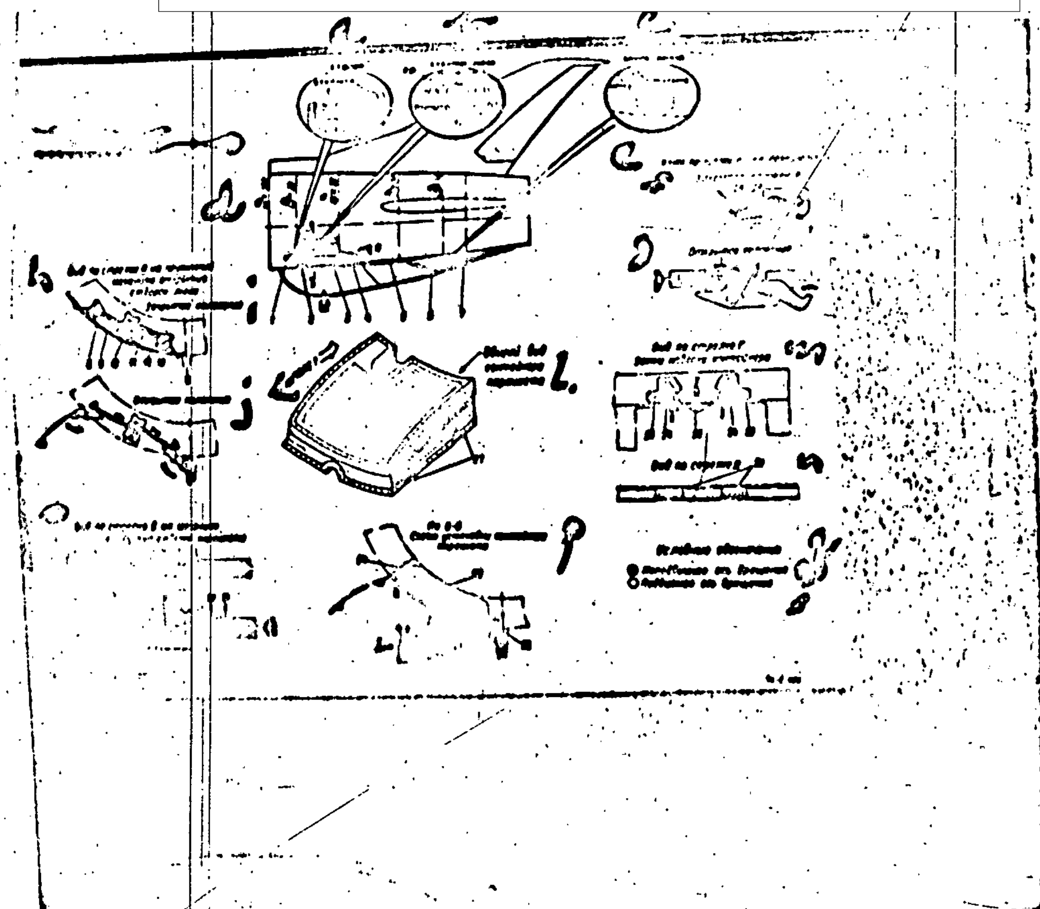

Fig. 118. Mounting [illegible] of the brake parachute.

a. stop: open, closed, [illegible]; b. hatch door: open close; c. hook lock: closed, open; d. frames 28A, 30, 32, 34, 36; e. hook latch; f. closed position: g. open position; h. view at arrow A of the spring mechanism for opening the hatch covers; i. closed position; j. open position; k. direction of flight; l. general view of the parachute container; m. view at arrow , container suspension locks; n. view at arrow ; o. view at arrow of the mechanism for opening the parachute covers; p. section B-B, diagram of the installation of the [illegible] chute container; q. arbitrary symbols; r. fixed axis of rotation; s. movable axis of rotation.

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Fig. 118. Mounting the brake chute.

1. front stop-lock; 2. spring mechanism for opening chute-container doors; 3. door-locking mechanism; 4. door-opening air cylinder; 5. parachute line; 6. chute release air cylinder; 7. catch for line-locking hook; 8, 13. actuating arms; 9. upper door; 10, 17. stopper rod; 11. spring mechanism; 12. lower door; 14. stop spring; 15. gear; 16. arresting device; 18. guide; 19. rod; 20. air-cylinder rod; 21. spring; 22. brake-chute container; 23. container suspension lock spring; 24. catches; 25. line; 26. boxes for container-suspension pivot bolts; 27. pivot bolts; 28. actuating arm; 29. shaft; 30. door lock.

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The end of the line is attached to ~~thexcatchxofxthexhoom~~ catch (7) of the hook lock.

The doors of the container housing are held in the closed position by two mechanical locks: stop-lock (1) and door lock (30). The air cylinder for opening the doors (4) is attached to frame 32.

The doors are held in the open position by a special spring mechanism (11).

The spring mechanism for each door consists of a guide rod with a spring, and an actuating arm.

When the doors are closed, the springs are under tension and continually press against the doors, striving to open them.

Parachute Control System

The brake-chute control system consists of the following units:

--an air cylinder to open the doors in the lower part of the fuselage at frame 32;

--an air cylinder to release the brake chute;

--a hook lock mounted on the .... of the tail section of the fuselage;

[remainder illegible]

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The release and opening of the parachute is accomplished by pressing the proper button. At the time the parachute opens, the "plus" stress is transmitted to one of the two electro-pneumatic valves 694000M, during the working of which a stream of air is admitted from the air system and into the parachute control system.

(Read carefully Chapter 5 of the [illegible] description.

[remainder of the page is illegible]

For this purpose, the stop-lock gear and the door-lock actuating arm have an inside socket for a hexagonal torque wrench.

The doors are locked by means of a wrench, first with lock (30) on the door, and then by the front stop-lock on the fuselage. When locking with the front lock the stop knob is pressed.

To check that the doors are locked, the gear hexagon of the mechanical ~~lock~~ stop-lock and the hexagon of the stop-lock actuating arm have special red arrows which show the open and closed positions of the doors. In addition, the stop on the fuselage is locked by a copper wire.

CHAPTER V

AIR AND HYDRAULIC SYSTEMS

1. Air System

General Information

The plane's air system consists of two ~~basic~~ separate systems--the ~~basic~~ main one and an emergency system (Fig. 119).

The main air system serves the following purposes:

--brakes the landing gear wheels;

--reloads the cannon;

--closes the overflow fuel valve;

--raises and pressurizes the canopy;

--controls the doors and releases the brake chute; and

--activates the de-icer system.

The emergency air system is used for emergency lowering of the landing gear and emergency braking of the main landing-gear wheels.

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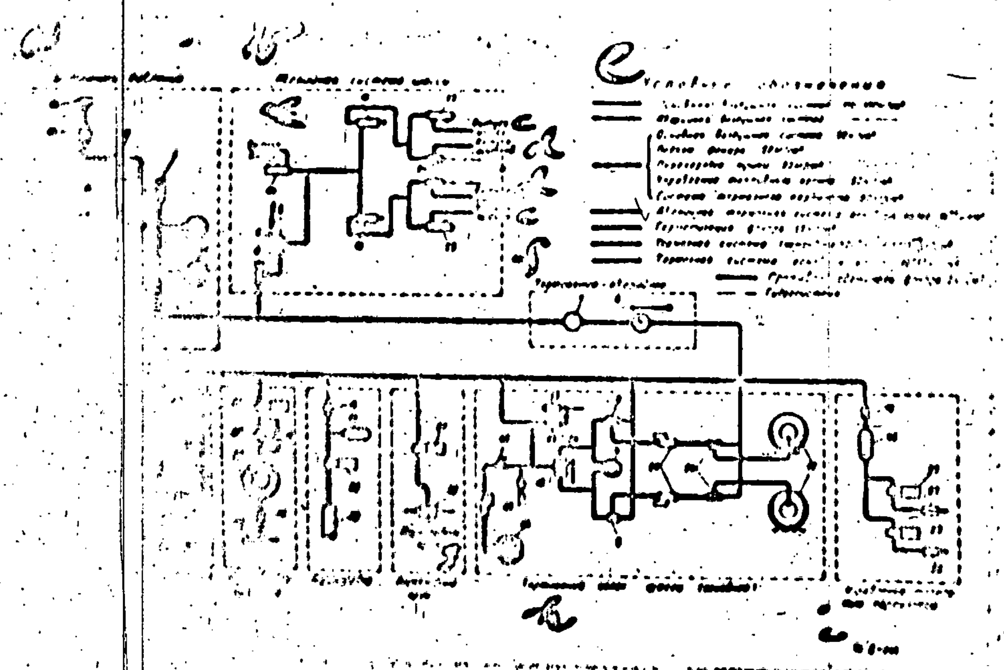

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Fig. 119. Schematic of the air system.

a. pressure source; b. emergency landing-gear system; c. lower landing gear;

d. lower flaps;

e. Arbitrary symbols:
- Main air system, 110-130 kg/cm^2
- Emergency air system
- Main air system, 50 kg/cm^2
- Canopy lift, 50 kg/cm^2
- Cannon reload, 50 kg/cm^2
- Fuel-valve control, 50 kg/cm^2
- Brake-chute system, 50 kg/cm^2
- Emergency main-wheel braking system, ...
- Canopy pressurization, 1.5 kg/cm^2
- Brake system (master pressure), $10.5^{+0.5}$ kg/cm^2
- Main-wheel brake system, ...
- Canopy de-icer, 3 kg/cm^2
- Hydraulic system

f. emergency braking; g. shut-off valve; h. braking of (main) landing-gear wheels;

i. brake-chute control.

[remainder illegible]

Fig. 119. Schematic of the air system.

1. emergency-system filler valve; 2. emergency-system tanks, capacity 1.3 liters each; 3. 2M-150 two-pointer air manometer; 4. emergency landing-gear lowering valve; 5. bleeder valve; 6. MV-12 two-pointer manometer for the braking system; 7. 682500 emergency-braking reducer; 8. 625300A emergency-braking valve; 9. UP-24/1 reduction accelerator; 10. main-system tanks, capacity 2 liters each; 11. main-system tanks in the main struts, capacity 2 liters each; 12. KT-82M main landing wheels; 13. on-board filler pipe; 14. air filter; 15. check valve; 16. main-system filler valve; 17. RV-50M reducer; 18. UP-22 switch; 19. cylinder for emergency release of main landing-gear struts; 20. UP-53/1-2 servo-valve; 21. canopy-lift cylinder; 22. automatic-braking cylinder; 23. hydraulic lock for main struts; 24. emergency valves;

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25. cannon-reload tank; 26. emergency switches; 27. 695000M pneumatic valve; 28. EK-48 pneumatic valve; 29. mechanism for pneumatic reloading of cannon; 30. fuel shut-off valve; 31. tank for emergency canopy-release system; 32. pressurizing profile forthe canopy (canopy pressurization hose); 33. emergency valve (membrane valve); 34. PU-8 (UL-35) differential; 35. PU-7 (UL-39) release valve; 36. parachute-release cylinder; 37. cylinder to open parachute doors; 38. cylinder to verify pressure in reserve tank; 39. alcohol tank; 40. RV-3 reducer; 41. canopy-control valve; 42. RV-1.5 reducer; 43. valve for braking the front strut; 44. hydraulic lock for front strut; 45. air tank for parachute-control system; 46. KT-38 front wheel; 47. electromagnetic servo-valve UP-53/1-2; 48. collector; 49. safety valve; 50. check valve; 51. filter; 52. cylinder to open canopy time-delay lock.

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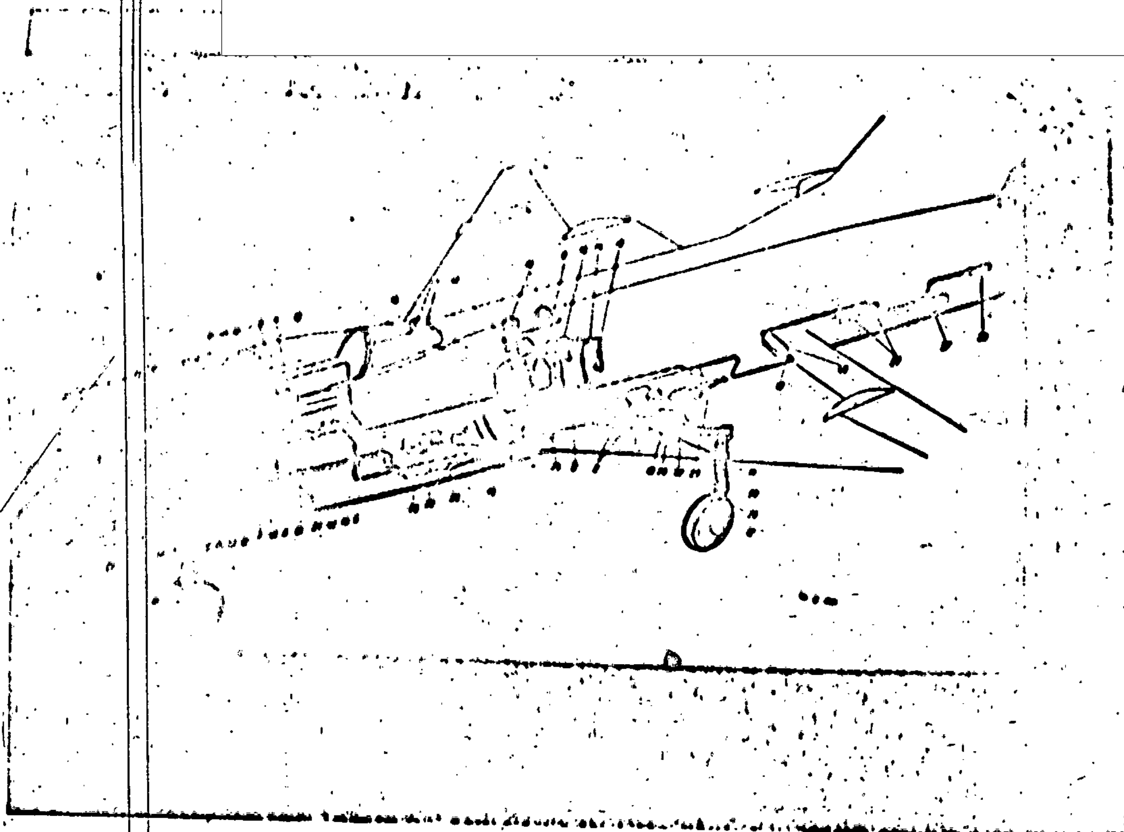

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Fig. 120. Diagram of the air system (numbers as in Fig. 119).

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Compressed air at reduced pressure should be fed to the wheel brakes, to the emergency wheel brakes, and to the controls for the parachute, the shut-off valve, and the de-icer system. Therefore, the system uses reducers to lower the pressure to that required in various circuits of the system.

In the main system, behind the air tanks there is an RV-50M reducer (17) which drops the pressure from 110-130 kg/cm^2 to 50 kg/cm^2; this reduced pressure is fed to all the components of the main system (an exception is the outlet to tank (31) for emergency canopy release, where a pressure of 110-130 kg/cm^2 is used).

The wheel-brake system has a PU-7 release valve (35) (the pressure to the front wheel is reduced) and two UP-24/1 reduction accelerators (9) (these reduce the pressure fed to the brake chambers of the main wheels).

An RV-3 reducer (40), feeding a pressure of up to 3 kg/cm^2, is installed in the de-icer system.

In the canopy-control system, an RV-1.5 reducer (42) lowers the pressure used to pressurize the canopy to 1.8 - 2.45 kg/cm^2.

In the emergency brake system a 682500 reducer (7) lowers the 110-130 kg/cm^2 pressure to 16^{+4}_{-1} kg/cm^2.

To increase the total air supply and assure maximum operation of the main units in the air system (in addition to the main filler tanks), the lines for the release and

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ejection of the parachute (45), in the cannon-reload system (2-), and in the emergency canopy ejection system (31) there are auxiliary tanks which contain a supply of air only for the above-mentioned part of the system.

These tanks are separated from their systems by check valves (15) and canbe used only for those units into whose control lines they are connected.

Whens operating, each of the systems is closed off by its own valves to prevent leakage from one system to another.

Technical Data on the Air System

1. Capacity of the air tanks of the basic system (two spherical tanks and two on the landing-gear struts) 8 liters

2. Capacity of the air tanks of the emergency system (two spherical tanks) 2.6 liters

3. Pressure in the air tanks of the main and emergency systems 110-130 kg/cm^2

4. Pressure in the brake lines to the KT-38 wheels of the front landing gear 10.5 ± 0.5 kg/cm^2

5. Pressure in the brake lines tothe KT-82 wheels of the main landing-gear assembly 16 ± 0.5 kg/cm^2

6. Pressure in the KT-82 wheel emergency brake line 16^{+4}_{-1} kg/cm^2

7. Pressure in tank for emergency canopy release 110-130 kg/cm^2

8. Pressure used to reload cannon, operate the fuel shut-off valve, raise the canopy, and control the parachute 50 kg/cm²

9. Pressure in the canopy de-icer system 3 kg/cm²

10. Pressure in the canopy pressurization system 1.8-2.55 kg/cm²

II. PRESSURE SOURCES (Fig. 121)

As reservoirs for the compressed air in the main system, the following are used:

--two spherical tanks (10), capacity 2 liters each;

--two chambers (11), capacity 2 liters each (one of these is in the upper part of the right-hand landing-gear strut, the other is in the upper part of the left-hand strut).

The emergency system has two spherical tanks (2), capacity 1.3 liters each.

The tank-filler line, common to all tanks, contains: on-board fill-pipe (13), air filter (14), air check valve (15), and two valves (1) and (16).

The pressure is measured with a 2M-150 dual manometer (3).

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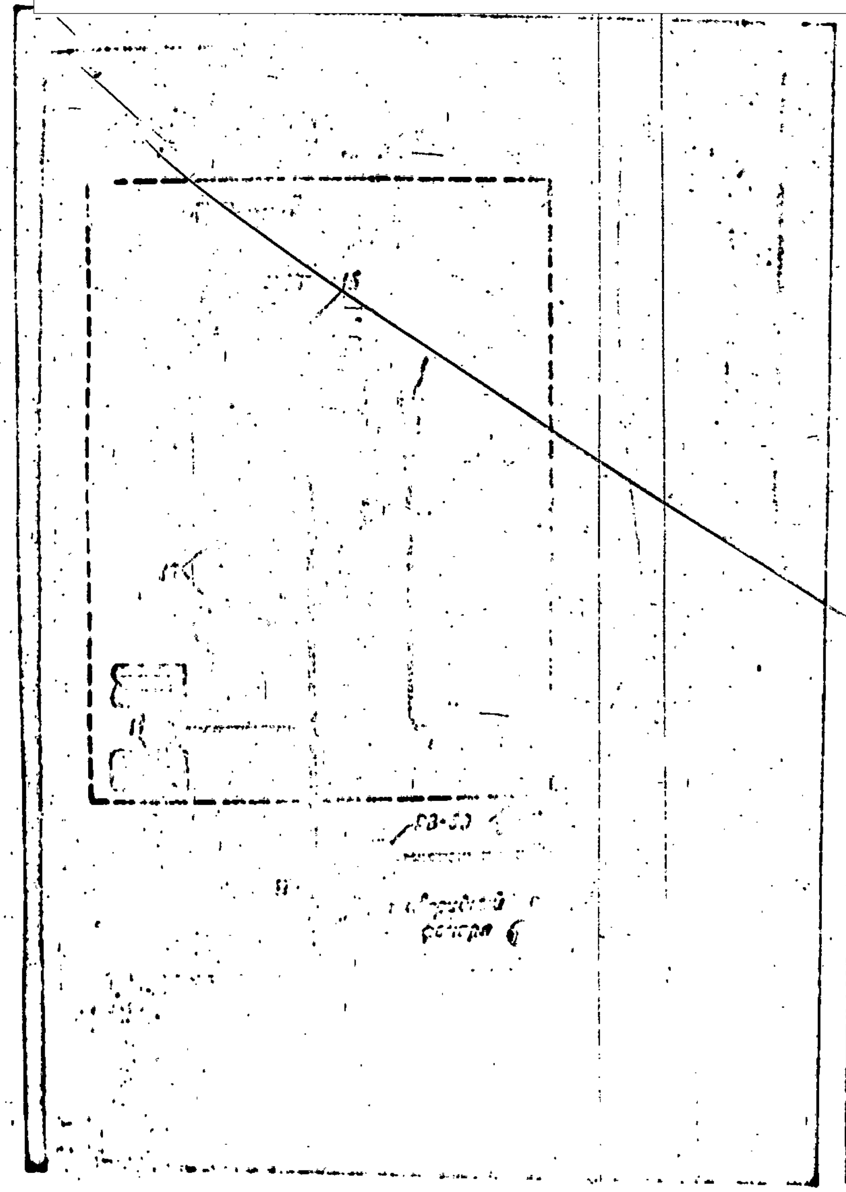

Fig. 121. Pressure sources (the numbering is the same as in Fig.119). a. for emergency landing-gear lowering and emergency braking; b. RH RV-50; c. to network; d. for emergency canopy ejection.

Units of the System Filler Lines

On-Board Fill-Pipe (Fig. 122).

The on-board fill-pipe is used to couple the ground pressure source to the air system.

The pipe assures that the connection will be pressurized and easily done.

The on-board fill-pipe consists of housing (1) and end cap (3) connected to the housing by a metal cord. The housing contains rubber packing (4), and the outlet pipe is coupled to the system lines.

The cap is locked by leaf spring (5). The spring is attached to the cap handle, and the other end is compressed against the corresponding projection on the housing.

The fill-pipe is located ~~xxxxxx~~ in the left wheel housing at frame 20.

Air Filter (Fig. 123)

The air filter, in the air-tank fill line, is designed to clean the compressed air of mechanical ~~xxxxxxxx~~ impurities. The filter body consists of cover (1) and housing (6). The cover and housing are connected together by means of a connector nut; this creates an inner cavity into whichthe filter element is placed. The filter cons'sts of felt washers (4), grid (5), and bearings (7), tightened onto shaft (8).

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Fig. 122. On-board fill-pipe. 1. housing; 2. cord; 3. cap; 4. rubber packing; 5. leaf spring.

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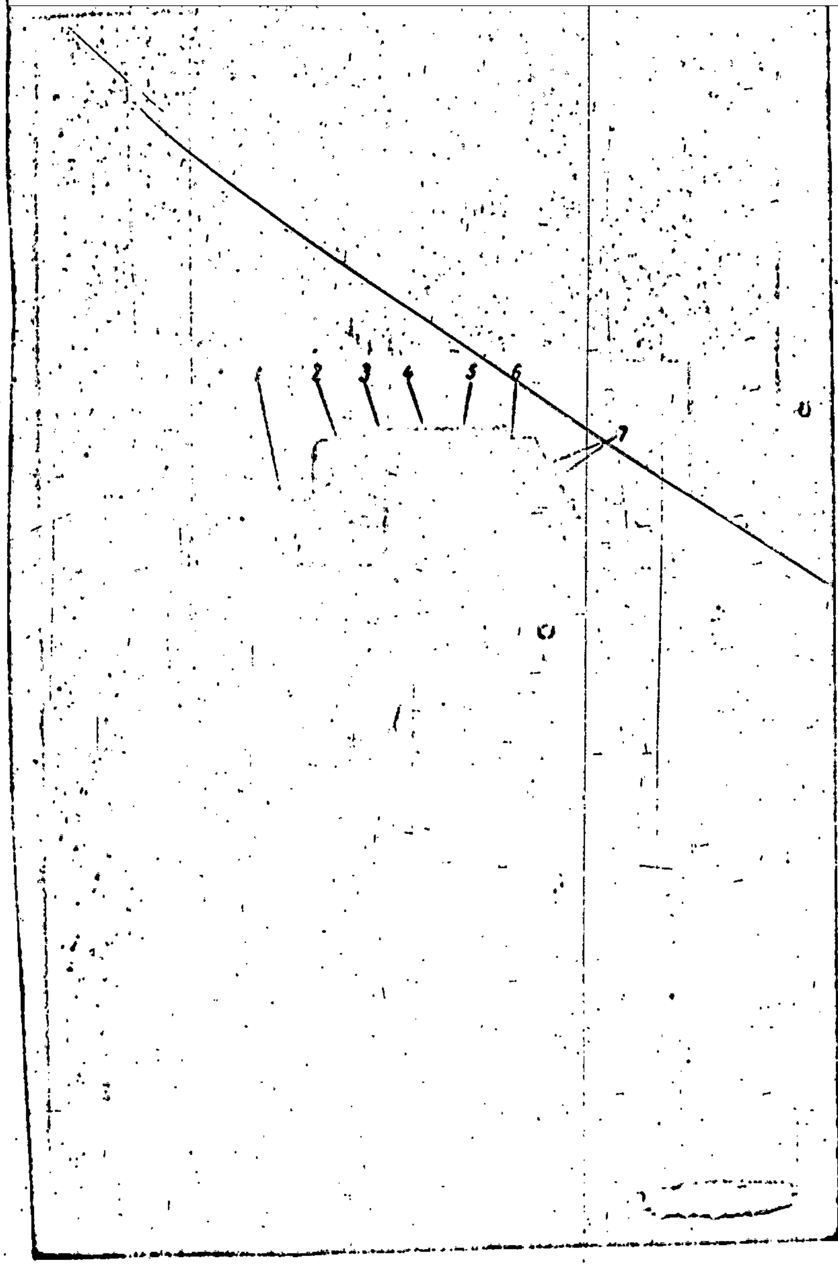

Fig. 123. Air filter. 1. cover; 2. connecting nut; 3. packing ring; 4. felt washer; 5. grid; 6. body; 7. bearings; 8. shaft.

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The packing element at the joint between the housing and the cover is rubber ring (3). Air can be fed to any of the fill pipes.

Check Valve (Fig. 124)

The check valve passes the flow of compressed air in one direction only, and prevents its reverse flow. The valve consists of cover (1), body (2), valve (3) and recoil spring (4).

In the closed position valve (3) is hermetically sealed by the end rubber packing.

To prevent incorrect connection of the valve when installing it, there is an arrow on the body which shows the direction of the air flow.

Fill Valve (Fig. 125)

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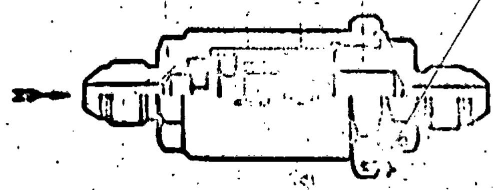

Fig. 124. Check valve. 1. cover; 2. body; 3. valve; 4. recoil spring.

Fig. 125. Fill valve. 1. scantling; 2. washer; 3. screw; 4. handle; 5. cover; 6. bushing; 7. plate; 8. packing ring; 9. bushing; 10. cover; 11. stem; 12. body.

In the body is a seat into which the stem needle fits, locking the valve in the seated position of the stem.

Two connections on the valve body connect 1) to the pressure line, and 2) to the cut-off section. By unscrewing the stem using the flywheel the needle is lifted from the seat, and the pressure line is connected to the system.

The fill valve for the main system has the words xNoxtmxk "Network Fill" stencilled on the handle; that for the emergency system has the words "Emergency Tank Fill" stencilled on the handle.

The valve for emergency lowering of the landing gear has a special handle, anodized a red color. On the handle is stencilled "Emgr. Landing Gear." The fill valvesxxxxxxxx are located in the right wheel housing; the emergency landing-gear xxxxxx lowering valve is on the right-hand instrument panel in the cockpit.

RV-50M Reducer (Fig. 126)

The RV-50M reducer serves to reduce the air pressure in the main system from 110-130 kg/cm^2 to 50^{+7}_{-1} kg/cm^2. The reducer consists of housing (5) which has pipe "A" - for air intake; "B" - for air outlet; injection valve (8); membrane (13); and reduction spring (2).

When pressure is fed to pipe "A" the compressed air goes through the inner channel and the opened injection valve to the outlet pipe. During the first moments when the pressure is applied, the injection valve is in the open position, held by means of

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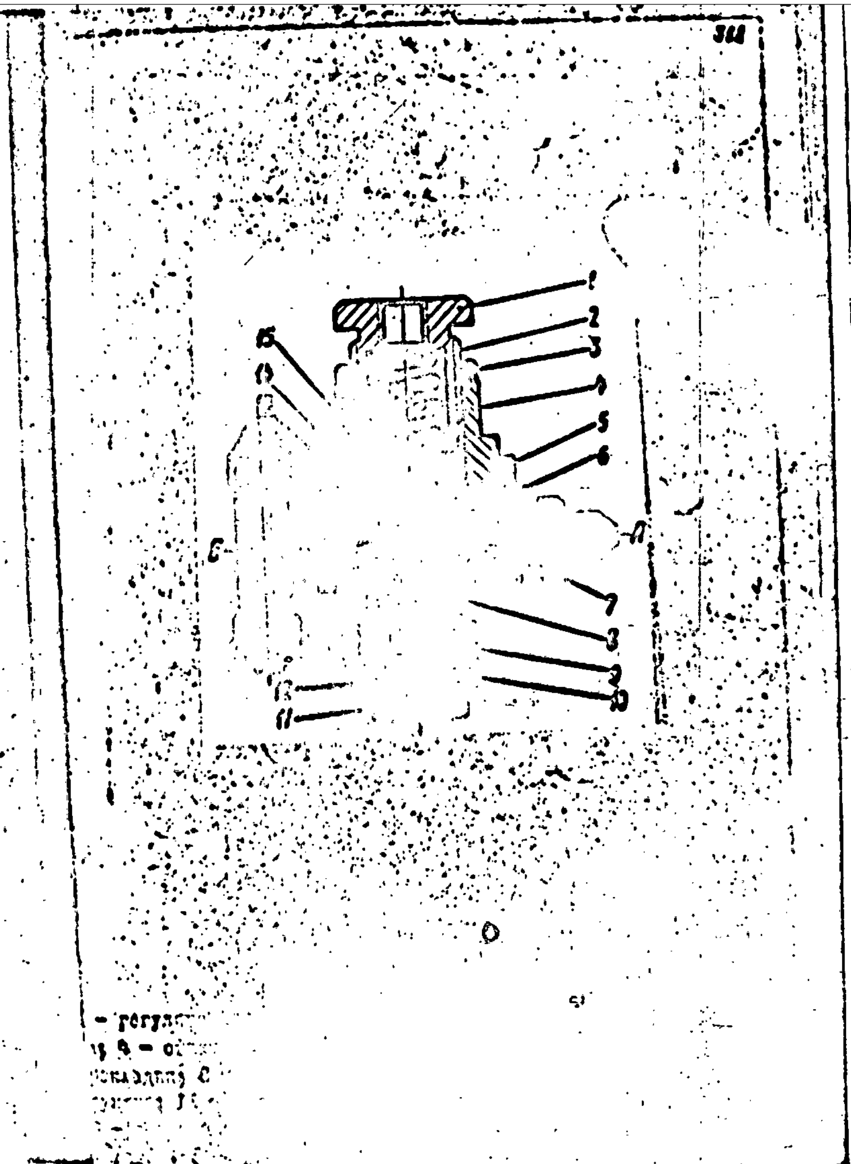

Fig. 126. RV-50M reducer. 1. adjustable cover; 2. reduction spring; 3. retainer nut; 4. barrel; 5. housing; 6. followers; 7. hermetic-sealing packing; 8. injection valve; 9. bearing cone; 10. recoil spring; 11. cover; 12. packing; 13. membrane; 14. bushing; 15. bearing gasket.

a calibrated deduction spring across the followers (6). As soon as the pressure begins to increase and reaches 50 kg/cm², the compressed air, reduced to 50 kg/cm², passing under the membrane and gradually compressing spring (2), moves the bearing gasket (15) upward, thus closing the injection valve by means of recoil spring (10). In this case the intermediate gaskets move upward together with the followers.

As air is expended from the system, the pressure beneath the membrane drops and the calibrated spring, by means of the bearing gasket and the intermediate gaskets and the followers, release the injection valve which permits the entry of a new quantity of compressed air from the fill tanks.

The RV-50M reducer operates continuously, maintaining in the system behind it a pressure within the limits 50^{+7}_{-1} kg/cm².

If, however, the pressure in the main tanks drops to 50 kg/cm² or lower, the reducer passes the remaining air into the system unimpeded, since the injection valve will be open constantly.

The reducer housing has a safety valve set for a pressure of 60^{+15}_{-2} kg/cm². If the reducer is put out of commission, the valve bleeds the excess pressure (that above which it was calibrated for) into the atmosphere.

Air Tanks (Fig. 127)

The air tanks are welded of 30KhGSA material.

The spherical tanks of the main and emergency systems are welded from two hemispheres. Two bushings (4) and (6) are used, one to fasten the tank, and the other to attach the connecting pipe (3) which is mounted on a copper pressurized [illegible] bearing disc (5).

The cylindrical tanks are made of cylinders with two spherical ends. The bushings welded along the axis of the tank contain the [illegible] pipes by which the tanks are coupled into the system.

All high-pressure tanks are made according to [illegible] Boiler-Inspection norms. The stencils on the outsides give brief technical characteristics and the dates of regular servicing.

2. WHEEL-BRAKING SYSTEM (Fig. 128)

The brake system provides for automatic and manual control of the braking of the front and main landing-gear wheels.

The brake system contains the following elements:

—PU-7 (VI-32) reduction valve (35);

—DU-#3 (VI-35) differential (34);

These may be UI-32 and UI-35, respectively. On this assumption, I will so designate them henceforth.

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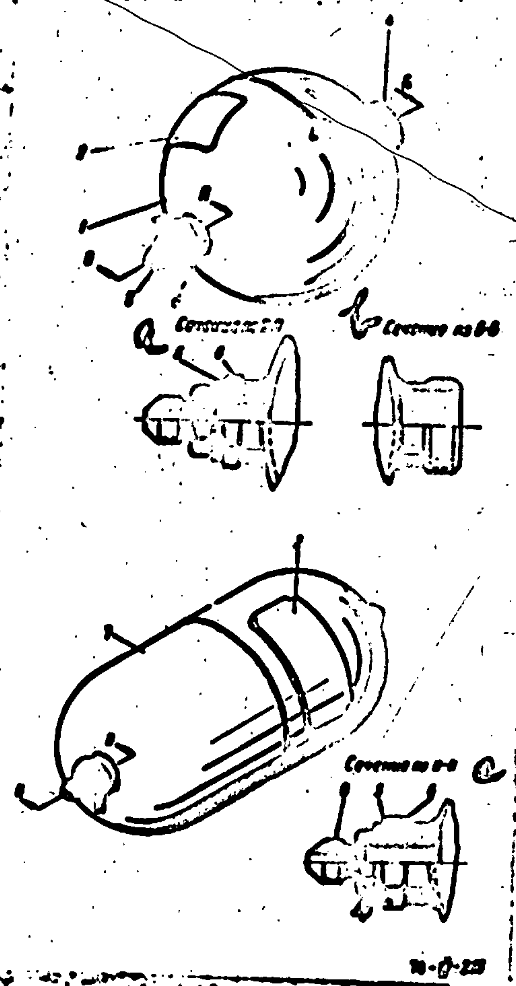

Fig. 127. Air tanks. 1. spherical tank; 2. stencil; 3. inlet pipe; 4. bushing with outside thread; 5. gasket; 6. bushing with inside thread; 7. cylindrical tank; 8. inlet pipe.

a. section A-A; b. section - ; c. section M-M.

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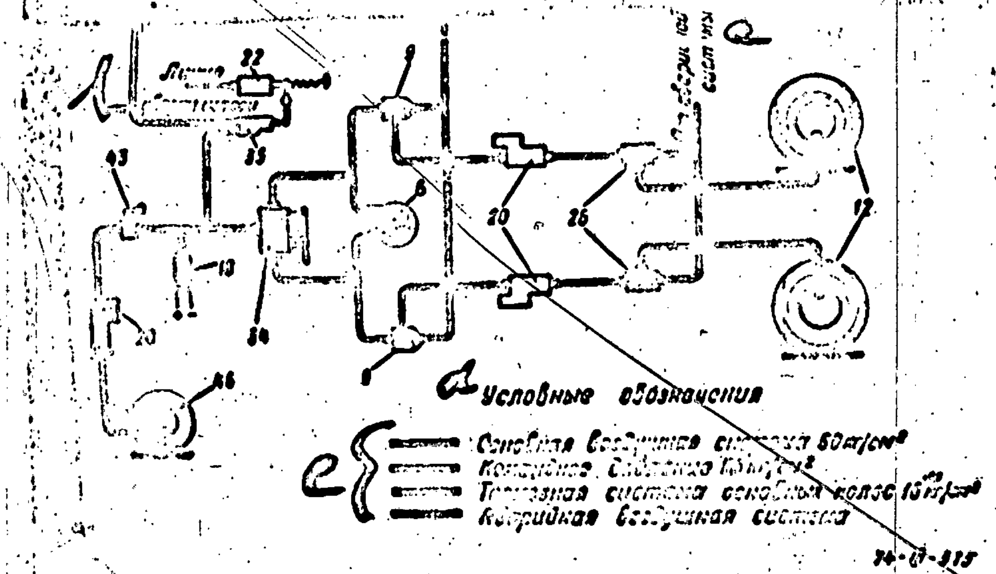

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Fig. 128. Wheel-braking system (numbered as in Fig. 119).

a. from PV-50M reducer; b. wheel-retract line; c. from emergency system; d. arbitrary designations: e. main air system, 50 kg/cm^2

master pressure, 10.5 $\pm$ 0.5 kg/cm^2

brake system for main wheels, 16 $\pm$ 0.5 kg/cm^2

emergency air system.

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--UP/24/1 reduction accelerators (9);

--MV-12 dual manometer (6);

--three UP-53/1-2 electromagnetic servo-valves (20);

--UP-22 switch (28);

--UN-33/1 valve to brake the front strut (43); and

--two 563600 emergency switches (26).

The UN-53/1-2 and UP-22 units, coupled with the inertial sensors: UA-24/2 for the KT-38 front wheel, and UA-23/2 for the KT-82M main wheels, have their own electrical circuit and assure automatic debraking of the wheels when one of the main wheels "grabs."

This system will be discussed in more detail below.

The braking of the wheels from the main system is accomplished by the pilot's pressing the brake handle on the control stick of the airplane.

When the brake handle is pressed motion is imparted to the rod of reduction valve PU-7. Depending on the amount of pressure applied to the brake handle, PU-7 reduces the pressure fed to it from the system 50 kg/cm^2 and the air begins to be compressed in differential PU-8, whose handle is kinematically connected to the foot pedals.

Then the air from the differential is fed, in the form of master pressure, to the UP-24/1 reduction accelerators where, in turn, the compressed air fed to them at a pressure of 50 kg/cm^2, depending on the master

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pressure, is reduced by a factor of 1.5, i.e., the air fed to the main wheels has a pressure which is 1.5-times greater than the master pressure from the PU-7. This factor is constant and does n t change during brakings under any conditions. Consequently, the pressure on the main wheels is always 1.5-times greater than the master pressure.

From the reduction accelerators pressure passes through the emergency valves to the brake chambers of the wheels (here the emergency valves play no part in the operations).

When maneuvering the plane on the ground, it can be turned around by releasing the brake on one of the wheels.

For this it is necessary to move the foot pedal to one side or the other, which imparts motion through the connecting rod to the PU-8[?] differential and, in final analysis, results in debraking of one of the landing wheels.

The plane turns relative to the braked wheel proportional to the angle of deflection of the pedal.

The front wheel can be braked as the pilot wishes depending on the landing conditions (wet ground, ice-covered ground) when the landing dista nce of the plane must be ~~mixxk~~ shortened.

For this the pilot must switch in the UP-33/1; then the brake line from the PU-7 is connected to the brake chambers of the KT-38 wheel through servo-valve UP-53/1.

[remainder illegible]

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In this case the pressure behind the PU-7 should be within the limits of 3-4 kg/cm^2, which is attained by adjusting the length of the rod of the automatic brake cylinder using the adjustable bolt.

After retraction, when the pump valve is in the "neutral" position, the rod returnes to its original position, by means of the recoi, spring, and the wheel is unbraked.

Debraking the wheels when they are braked by means of the handle on the control stick is done by bleeding air from the brake lines; for this the handle must be released. Through the PU-7 the air is bled from the brake chamber of the front landing gear, and the ~~xxxxxx~~ master pressure is released from the UP-24/1 accelerators. The compressed air from the chambers of the main wheels is bled through the UP-24/1.

As the plane is moving it is possible to switch from ordinary braking to braking using the system of automatic wheel debraking. To change over it is necessary, without releasing the brake handle, that the ______ A3S-5 with the inscription "Automatic Wheel Brake" be set in the position "Switched On."

[remainder illegible]

The brake-release system can be switched on before take-off, before landing, before the flight, or at the moment of landing, depending on the operational conditions.

The electrical circuit of the brake-release system is readied for operation by the UP-22 switch.

Consequently, turning on the switch "Automatic Wheel Braking" still does not feed electrical energy to the UP-53/1, UP-24/2, and UA-23/2. Only after UP-22 has been turned on is the brake-release system ready to operate. After the UP-22 has been turned on, by pressure from PU-7, voltage is fed to wheel sensors UA-24/2 and UA-23/2. If one of the wheels "grabs," sensor UA-23/2 closes the electrical circuit and power is fed to the respective servo-valve UP-53/1, which bleeds air from the brake chamber, simultaneously cutting off pressure from the reduction accelerators. When "grabbing" stops, an electrical pulse from UP-53/1 is taken by the sensor, and the brake line is again coupled to the wheel brake chamber.

The automatic brake-release system uses locking, in that if one of the wheels "grabs," this wheel is debraked as is the front wheel.

If the front wheel "grabs," the main wheels are not debraked. The braking and debraking time for the wheels under normal conditions is 2 seconds. (With manual braking, the braking time is 2 seconds, the debraking time is 3-3.5 seconds).

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Brake-System Units

PU-7 (VI-39) Reducing Valve (Fig. 120)

The PU-7 reducing valve serves to feed compressed air to the brake system with simultaneous reduction of the pressure fed to it from the main system. Pressure is fed from the PU-7 to the KT-38 front wheel (as working pressure) and to the UP-24/1 accelerators (as master pressure), is proportional to the displacement of the followers; motion is imparted to the follower by a special handle which is activated by the brake handle on the control stick.

Air from the system at a pressure of 50 kg/cm^2 is fed to pipe "A" of the valve and cannot enter the brake system until the brake handle is pressed.

At the same time, the brake system, connected to pipe " ," communicates with the atmosphere through the small open bleeder valve (7).

The compressed air is retained in the tanks by the large (10) and small (11) inlet valves.

By pressing on the brake handle, the pilot by means of the two-position lever, presses on lifter (1) of the PU-7 valve; the reduction spring (5) moves piston (3) down.

[remainder illegible]

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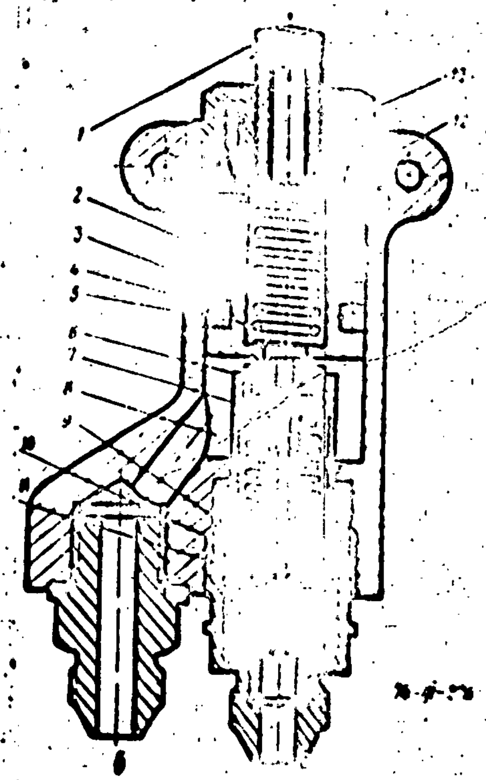

Fig. 129. Reducing valve.

1. lifter; 2. mantle ("stocking") membrane; 3. piston; 4. housing; 5. reducing valve; 6. large bleeder valve; 7. small bleeder valve; 8. middle cavity; 9. lower cavity; 10. large inlet valve; 11. small inlet valve; 12. bushing; 13. cover.

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With further downward movement of the lifter, small inlet valve (11) opens. Compressed air from the tanks passes through lower cavity (9) and middle cavity (8) of valve PU-7 to the brake system.

When small inlet valve (11) is opened, the pressure of the compressed air beneath large inlet valve (10) immediately drops sharply and, because of the difference in pressures above and below it, the large inlet valve opens a large aperture for the passage of air, which accelerates the debraking process.

If there must be rapid debrakings of the landing-gear wheel, one must rapidly release the brake handle on thecontrol stick; the lifter is freed, the piston lifts upward, and the piston seat leaves the large bleeder valve, opening a large aperture for release of compressed air to the atmosphere, which accelerates the debraking process.

The small inlet and bleeder valves assure smooth gradual braking; the large valves make possible very fast braking and debraking.

The pressure behind the PU-7 valve is determined by the flow areas when the inlet valves are open, i.e., by the amount the lifter moves.

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PU-8 (VI-35) Differential (Fig. 130)

The PU-8 differential permits individual braking of the wheels when taxiing.

In the neutral position, lever (1) does not press against rocker arm (2) and therefore the air fed from the system through the PU-7 valve to pipe "A" of the differential moves piston (4) until it stops against the rocker arm; through the slot in the inlet valve the air enters the middle chamber of the differential, and from there to the UP-24/1 as master pressure.

The end of the differential lever is attached to the rudder pedals by means of spring-loaded reducing connecting rod (7).

A deflection of lever (1) by 15° to one side or the other does not affect the overall breaking of the wheels.

With greater deflections, lever (1) presses against rocker arm (2); one of pistons (4), released from pressure of the rocker arm, lifts to its seat and valve (6) prevents compressed air from entering the upper chamber.

Under pressure of the air trapped in the upper chamber and in the wheel brake coupled with this chamber, the piston in the given chamber lifts and allows air to escape, i.e., [remainder of paragraph illegible]

Air continues to pass to the other wheel, and therefore there will be a specific pressure in the second upper chamber and the second brake chamber. When the air is bled, the pressure in the first chamber of the differential will drop until the pressure difference in the different cavities

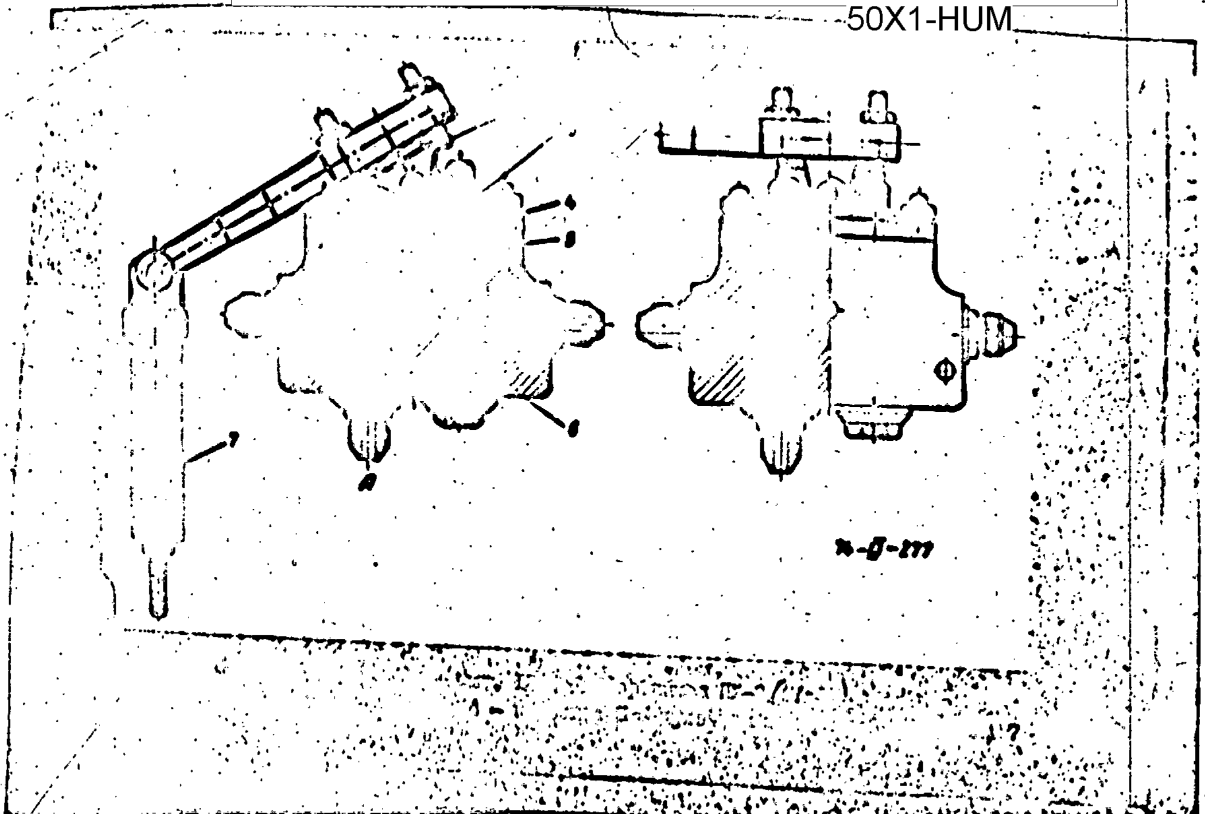

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Fig. 130. PU-8 (VI-35) differential.

1. lever; 2. rocker arm; 3. bushing; 4. piston; 5. stocking membrane; 6. valve; 7. reducing connecting rod.

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of the differential (operating through the pistons of the upper chamber on the rocker arm) is balanced by the force of compression of the spring in connecting rod (7).

Then the bleeder opening closes when piston (4) presses against valve (6).

The pressure difference in the differential cavities corresponds to a specific difference in the braking moments of the wheels, which is necessary for turning the plane around, since the force of compression of the spring in the reducing connecting rod depends on the angle of deflection of the pedal, and is independent of the change in the pressure fed to the differential. The PU-8 differential is located next to the PU-7 on the floor of the cockpit ahead of the control stick between frames 6 and 7. The name-plate for the PU-8 bears the number U1-35.

<u>UP-24/1 Reduction Accelerator</u> (Fig. 131)

The UP-24/1 reduction accelerators are located one in each of the main wheel housings. Each of the UP-24/1's operates on one KT-82M wheel; there is no reduction accelerator in the brake line for the front wheel.

The UP-24/1 reduction accelerators are designed to feed to the KT-82M wheels pressures of compressed air which are 1.5-times greater than the control, master pressure from the PU-7.

Since the accelerators are installed in the immediate vicinity of the wheels, the braking cycle is much faster, since the length of the line from the accelerator to the wheel brake is shorter.

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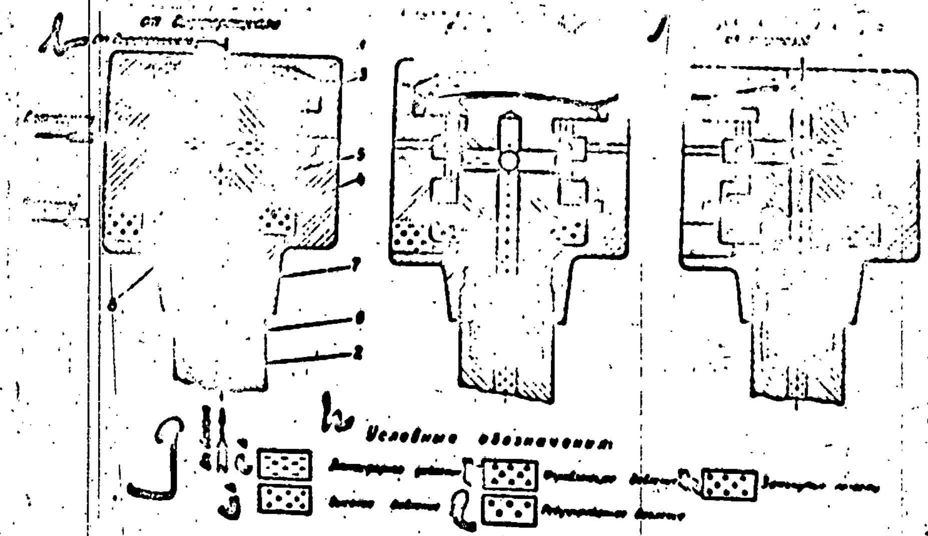

Fig. 131. UP-24/1 reduction accelerator.

1. housing; 2. guide; 3. membrane; 4. membrane; 5. piston; 6. inlet valve; 7. bleeder valve; 8. spring.

a. start of pressure feed from differential; b. from differential; c. to atmosphere; d. to brake; e. inlet of compressed air to brakes; f. outlet of compressed air from brakes; g. from tank; h. arbitrary designations; i. atmospheric pressure; j. high pressure; k. control pressure; l. reduced pressure; m. closed cavities.

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Coupling of the accelerators into the main-wheel brake lines makes possible braking of the main wheels with a pressure in the chambers of up to 15 $\pm$ 0.5 kg/cm^2; axx pressure of 10.5 kg/cm^2 is fed directly to the front wheel from the PU-7.

The indicated pressure limits have been established from technical data on brake wheels KT-38 and KT-82M.

The UP-24/1 reduction accelerator consists of housing (1), upper and lower membranes (3) and (4), control piston (5), and inlet and bleeder valves (6) and (7).

The accelerator has four pipes:

--the pipe for entry of the master pressure;

--the pipe for entry of 50 kg/cm^2 pressure from the xxxxxx supply;

--the pipe to lead off the reduced pressure to the brakes of the main wheels;

--the pipe to bleed airs from the brake lines when debraking.

[remainder illegible]

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When the pressure beneath the guide piston increases such that it balances the pressure above the piston, the guide piston moves a certain distance under the influence of spring (8). ~~This~~ The only result is that the inlet valve returns to its seat and shuts off pressure from the supply, preventing a further rise in pressure in the brakes. At the same time, the air-bleed line from the brakes to the atmosphere will be shut off~~s~~ by the bleeder valve. If, however, the master pressure decreases, piston (5) will move upward and the bleeder valve will be re-seated. The pressure in the brakes begins to drop when the lifter moves from the end of the ~~xx~~ bleeder valve and opens the passage into the atmosphere. Thus, the reduction accelerator ~~xxxxxxx~~ reacts rigorously to all changes in master pressure. Reduction of the accelerator is assured by selection of the diameters ~~xxxxxxxxxxxx~~ above and below the control piston. ~~xxxxxxxxxx~~ The ratio of these areas is 1:5; this means that to balance the control piston the pressure beneath it should be 1.5-times higher than the master pressure. The upper ~~xxxxx~~ and lower cavities are separated by two membranes; between these air passes into the atmosphere.

UP-33/1 Valve for Coupling the Front Strut (Fig. 132)

The valve for cutting in the front strut is designed to connect the front-wheel brake line with the common wheel-brake system.

By cutting in the UP-33/1 and pressing on the brake handle, the pi t can brake all three wheels; when UP-33/1 is hled, however, there will be no braking of the front wheel.

The xxix UP-33/1 consists of housing (8), rod (3), valve (6)x with spring (7), seat (5), guide (2), and recoil spring (4).

When the valve is closed, the air coming throu h the inlet pipe does not reach the outlet pipe, since valve (6) closes off the flow opening.

When the valve is opened, the rod turns, thus xxx moving downward, since pi n (9) through the rod moves along the inclined grooves in the guide which has a stop groove at the end o the taper. Therefore, the rod is stopped at the extreme position, which prevents self-disconnecting of the valve when the handle is pushed.

When the rod moves downward the inlet valve is moved downward by the rod; the inner performation of the rod, in contact with the atmosphere, is cut off. Downward movement of the inlet valve leads to communication with the brake line.

The brake for the front wheel can be cut off even when there is pressurein the brake system.

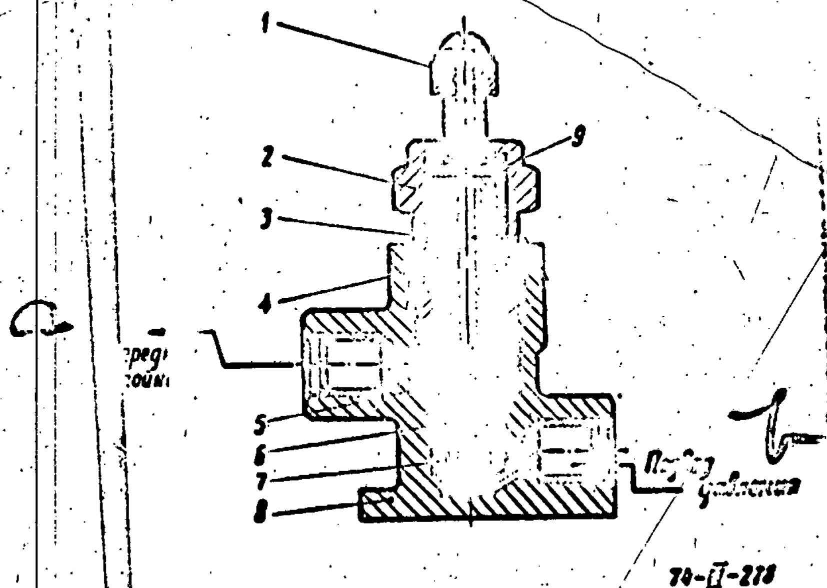

Fig. 132. Kalmanfor UP-33/1 valve for cutting in the front-wheel braking.

1. handle; 2. guide; 3. rod; 4. recoil sprinr; 5. seat; 6. valve; 7. sprinr; 8. housing; °. pin.

a. to 'ront strut; b. pressure feed.

When the pin is removed from its stop position the rod, actuated by the spring, returns to its initial position; the inlet valve is seated, cutting out the brake line, and pressure from the front-wheel brakes is bled to the atmosphere through an opening in the rod.

The front-wheel cut-in valve is located in the cockpit. The control handle is on the instrument panel, to the upper left.

UP-22 Switch.

The UP-22 switch (Fig. 131) serves to switch in the electric circuit of the automatic debraking system when there is pressure in the brake system, and to switch out the circuit when there is no pressure.

When air pressure is fed to the brake line from the PU-7 valve to pipe (1), valve (2), under the effect of pressure which overcomes the resistance of spring (3), moves and closes the electric circuit by means of end switch (6).

When there is no pressure in the line, the valve is returned by spring (3) to its initial position, releasing the knob on the end switch, and the electric circuit is cut out.

When the pressure increases to 0.7 kg/cm^2 the switch makes the circuit.

The UP-22 is on the floor of the cockpit next to the PU-7 valve.

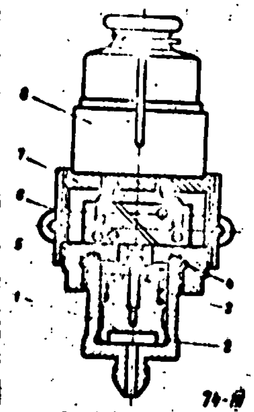

Fig. 133. UP-22 switch.

1. pipe; 2. valve; 3. spring; 4. pressurizing packing; 5. housing; 6. end switch; 7. end; 8. electric plug.

UP-53/1-2 Electromagnetic Servo-Valve (Fig. 134)

The electromagnetic servo-valve (Fig. 134) is designed to be installed in the system for automatic debraking of the main wheels.

The valve freely passes air to the brake chamber when there is no current in theelectric circuit and removes pressure from the chamber with simultaneous cut-off of air from the brake system.

Figure 134 shows the valve in the "Brake" position. No current is fed to the coil winding and compressed air freely enters the brake chamber.

When current is fed to the coil (Fig. 134), when the wheel "grabs" and the UA-24/2 operates, core (2), overcoming the resistance of spring (4), is attracted to the feed pipe, preventing pressure from entering the brakes.

At the same time as the core moves away, servo-valve (3) opens; it has a spring (4) which serves as a buffer to prevent the rubber of the servo-valve from being damaged when it strikes against the seat of valve (5).

Here, air is bled from chamber "A" into the atmosphere, freeing from back pressure valve (5) which, under the influence of the pressure in the brakes, opens and bleeds air from the brakes through two openings, into the atmosphere.

After "grabbing" has stopped, the electrical pulse

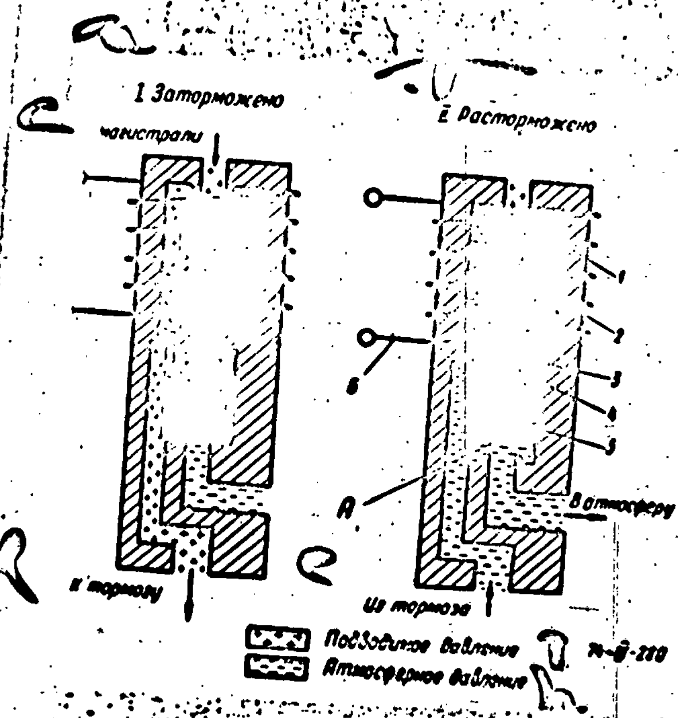

Fig. 134. UP-53/1-2 electromagnetic servo-valve.

1. housing; 2. core; 3. servo-valve; 4. spring; 5. valve; 6. electromagnetic coil. a. I - Braked; b. II - Debraked; c. to line; d. to brake; e. from brake; f. to atmosphere; g. incoming pressure; h. atmospheric pressure.

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is removed and the core, spring-actuated, returns and the servo-valve is seated. Then, by means of the air pressure, valve (5) closes the bleeder opening and again the cavity of the brake chamber is connected with the brake line.

The servo-valves are installed on the main struts; the servo-valve for the front wheel is in the housing for the wheel at the bottom near frame No. 5.

IV. PARACHUTE CONTROL (Fig. 135)

The chute-container doors are opened and the chute is released at the will of the pilot by feeding pressure to the opening and release cylinders by means of electropneumatic valves 695000M (27).

Air from the main system, through reducer RV-50M and check valve (15) fills the supply tank (45), whichhas a capacity of 1.3 liters.

When the respective control knobs are pushed, pneumatic valve 695000M (27) operates and pressure is fed to the opening and release cylinders.

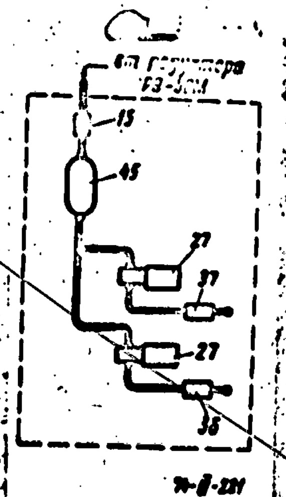

Fig. 135. Parachute control (numbering same as in Fig. 1:9).

a. from RV-50M reducer.

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Units of the Chute-Control System

695000M Electropneumatic Valve (Fig. 136)

The 695000M electropneumatic valve is designed to feed pressure to the cylinders when the electric circuit which powers the coil is closed, and to bleed the pressure when the electromagnet is currentless, with simultaneous blocking of the pressure channel from the circuit.

The valve consists of housing (4), which contains inlet valve (5), bleeder valve (7), and electromagnet (2) with armature (1).

If voltage is not fed to the magnet coil, the inlet valve is in the closed position because of spring (6).

The bleeder valve is compressed by lifter (3) in the inlet valve, and couples the lead-out pipe to the atmosphere.

When voltage is fed to the coil, the armature moves the bleeder valve until it is seated, after which the outlet pipe is cut off from the atmosphere. Simultaneously, through damper-spring (6) which prevents rapid wear of the rubber packing of the bleeder valve, valve (5) moves, pressing spring (8).

In this case the valve-pressure-feed cavity is connected to the outlet pipe and compressed air enters thecylinder.

When the voltage is removed from the coil, by the action of compressed

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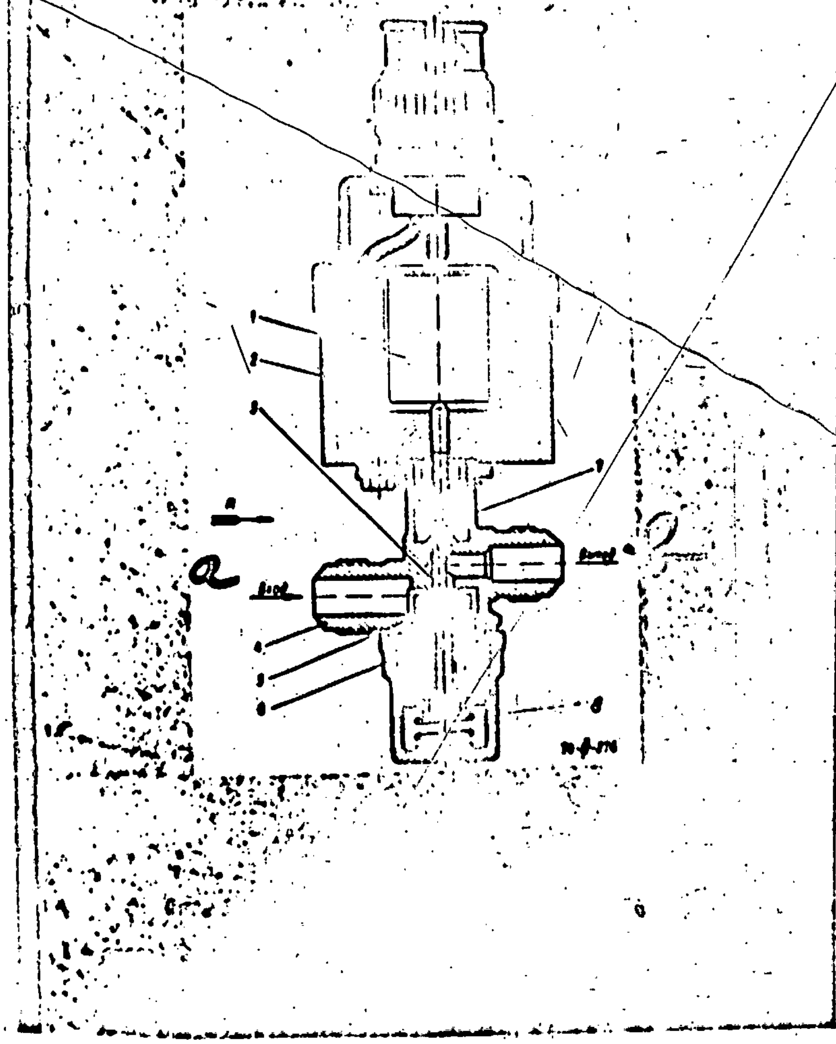

Fig. 136. 6950OOM electropneumatic valve.

1. armature; 2. electromagnet; 3. lifter; 4. housing; 5. inlet valve; 6. spring;

7. bleeder valve; 8. spring.

a. inlet; b. outlet.

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springs (8) the bleeder valve is seated, the line closes, and compressed air from the cylinder is bled through the bleeder valve.

PRECAUTION: The 6050DOM valve cannot ~~be~~ have current fed to it for more than one minute, to avoid overheating of the magnet.

Chute-Release Cylinder (Fig. 137)

The cylinder consists of housing (2) and cover (1). Inside the housing are rod (4) and recoil spring (3).

The rod is hermetically sealed along the piston by rubber ring (6). When pressure is fed the rod moves to the release position, releasing the chute from the lock.

When pressure is removed the rod ~~returned~~ returns to its original position by means of the recoils spring. The ~~rod~~ cylinder is attached to bracket (5). The cavity where the spring is located is in communication with the atmosphere through a hole in the housing.

The door-opening cylinder is of analogous design.

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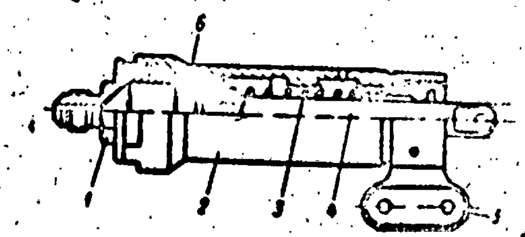

Fig. 137. Chute release cylinder.

1. cover; 2. housing; 3. recoil spring; 4. rod; 5. bracket; 6. sealing ring.

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V. EMERGENCY AIR SYSTEM

The emergency air system (Fig. 119) is designed for emergency lowering of the landing gear and emergency braking of the wheels when landing, in the event the main hydraulic or main air systems are put out of operation.

The pressure sources in the system are two air tanks (2) with a capacityof 1.3 liters each.

The tanks are filled through the fill valve from the line which is common to the main system.

After the tanks are filled, which is determined by the reading of the 2M-150 manometer, the valve is closed and the system shut off.

Compressed air is fed, in the emergency brake system through the 682500 reducer (7) in which it is reducedto 16^{+4}_{-1} kg/cm^2, to the emergency brake valve (8) and to the emergency landing-gear lowering valve (4).

Emergency braking with a drop in pressure in the main air system is accomplished merely by pulling the emergency-brake connecting-rod handle which is connected through an actuating arm with the valve.

To lower the landing gear in an emergency with a drop in pressure in the main hydraulic system it is necessary to open the valve on the right side of the instrument panel in the cockpit (the one with the marking "Emer. Landing Gear."

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Emergency Braking

The emergency brake system (Fig. 138) is powered by the emergency-system tanks, and includes a 682500 reducer (7), which reduces the pressure from 110-130 kg/cm^2 to 16^{+1}_{-1} kg/cm^2; a 625300A emergency brake valve (6); and two 563600 emergency switches (26).

When the emergency brake system must be used, the pilot pulls the lever of the emergency valve, thus coupling the high-pressure line with the brakes of the main wheels (12). But since a reducer is installed ahead of the emergency valve, the high pressure is reduced to 16^{+1}_{-1} kg/cm^2, and the already reduced air, through the emergency brake valve, enters the emergency switches; [remainder illegible]

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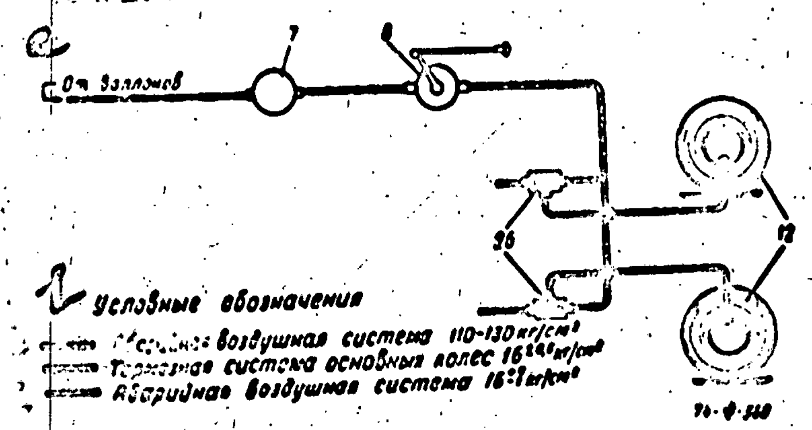

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Fig. 135. Emergency braking (the numbering is as in Fig. 119).

a. from tanks; b. arbitrary designations; c. emergency air system, 110-130 kg/cm^2; d. main-wheel brake system, $16^{+0.5}$ kg/cm^2; e. emergency air system, 16^{+4}_{-1} kg/cm^2.

50X1-HUM

Elements of the Emergency System

682500 Reducer (Fig. 139)

The 682500 reducer is designed to reduce the air in the emergency air system for emergency braking (from 110-130 kg/cm^2 to 16^{+4}_{-1} kg/cm^2).

The reducer operates analogously to the RV-50M reducer in the cockpit.

Emergency Brake Valve (Fig. 140)

The emergency brake valve is designed to feed pressure from the emergency system to the main-wheel brakes.

The valve is located in thecockpit and is controlled by levers on the upper left-hand corner of theinstrument panel.

The valve, a slide-type, consists of housing (1) and cover (4). In the inner cavity is mounted slide (2) which is ground with the corresponding planeof the housing.

The slide is pressed against the housing by spring (3) and is activated by shaft (5) to which lever (6) is attached. The lever travel is limited by the stops of gasket (8) mounted on the housing.

The housing has two connecting pipes which are connected by channels with two openings on the housing face along which the slide moves; on the base of the slide is a shaped cutout, and two arc-shaped cuts are made in the face itself.

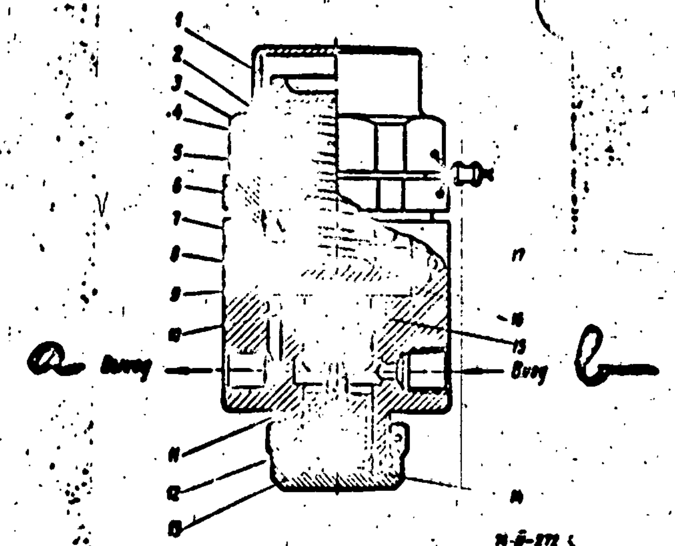


Fig. 139. 682500 Reducer.

1. cover; 2. [illegible]; 3. packing; 4. nut; 5. calibrated spring; 6. barrel; 7. calibrated spring; 8. support; 9. housing; 10. nut; 11. lifter; 12. piston; 13. cover; 14. packing; 15. stop; 16. membrane; 17. ring.

a. outlet; b. inlet.

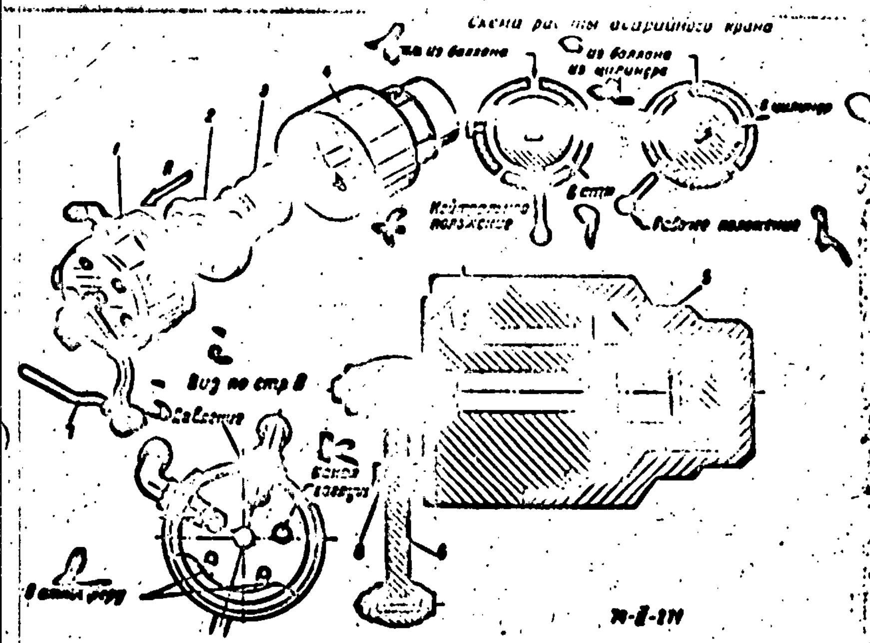
Fig. 140. Emergency brake valve. 1. housing; 2. slide; 3. spring; 4. cover; 5. shaft; 6. lever; 7. connecting rod; 8. gasket; 9. [remainder illegible]

a. diagram of the operation of the emergency valve; b. from tank; c. from tank; d. from cylinder; e. to cylinder; f. neutral position; g. to atmosphere; h. working position; i. view at A; j. pressure; k. plug channel; l. to atmosphere

In additon to the two openings on the housing face there are two openings to the atmosphere.

The mixture slide is installed in the housing such that in the "Debrake" position the pressure channel from the emergency circuit through the 6825'0 reducer and the shared cutout communicates with the inner cavity of the valve.

[remainder illegible]



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Emergency Switch 563600

The emergency switches (Fig. 141) are located on the main struts, one on each side.

The switch is designed (during emergency braking) to feed compressed air from the emergency system to the brake chambers, simultaneously cutting off the supply of air from the main brake system.

The valve consists of housing (1), stopper (2), connecting pipe (3), and spring (4).

Air from the emergency supply comes in at pipe "A." The stopper (2), previously seated in the housing, is then abruptly thrown to the right and, overcoming the force of the recoil spring, seats itself in pipe "B," closing the duct for the main brake line.

Therefore, it becomes possible for air from the emergency system to enter pipe "B," which is connected with the brake chamber. When the wheels have been debraked (which is possible when the lever of emergency valve 625000 is released), the pressure in the brake line drops and the stopper, by means of the recoil spring, is moved to the left, again bringing the brake chamber into communication with the main brake line.

The channels are pressurized in either case by rubber end packing at the ends of the stopper.

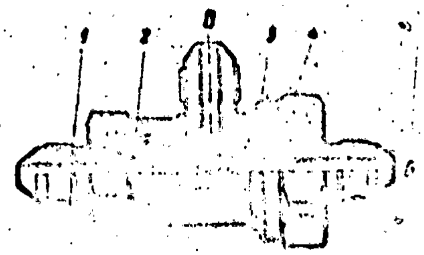

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Fig. 141. 563600 emergency switch.

1. housing; 2. stopper; 3. connecting wire; 4. spring.

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Emergency Landing-Gear Lowering

Thexlandingxgearx

Emergency lowering of the landing gear (Fig. 142) is xxxxxx done xxxxx when the main hydraulic system is put out of commission.

The emergency wheel-lowering system contains: emergency lowering valve (4), bleeder valve (5), two cylinders (10) for emergency release of the main struts from their suspension locks, and two emergency valves (24) in thesystem for opening the landing-gear doors.

Emergency lowering of the landing gear is done without first opening the mechanical/suspension locks on the wheelxxxxxxxxxxxxxxxx struts.

When valve 652200A of the emergency landing-gear lowering system is opened (this valve is on the right on the instrument panel in thecockpit), compressedair from the emergency tanks, at a pressure of 110-130 kg/cm^2, is fed through the valve and bleeder valve to the cylinders for emergency release from the suspension locks, which are connected mechanically xxxxxxx with the mechanical wheel-flap locks.

After opening the strut suspension locks and the wheel-flap locks the compressed air is fed through the emergency valves to xxx lower the flaps, and through the hydraulic locks to x lower the wheels.

For the front strut, compressed air is fed directly to the hydraulic lock, and through it to the strut lift, lowering the wheel.

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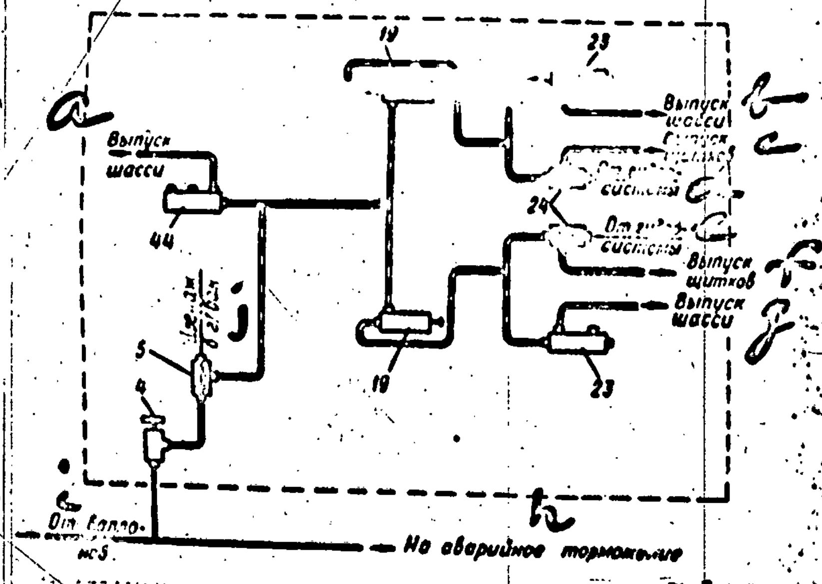

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Fig. 142. Emergency landing-gear lowering. (numbers same as in Fig. 119). a. landing-gear down; b. landing gear down; c. flaps down; d. from hydraulic system; e. from hydraulic system; f. flaps down; g. landing-gear down; h. to emergency brakes; i. from tanks; j. bleeder.

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Elements of the Emergency Landing-Gear Lowering System

Bleeder Valve (Fig. 143)

The bleeder valve is analogous in design to the emergency switch. When pressure is applied, the compressed air moves the stopper such that the wheel-lower lines, previously continually coupled with the hydraulic tank by a pipe system, are coupled with the wheel-drop line going to valve 652200A through which air is fed during emergency lowering.

When emergency lowering is completed, when the compressed air is removed from the landing-gear lifts, the stopper returns to its initial position and again the emergency landing-gear lowering line is coupled with the tank, allowing drainage of the fluid which might get into the air system if the valves of the hydraulic locks and the emergency valves are not pressurized.

Emergency Main-Wheel Release Cylinder (Fig. 144)

The emergency release cylinders are designed to open the suspension locks of the main struts and the connected suspension locks for the wheel flaps.

The cylinder consists of housing (5), valve (7) which slides along the guide of the rod, and cover (12) attached by nut (11).

S E C R E T

Fig. 143. Bleeder valve.

1. cover; 2. packing; 3. spring; 4. valve; 5. housing.

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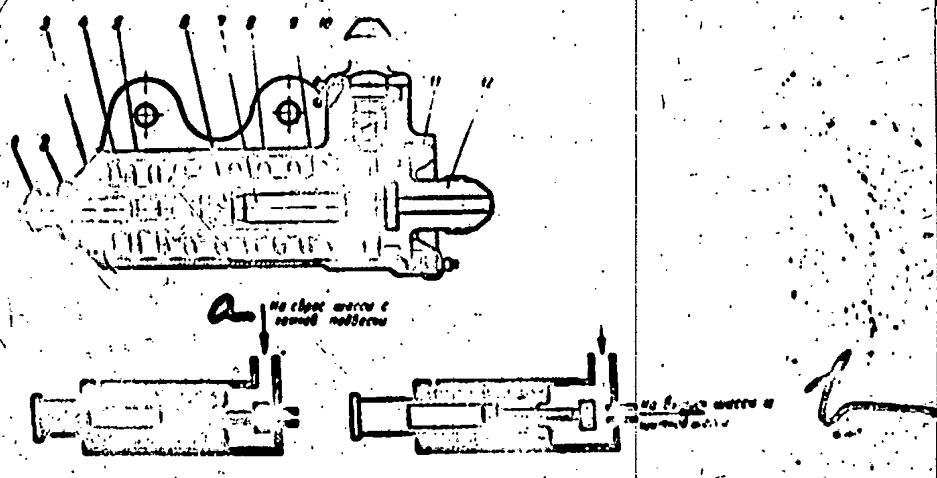

[illegible]

Fig. 144. Emergency main-strut release cylinder.

1. adjustable bolt; 2. retainer nut; 3. stuffing box; 4. rod; 5. housing; 6. limiting bushing; 7. valve; 8. recoil spring; 9. nut; 10. connecting pipe; 11. nut; 12. cover;

a. to release landing gear and suspension locks; b. to lower landing gear and flaps.

S E C R E T

The cylinder housing has two lugs, by means of which it is attached using bolts.

The cylinder has two connecting pipes: one (1) is screwed into the housing and connects the pressure line with the inner cavity; the second is in cover (12) and connects to the line to the hydraulic lock and the emergency wheel-flap valve.

When emergency air for wheel lowering is fed in, the pressure is first fed to the lock cylinder (through the bleeder valve), to its inner cavity. This causes the rod to move and the recoil spring to be compressed. As soon as the rod has moved 14 mm, which is sufficient to release the struts from the suspension locks, the valve (up to this time seated by the pressure) is removed from its seat by means of the guide shoulder, and air passes through the pipe in the cover to the hydraulic lock and the emergency valve, which results in simultaneous opening of the flap and lowering of the strut. When the pressure is removed, the spring drives the rod back to its original position and the valve is seated.

Emergency Valve (Fig. 145)

The emergency wheel-lowering line contains two 674400 emergency valves.

The emergency valve serves to cut off the hydraulic system from the emergency wheel-lowering system at the moment the latter comes into play. They are also used to cut off the emergency system from the hydraulic system when the latter is operating normally.

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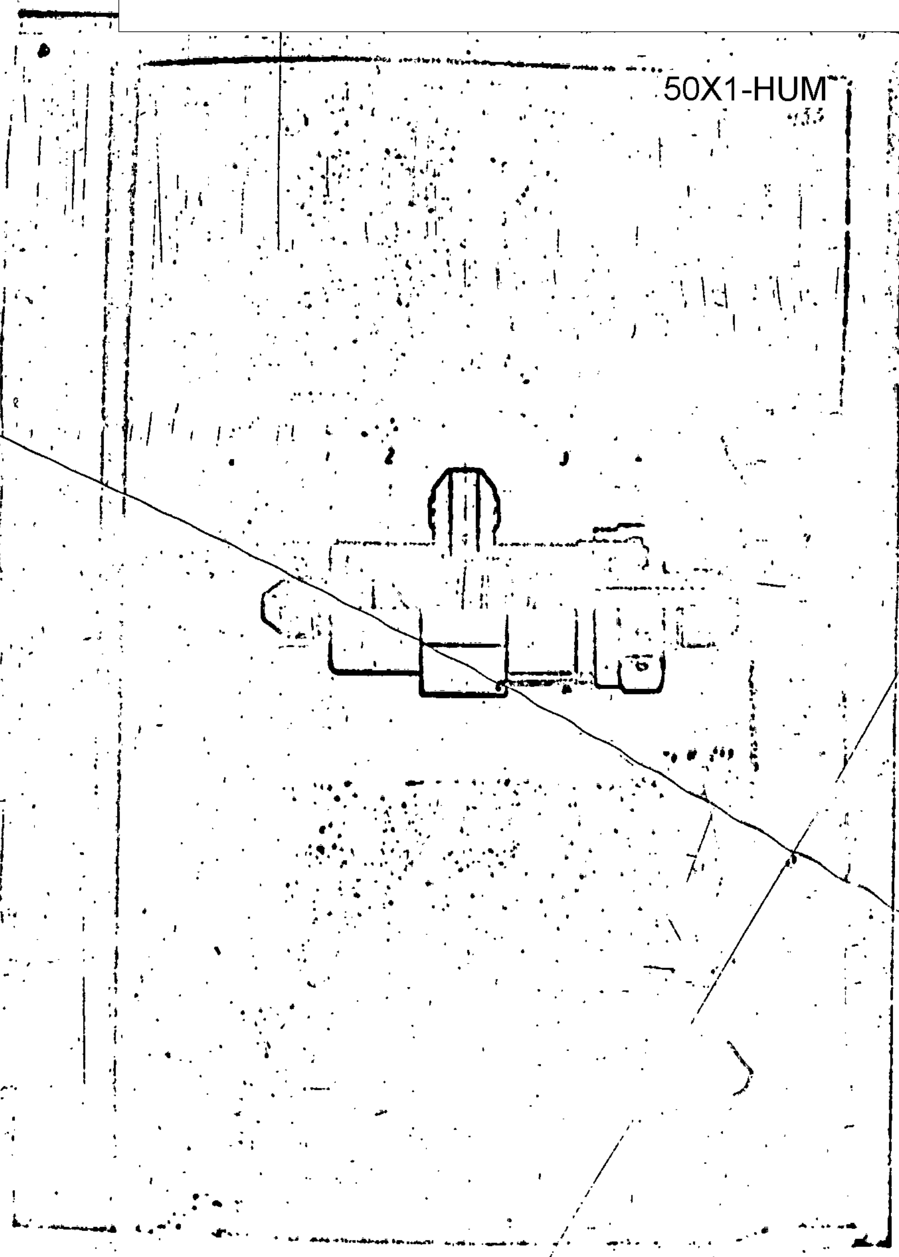

Fig. 145. Emergency valve.

1. housing; 2. piston; 3. spring; 4. cover.

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Each valve has three connecting pipes, by one of which they it is coupled to the air system of the emergency wheel-lowering system.

The valve consists of housing (1), cover (4), piston (2), and spring (3).

The piston, under the action of spring (3) and the pressure of the fluid, constantly cuts off the compressed air channel, preventing the fluid from entering the emergency air system.

During operation of the emergency air system the piston, because of air pressure, overcomes the tension of spring (3), passes to the end of the fluid inlet pipe, and cuts it off, simultaneously allowing air to enter the wheel-lowering line.

To hermetically seal the air system, the piston has a conical projection, and rubber packing on the end facing the hydraulic system, which closely presses against the sharp edge of the seat in the inlet pipe and prevents air from entering the damaged hydraulic system.

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II. THE HYDRAULIC SYSTEM

1. General Information

The plane's hydraulic system (Fig. 146) consists of two independent systems: the booster system and the main system.

The booster system is designed to feed the control boosters: the two-chamber BU-51MS booster and the aileron booster.

The main system has the following jobs:

--to retract and lower the cone of the inlet duct of the engine;

--to control the surge-control ~~xxxxxxx~~ vents;

--retract and lower the wing flaps;

--retract and lower the landing gear;

--control the brake flaps;

--control the afterburner vents;

--feed the second chamber of the BU-51MS booster; and

--automatic braking of the wheels during landing-gear retraction.

The main system is ~~xxxxxxxx~~ a duplicate system for the GU-45A aileron boosters.

[remainder ~~xxxxx~~ illegible]

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_______, compressed air enters the pressure-boosting system from the sixth stage of the engine compressor.

At the outlet from the pumps the fluid, before entering the elements of the system, passes through filters (43) and (37) which have fine paper filtering elements for purification of the fluid.

Pressure in the system is measured by the 2ЗДМ-250 dual remote-control electric manometer (30).

The proper pressure in both hydraulic systems is assured by regulators in the pumps. A rise in pressure above the maximum is prevented by safety valves (41) and (35).

Each system has one spherical (19) and (26) and one cylindrical hydraulic accumulator (54) and (63).

The spherical hydraulic accumulators in each system can expend their supply of fluid only on the aileron boosters and the stabilizer boosters.

For this, in the main system the spherical accumulator is separated from the other parts of the system by a check valve (in the main system and the booster feed line there is also a control for the engine-nozzle vents).

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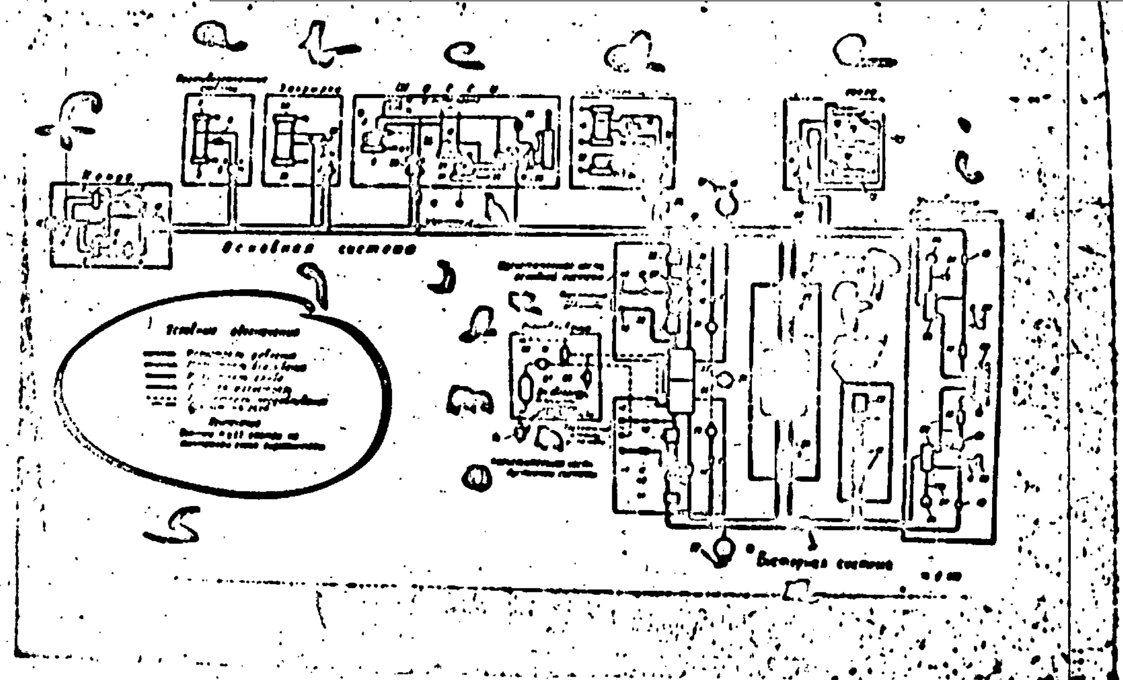

Fig. 146. Diagram of the hydraulic system.

a. surge-control vents; b. wing flaps; c. landing gear, to left wheel; d. brake flaps; e. nozzle; f. cone; g. main system; h. delivery; i. stabilizer control; j. delivery part of the main system; k. attachment of ground source; l. pressure increase, to atmosphere; m. from emergency air system, from engine; n. attachment of ground source; o. delivery part ofthe booster system; p. aileron control; q. emergency pressure source; r. booster system;

s. arbitrary designations:

pressure line
intake line
run-off line
working line
pressure-increase line
pump bleeding

remarks

for positions 11 and 52, see the mounting diagram for the hydraulic system.

S E C R E T

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Fig. 146. Diagram of the hydraulic system.

1. three-position cone cylinder; 2. surge-control-vent cylinder; 3. hydraulic lock for cone cylinder; 4. valve GA-185 of the second position of the cone; 5. valve GA-184 of the surge-control vents; 6. choke; 7. valve GA-165 of the first position of the cone; 8. hydraulic lock for the front-wheel jack; 9. front-wheel jack; 10. automatic brake cylinder; 11. hydraulic lock for main-wheel jack 12. check valve; 13. emergency valve; 14. air reducing valve PU-7; 15. side brake flap cylinder; 16. cycling valve; 17. landing-gear flap cylinder; 18. 11IF-4 filter for fine filtration of the circulation line; 19. spherical hydraulic accumulator; 20. valve GA-140 for the side brake flaps; 21. sensor for the DV-250 manometer of the main system; 22. valve GA-190B for cutting off the BU-45A[?] from the main system; 23. valve GA-190B for cutting off the BU-45A[?] from the booster system; 24. thermovalve for brake flaps; 25. sensor of the DV-450 [250?] manometer of the booster system.

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26. choke; 27. landing-gear suspension lock cylinder; 28. one-way choke; 29. matching valve; 30. main-wheel jack; 31. wing-flap valve GA-165; 32. cylinder for lower brake flap; 33. landing-gear valve GA-142/1; 34. valve GA-134 for lower brake flap; 35. GA-186M safety valve for main system; 36. fine-filtration filter FG-11/2; 37. fine-filtration filter FG-11/2; 38. pump NP34-2T for main system; 39. manometer UK-250 (29DM-250); 40. pump NP34-2T for booster system; 41. safety valve GA-186M for booster system; 42. gauze strainer; 43. fine-filtration filter FG-11/2; 45. on-board valve (delivery); 46. on-board valve (inflow); 47. removable valve; 48. on-board fill-pipe (inflow); 49. on-board fill-pipe (delivery); 50. wing-flap cylinder; 51. BU-45A aileron booster (left wing); 52. BU-45A aileron booster (right wing);

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53. main-system compartment in hydraulic tank; 54. cylindrical hydraulic accumulator of the main system; 55. GA-135T pressure relay of the main system; 56. GA-235T pressure relay of the booster system; 57. 8006COA fill valve; 58. fine-filtration filter IIGF-4; 59. NP-37T emergency pumping station; 60. BU-51MS[?] stabilizer booster; 61. valve GA-190B to cut off XXx BU-51MS from booster system; 62. valve GA-184M of the booster vents; 63. GA-173 measuring device; 64. DV-25- manometer for cylindrical accumulator; 65. cylindrical hydraulic accumulator of the booster system; 66. compartment for booster systemin hydraulic tank; 67. pressure-boost unit; 68. RV-1.5 reducer; 69. bleeder valve; 70. pressure-boost valve; 71. on-board fill-pipe to increase pressure of tank; 72. booster-ring cylinder; 73. synchronizing valves; 74. sediment trap.

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[this is evidently Fig. 147, although there is no visible caption to it. In addition, none of the [illegible] callouts are readable. Translator.]

During normal operation of the booster and mains systems, the stabilizer booster xxxxx receives power for the chambers simultaneously from both systems; the aileron boosters operate only from the booster system.

In the event the booster system is immobilized, the aileron boosters are switched over tovthe main system, while the stabilizer booster operates on one chamberx.

To assure a landing when the engine is jammed or the booster and main system pumps are inoperative, the booster system has emergency pumping station NP-27T (59) driven by an electric motor which is powered by the plane's electrical circuit.

Both systems have lights to signal a drop in pressure. Thee'ectric circuit for each bulb is operated through pressure relays (56) and (55) when the pressure in thesystem drops.

In the booster system, the pressure relay simultaneously signals a drop in pressure and activates the NP-27T pumping station.

To increase the purity of the working fluid, besides the filters on the pumps the system has the following

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filters:

--filters 11OF-4 at the inlet to the BU-51MS booster from the booster and main systems;

--gauze strainer (42) for overflow to the tank from the booster system, and filter GF 11-2 for overflow from the main system;

--11FO-4 fine-filtration filter for overflow in the circulation line (from the NP-34/2T pump of the main system); and

--in pressure-boost unit (67) there is a ball filter to filter the compressed air delivered to the tank pressure-boost system from the compressors.

Chokes are installed behind the valves for the landing gear, the brake flaps, and the wing flaps, to lower the overflow pressures in the main system.

In addition, in the system for control of the wing flaps, the cone, and the surge-control vents there are chokes to obtain the required speed of operation of the units.

To operate the systems on the ground there are on-board connecting pipes to couple with a ground hydraulic installation and a pipe to connect to the hydraulic tank pressure boost.

The high-pressure lines are made of 1Kh18N9T stainless steel piping; the overflow lines are made of AMtsM tubing.

The diagrams of the systems are shown in Figs. 146 and 147.

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Basic Technical Data of the Hydraulic Systems

1. Working fluid - inert oil: AMG-10 (GOST 6794-53)

2. Total volume of fluid in both systems: 36 liters

3. Total volume of compartment for main system in hydraulic tank: 10.5 liters

4. Total volume of compartment for booster system in hydraulic tank: 8.0 liters

5. Volume of mixture poured into tank for each system: 6.5 liters each

6. Hydraulic tank feed pressure: 1.8-2.55 kg/cm^2

7. Safety valve for feed system calibrated for: 2.8 ± 0.2 kg/cm^2

8. Maximum working pressure for zero output of pump: 210^{+5}_{-10} kg/cm^2

9. Maximum output of pump, corresponding to pressure of 130 kg/cm^2

   for 4000 rpm: at start of operation, no less than 35[?] liters/minute
   at end of guaranteed lifetime, no less than 25[?] liters/min.

   for 500 rpm: at start of operation, no less than 4 liters/minute
   at end of guaranteed lifetime, no less than 2.5 liters/min.

10. Safety valve GA-186M calibrated for: 2.8^{+5}[?] kg/cm^2

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11. Fill pressure in hydraulic accumulators	50^{+5} kg/cm²
12. Amounts of fluid filling the cavities of the accumulators with a system pressure of 210 kg/cm²:	
for the spherical accumulator	1.15 liters
for the cylindrical accumulator	0.83 liters
13. Thermovalve of brake-flap cylinders calibrated for	256 25±5 kg/cm²
14. Hydraulic locks of the cone open and close within the limits	70-30 kg/cm²
15. Thermovalve in the landing-gear hydraulic lock opens at	275^{+15}_{-5} kg/cm²
16. BU-45A booster converts to the main system when the pressure in the booster system drops to	85±10 kg/cm²
and goes back when the pressure in the booster system rises to	100±5 kg/cm²
17. GA-135 pressure relay turns off the signal light and the pumping station at a pressure of no higher than	195 kg/cm²
it goes on at a pressure of	165^{+10}_{-5} kg/cm²
18. Maximum output of emergency pumping station at start of operation, no less than	1.7 liters/minute
at end of guaranteed lifetime, no less than	0.9 liters/minute.

The Main Hydraulic System

A. The Delivery Part of the System (Fig. 14")

In them main ~~[illegible]~~ hydraulic system pressure is created by an NP34-2T piston pump of variable output.

The pump is powered from hydraulic tank (58) through ~~[illegible]~~ a suction pipe and ~~tubex~~ hose.

In the pressure line behind the pump there are units arranged in the following sequence: check valve (12), fine-filtration filter FG11/2 (37), safety valve GA186M (35), spherical hydraulic accumulator (19), sensor of DV-250 manometer (21), with damper (6).

As the engine operates, the pump delivers fluid to the system, creating pressure in it. Passing through the check valve, which passes thr fluid only away from the pump, the fluid enters filter FG-11/2.

After filtration the fluidxgoes to:

--the hydraulic accumulators and fill them, creating a ~~[illegible]~~ reserve of hydraulic energy;

--the sensor of the DV-250 manometer through the damper which smooths the pressure pulsations;

--the valves that control the units;

--the stabilizer booster and the aileron boosters (when the aileron-booster valve is cut in);

--the pressure relays, and turns off the pressure-drop indicator lights. Thusp the continual fedding of pressure to

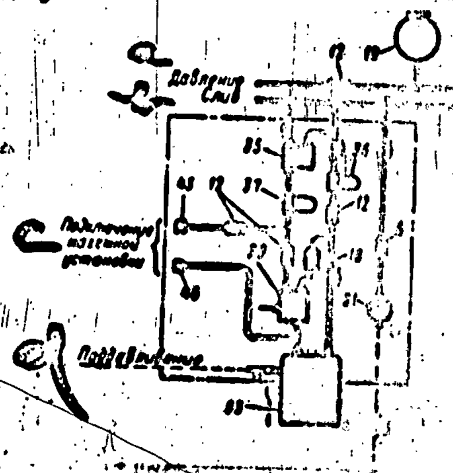

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Fig. 146. Delivery part. (positions as shown in Fig. 146)

a. pressure; b. overflow; c. coupling for ground installation; d. feed

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the valves of the system and the control boosters assures that the system will be constantly ready to operate.

When the maximum working pressure is attained, the pump output regulator sets the pump to the minimum output position. [remainder illegible]

Rise in the pressure in the system to 240^{+5} kg/cm^2 couples the delivery line to the overflow, maintaining in the system a pressure of no less than 210^{+5}_{-10} kg/cm^2.

Elements of the Delivery Part of the System

Hydraulic Tank (Fig. 149): of welded design, made of sheet AMG3M-L1.5 material.

The pressurized bulkhead (10) divides the tank into two compartments: the booster and the main. The arrangement of each compartment is identical.

The fluid enters through filler neck (1) which has gauze strainer (11) and a plug with a measuring stick (12).

Bulkhead (6), equipped with two valves (one with a weak spring (7) opens downward, the other (8) with a strong spring opens upward), is designed to assure normal pump-operating conditions during inverted flight.

During filling, by means of the pressure of the column of fluid, the valve with the weak spring opens, and the lower part of the tank fills. The air forced out from this section passes through bleeder tube (9).

Suction pipe (4) has a tube through which the fluid can be withdrawn from the bottom cavity no matter what the position of the tank in space. During inverted

Fig. 149. Hydraulic tank. [legend and callouts illegible]

flight the fluid in the lower cavities is retained by valves; the valve with the weak spring is closed by the pressure of the mixture and the valve with the strong spring is closed by the strong spring. As the pressure rises in this cavity due to fluid from the system, the excess mixture passes out through the valve with the strong spring. The bleeder pipe has a 3-mm opening in its upper part; during inverted an insignificant amount of fluid passes from the lower to the upper cavities through the tube.

The levels of the fluids in the compartments are identical; to prevent the over-filling of one compartment as a result of leakage of the fluid through the BU-45A booster switch, the tank has a leakage tube.

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Pump NP34-2T (Fig. 150) is designed to create pressure in the systems. The pumps are installed on the engine gear box with a constant gear ratio.

Basic Technical Data

1. Number of rpm of the pump: maximum 406(87)0 rpm

2. Pressure at zero output, during which fluid delivery ceases 210^{+5}_{-5} kg/cm^2

3. Inlet pressure 2.2 atm.

4. [remainder illegible]

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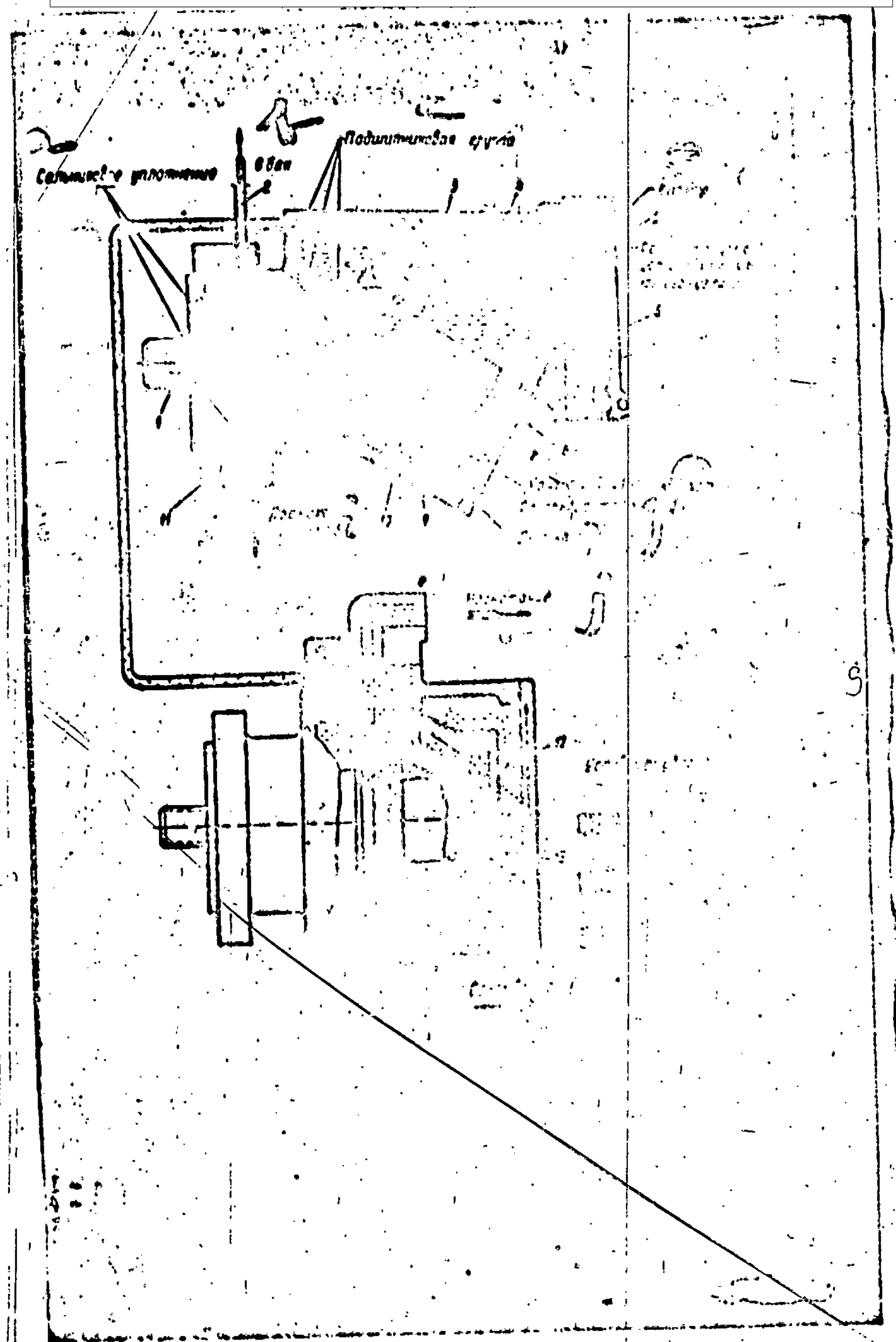

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Fig. 150. NP34-2T pump.

1. pump shaft; 2. outside circulation line; 3. piston; 4. outlet-regulator cylinder; 5. regulator slide valve; 6. calibrated spring; 7. regulator housing; 8. cradle [illegible]; 9. slide-valve; 10. cylinder block; 11. housing; 12. delivery line; 13. suction line.

a. packing; b. [illegible] to tank; c. bearing group; d. filter; e. regulator for the setting angle of the oscillating unit; [illegible] f. oscillating unit; g. distributor; h. cradle; i. bleeding; j. delivery; k. arbitrary designations; l. delivery pressure; m. suction pressure; n. bleeding; o. suction.

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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COUNTRY	USSR	REPORT	
SUBJECT	English Translation of MIG-21F-13 Aircraft Manual Entitled Aircraft Ye-6T, Technical Description, Book III, Construction, Parts 1 and 2	DATE DISTR.	5 June 1963
		NO. PAGES	1
DATE OF INFO.			
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English translation of pages 454 - 682 of a Russian-language manual on the MIG-21F-13 aircraft entitled Aircraft Ye-6T, Technical Description, Book III, Construction, Parts 1 and 2

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Aircraft Ye-6T
Technical Description
Book III
Construction
Parts 1 and 2
Pages 454-682

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Since the axis of the cylinder block forms a certain angle with the axis of the drive shaft, as the shaft and its coupled cylinder block turns, pistons (3) undergo reciprocating motion in the piston openings of the cylinder block. Here, in those chambers where the pistons move out of the block (from right to left) there is suction of the working fluid from the suction line, while in the chambers where the pistons move into the block (from leftx to right) the fluid is expelled under pressure through the arc-shaped cut in the delivery line.

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Check Valve (Fig. 157)x assures flow of the fluid in one direction only, corresponding to the direction of the arrow ~~in~~ on the housing. When the pressure is balanced ahead of and behind the valve, piston (2), moved by recoil spring (3), is seated, closing off the line. When the pressure ahead of the valve drops, the valve maintains the pressure behind the valve, preventing the fluid from moving in the opposite direction. The valve housing is of Dural, and the connecting pipe (which forms the seat) is of steel.

The hydraulic system uses check valves of identical design, that differ only in their flow areas:

674500B	4 mm diam.	12x1 pipe thread
674600B	6	14x1
671600B	8	16x1
671700B	10	18x1.5
671800B	12	20x1.5

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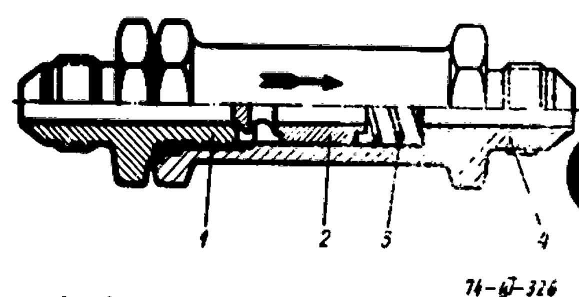

Fig. 151. Check valve.

1. connecting pipe; 2. piston; 3. spring; 4. housing.

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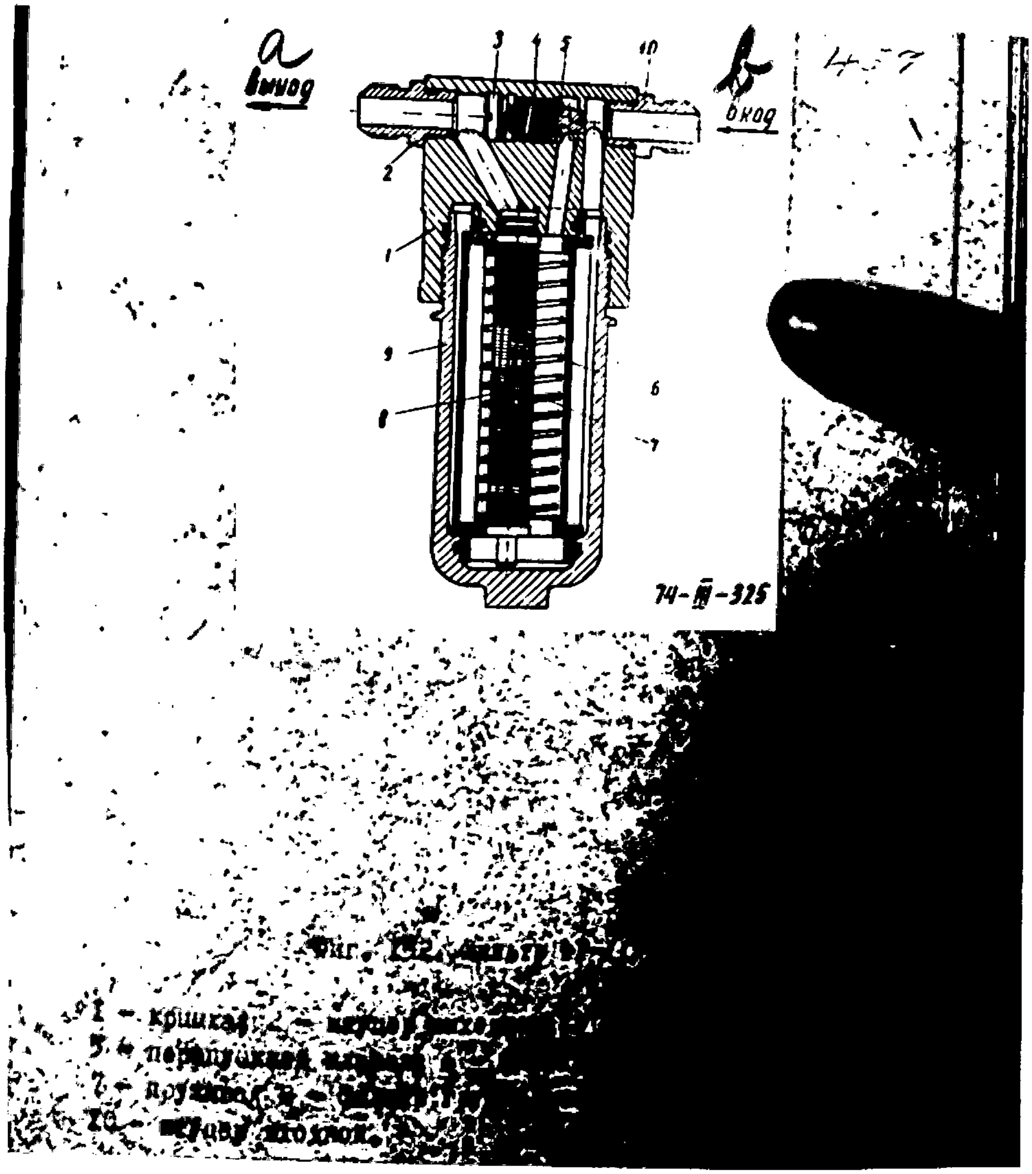

F'g. 152. Filter FG-11/2

1. cover; 2. outlet pipe; 3. nut; 4. spring; 5. ~~overflow~~ by-pass valve; 6. fine-filtration filter element; 7. spring; 8. rough-filtration filter; 9. barrel [?]; 10. inlet pipe.

a. outlet; b. inlet

The filters are installed in the engine compartment—one on the left (the booster system) and two on the right (the main system)—between frames 26 and 27.

The filters are reached through the engine inspection doors.

Filter 11GF4 (Fig. 153) are designed to remove foreign particles from the AMG-10 fluid.

Technical Data on the Filter

1.	Maximum working pressure	220 kg/cm^2
2.	Maximum handling capacity	10 liters/minute
3.	Filtration purity	10 microns
4.	Hydraulic resistance of a clean filter: no more than	1.8 kg/cm^2
5.	Pressure drop at which the overflow valve operates	7 $\pm$ 1 kg/cm^2.

The filter consists of cover (1), barrel (7) which forms the housing containing fine-filtration filter (3), rough- filtration filter (4), and by-pass valve (6).

The connection between the head of the paper filter element and the head and barrel has packing consisting of rubber rings. The wire rough-filtration filter is threaded onto the head.

The paper filter consists of a corrugated paper body to which a plastic head is attached.

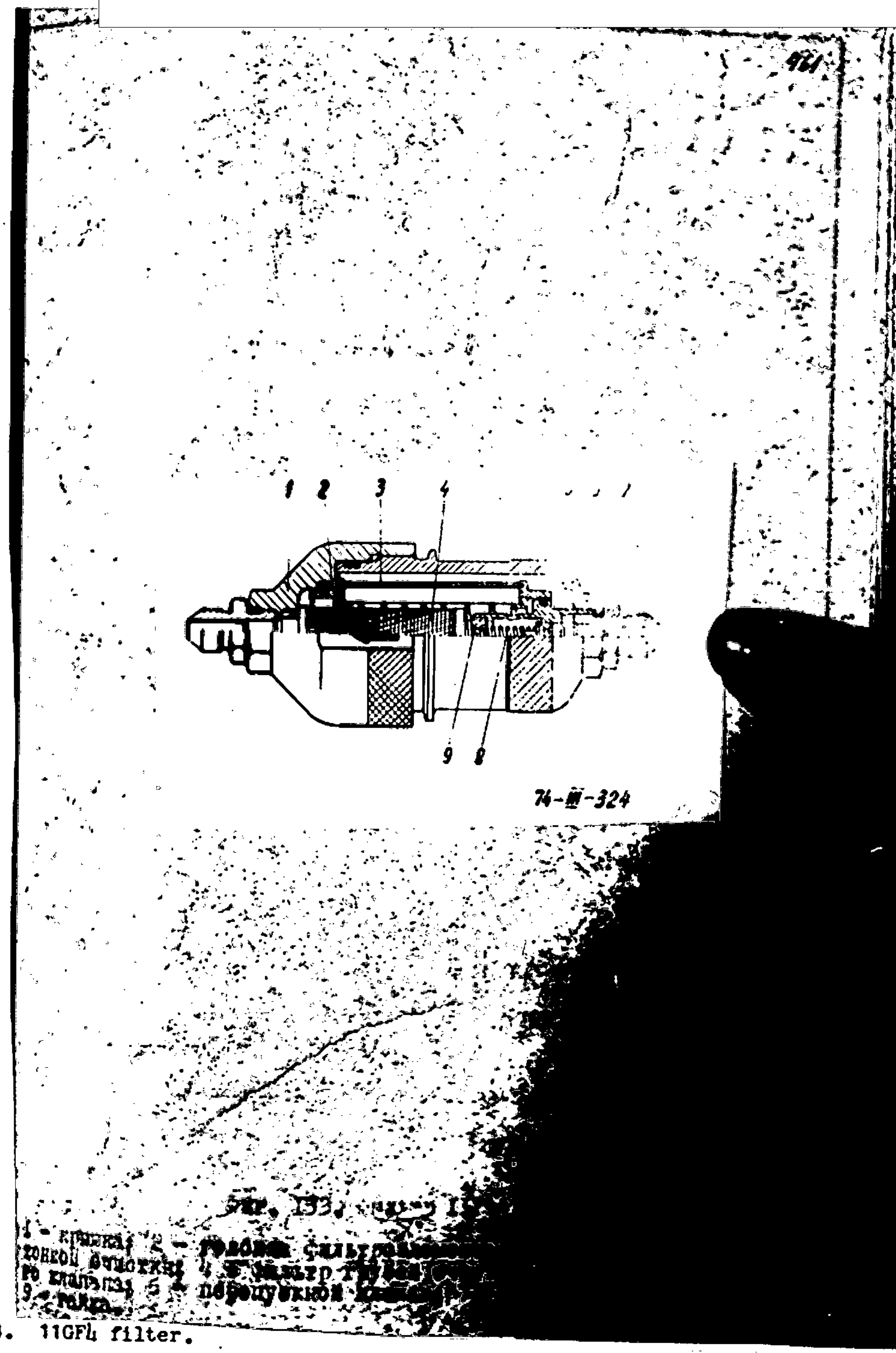

Fig. 153. 11GF4 filter.

1. cover; 2. filter-element head; 3. fine-filtration filter element; 4. rough-filtration filter; 5. [illegible]; 6. by-pass valve; 7. barrel; 8. spring; 9. nut.

Inside the paper filter is a spring framework.

The wire filter is formed of aluminum tubing with longitudinal corrugations and openings, and shaped wire which formsfiltering slits when wound around the framework.

The working fluid passes through the inlet opening into the inner cavity of the filter. Through the filtering screen of the fine-filtration filter the fluid passes to the rough-filtration filter, and through it to the outlet pipe. If the paper filter becomes clogged, when the pressure drop reaches 7 ± 1 kg/cm^2 the fluid passes through the by-pass valve and the rough-filtration filter, by-passing the paper filter element. The filters are placed as follows: one in the back-fairing behind the canopy and two in the [region ahead of the rudder?] between frames 32A and 32.

Safety Valve GA-186M (Fig. 154)

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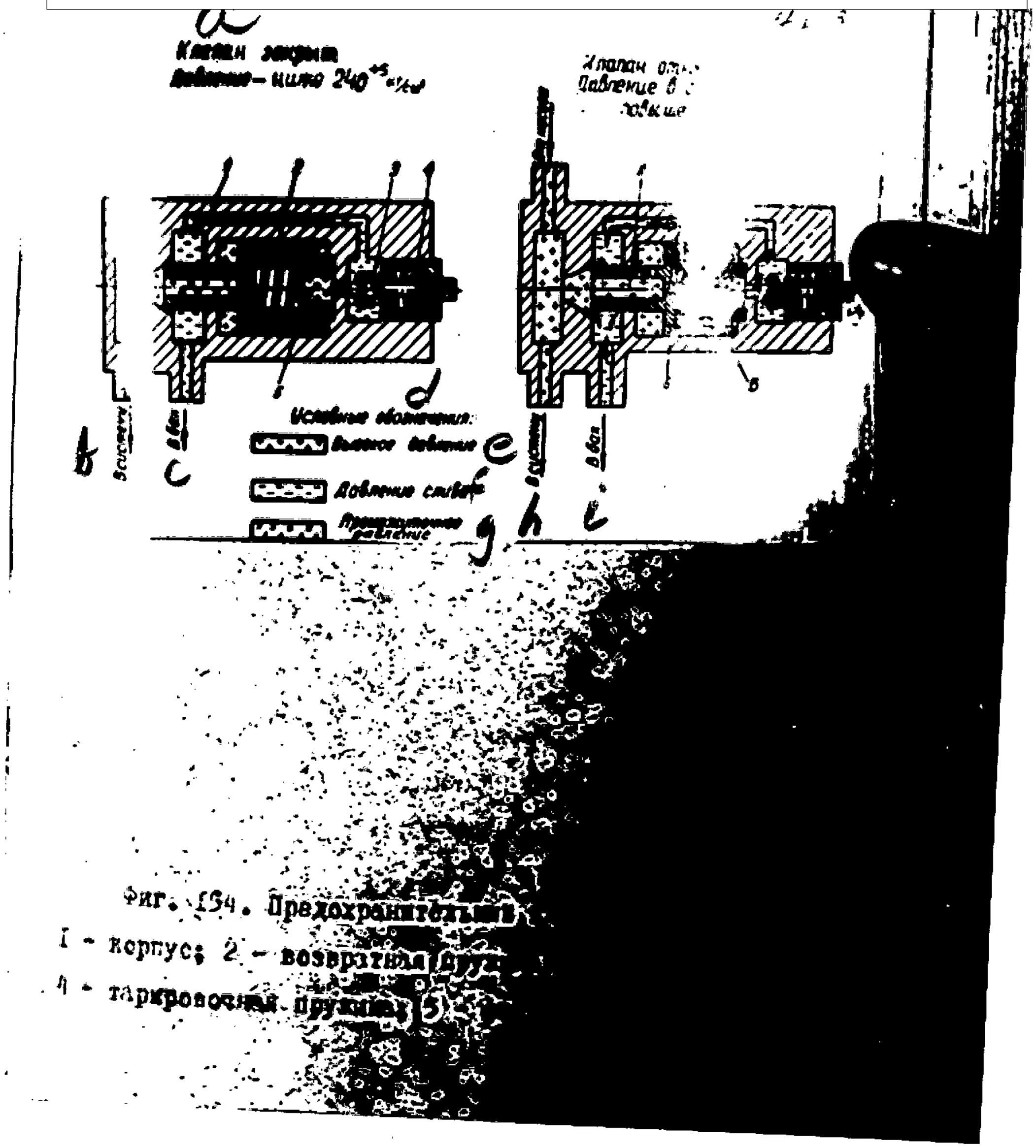

Fig. 154. GA-186M safety valve.

1. housing; 2. recoil spring; 3. sensor-valve; 4. calibrated spring; 5. filter; 6. main valve.

a. valve closed, pressure $< 240^{+5}$ kg/cm^2; b. to system; c. to tank; d. arbitrary designations; e. high pressure; f. overflow pressure; g. intermediate pressure; h. to system; i. to tank.

[remainder illegible]

opens and passes the fluid from the high-pressure cavity to the overflow. Here there forms a pressure drop in cavities A and , which is maintained by throttle M.

The main valve moves to the right, allowing the fluid to discharge from the pressure line.

When the pressure in the system drops to 220 kg/cm^2 the sensor-valve is reseated by the spring, the pressure drop in cavities A and disappears, and the main valve is returned to its original position by the recoil spring.

The valve is considered closed if the leakage through it does not exceed 100 cm^2 per minute.

The safety valvesare located in the engine compartment, one in each system, between frames 26 and 27.

Spherical Hydraulic Accumulator (Fig. 155)

The plane has two hydraulic accumulators, one in each of the hydraulic systems.

They are designed to collect the fluid as the system operates and feed it to the system with high flow-rates to accelerate operation of the units.

The spherical accumulator is, at the same time, a damper for the pressure pulsation created by the pump.

It consists of housing (4) and cover (3) on which filler valve (2) is mounted. The element which separates the gas and hydraulic cavities is an elastic spherical rubber diaphragm (5) whose lower part rests on

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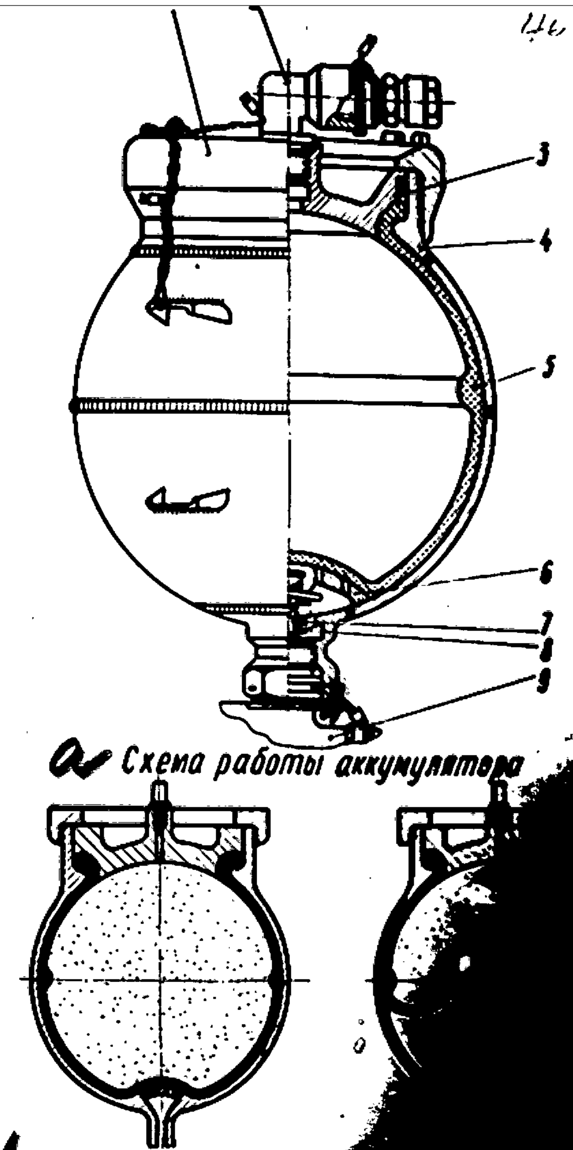
Fig. 155. Spherical hydraulic accumulator.

1. nut; 2. filler valve; 3. cover; 4. housing; 5. diaphragm; 6. cone; 7. illegible; 8. illegible; 9. collector.

a. operation of the accumulator; b. I. Initial position--gas cavity filled with nitrogen; c. II. Wotking position--hydraulic cavity filled with fluid under pressure.



Фиг. 130.

1 - гайка; 2 - ...
4 - корпус; 5 - ...
6 - коллектор; ...

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cone (6) which has a great many small-diameter openings.

The housing is made of sheet 30KhGSA steel, the diaphragmix is of V-14 rubber. The fluid under pressure enters the hydraulic cavity through the collector and, compressing the nitrogen, presses the diaphragm diaphragm upward toward the cover, forming a supply of hydraulic energy.

When there is consumption in the system, the nitrogen expels the accumulated fluid into the system.

The fill pressurex is 50^{+5} kg/cm^2. Filling is done with nitrogen according to TUMKhP - 4280-54, type I or II, with a dew point of no more than 35°C.

The amount of fluid filling the hydraulic cavity of the hydraulic accumulator at 210 kg/cm^2 is 1_5 liters. The accumulators are installed underneath, between frames 20 and 22.

[remainderillegible]

to the UK2-250, where it is converted into a proportional movement of the manometer arrow.

Technical Data

1. Range of pressure measurements — 0-250 kg/cm²

2. Reading errors

a) in the range 180 to 220 kg/cm² — ±7 kg/cm²

b) at all other points — ±15 kg/cm²

A detailed description of the design is given in Book IV (Chapter III) of the technical description.

Sensors are located in the booster and main systems. They are placed as follows:

--in the left main-wheel housing on frame 20: booster-system sensor

--between frames 20 and 22, below and to the right: main-system sensor.

The indicator is on the lower left of the instrument panel in the cockpit.

The throttle (Fig. 156) is designed to brake the flow of the fluid.

Throttles are located ahead of the ma ometer sensors to eliminate the effect of pressure pulsations on the manometer readings.

The throttle consists of housing (1), cover (5), a collection of throttle washers (3) attached by nut (4), and support (2). The packet is protected by perforated screen (6). The washers are separated by spacing rings. Each washer has two throttle openings 0.5 mm in diameter.

The washer installation provides for setting the throttle openings in mutually perpendicular planes for each neighboring pair of washers. The fluid flow, moving through this labyrinth, is decelerated as it passes through the throttle washers. The throttles for the DV-250 sensors are mounted in the accumulator collectors.

<u>On-board</u> <u>removable connecting pipes</u> (Fig. 157) serve to couple the ground hydraulic sources when checking the booster and main systems on the ground.

To the right, in the region of frames 27 and 28, in the housing of the on-board fill-pipes, are located two pipes: the suction pipe and the delivery pipe for the main system. To the left, in the same area, are the on-board fill-pipes for the booster system where, in addition to the above-mentioned two pipes, there is a pipe for connection of the ground feed.

The design of the suction and delivery pipes is similar, except for the flow-area diameters.

The on-board fill-pipe consists of housing (5), angle piece (3), valve (4), plug (6), and ring (1).

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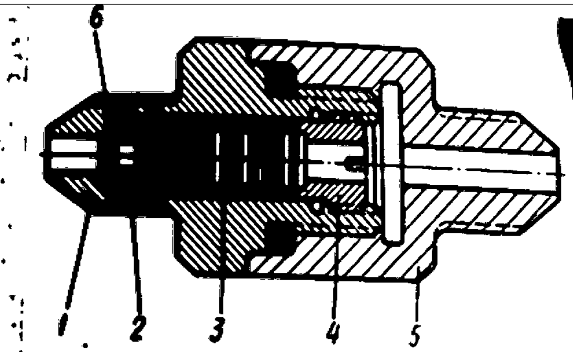

Рис. 156. Дроссель.

1 – корпус; 2 – опора; 3 – дроссельная шайба; 4 – ...
5 – крышка; 6 – решетка.

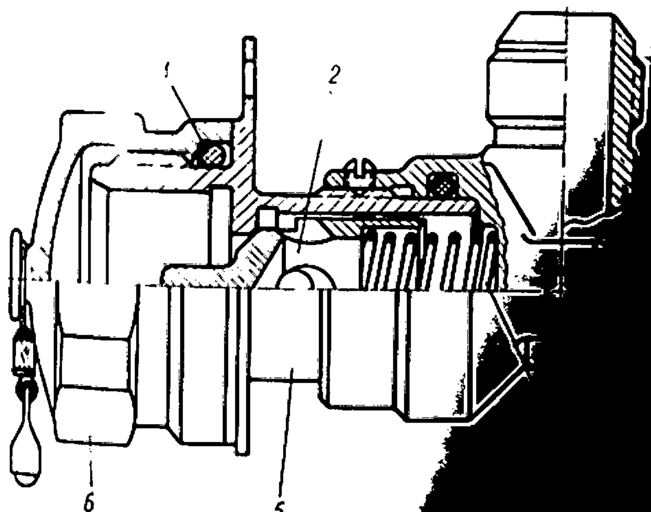

Рис. 157. ...

Fig. 156. Throttle.

1. housing; 2. support; 3. throttle washer; 4. nut; 5. cover; 6. perforated screen.

Fig. 157. On-board fill-pipe.

1. ring; 2. valve; 3. angle piece; 4. spring; 5. housing; 6. plug.

When connecting the respective pipes to the ground source it is necessary to remove the plug and thread the connecting nut of the ground pipe to the housing (5).

Then, by means of the appropriate lug on the ground pipe, the valve is moved (through the lifter of valve (2)) to the extreme right-hand position, and the ground source is ~~thus~~ thus coupled to the plane's hydraulic system. When the ground pipe is removed, the recoil spring returns the valve to its seat and the line is cut off. Then the pipe is ~~covered~~ closed with the plug and rubber ring (1) which provides additional hermetic sealing of thevalve.

The ground-feed pipe has no inner moving parts, and is made in the form of an ordinary fill-pipe with ~~flow~~ a flow channel.

When the feed hose is removed, the pipe is closed with the plug.

B. Cone-Control System (Fig. 158)

[remainder illegible]

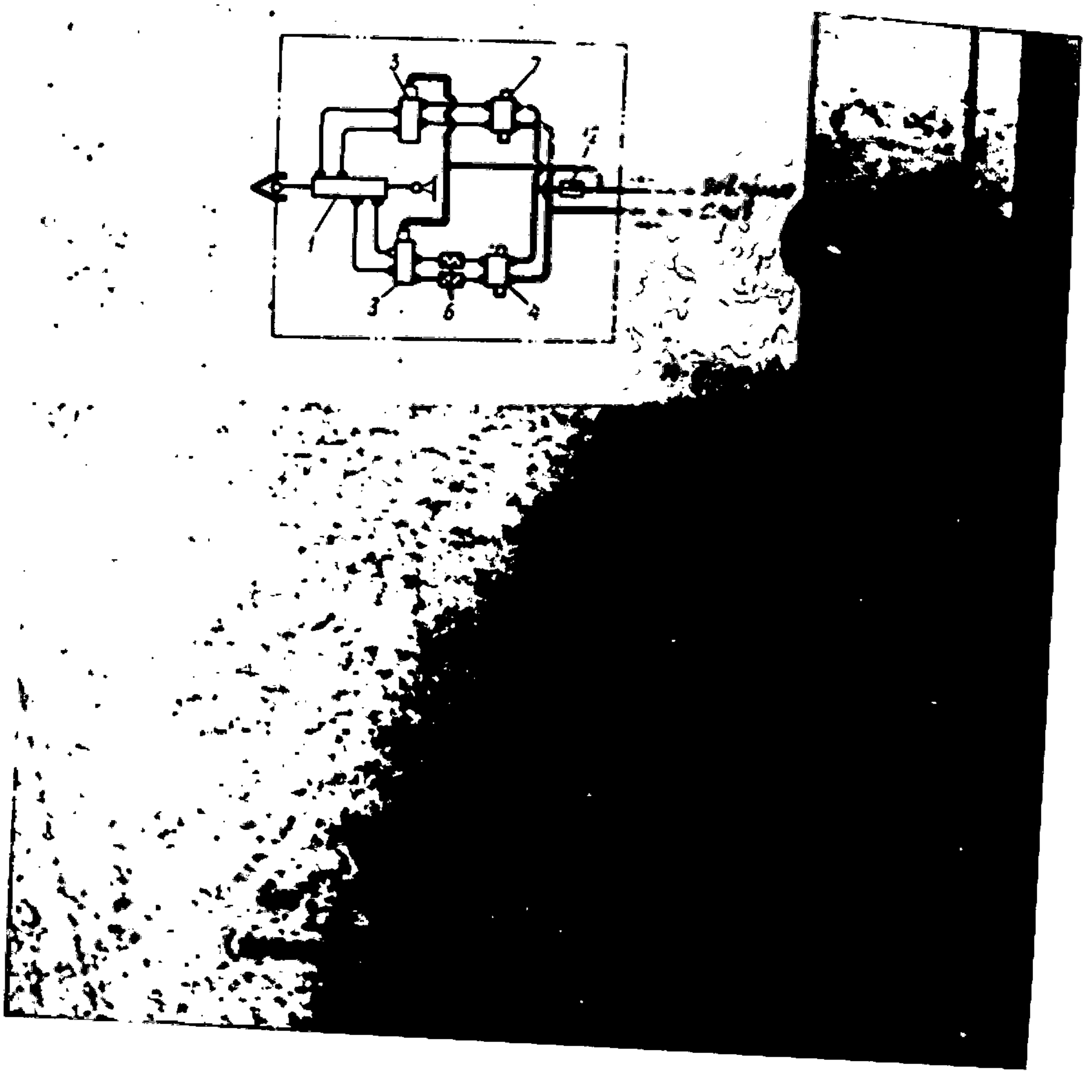

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Fig. 158. Cone-control system.

(numbering as in Fig. 146)

a. pressure; b. overflow.

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The control system consists of two GA-185 electromagnetic valves [one valve (7) controls the first extended position; the second (4) controls the second extended position], three-position retract and ~~lower~~ extend cylinder (1), two hydraulic locks (3), throttles (6) in the retract and ~~lower~~ extend lines of the cone in the second position, and check valve (12).

The GA-185 valves are installed in the hydraulic system and the electrical system such that when the 2PN-45 switchis in the "Automatic" position and there is pressure in the system, the cone is in the retracted position (this is the state corresponding to the position of the plane when parked or when flying at speeds less than M = 1.5, and with normal pressure in the system); the hydraulic locks for the cone are always im open by signal pressure [remainder of paragraph illegible]

Automatic Cone Control
(2PN-45 in "Automatic" position)

[remainder illegible]

GA-185, switching, feeds fluid to the cylinder which moves the xxx cone to the second extended position.

When the speed drops there is reverse switching of the MAK relay and through it, switching of the appropriate GA-185 valves. The cone isx retracted by the cylinder from the second extended position to the first extended position, and then it is completely withdrawn.

When the pressure in the system drops to 35 kg/cm^2 the hydraulic locks close and the cone is fixed in that position inx which it was/when the pressure dropped in the system. The hydraulic locks have thermovalves tox prevent destruction of the cylinders due to thermal expansions of the fluid.

To exclude sagging of the cylinder under the air load, the pressure line to the valves has a check valve.

The cone goes into the first extended position in 2 seconds; this is assured by 1-mm throttles in the cylinder design.

Besides similar apertures, for the second extended position in the lower and retract lines themsleves there are individual throttles fx to assure extention to the second position in 3-4 seconds.

Manual Cone Control

(PN-45 switch in "Manual" position)

The cone can be set to any of the three positions by ~~means of~~ setting manual-control switch ____________

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FIRST LINE OF TEXT

in the following positions:

--"Extend, first position"

--"Extend, second position"

--"Retract"

The cone is held in all positions by

--pressure of the fluid, with normal pressure in the system;

FIRST LINE OF TITLE

--the hydraulic locks, with a drop in pressure.

With manual control, current is fed to the valves by by-passing the MAKh relay.

Cone-Control Elements

The cone cylinder (Fig. 159). The three-position cone cylinder ~~is~~ consists of three connected cylinders separated by bushing~~s~~ (5); each of ~~which~~ the cylinders consists of liner (4) and (8) and rod (3) and (7) with ________

[remainder illegible]

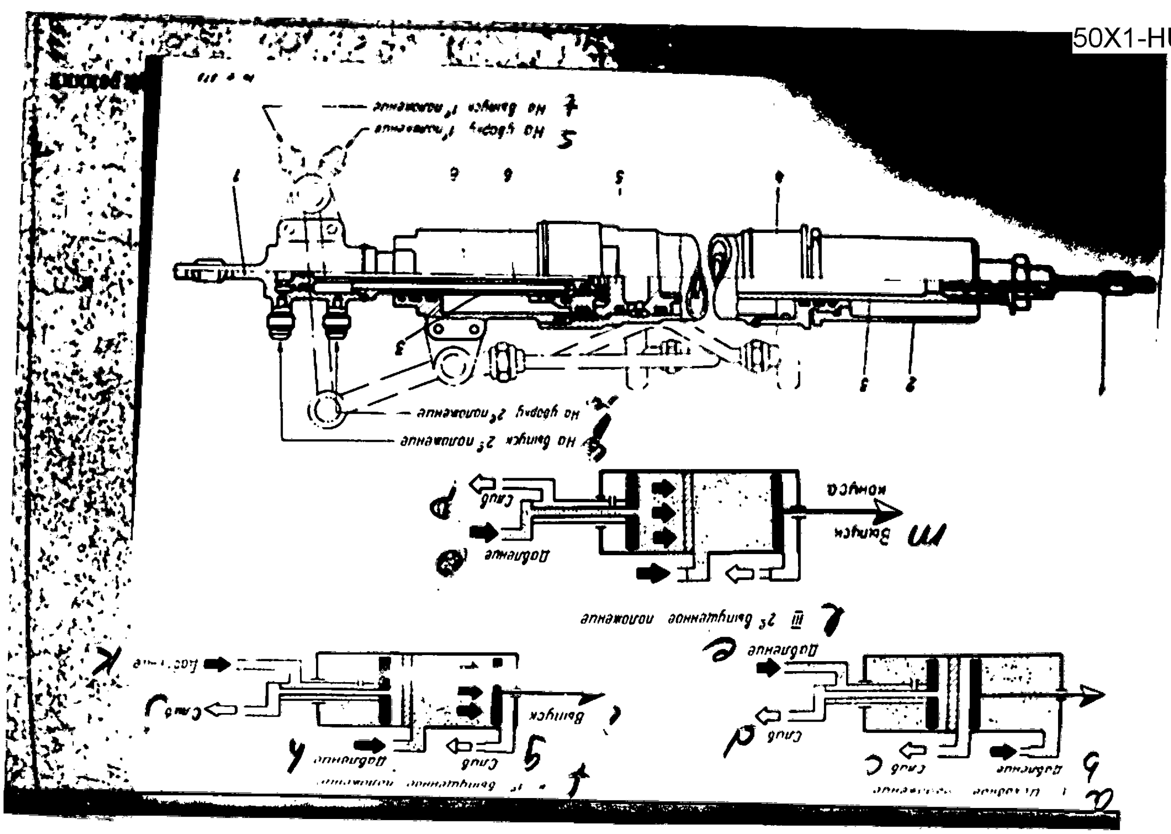
Fig. 159. Cone cylinder. 1. eye bolt; 2. bushing; 3. rods; 4. liner; 5. separating bushings; 6. inner rod; 7. fixed rod; 8. liner.

a. I. Initial position; b. pressure; c. overflow; d. overflow; e. pressure; f. II. First extended position; g. overflow; h. pressure; i. cone extention; j. overflow; k. pressure; l. III. Second extended position; m. cone extention; [no "n"] o. pressure; p. overflow; q. to extend, second position; r. to retract, second position; s. to retract, first position; t. to extend, first position.

50X1-HUM

50X1-HUM

S-E-C-R-E-T



S-E-C-R-E-T

rod (6). The rod remains in place, and the cone begins to move, simultaneously moving the first-position cylinder rod.

In this case the swivel connection operates, permitting power to be transmitted to the first cylinder, i.e., the pipes on theliner of the first cylinder move relative to the fixed mixture-feed pipes. The cone is retracted in reverse order.

The 1-mm throttle openings are located:

--in the shafts of the swivel connections for the line of the first extended position; and

--in the fluid-feed pipes and rods for the line of the second extended positionx.

The swivel connection consists of a collection of shafts and collars, forming a swivel elbow.

The front part of the cylinder lining of the first position has mounted on it a bushing which serves as a support for the cylinder when the cylinder housing moves.

The bushing moves in a guide in the partition of frame 2.

The travel of the rod of the first-position cylinder is 130±1 mm.

The travel of the rod of the second-position cylinder is ________

________ The cylinder is installed between frames 2 and 3 in the equipment compartment.

Cone cylinder hydraulic lock (Fig. 160); this is designed to fix the position of the ~~cylinder~~ cone-cylinder rod in the position in which it is at the moment the pressure drops.

The hydraulic lock consists of housing (3), bushing (5) and slide (4) with thermovalve (12), calibrated springs (10), piston (7), stop (6), cover (11), and signal-pressure pipe (1) with throttle packet (13).

The housing of the hydraulic lock has 4 pipes which couple the lock to the "retract-extend" line.

The signal pressure is fed through a separate pipe.

[remainder illegible]

FIRST LINE OF TEXT

Fig. 160. Cone-cylinder hydraulic lock.

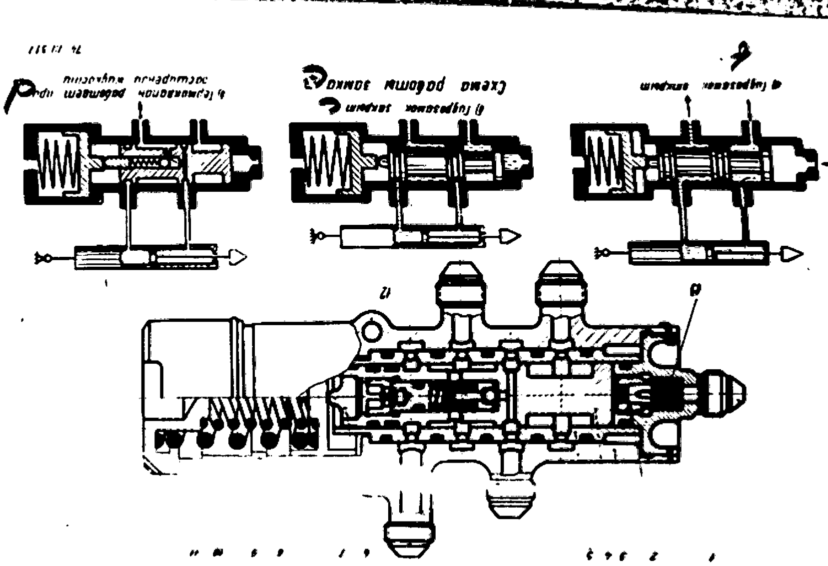
1. signal-pressure pipe; 2. nut; 3. housing; 4. slide; 5. ~~[illegible]~~ bushing; 6. stop; 7. piston; 8. detainer; 9. lock ring; 10. calibrated springs; 11. cover; 12. thermovalve; 13. throttle packet.

a. signal pressure; b. hydraulic lock open; c. hydraulic lock closed; d. thermovalve operates when fluid expands; e. diagram of lock operation.

FIRST LINE OF TITLE

50X1-HUM

S-E-C-R-E-T



Фиг. 160. Гидрозамок цилиндра конуса.

S-E-C-R-E-T

50X1-HUM

The slide is inserted in the bushing with a gap of 4-8[?] microns assuring hermetic sealing of the cylinder cavities according to the established norm.

Thermal expansions of the mixture in the closed volume do not result in increased pressure, since the slide has thermovalve (12) which releases at 240^{+10} kg/cm^2 and forces pressure out the overflow pipe.

The movement of the slide is limited by stop (8) on which is a piston which prevents further compression of the calibration springs; the lock is calibrated by the cover.

Valve GA-185 (Fig. 161)x is a two-position electromagnetic servo valve.

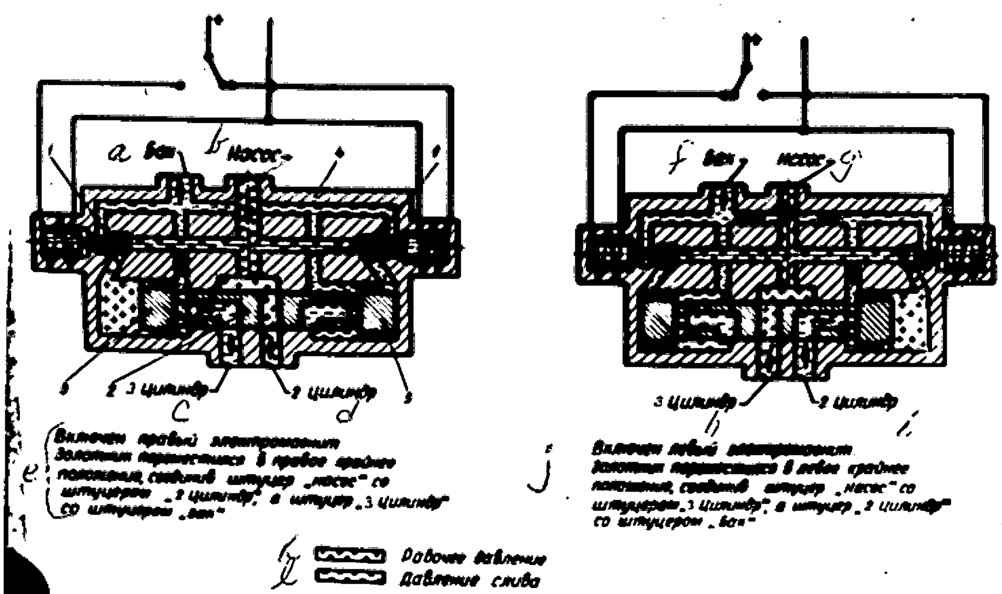
The valve consists of two electromagnetic valve sensors (1) and slide (2) moved by pistons (3).

The parts are enclosed in housing (4) made of an aluminum alloy.

When the right-hand electromagnet is switched on the armature, as it moves, seats the valve ball, preventing the fluid from entering the "pump" pipe to the right-hand piston, and bringing it into communication with the "tank" pipe cavity.

The slide, due to pressure on the left-hand piston, moves to the extreme right-hand position.

The slide is set such that the cavity



Фиг. 161. Кран ГА-185.
1 - клапанный датчик; 2 - золотник; 3 - поршень; 4 - корпус.

Fig. 161. GA-185 valve. 1. valve sensor; 2. slide; 3. piston; 4. housing.

xx a. tank; b. pump; c. third cylinder; d. second cylinder; e. Right electromagnet switched on: slide moves to extreme right, connecting pipe "pump" with pipe "second cylinder," and pipe "third cylinder" with pipe "tank." ; f. tank; g. pump; h. third cylinder; i. second cylinder; j. Left electromagnet switched on: slide moves to extreme left position, connection pipe "pump" with pipe "third cylinder," and pipe "second cylinder" with pipe "tank." ; k. working pressure; l. overflow pressure.

of the pipe "1 pump" is connected with that of the pipe "2 cylinder," while the cavity of the pipe "3 cylinder" is connected to the pipe "4 tank."

When the right electromagnet is cut out and the left one cut in, the valve ball prevents fluid from entering the pipe "1 pump" to the left piston, bringing it into communication with the cavity of the pipe "4 tank."

The slide, under pressure on the right piston, moves to the extreme left. The slide is set such that the cavity of the pipe "1 pump" is connected with that of the pipe "3 cylinder," while the cavity of the pipe "2 cylinder" is connected with that of the pipe "4 tank."

Valve GA-185 has no neutral position. When allelectromagnets are turned on the valve remains in the position in which it was before they were turned on.

Cone-control valves GA-185 are located in the front-strut compartment, between frames 5 and 6, on the right.

Throttle

The throttles installed in the extend and retract line of the cone in the second extended position are analogous in design to those described in the section "Delivery Part of the System."

They are located in the front-strut compartment, to the right between frames 3 and 4A.

FIRST LINE OF TEXT

C. Anti-Surge Vent Control (Fig. 162)

The anti-surge vent control system includes two vent cylinders (2) and a hydraulic electromagnetic valve GA-184 (5). The discharge line includes throttle (6) to decrease the discharge rate of the vents.

In flight the vents are opened and closed automatically depending on the flight speed, the position of the throttle control, and the angle of deflection of the stabilizer.

When necessary the vents canbe controlled manually, by means of a special switch.

Just as in the cone-control system, there are two switches in the cockpit for the vents:

--one (in common with the cone switch) for the positions "Automatic" and "Manual"; and

--the other for manual retraction and extension of the vents.

The by-pass vent opens in the following cases:

1. The by-pass vents should open when the engine control lever (RUD) is removed from the stop "boost" - when the RUD is pulled forward at M $\geq$ 1.5 (the "boost" bulb does not light),

2. The by-pass vents should be open for positions of the RUD from the stop "Stop" to the stop "Boost" at M $\geq$ 1.5, and closed when in the "Boost" position (the "boost" bulb is lit),

3. The by-pass vents should open at M $\geq$ 1.5 when the leading edge of the stabilizer dips at an angle of $20^{\circ +1^{\circ}}$.

The vents are held in the open and closed positions by pressure of the fluid.

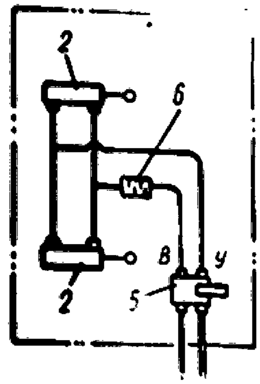
Elements of the Vent Control System

Vent Cylinder (Fig. 163); this consists of housing (3), rod (2), stop bushing (4), and cover (1).

The cylinder is kinematically coupled such that when the vents are extended the rod is retracted, and when the vents are retracted the rod is extended.

Because of this the stop bushing does not permit the rod to travel the entire length and open the vent to its maximum angle. The bushing in thecylinder projects 11 mm from the end, which corresponds to a vent-opening angle of 20°. The maximum opening-angle for the vents is 30°; in this case the stop bushing of the cylinder should be removed.

The vent cylinders are mounted in the special-equipment compartment between frames 2 and 2A.



а Давление
б Слив

Фиг. 162. Управление пр...
(Ко...

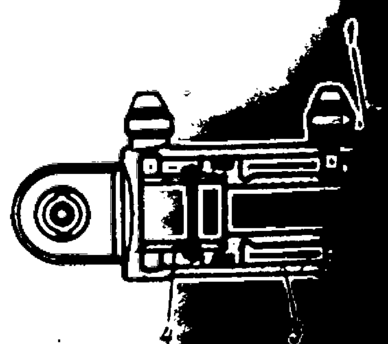


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Fig. 162. Anti-surge vent control (numbering as in Fig. 146). a. pressure; b. overflow.

Fig. 163. Vent cylinder. 1. nut; 2. rod; 3. housing; 4. stop bushing.

FIRST LINE OF TEXT

Vent throttle (Fig. 164), installed in the discharge line, is similar in design to the damper described in the section "Delivery Part of the Systems" but it has xxxxxxxx fewer throttle washers (2). Installation of the throttle insure extension and retraction of the vents in 1-2 seconds. It isinstalled in the front landing-gear strut.

Valve GA-184 (Fig. 165) is a two-position electromagnetic xxxxx servo-valve

FIRST LINE OF TITLE

It consists of electromagnetic valve sensor (4) and slide (3) controlled by a sensor through two pistons and switching the fx fluid feed under pressure.

The parts of the element are located inside housing 1, cast of aluminum alloy.

When the electromagnet is turned on the ball, under pressure of the fluid entering from the pump through an opening in the housing, is pressed to the right and permits passage of the fluid into the inner cavity of the first piston (9).

The area of this piston, on which the fluid acts, is greater than that of piston (2) of the slide; therefore, under the influence of the pressure of the fluid on the first piston the slide moves to the extreme left.

The slide, occupies a position in which cavity "1 pump" is connected with the cavity "3 cylinder" and cavity "2 cylinder" is connected with the cavity "4 tank."

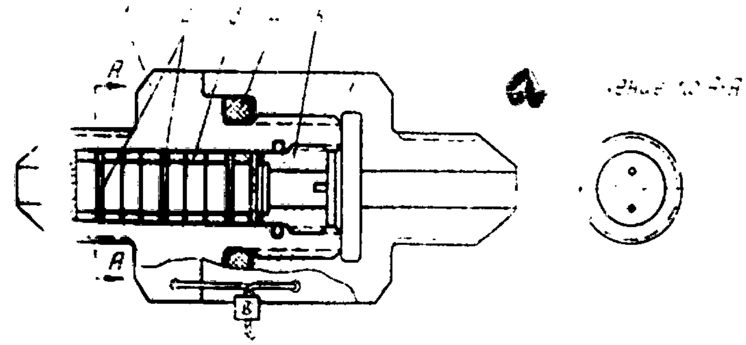

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Fig. 164. Vent throttle. 1, housing; 2. throttle washer; 3. spacer ring; 4. packing ring; 5. nut; 6. cover;

a. cross section A-A

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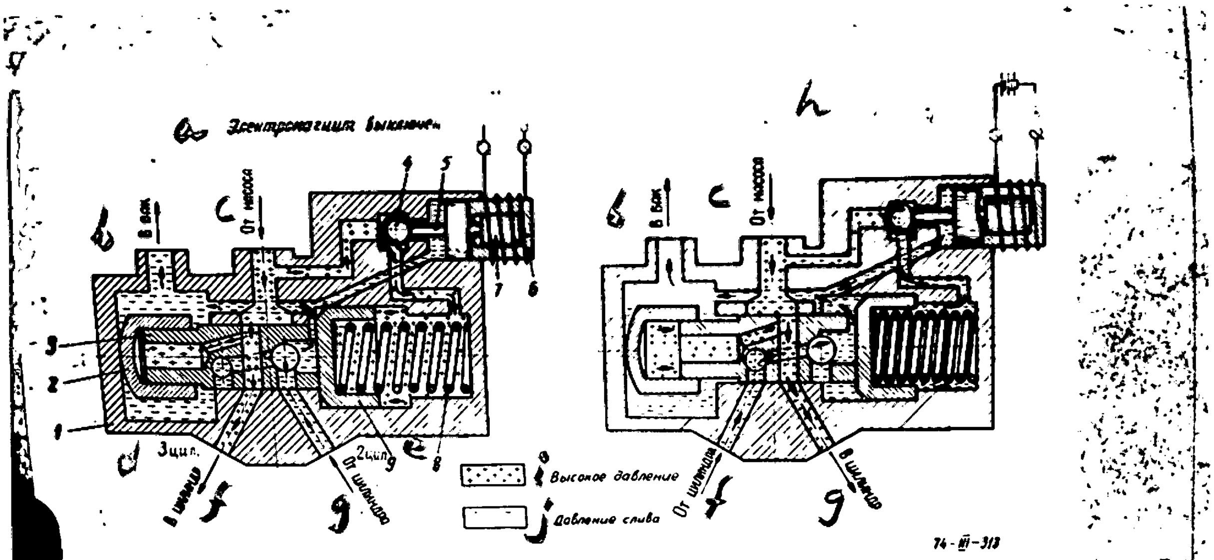

Фиг. 165. Кран ГА-184.

[redacted] 3 – золотник; 4 – клапанный датчик; 5 – толкатель; 6 – корпус катушки; [redacted] 9 – поршень.

S-E-C-R-E-T

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Fig. 165. Vaîve GA-184. 1. housing; 2. piston; 3. slide; 4. valve sensor; 5. lifter; 6. coil housing; 7. armature; 8. spring; 9. piston.

a. electromagnet switched on; b. to tank; c. from pump; d. 3 cylinder; ~~kx~~

e. 2 cylinder; f. to cylinder; g. from cylinder; h. electromagnet turned off;

i. high pressure; j. overflow pressure.

When the electromagnet is turned on, armature (7) moves, seating the valve ball, preventing the fluid from passing from pipe "1 pump" to the inner cavityof the piston and coupling it with the overflow into the tank. The slide, under pressure of the fluid at its left end moves to the extreme right, compressing spring (8) and moving the piston to the stop.

The slide occupies a position such that the cavity "1 pump" is connected with the cavity "2 cylinder," while the cavity "3 cylinder" is connected with the cavity "4 tank."

If the electromagnet is turned off, the valve moves back to the initial position, due to pressure.

The valve is located in the compartment of the front landing gear, to the left.

D. Wing Flap Control System (Fig. 166)

The wing flap control system includes:

--GA-185 electromagnetic valve (31), and

--two extend and retract cylinders (50).

To obtain the set extend speed (2-3 seconds) for the wing flaps the extend line contains two 1-mm-diameter throttles in series, one of which is mounted in the outlet pipe of valve GA-185.

The wing flaps are held in the retracted position by the mechanical locks of the hydraulic cylinders; they are held in the extended position by pressure from the fluid.

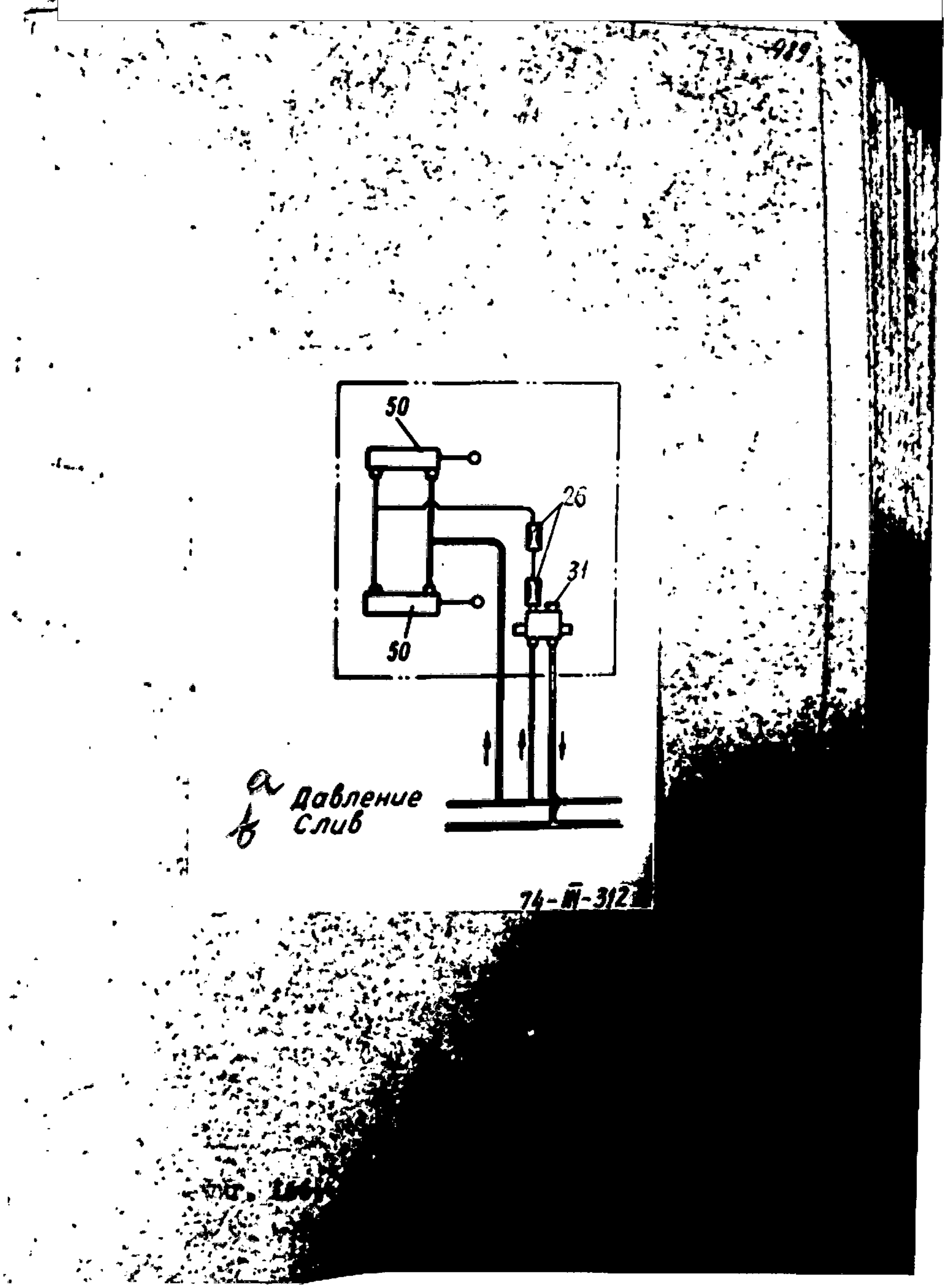

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Fig. 166. Wing flap control system (positions as in Fig. 146).

a. pressure; b. overflow.

The wing flap cylinders are coupled to the hydraulic system such that "retraction" pressure is fed constantly from the system, while "extension" pressure is fed from the valve. When the valve is set for "extension," the cylinder rods extend due to the difference in areas of the piston of the cylinder (the area of the piston for retraction is less, by the value of the rod area, than that of the piston for extension).

When the valve is set for "retraction," the extension line is coupled with the overflow and then the cylinder rod retracts under the pressure of the fluid constantly fed to it. Since there is no fixation of the wing flaps in the extended position, at a specific flight speed the flaps will be retracted by the forces of the aerodynamic load and the action of the pressure of the fluid fed to the retract line.

Thus, the wing flaps of the plane can be called "floating" flaps. For such flaps, with increasing speed the angle of extension decreases. The fluid is forced out through the extend line to the system and is used to refill the accumulators, or, if the pressure exceeds 240^{+5} kg/cm^2, it is bled off to the overflow through the safety valve.

The GA-185 valve is controlled from the MZ-1 panel on the left of the instrument board. There are two buttons: "Extend" and "Retract."

Signal lights, in the form of arrows, show up on the corresponding buttons.

When the "Extend" button is pushed, the valve GA-185 feeds fluid for extension, and the wing flaps, after extension, are set in accordance with the flight speed.

When the "Extehd" button is pushed, the sign "Wing Flaps Extended" appears on the control panel. If when the flaps are extended the landing gear is not lowered, the signal "Lower Landing Gear" appears on the PPS-2 signal board.

Elements of the Wing Flap System

Wing flap cylinder (Fig. 167); this is designed to retract and extend the flaps. The cylinders are held in the extended position by fluid pressure; they are held in the retracted position by fluid pressure and a mechanical swivel lock.

The wing flap cylinder consists of liner-housing (1), an extendable rod with swivel lock (2) and adjustable bolt (4), fixed rod (6), and the locking mechanism of the bushing-lock (5).

At the end of the "retract" cycle, the balls of the lock, mounted in the rod piston, press against the bushing of the locking mechanism and move, compressing the spring until the balls drop into the hole in the steel bushing which is fixed in the housing.

At this moment, due to the compression forces of the springs of the locking mechanism bushing, the balls engage in the hole and the bushing passes beneath the balls and immobilizes them, preventing their release.

The cylinder rod is locked in this position.

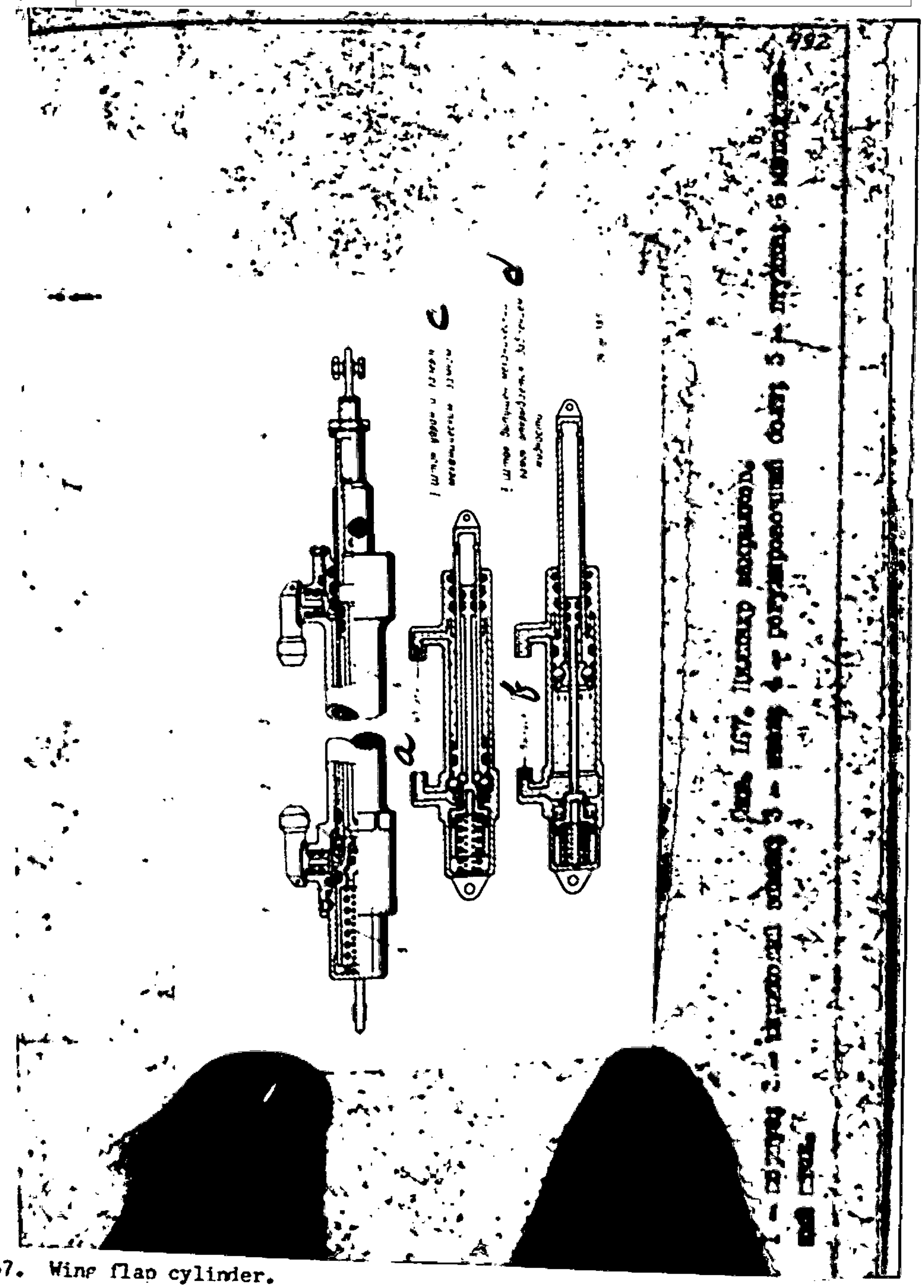

Fig. 167. Wing flap cylinder.

1. housing; 2. ball lock; 3. rod; 4. adjustable bolt; 5. bushing; 6. fixed rod.

a. retract; b. extend; c. I. Rod retracted and locked by mechanical lock;

d. II. Rod extended, mechanical lock opened by fluid pressure.

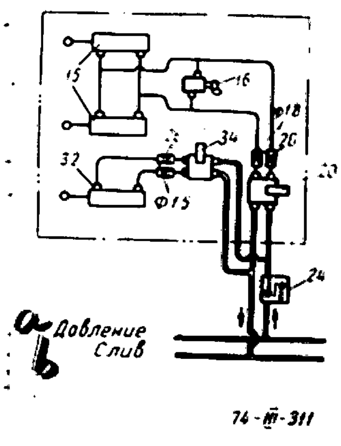

Fig. 168. Brake flap control system (positions as in Fig. 146).

a. pressure; b. overflow.

The control buttons are connected in parallel into the electrical circuit.

The hydraulic system for control of the brake flaps begins with the combination valve (consisting of a check valve and a thermovalve) installed in the delivery line.

Behind the check valve the pressure line branches to the GA-140 side-flap valve and the GA-184 ~~xxxxxx~~ center-flap valve. The outlet pipes of the valves are coupled, respectively, to the brake-flap cylinders. The retract and extend lines for the side brake flaps can be inter-connected by a cycling valve.

The cycling valve is designed to connect (cycle) the systems of the side flaps in order that when the technical equipment is operating in the region of the closed side flaps they will not open by chance when pressure is created in the system.

[remainder illegible]

as follows.

When the button on the control stick or the throttle control is pushed, power is fed to the electromagnets of the valves and the valves go into the "Extend" position.

The brake flaps--side and center (if the tank is not suspended)--are extended.

When the button is returned to the initial position, the electromagnets of the valves are released and the valves go to the position "Retract." The brake flaps then retract.

The brake flaps are held in the retracted and extended position by fluid pressure.

If there is no pressure in the system, the flaps are held in the retracted position by the check valve.

The thermovalve, mounted inside the check valve, bleeds excess pressure of the working fluid which occurs due to a rise in temperature during operation of the plane.

The following throttles are installed to lower the overflow pressures in the working valve lines:

--in the extend and retract line behind the GA-140 valve there are 1.8-mm throttles mounted in the valve pipes;

--in the extend and retract line behind the GA-184 valve are 1.5-mm throttles. One throttle is mounted in the valve extend pipe, the second is in the retract line.

The throttles are inspected and flushed out every 50 hours of flight time.

Elements of Brake-Flap Control

Brake flap thermovalve (Fig. 169); this consists of housing (1), cover (4), check valve (6) with spring (5), seat (3), and calibrated spring (7) with stop (2).

The valve is included in the system such that the fluid fed to the valves passes through the inlet pipe and the check valve, and enters the valves.

With no pressure in the system, the check valve is closed and cuts off the brake flap system from the delivery line.

Since the valves with brake flaps retracted connect the retract line with the delivery line, consequently the check valve prevents expulsion of the fluid from the [illegible] retract line into the system, i.e., suction of the brake flaps during flight is eliminated. When the pressure in the retract cavities rises to 20^{+5} kg/cm^2, the check valve together with the seat moves under the influence of the pressure, compressing the calibrated spring. When this pressure is reached the ball of the valve is thrown against the stop, due to which excess pressure is bled off.

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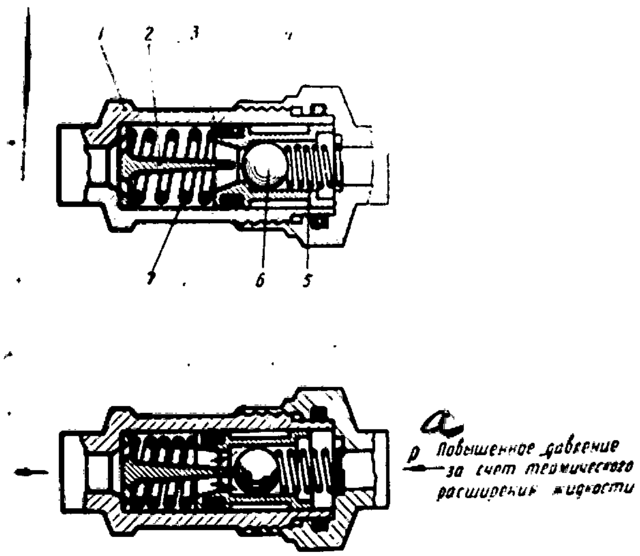

Фиг. 169. Термоклапан тормозных щитков:
1 – корпус; 2 – упор; 3 – седло; 4 – крышка; 5 – пружина;
6 – шарик; 7 – тарировочная пружина.

Fig. 169. Brake flap thermovalve.

1. housing; 2. stop; 3. seat; 4. cover; 5. spring; 6. ball; 7. calibrated spring.

a. increased pressure due to thermal expansion of the fluid.

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In a normally operating system and with thermal expansions of the fluid in the cut-off volume, the valve opens when the pressure drops to 20^{+5} kg/cm^2, i.e., the pressure behind the valve is greater, by the value of the valve calibration, than in the system. This prevents damage to the flap cylinders. The valve is located to the right in the engine compartment between frames 22 and 23.

Cycling valve (Fig. 170); this is designed to connect the extend line for the side flaps with the retract line when working with the plane on the ground, in order to exclude chance closing of the flaps to prevent unfortunate accidents when working near the flaps.

The valve consists of housing (2), recoil spring (6), rod (3), covers (1) and (4), and handle (5). The rod has a clearance of 4-6 microns in the housing, to eliminate great leakages between the flap control lines.

The rod is hydraulically balanced. The lines are connected by pulling out the rod and placing a special fork with a marker between the cover and the handle. The initial overlap between pipes, realized by the shoulder ofthe slide, disappears, and the cavities of the pipes are coupled across the central channel in the slide.

The valve is located in the right main-wheel housing.

The valve handle is red. The rod is held in the extended positionby a pin with a marker.

Valves GA-184 and GA-140; these are of similar design. Unlike the GA-184, the GA-140 has large flow areas and a manual-control knob in the electromagnet housing.

The operation of the GA-184 is given in the section "By-Pass Vent Control." The GA-140 is located in the lower part of the compartment between frames 20 and 22; the GA-184 is to the right in the engine compartment, between frames 26 and 27.

The Side Brake Flap Cylinders (Fig. 171); these have the design feature that the feeding of fluid for retraction is done using a special inner device, which eliminates the need for outside fulhxmx pipes and lines.

The components of the cylinder are:

--fill pipes (1);

--cylinder cover (2);

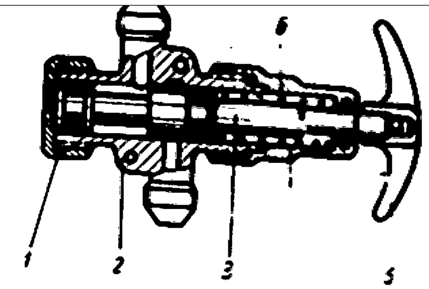
--cylinder housing (3);

--inner bushing (4);

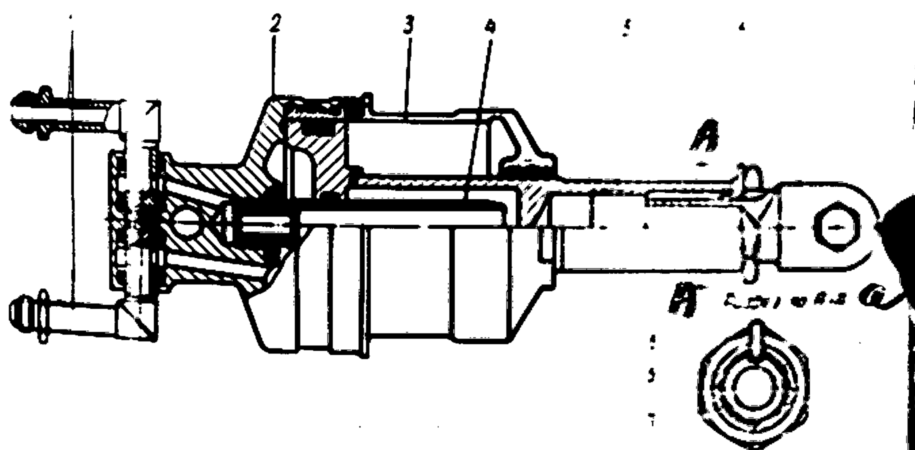
--rod with piston (5);

--locking block (6); and

--eye bolt (7).



Фиг. 170. Кран колебания.
1 – крышка; 2 – корпус; 3 – шток; 4 – крышка; 5 – ручка;
6 – возвратная пружина.



Фиг. 171. [illegible]
1 – штуцер; 2 – крышка; 3 – [illegible]
5 – шток; 6 – буксир [illegible]

Fig. 170. Cycling valve.

1. cover; 2. housing; 3. rod; 4. cover; 5. handle; 6. recoil spring.

Fig. 171. Side brake flap cylinder.

1. pipe; 2. cover; 3. housing; 4. inner bushing; 5. rod; 6. block; 7. eye bolt.

a. cross section A-A.

When pressure is fed for retraction, the fluid passes along the inner channel, through the rod cavity and opening, and into the retract cavity. The rod is extended by means of the extend pipe coupled with the cavity beneath the piston.

The lower brake flap cylinder, unlike that just described, has an outside retract-pressure feed. The side brake flap cylinders are located between frames 12 and 13; the lower brake flap cylinder is between frames 24 and 25.

F. Landing Gear Control System (Fig. 172)

The landing gear control system assures retracting and lowering of the main and front landing gears, and also opening and closing of the main strut flaps.

The landing gear control hydraulic system consists of:

--landing gear valve GA-142/1 (33);

--three check valves (12);

--two matching valves (29);

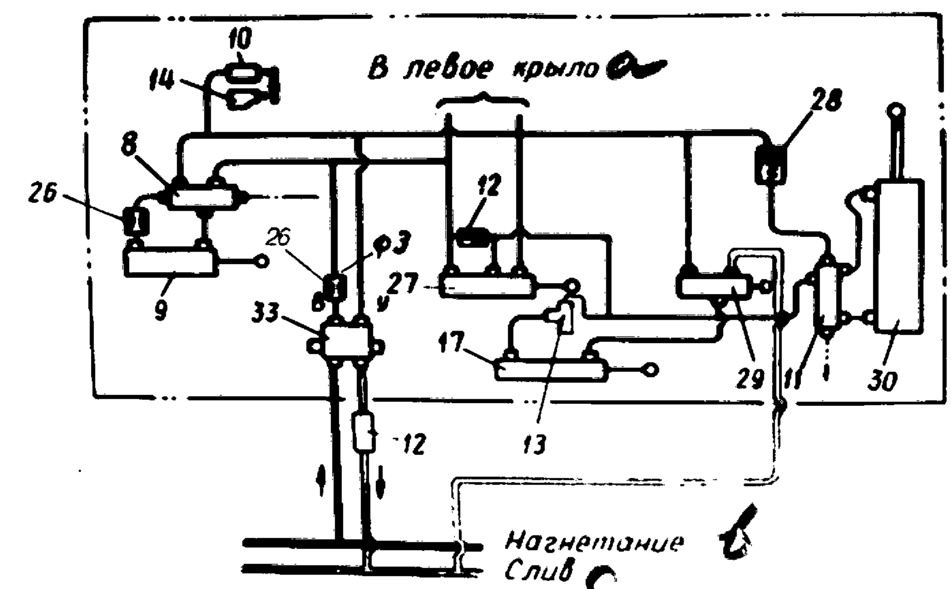
--three cylinders for retracting and lowering the landing gear struts (9) and (30), equipped with hydraulic locks (8) and (11);

--two cylinders for retracting and lowering the main strut flaps (17);

--two emergency valves (13); and

--cylinders for landing gear suspension locks (27);

The pilot controls the GA-142/1 landing gear valve by means of a switch in the cockpit.



Фиг.172. Система управления шасси (позиции даны по фиг.146)

Fig. 172. Landing gear control system (positions as in Fig. 146).

a. to left wing; b. delivery; c. overflow.

he switch has three positions: "Lower," "Retract," and "Neutral."

These three positions correspond to the three positions of the GA-142/1 valve.

When the switch is in the "Lower" position the valve connects the lowering line with the delivery line, and the retract line with the overflow line.

The fluid, through the lowering line, is first fed to the cylinders of the main landing-gear strut suspension locks, and also to the hydraulic lock and cylinder of the front strut.

After opening the locks, when the main and front struts are freed from their suspension, the fluid passes through the cylinders for opening the main strut locks and goes to the hydraulic locks of the main struts, and then to the cylinders of the retracting gear and also to the landing gear flap cylinders.

First the landing-gear flaps are lowered, then the main struts.

The front strut is lowered somewhat ahead of this, since the fluid to lower the front strut is fed immediately to the hydraulic lock and the strut retracting gear.

The main struts are held in the lowered position by the inner mechanical locks of the retracting gear cylinders and by the hydraulic locks, while the front strut is held in this position by the stop and the hydraulic lock.

After lowering of the landing gear for a landing the switch remains in the "Lowered" position until the plane has stopped taxiing and come to a stop; then it is turned to the "Neutral" position and fixed with a marker.

When the switch is turned to the "Retract" position the GA-142/1 valve connects the retract line with the delivery line and the lowering line with the overflow.

The fluid, under pressure, passes to the hydraulic lock of the front strut and to the automatic braking cylinder.

Simultaneously, the fluid is fed to the hydraulic locks of the main landing gear struts, the cylinders of the suspension locks, and the matching valves. The cylinders of the suspension locks remain in their original position, making it possible for the locks to close when the struts are raised into them.

From the hydraulic locks the fluid is fed to the retracting gear-cylinders and all three struts retract. At the end of retraction, the main struts press againstthe rods of the matching valves, through which, when the rods are compressed, the fluid is fed to raise the flaps of the main struts.

When the suspension lock cylinders are set in the initial position the lowering line is closed off; at this time it acts as an overflow line. Then the overflow is directed through the check valve and the cycling line of the suspension lock cylinder.

The automatic braking cylinder, when pressure is fed to it during retraction of the landing gear, presses against the lever of brake valve PU-7 and brakes the wheels.

When the valve is set in the "Neutral" position, the lower and retract lines are coupled to the overflow line.

To lower the overflow pressure in the lowering line of the

GA-142/1 there is a 3-mm throttle in the valve pipe.

To prevent a rapid drop of the struts under their own weight at the moment of lowering, the retract lines contain:

--a 2.5-mm throttle for the front strut, mounted on a steel angle plate by means of two compression nuts; and

--1.2-mm one-way throttles for the main struts.

To exclude the influence of overflow pressures in the system, arising during operation of the brake flaps, which might result in removal of the retracters of the landing gear from the mechanical locks, the overflow line behind the GA-142/1 valve has a check valve mounted in the valve overflow pipe.

The struts are held in the retracted position by suspension locks.

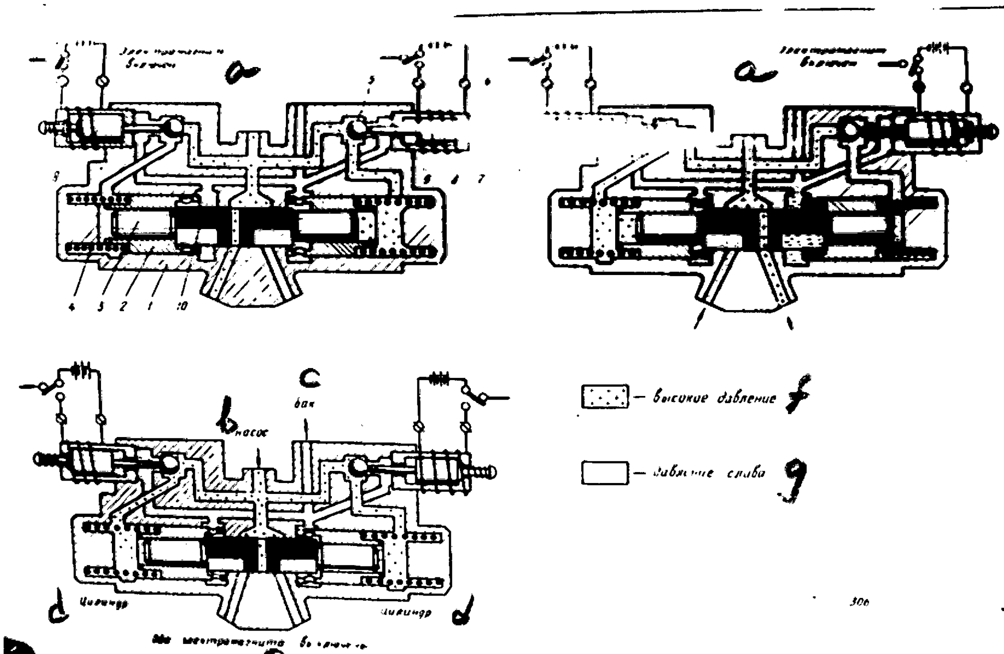
After retraction of the landing gear, the signal light "Landing Gear Retracted" lights up, and the switch should be set to the "Neutral" position and held in place by the marker.

After lowering of the landing gear the signal light "Landing Gear Lowered" lights up on the signal panel.

Elements of the Landing Gear

The landing gear valve GA-142/1 (Fig. 173) is a three-position electromagnetic servo-valve.

The valve consists of two electromagnetic sensors



300

рпус

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Fig. 173. GA-142/1 landing gear valve.

1. housing; 2. bushings; 3. plunger; 4. spring; 5. valve sensor; 6,7,8 [illegible];
9. lifter; 10. slide.

a. electromagnet switched on; b. pump; c. tank; d. cylinder; e. both electromagnets switched off; f. high pressure; g. overflow pressure.

(5), regulating slide (10), plungers (3) and bushings (2) with springs (4) located in housing (1) made of aluminum alloy.

Manual-control knobs are provided for in the design of the valve.

When the electromagnets are switched off, the balls of the pressure sensors are seated. The cavities to the left and right of the regulating slide are coupled with the pressure line, and the slide is in the middle neutral position because of the springs. Both outlet pipes are connected with the overflow.

When the left-hand electromagnet is switched on, its armature, as it moves, presses against ball (5), seating it. Now the cavity to the left of the regulating slide is coupled with the overflow, while the cavity to the right remains coupled with the pressure line.

The right-hand plunger, under pressure, moves slide (10) to the extreme left position.

The right-hand bushing during this remains in place, since it butts against the housing.

The left-hand plunger and bushing move together with the slide to the extreme left-hand position until the right-hand bushing does not butt against the housing.

Now the left-hand pipe is connected with the pressure line, and the right-hand one is coupled with the overflow.

When the left-hand electromagnet is switched off, the ball, due to fluid pressure, is released from its seat and the cavity to the left of the slide is connected with the pressure line.

The slide begins to return to the neutral position, since it is acted upon by the force from the left bushing because of the spring, xxxxx because of the fact that the forces from the fluid pressure are balanced.

The slide pressure ceases as soon as the left-hand bushing reaches the stop in the housing.

Now the cavity "Pump" is closed and the outlet pipes communicate with the overflow.

[remainder illegible]

The check valve, consisting of a ball, slide, spring, and housingwith cover, is screwed into the "Tank" recess of the housing.

The check valve ~~xxxx~~ passes the flow of fluid in a direction away from the valve and prevents pressure from being propggated from the overflow lines of the system to the landing-gear control system.

The valve is installed to the right in the engine compartment between frames 24 and 25.

Suspension Lock Cylinder (Fig. 174)

The suspension lock cylinder of the main landing gear struts consistsof housing (1), rod (2) with adjustable screw and retainer nut, fixed plunger (3), with cover (4).

The cylinder rod is hydraulically balanced, i.e., the area of the rod piston in the "retract" cavity is equal to that of the rod piston in the "lower" cavity. This is due to the fixed plunger incorporated in the design, along which the rod moves from the lowering line. The diameter of the plunger ~~xxx~~ shaft is equal to that of the cylinder rod.

This prevents spontaneous operation of the cylinder when pressure occurs in both cavities of the cylinder when the GA-142/1 is in the neutral position (i.e., when overflow pressure occurs).

The cylinder housing has three pipes--one for the retract line and two for the lowering line.

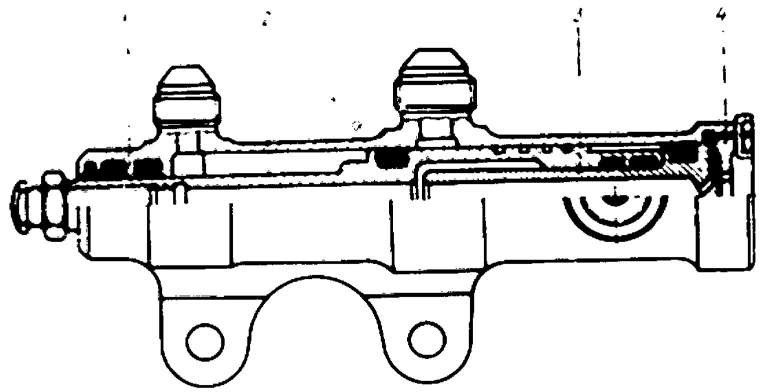

Fig. 174. Suspension lock cylinder.

1. housing; 2. rod; 3. plunger; 4. cover.

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The cylinder rod is placed in the cylinder with only slight clearance, ~10 microns, to decrease leakage when lowering the landing gear.

When pressure is fed for lowering, the fluid acting on the rod moves it so as to open the suspension lock; pressure is not fed to the other elements in the lowering line for the main landing gear. After release of the rod, the way isclear for the fluid to pass to the second lowering pipe, and the fluid enters the flap cylinders and the retraction hydraulic lock, continuing the lowering cycle.

The lowering line is locked such that the pressure for lowering the main struts is not fed to the landing gear retractor while the strut is still in the suspension lock.

The front strut has its own locking, which uses, to open the suspension lock in the retracted position, the initial travel of the strut retractor for lowering.

During retraction, when the rod, because of pressure, moves to the initial position and uncouples the lowering openings (which at this moment are the overflow line), overflow from the lowering cavity of the landing gear retractor is fed through a special cycling line which has a check valve.

The lock cylinders are installed together with the suspension locks in the wing between ribs 1 and 2.

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Hydraulic Lock (Fig. 175)

The hydraulic locks of the main and front landing gear are identical in design and differ only in the configuration of the connecting pipes.

The hydraulic lock consists of housing (1) and (4), connecting nut (2), liner (7), valve (8) with a thermovalve, emergency lowering valve (10) and piston (3) with lifter (6) and recoil spring (5).

The hydraulic lock is designed to cut off the fluid in the retractor lowering cavity, which prevents retraction of the main struts during a breakdown in the mechanical locks of the retractors.

When pressure is fed to lower the gear, the fluid fed to pipe "A" enters the cavity of housing (4). Then, compressing the valve with the thermovalve, the fluid ~~stream~~ passes through the outlet pipe to the retractor and the strut is lowered.

When the struts have been lowered, and the pressure ahead of and behind the valve is balanced, the valve with the thermovalve, by means of recoil spring (9), is seated, thus closing off the fluid in the retractor lowering cavity.

When the landing gear is retracted, the fluid, fed to pipe "B," moves the piston and the lifter to the extreme left-hand position. Now the lifter presses against the valve with the thermovalve, thus permitting passage of the fluid from the lowering cavity to the overflow line. When retraction has ended, when the landing gear valve is in the "Neutral" position, the recoil spring of the piston

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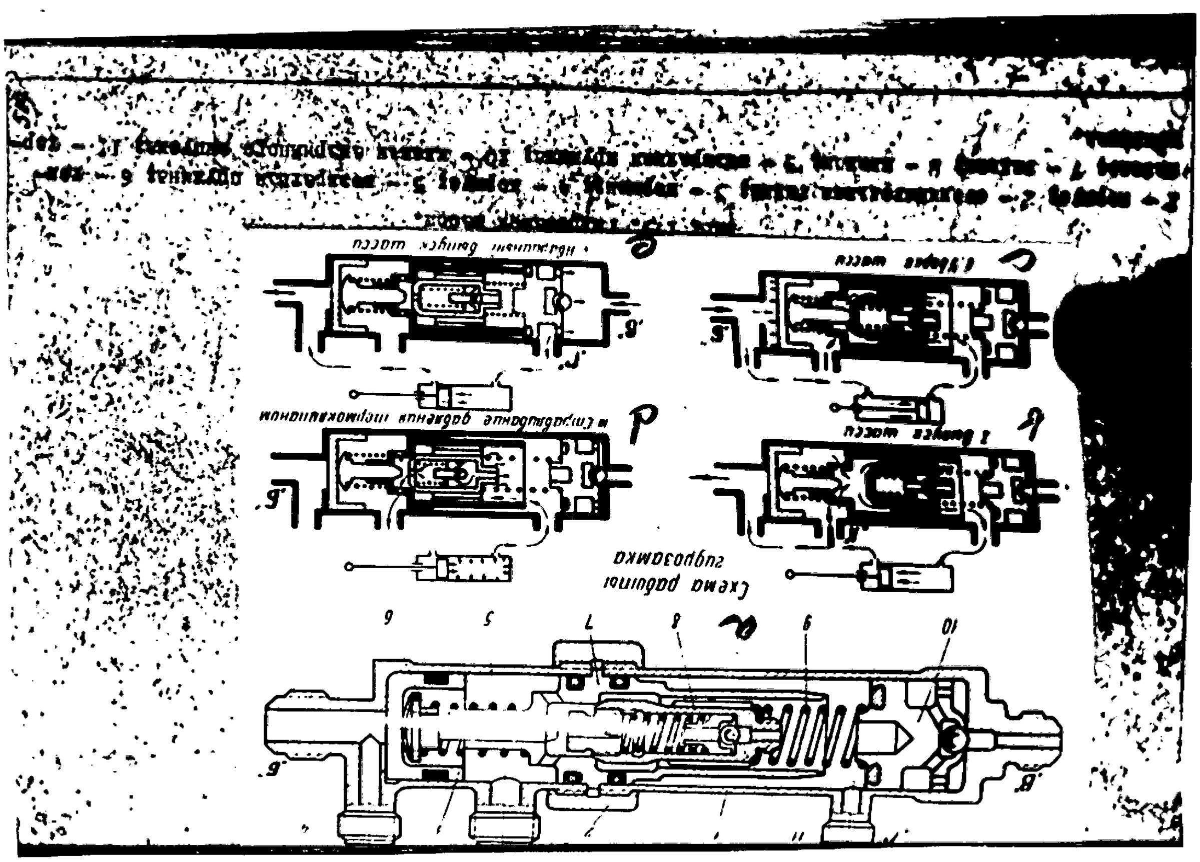

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Fig. 175. Landing gear hydraulic lock.

1. housing; 2. connectingx nut; 3. p'ston; 4. housing; 5. recoil spring; 6. lifter; 7. liner; 8. valve; 9. recoil spring; 10. elergency lowering valve; 11. thermovalve.

a. diagram of the operation of the hydraulic lock; b. I. Landing gear lowering; c. II. Landing gear retraction; d. III. Pressure bleed by means of thermovalve; e. IV. Emergency landing gear lowering.

returns the lifter and the piston to the initial position, and the valve with the thermovalve is seated by means of its spring.

With thermal expansions of the fluid in the volume cut off by the valve, the pressure is bled off through the thermovalve mounted on the valve of the hydraulic lock.

Thermovalve (11) consists of a ball, a stop, and a spring with a nut; it is calibrated to open at 275 kg/cm^2 pressure.

The nut is locked by means of the spring of the threaded part of the nut, due to which in the nut there is a special slot with subsequent release of the groove.

During emergency lowering of the landing gear the compressed air, fed to pipe xxx "B" moves the emergency lowering valve to its seat which is formed by the end of the liner. Now the air passing through pipe "Г" lowers the landing gear; hermetic sealing between the air cavity and the hydraulic system is realized by end packing of the emergency lowering piston pressed against the liner end.

When air is bled from the emergency lowering line, the emergency lowering valve is seated in housing (1) by the recoil spring.

The hydraulic locks for the main struts are located on the retractors; the hydraulic lock for the front strut is located to the right in the strut housing, between frames 5 and 6.

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Front Landing Gear Strut Retractor-Cylinder (Fig. 176)

The retractor cylinder consists of upper cover (2) with suspension swivel (1), liner (4), rod (5) with eye bolt (7) and retainer nut, and lower cover (6) with a hold-down nut.

By means of this cylinder the front strut is lowered or retracted.

The kinematics of the motion of the front strut and the coupling of the cylinder to it are such that when the strut is lowered the rod is withdrawn into the cylinder, and when the strut is retracted the rod is projected from the cylinder.

Pressure is fed to to the retract and lower cavities through suspension swivel (1) of the cylinder, which eliminates the need for flexible conduits.

Main Landing Gear Strut Flap Cylinder

This cylinder is similar in design to the retractor of the front landing gear strut. The flap cylinders are installed in the right and left wheel housings.

Matching Valve (Fig. 177)

To avoid damage to the main wheel flaps when the landing gear is retracted, there must be a strict sequence to retracting the strut and the flap.

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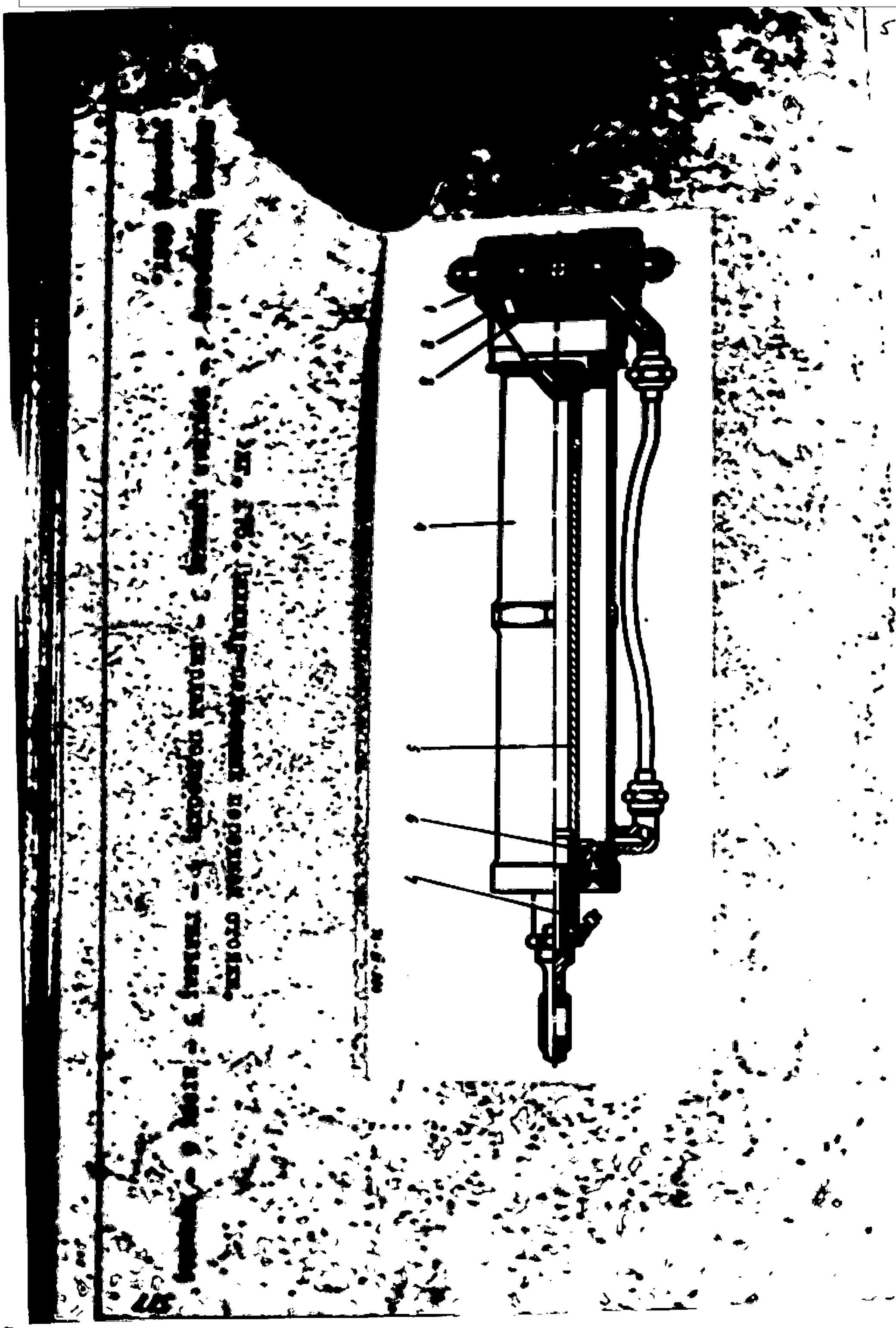

Fig. 176. Front strut retractor-cylinder.

1. suspension swivel; 2. upper cover; 3. suspension universal joint; 4. liner; 5. rod; 6. cover; 7. eye bolt.

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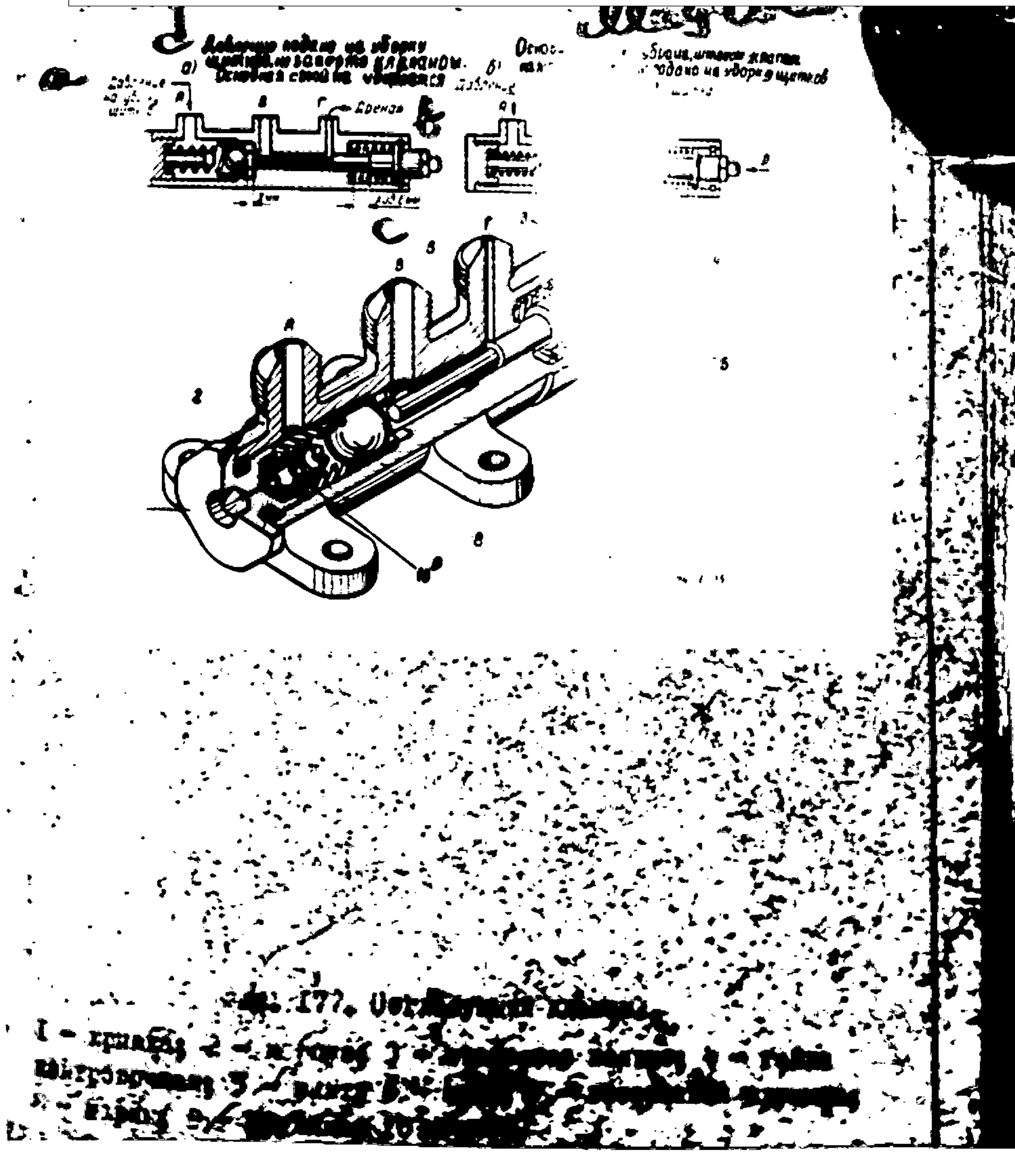

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Fig. 177. Matching valve.

1. cover; 2. housing; 3. stop rings; 4. lock nut; 5. screw; 6. rod; 7. recoil spring; 8. ball; 9. spring; 10. stop.

a. pressure to retract flaps; b. bleed; c. 6-mm travel; d. a) pressure fed for retraction of flaps, but blocked by valve. Main strut retracted.

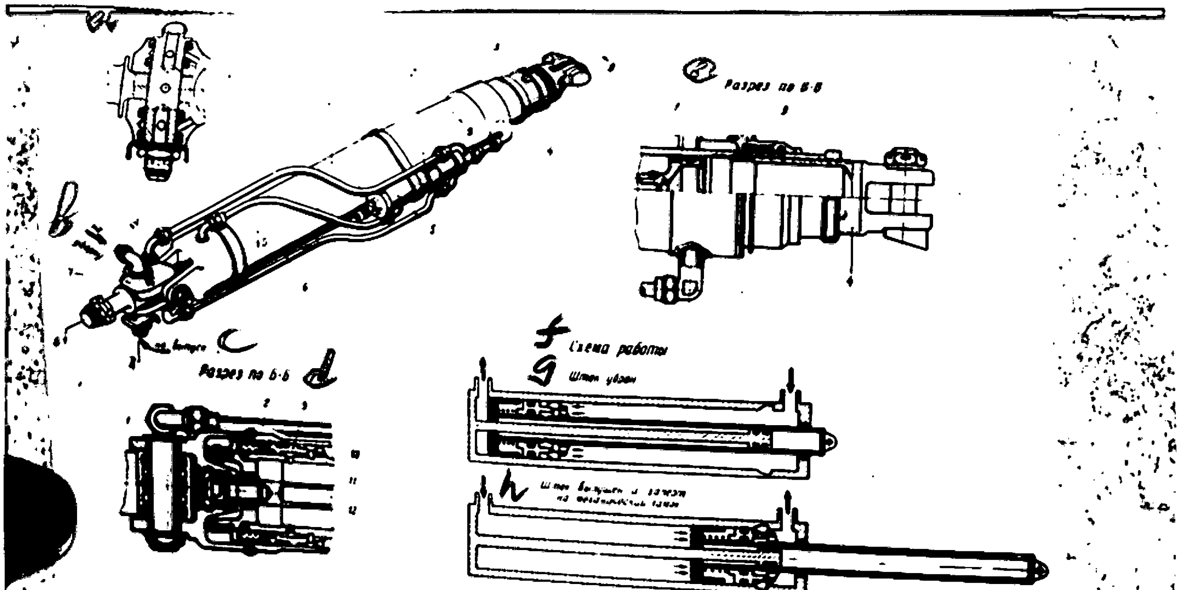
[remainder illegible]

Such synchronization (or matching) of strut and flap retraction is attained by installing a matching valve in the flap cylinder retraction line.

The matching valve consists of housing (2), check valve with ball (8), spring (9) with stop (10), and rod (6) with recoil spring (7). When retract pressure is fed, the fluid goes to the strut retractors and the flap cylinders. The main struts begin to retract, but fluid is not fed to the flap cylinders because passage to the retract cavity of the cylinder is blocked by the check valve of the matching valve. When the struts are locked in the retraction locks, the projection on the strut cylinder presses against the rod of the matching lock, which moves the ball of the check valve. Then the fluid enters the cavityof the landing gear flap retraction cylinders, the flaps are retracted, and they cover the wheels of the landing gear.

When lowering the landing gear the rod is set in its initial position by recoil spring (7). The ball is seated. But since during flap lowering the flow of fluid to overflow from the retract cavity travels in the opposite direction, in this case the check valve does not prevent its movement.

If the valve is not pressurized, or if there is no bleeding, partial retraction of the flap is possible, causing damage. To eliminate this



[illegible] Цилиндр-подъемник главных стоек шасси:

1 – гильза цилиндра; 2 – трубка линии уборки; 3 – нижняя крышка; 4 – ушковый болт; 5 – гидроза-
мок; 6 – трубка линии выпуска; 7 – узел подвески; 8 – кардан; 9 – стопорная втулка; 10 – шток;
11 – внутренний поршень; 12 – разжимное кольцо.

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Fig. 178. Main landing gear strut retractor-cylinder.

1. cylinder lining; 2. retract line; 3. lower cover; 4. eye bolt; 5. hydraulic lock; 6. lower line; 7. suspension fitting; 8. universal joint; 9. stop bushing; 10. rod; 11. inner piston; 12. expanding ring.

a. section A-A; b. retract; c. lower; d. section Б-Б ; e. section B-B; f. diagram of operation; g. rod retracted; h. rod extended and locked by mechanical lock.

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The retract and lowerx cycles are accomplished as follows:

--when pressure for lowerin- is fed in, the fluid passing through the axle of the universal joint and the universal joint itself enters the hydraulic lock and through it goes to the lowering cavity. Acting on the area of the rod piston, the fluid moves the rod.

The rod piston incorporates anx expanding ring-lock (12) and a stop bushing (9) with a spring. When the rod moves to lower the struts, and in the retracted position, the expanding ring is compressed, the bushing is pressed out, and the spring is under tension.

At the moment the rod goes into the lowered position ahead of the stop, the expanding ringx coincides with a special slot in the housing and this per its it, as it expands, to snap into the slot. The ring is then fixed by the bushing by means of the spring and pressure such that the outside diameter of the bushing projection goes into the ring, preventing [illegible] compression of the lock. The lock is closed and when an axial load for retraction is in effect, the rod cannot move, i.e., its projection rests against the fixed ring.

During retraction, under pressure of the mixturex the bushing moves to the left, freeing the expanding ring; when the rod moves for retraction the expanding ring again compressed along the sides of the groove in the housing to a size equal to the cylinder diameter; the rod can then be retracted, and the landing gear strut is retracted.

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An internal piston device makes it possibleto increase the diameter of the cylinder rod without decreasing the area of the piston in the "retract" cavity.

Automatic Brake Cylinder (Fig. 179)

The automatic brake cylinder is installed in the landing gear retract line. By means of the automatic brake cylinder the lever of valve PU-7 is pressed and there is subsequent braking of the wheels during retraction.

The cylinder consistsof housing (3), cover (1), and rod (2) with recoil spring (4).

When retract pressure is fed in, the rod moves under the action of the incoming fluid and, moving the pressure lever of the PU-7, braking occurs.

After the ~~xxixx~~ GA-142/1 landing gear valve is set at "Neutral," the rod is returned to its initial position by the spring, and the wheels are debraked by means of the PU-7. The adjustable screw is set such that the pressure in the brake system when the PU-7 operates will be ~~xxxxxx/xx~~ 3-4 kg/cm^2. The cylinder is installed on the control pedestal between frames 6 and 7.

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One-Way Throttle (Fig. 180)

The one-way throttle assures deceleration of the fluid flow in one direction, and unimpeded passage of the fluid in the other, opposite direction.

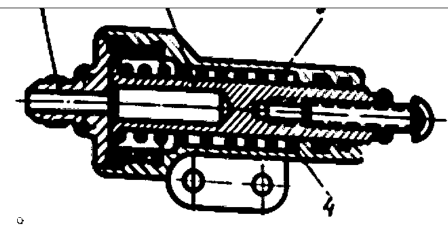
Such an operational set-up is attained by using, in the design, a check valve having a small opening in its plunger (6), which connects the inlet and outlet pipes.

When pressure is fed in the direction opposite to the plugger, the fluid can pass only through the calibrated opening, with considerable deceleration of the flow.

With reverse flow of the fluid the plunger, due to pressure, moves to the left, compressing recoil spring (4), and the flow of fluid passes unhindered through the throttle.

In the hydraulic system the one-way throttles are installed in the main landing gear strut retraction line such that at the moment of lowering they throttle the fluid that overflows from the retractor retraction cavities, assuring smooth lowering of the struts. During retraction the throttles do not affect the rate of retraction, since the flow is not decelerated in this direction.

The one-way throttle consists of housing (1), cover (2), plunger (6), protective mesh (5), spring (4), and support (3). The diameter of the throttle opening in the plunger is 1.2 mm; it is prevented from clogging by mesh (5).



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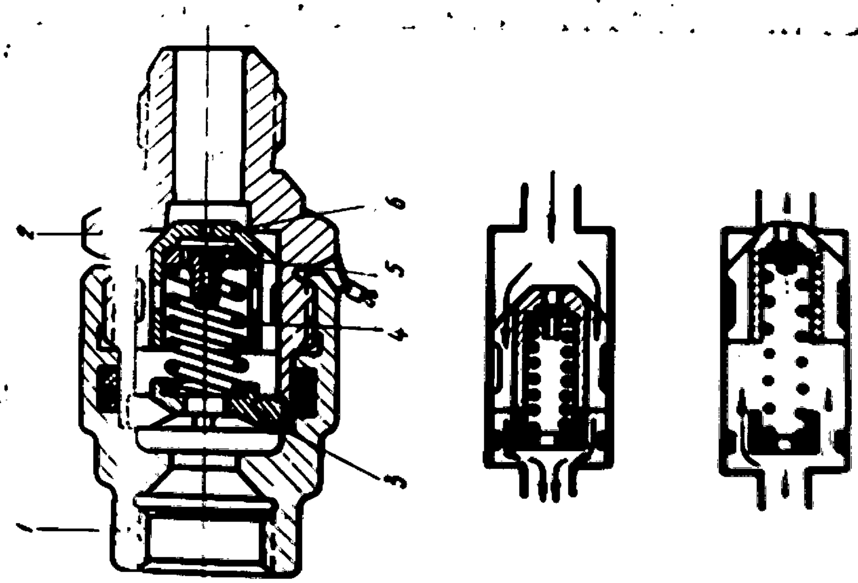
Фиг. 179. Цилиндр автоматического торможения.

1 – крышка; 2 – шток; 3 – корпус; 4 – возвратная пружина.



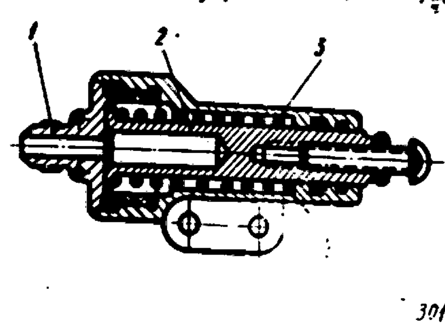
[illegible]

Fig. 179. Automatic brake cylinder.

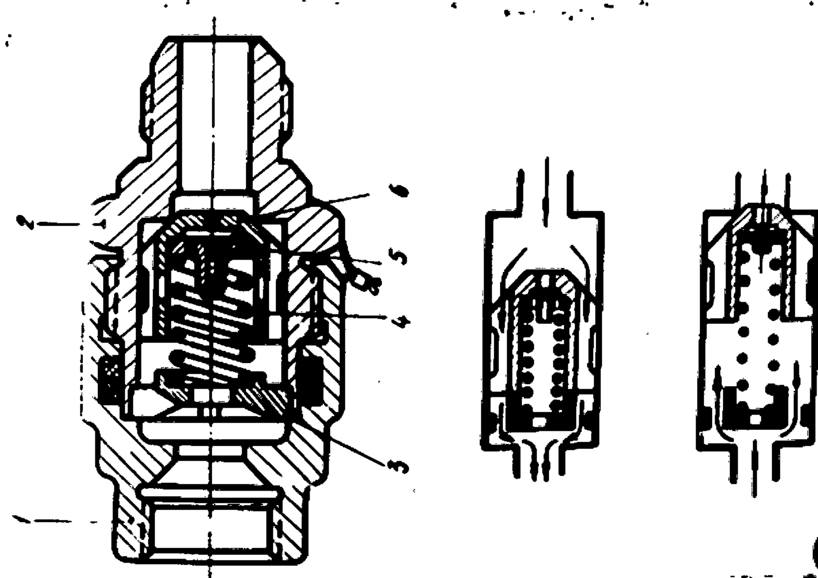
1. cover; 2. rod; 3. housing; 4. recoil spring.

Fig. 180. One-way throttle.

1. housing; 2. cover; 3. support; 4. recoil spring; 5. protective mesh; 6. plunger.



Фиг. 179. Цилиндр автоматического торможения.
1 - крышка; 2 - шток; 3 - корпус; 4 - возвратная пружина.



Фиг. 180. [illegible]
[illegible] корпус; 2 - [illegible] [illegible]
[illegible] заглушка корпуса; 6 - [illegible]

One throttle is installed in each wing, and mounted on the main strut retractor cylinders (on the retract pipes).

G. System for Control of the Engine Afterburner Vents (Fig. 181)

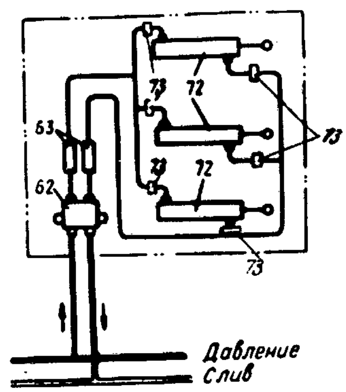
The engine afterburner vents are controlled automatically, depending on the position of the engine control lever (RUD). The hydraulic system for the vents contains a GA-164M hydraulic valve (62) and GA-173 metering devices. Behind the metering devices the line goes to the hydraulic collector for the engine, to which in turn are coupled the afterburner vent cylinders (72).

When the RUD is moved from the stop "Stop" to the stop "Maximum," the vents are in the position "Maximum."

When the RUD is set in the position "Minimum Afterburner," the GA-164M receives an impulse from one of the coils of the valve. The valve, being switched on, extends the vents to a specific opened position.

A change in the diameter of the flow area from 526 mm [?] to 610 mm [?] occurs without further movement of the RUD.

[remainder illegible]



Фиг. 181. Система управления форсажными [illegible] двигателя. ([illegible] по фиг. 146)

Fig. 181. Engine afterburner vent control system (positions as in Fig. 146).

a. pressure; b. overflow.

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The valve is switbhed in, i.e., reverse coupling of the vent-control cylinders with the RUD is accomplished, by means of the reverse-coupling sensor incorporated in the design of one of the cylinders.

The GA-173 metering devices, in the retract and lower lines between the GA-164M valve and the cylinders, are designed to allow passage toward the cylinders of a specific amount of mixture with subsequent closing of the system if the lines are damaged. The metering devices allow fluid to pass unimpeded in the reverse direction.

Elements ofthe Engine Nozzle [?] Vent Control System

The GA-164M valve (Fig. 182) is a combination of a three-position electromagnetic valve and a two-way hydraulic lock equipped with thermovalves.

The valve is designed to control the afterburner vent cylinders by feeding fluid pressure to the retract and lower cavities, closing off the fluid in the cylinders at any intermediate position.

The design of the valve provides for thermovalves to protect the cylinders in the system from thermal expansions of the fluid in the closed volumes.

The valve consists of housing (1) made of aluminum alloy, a two-way hydraulic lock, a hydraulic distributive device consisting of two sensors (2), ..., and two recoil springs (3), and two thermal valves (8).

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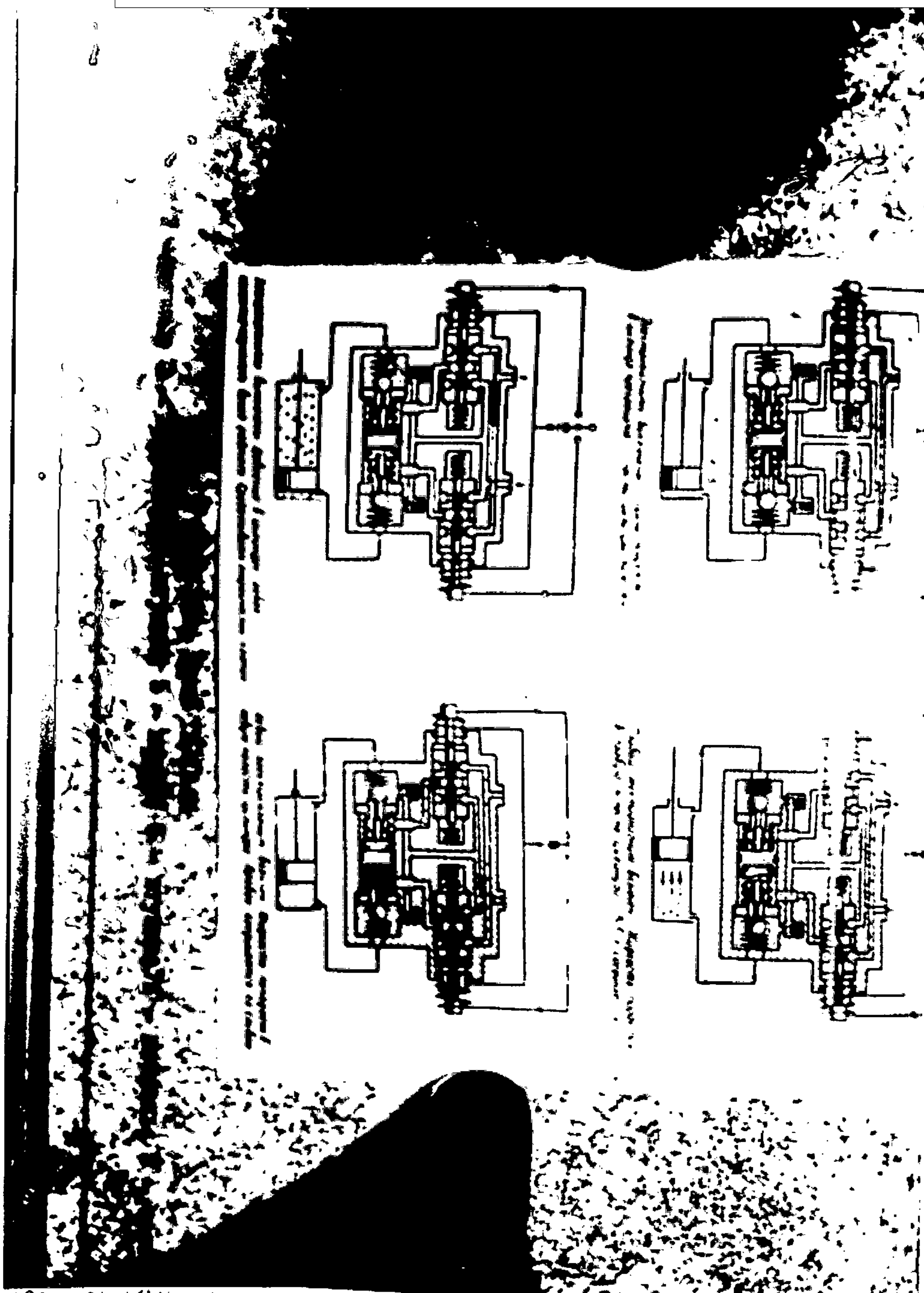

Fig. 182. GA-164M valve.

1. housing; 2. sensor; 3. cover; 4. bushing; 5. ball; 6. bushing; 7. piston; 8. thermovalve.

[calloutsx illegible]

During operation, the GA-164M valve can be set to the following positions:

1. When there is no current in the electromagnets, distributor valves (2) are pressed by springs (3) to the seats of bushings (4) such that there is no access of fluid from the high-pressure line to the cylinder.

The two-way hydraulic lock is closed in this position, i.e., balls (5) are seated in fixed bushings (6), while switching piston (7) is in the neutral position.

The fluid is closed off in the lower and retract cavities of the cylinders.

2. When voltage is fed to the right-hand electromagnet and when the armature of the magnet moves, the right-hand distributor valve moves to the left, compressing the spring. The valve is set such that the right-hand cavity is coupled with the pressure line and cut off from the overflow line.

The fluid presses against the ball of the hydraulic lock and enters the lowering cavity of the cylinder. Simultaneously, the fluid moves the switching piston which, by means of the lifter, opens the other ball of the hydraulic lock; this assures overflow of fluid from the overflow cavity when the rod is extended.

3. When the left-hand electromagnet is switched on there is analogous functioning of the valve for the left-hand distributor device. The fluid retracts the rod and overflows into the lowering cavity through

the ball of the lock, which has been opened by the piston.

When voltage is removed from the coil, the distributor slide is immediately seated by the spring and the valve is returned to the initial position described above in point 1.

4. With thermal expansions ofthe fluid, pressure is bled off through thermo-valves (8) whose inner cavities are coupled to the overflow. The thermovalves open at a pressure of 240^{+10} kg/cm^2.

The valve is installed in the upper right-hand part of the thermal accumulator compartment, between frames 31A and 33.

GA-173 metering device (Fig. 183); this is designed to cut off a damaged section of the line; this is done by closing off the feed ducts after a specific amount of fluid has been allowed to pass.

The GA-173 metering device consists of the following parts: housing (1), liner (2), floating valve (3), slide (5), valve (6), stop (9), diaphragm (12), and recess (11).

The liner has a rubber packing gasket (14) which separates cavities "A" and "Б" of the element. Pipes are screwed into the bottom of the housing and the cover.

Diaphragm (12) can move axially, from 0.3-0.4 mm.

When fluid enters the unit through opening "B," the diaphragm is pressed tightly against the seat of recess (11)

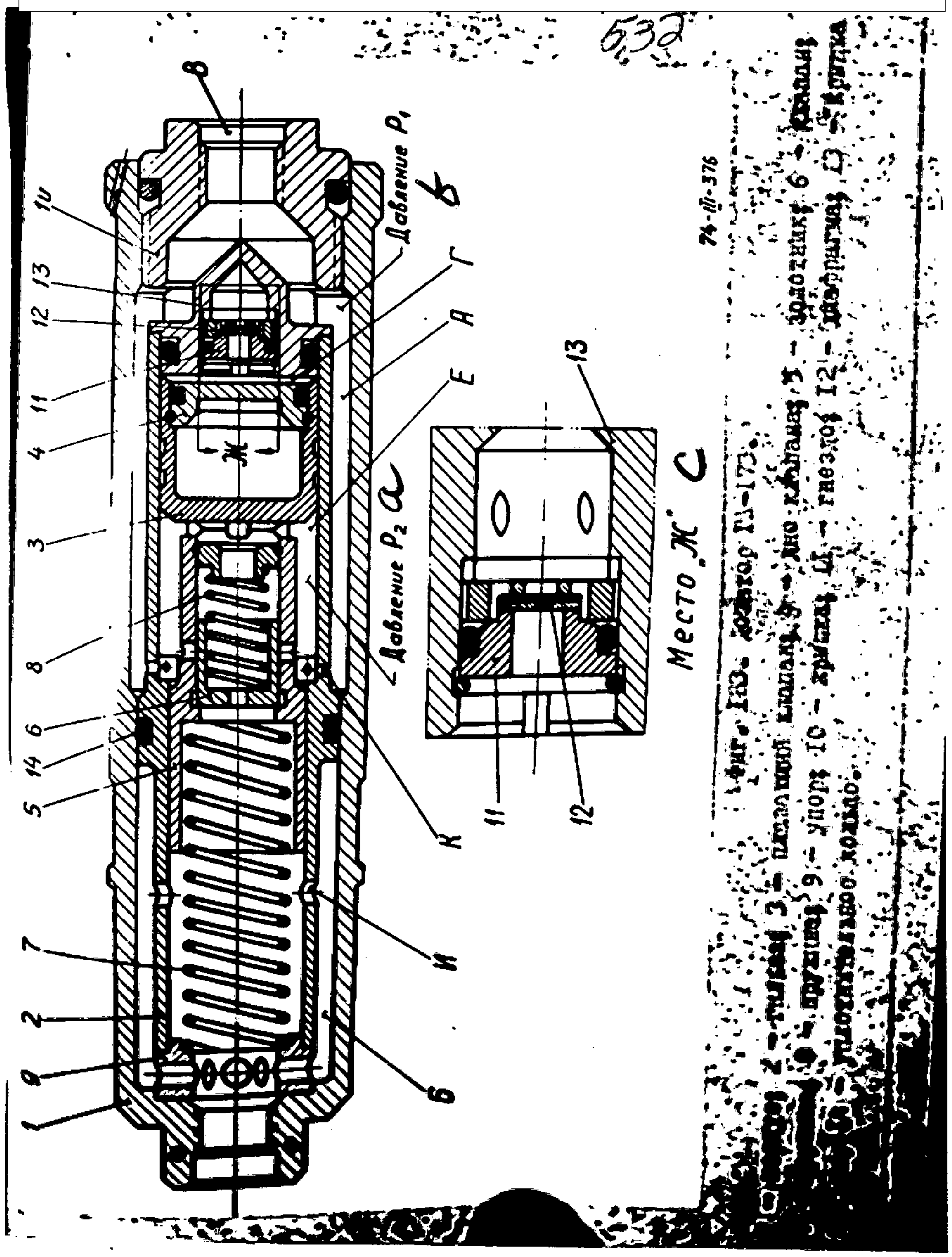

Fig. 183. GA-173 metering device.

1. housing; 2. liner; 3. float valve; 4. end of valve; 5. slide; 6. valve; 7. spring; 8. spring; 9. stop; 10. cover; 11. recess; 12. diaphragm; 13. liner cap; 14. packing ring.

a. pressure P_{a2}; b. pressure P_1; c. point "Ж" and allows passage of fluid into cavity ~~xxxxx~~ "Г" (there is only a calibrated opening between valve (3) and recess (11)).

When the fluid flows in the opposite direction, it presses the diaphragm away from the seat, increasing the flow area. If pressure is fed to opening "B," from opening "Д," a certain amount of fluid flows out, after which it is cut off by valve (3).

Fluid flows ~~in~~ through the metering device in the opposite direction unimpeded.

The fluid entering at pipe "B" passes from cavity "A" to cavity "E" through calibrated opening "K" of liner (2).

By means of fluid pressure, slide (5) is pressed to the extreme ~~left~~ left and allows passage of the fluid through opening "И" to cavity "Б" and, further, through the opening inx stop (9) to pipe "Д."

As fluid flows through opening "K," there is a pressure drop between cavities "A" and "E."

There is a similar pressure drop on both sides of diaphragm (12).

[remainder illegible]

[Note: there may be some uncertainty regarding the Russian lettering; the original was quite blurred, so that in many cases only a guess could be made. Trans.]

of fluid, necessary to assure complete working of the valve, the valve is seated in the liner and the main flow of the fluid is cut off. For any flow-rate of the fluid passing through the unit the pressure drop, which changes in valve, remains identical for opening "K" and for the diaphragm.

Because of this, the ratio between the volumes of fluid passing through opening "K" and the diaphragm remains constant for all flow-rates.

And since through the diaphragm there always passes, until valve (3) locks, the same volume (equal to the product of the valve flow area times its travel), the amount of fluid passing through opening "K" and, consequently, through the entire metering device, should be constant.

During reverse flow of the fluid the diaphragm, moving under the effect of the fluid, leaves its seat, making possible rapid outflow of the fluid from the cavity of the floating piston.

The piston leaves the seat in the liner and returns to its original position; here the slide is returned by means of the recoil spring.

The fluid, compressing valve (6), flows unimpeded through the metering device to pipe "?."

The metering devices are installed in the upper left-hand part of the hydraulic accumulator compartment, between frames 31A and 33.

System for Powering the Control Boosters from the Main System (Figs. 184, 185)

Fluid is fed from the main-system pressure line to the control-system boosters BU-51MS (60) and BU-45A 2 (51).

Pressure is fed to the BU-45A boosters through valve GA-190B (22), which makes it possible to cut off the BU-45A boosters from the main system, if necessary.

Booster BU-51MS is powered through a line which includes: check valve (12), cylindrical hydraulic accumulator (54), GA-135T pressure relay (55), and 11GF-4 fine-filtration filter (58).

The BU-51MS booster is powered continuously; the BU-45A boosters are cut out by the pilot with a drop in pressure in the landing-gear and booster systems.

Elements of the Control Booster Powering System

Valve GA-190B (Fig. 186) is a two-position valve, installed in the BU-45A and BU-51MS powering system; it is designed to feed fluid under pressure to the boosters or to connect the booster delivery line with the overflow line during switching.

The valve consists of housing (1), valve-sensor (4) controlled by electromagnet (6), and distributor slide (3). The distributor slide is moved by means of two pistons (2) and (5), one of which (2) has a recoil spring.

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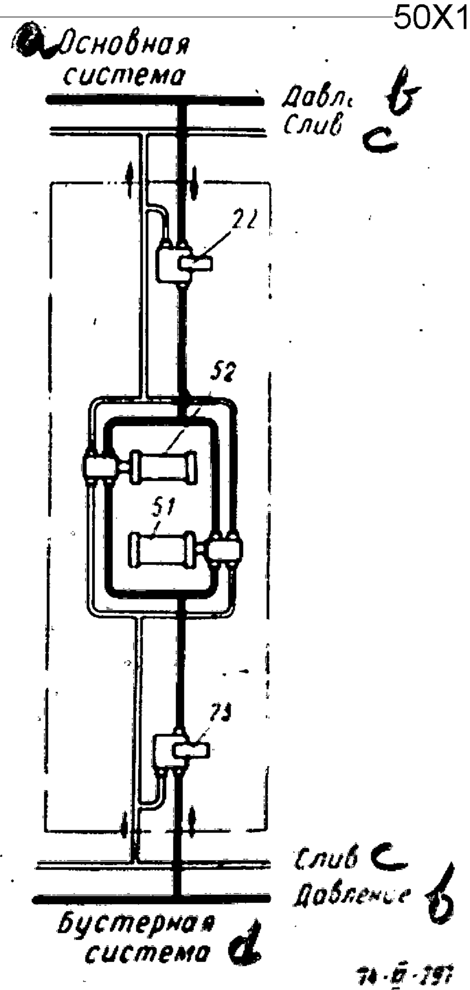

Фиг. 184. Схема питания бустеров БУ-45А от основной и бустерной системы. (позиции даны по фиг. 146).

Fig. 184. Diagram of the powering of the BU-45A boosters from the main and booster systems (positions as in Fig. 146).

a. main system; b. pressure; c. overflow; d. booster system.

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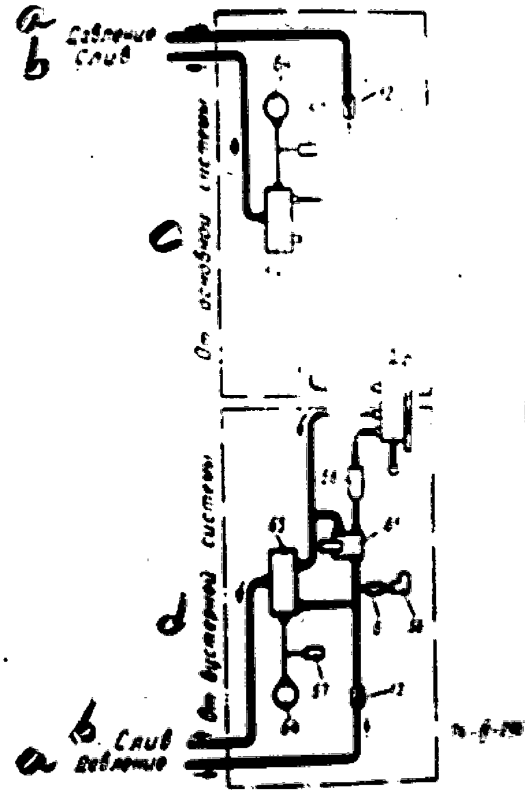

Fig. 185. Diagram of the powering of the BU-51MS booster from the main and booster systems (positions as in Fig. 146).

a. pressure; b. overflow; c. from main system; d. from booster system.

S-E-C-R-E-T

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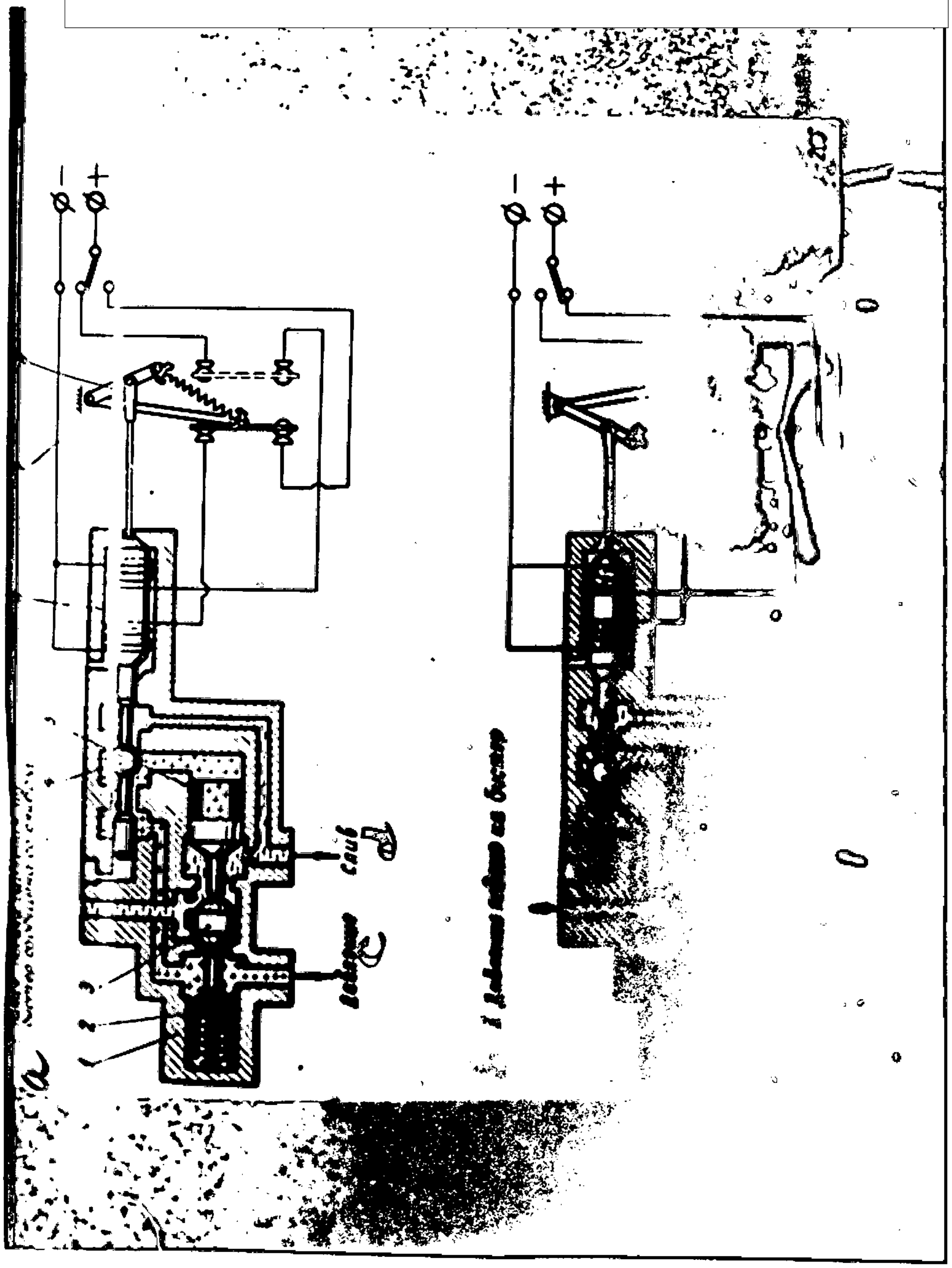

Fig. 186. Valve GA-190B.

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1. housing; 2. piston; 3. distributor slide; 4. valve-sensor; 5. piston; 6. electromagnet; 7. actuating arm; 8. articulated lever.

a. I. Pressure-feed line to booster connected to overflow; b. II. Pressure fed to booster; c. pressure; d. overflow.

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~~Thx~~ The housing of the electromagnet contains two coils. In the right side of the electromagnet housing is actuating arm (7) for the switch, and articulated lever (8) with a spring, which is coupled with the magnet armature through a link and tie rod.

The articulated lever makes it possible to fix the valve-sensor in its extreme positions and throw the actuating arm of the switch from one position to the other.

When voltage is fed to the left coil the armature moves to the left and the valve-sensor ~~xxxxxxxx~~ connected to it also moves; this cuts off the delivery line from the cavity at the right-hand control piston, connecting it to overflow.

Here, due to action of the spring, the/left striker of the control piston moves the slide and also the right-hand control piston such that the delivery line is coupled with the outlet pipe and ~~xx~~ goes to the booster.

At the moment the armature is stopped, the actuating arm of theswitch cuts the current in the left coil, while the valve-sensor is fixed by the articulated lever and the spring. The contacts of the actuating arm are ~~xxxxxx~~ thrown over to the electric circuit of the right coil, preparing it to switch on the valve.

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When power is fed to the right coil, pressure is fed through the valve-sensor to the right control piston, which switches the slide. The pressure line is blocked while the booster feed line is connected to overflow. The GA-190B valves are installed below, between frames 20 and 22.

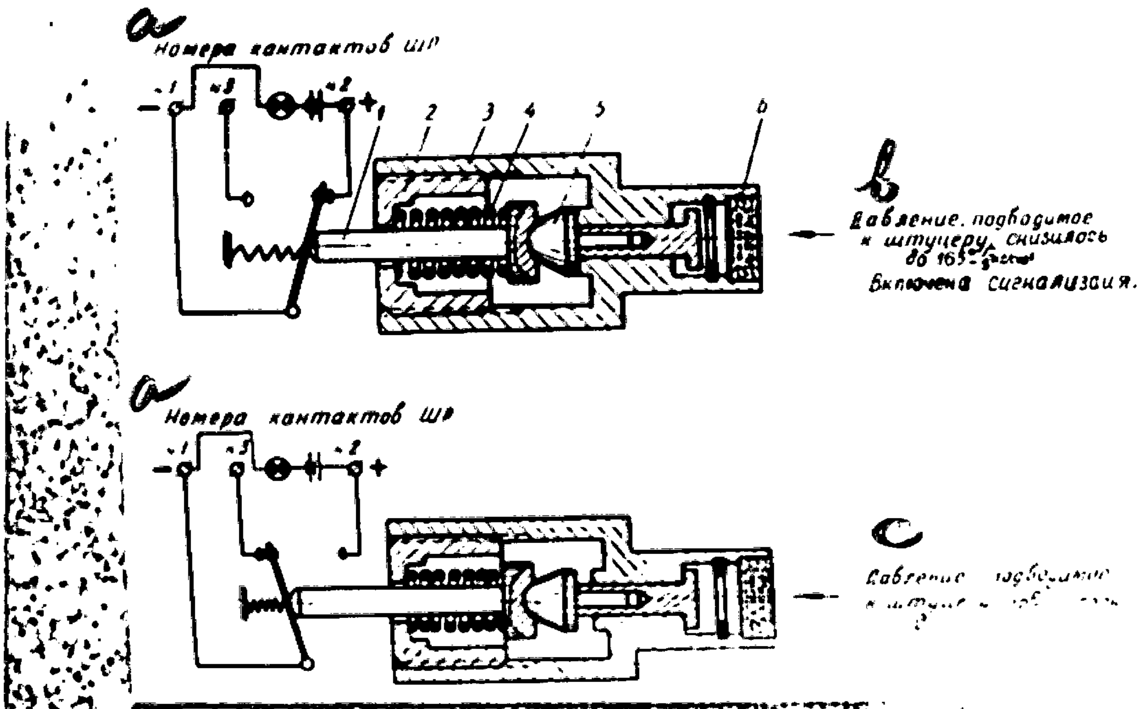
GA-135 pressure relay (Fig. 187); this is designed to automatically open and close the electric ~~circuit~~ signalization circuit and switch on the NP-27T, depending on the fluids pressure in the hydraulic system.

The relay consists of housing (3), seat (1), lifters with piston (5), nut (2), and spring (4).

Micro-switch KV2-140 is attached to the housing holder, and is covered. The electrical line is plugged into the microswitch.

When the pressure fed to the pipe is less than operating pressure, the spring holds the seat away from the switch button. The switch keeps the circuit closed. When the piston pressure rises and overcomes the force of the spring, the seat moves to the left and presses the switch button. The switch operates and breaks the electric circuit.

A further rise in pressure moves the piston to its stop, movement of the seat stops, and the circuit remains open.



Фиг. 187. Реле давления ГА-135Т.
1 — седло; 2 — гайка; 3 — корпус; 4 — пружина; 5 — толкатель; 6 — демпфер.

Fig. 187. GA-135T pressure relay.

1. seat; 2. nut; 3. housing; 4. spring; 5. lifter; 6. ~~damper~~ buffer.

a. number of contacts ShR; b. pressure fed to pipe drops to 165^{+10}_{-5} kg/cm^2; signal turned on; c. pressure fed to pipe rises to 195 kg/cm^2; [signal turned off?]

(according to text, p. [illegible])

Ahead of the relay there is buffer (6) to eliminate the influence of pressure pulsations on the relay.

The relay closes the circuit when the pressure drops to 165^{+10}_{-5} kg/cm^2 and opens it when the pressure is no higher than 195 kg/cm^2. The relays are installed ab ove, between frames 30 and 32, on the rudder partition.

Cylindrical hydraulic accumulator (Fig.188); one cylindrical hydraulic accumulators is installed in each of the two systems, and is designed to increase the relaibility of the stabilizer control system. Ahead of the cylindrical hydrau lic accum lators, in the delivery lines, there are check valves which make it possiblefor the accumulators to discharge only in the direction of the BU-51M booster.

The hydraulic accumulator consists of liners for the high-pressure (3) and low-pressure (7) cavities coupled by sleeve (5), covers (2) and (8), and piston group (4).

In the hydraulic accumulators there are a high-pressure cavity, a gas filling cavity, and an overflow pressure cavity. Each of the cavities has a pipe, while there are two in the overflow cavity.

The gas cavity is filled through a fill pipe which is separate from the accumulator. The gas cavity is filled with nitrogen to 50 kg/cm^2; at this time the piston should be in the extreme right-hand position.In this case the volume of the hydraulic high-pressure cavity is minimum, while that ofthe overflow cavity is maximum.

When the fluid pressure in the system is higher than the filling pressure,

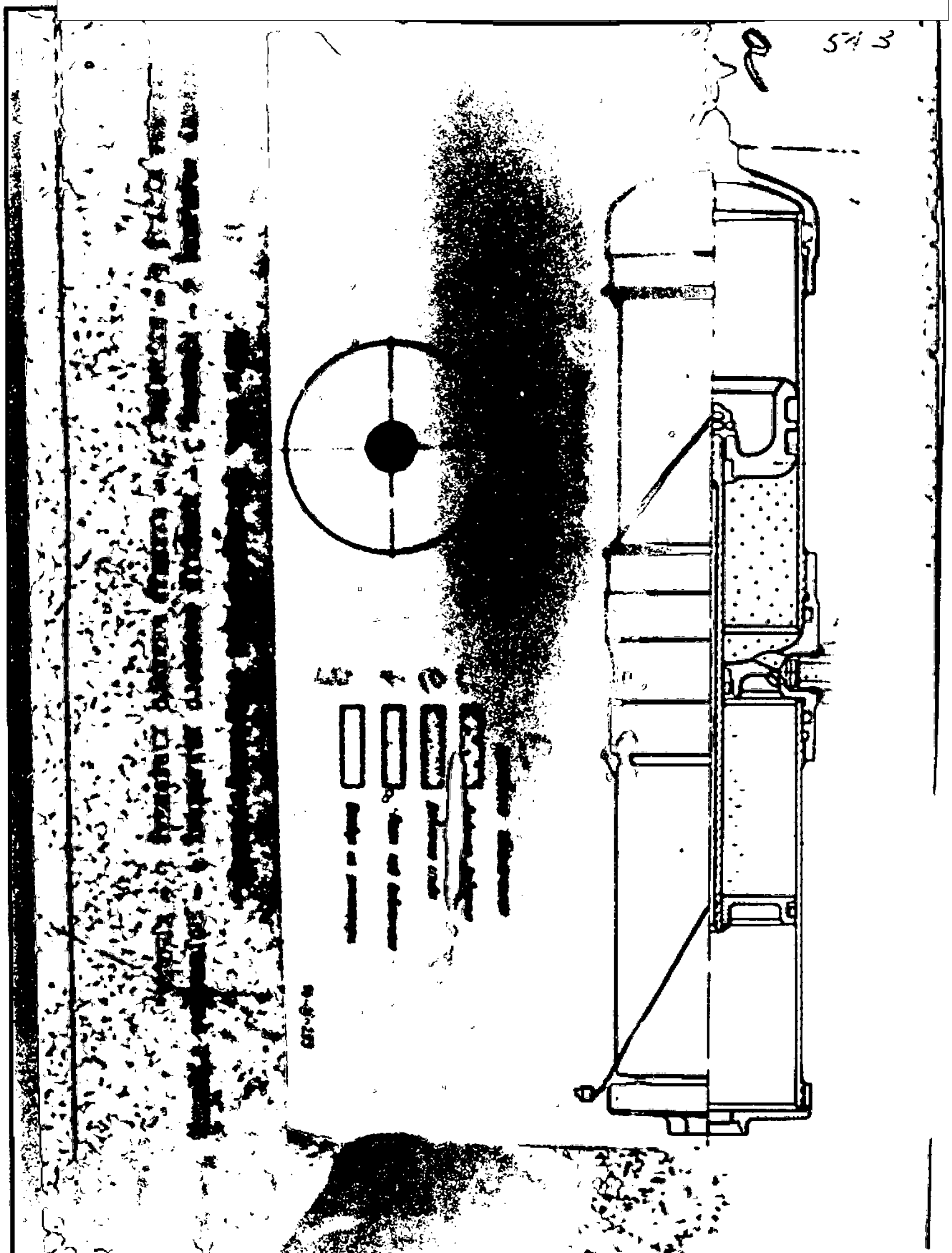


Fig. 188. Cylindrical hydraulic accumulator. 1. fill pipe; 2. cover; 3. high-pressure cylinder; 4. piston group; 5. coupling sleeve; 6. fill pipes; 7. low-pressure cylinder; 8. cover.

a. from on-board fill pipe; b. view at "A"; c. arbitrary designations ; d. working pressure; e. overflow pressure; f. nitrogen under pressure; g. air from atmosphere.

the piston begins to move, compressing the gas.

With an increase in the volume of the high-pressure cavity, since the pistons are interconnected by a rigid rod, the piston in the overflow cavity forces the fluid into the overflow line.

Thus, the supply of fluid in the tank is not used to fill the cylindrical hydraulic accumulators.

Fluid from the BU-51MS booster overflows into one of the overflow pipes, while the second pipe is connected with the overflow line. The accumulator is cut off from the overflow cavity by the cover which is in communication with the atmosphere through a filter, to prevent compression during movement of the pistons. During discharging of the accumulator, i.e., when decreasing the volume of the high-pressure cavity, the low-pressure cavity is filled.

ATTENTION: 1. When filling the accumulators with nitrogen to a pressure of 50^{+5} kg/cm^2 it is necessary, on completion of the filling, to move the handle slightly in a longitudinal direction. The pressure according to the control manometer should not drop, and the stabilizer should not move.

2. It is forbidden to feed pressure to the delivery pipe when the overflow pipes are stopped up or the overflow line is closed, and also to operate the stabilizers from any system when the ~~pix~~ lines are clogged in the other system.

The fill pressure is controlled by manometers in the accumulator-fill line. The fill pipe for the accumulator and the manometer are located in the upper left of the accumulator compartment, between frames 31A and 33.

Fill valve 800600/A (Fig. 189); this valve is installed in the spherical and cylindrical hydraulic accumulators to fill their gas cavities with subsequent closing off of the cavities after filling.

The valve consists of housing (4), cover (1) with a cable, and pressure rod (3) with recoil spring (5).

The rod consists of a conical rubber washer (7), bushing (6), and nut (2). The conical washer is located in a corresponding indentation in the housing.

When filling the accumulators, by means of special pressure device rod (5) with rubber conical washer (7) is pressed down and the cavity begins to fill with nitrogen. When the rod moves in the reverse direction the conical washer is seated and held in place by the nitrogen pressure, assuring hermetic sealing of the gas cavity.

H. Hydraulic Booster System (Fig. ___)

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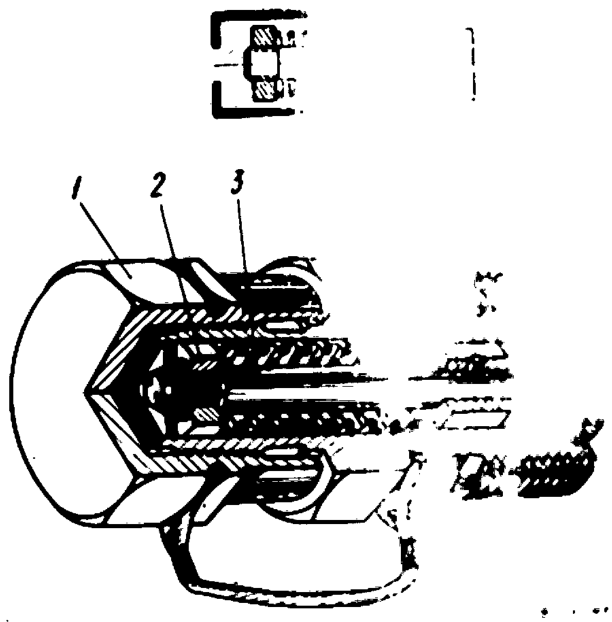

Fig. 1-9. 800600/A fill valve.

1. cover; 2. nut; 3. pressure rod; 4. housing; 5. spring; 6. bushing; 7. conical rubber washer.

The stabilizer booster feed system includes check valve (12), cylindrical hydraulic accumulator (65), valve GA-190B (61), and 11GF-4 fine-filtration filter (58).

The GA-135 relay, signalling a drop in pressure in the system, is installed behind the check valve.

The hydraulic booster system includes emergency pumping station (59), designed to assure power for the BU-51MS stabilizer booster if the NP-34/2T pumps fail or if the engine jams.

The GA-190B valves installed in the booster system delivery lines at the control boosters are used in the following cases:

1. During ground checks of the operation of the BU-45A and BU-51MS boosters from the main system; by pressing a button on the right-hand instrument panel the GA-190B is cut out in the booster system and both the BU-45A and the BU-51MS boosters are switched out of the delivery line of the booster system and operate only from the main system.

2. With a drop in pressure in the main hydraulic system and in the booster system (both signal lights burn), by turning a switch on the left-hand instrument panel the GA-190B relays, installed in the booster and landing gear systems in the delivery lines ahead of the BU-45A booster, are cut out.

When both BU-45A's are cut out from both systems, the ailerons are controlled mechanically, and the entire pressure supply is expended only on powering the BU-51MS booster.

During normal operation of the systems the GA-190B valves are always cut in to feed pressure to the boosters.

The ~~xxx~~ button for cutting out the boosters from the booster system is used only during ground control checks.

With normal pressure in the booster system the aileron boosters operate from the booster system, while when the pressure in it drops to 85 $\pm$ 10 kg/cm^2 there is automatic transition to the main system by means of a special switch in the booster head. With an increase in pressure in the booster system, at 100 $\pm$ 5 kg/cm^2 the aileron boosters begin automatically to be powered by the booster system.

The emergency pumping station is turned on if the pressure in the booster system drops to 165^{+10}_{-5} kg/cm^2.

In addition to the signal lights going on, voltage is fed to the electric motor of the pump and fluid ~~main~~ begins to be delivered to the system.

If it is not operated by the control handle, the pumping station raises the pressure in the booster system and is automatically cut out by the pressure relay at a pressure of no more than 195 kg/cm^2.

Since the delivery line from the NP-27T is connected to the booster-system pressure line ahead of the check valve at the cylindrical accumulator, the pressure created by the station is used to fill the spherical and cylindrical accumulators.

The relay opens the circuit for electrical powering of the station and signalling only due to an increase in pressure from the NP-34/2T pump.

For convenience in examination, the entire system can be divided into four separate parts:

--the delivery part of the system;

--the BU-45A booster powering system;

--the BU-51MS booster powering system; and

--the emergency system with pumping station NP-27T.

The Delivery Part of the System

The delivery part of the system (Fig. 190) is anologous in design and operation to the delivery part of the main system.

The differences areas follows:

1. In the overflow line ahead of the tank there is a gauze strainer (42) instead of the FG-11/2;

2. The pump circulation line contains no 11GF-4 fine-filtration filter;

3. The ground coupling lines contain a tank-fill pipe (71).

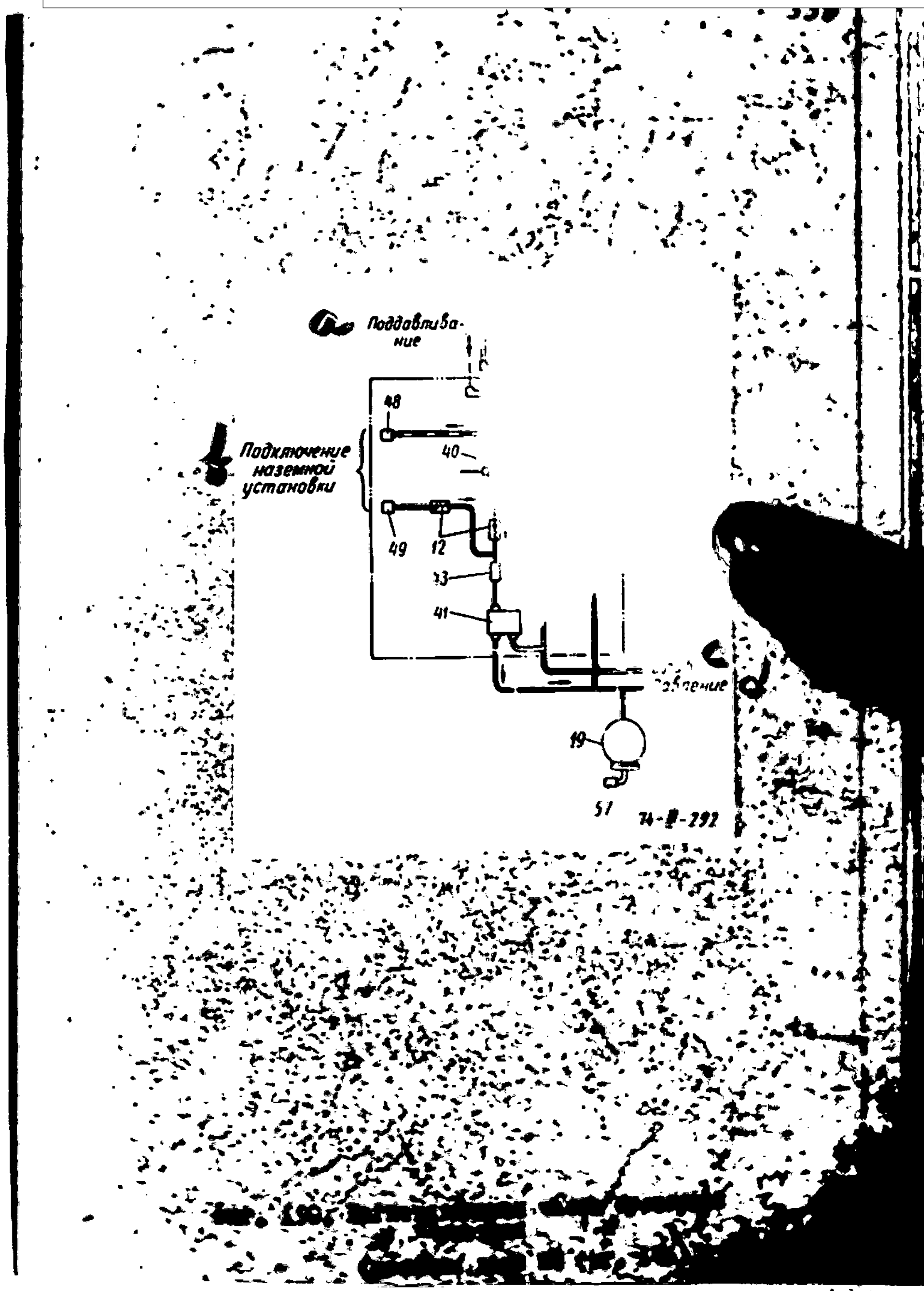

Fig. 190. Delivery part of the booster system (positions as in Fig. 146).

a. feed; b. switching in of ground installation; c. overflow; d. pressure.

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The delivery part of the system consists of the booster compartment of the hydraulic tank (65), pump NP-34/2T (40), check valve (32?) behind the pump, filter FG-11/2 (43), safety valve GA-186M (41), a hydraulic accumulator and valves for switching in the ground pump (48) and (49). To the pressure line is coupled the sensor of manometer DV-250 (25), with a buffer (6) at the input.

Pump NP-34/2T, creating pressure of the fluid in the system, delivers fluid to the BU-45A boosters through the valve GA-190B, and constantly to the BU-51MS booster.

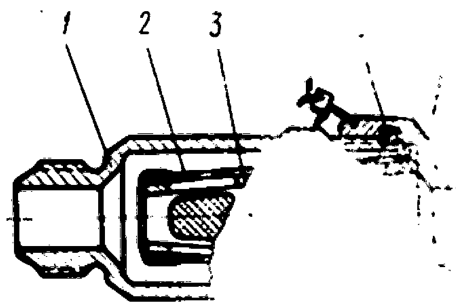
The operation of the delivery part of the booster system is analogous to the main system.

Elements of the Delivery Part of the Booster System

Gauze strainer (Fig. 191); this is installed in the overflow of the booster system ahead of the tank. The strainer is designed to filter the overflow fluid from the boosters; it consists of housing (1), cover (5), strainer frame (3), and the gauze strainer itself (2).

The strainer has 40-micron mesh. Fluid is fed to the pipe from the side opposite to the cover of the housing. The strainer element is flushed every 50 flying hours.

The strainer is located to the left in the engine compartment, between frames 27 and 28.



Фиг. 191. Сетчатый фильтр.

1 - корпус; 2 - фильтр; 3 - каркас фильтра; 4 - кольцо уплотнительное; 5 - крышка.

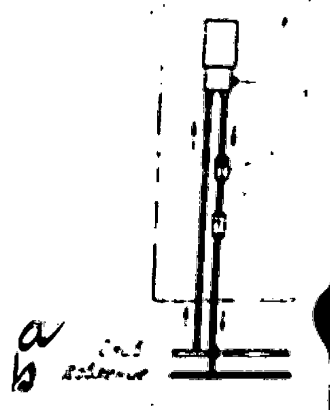


Fig. 191. Gauze strainer.

1. housing; 2. ~~filter~~ strainer; 3. strainer frame; 4. packing ring; 5. cover.

Fig. 192. Emergency pumping station system (positions as in Fig. 146).

a. overflow; b. pressure.

A. Control-Booster Power System

System for Powering the BU-45A from the Booster System (Fig. 184)

The system for powering the BU-45A from the booster system includes: valve GA-190B (23) and connecting lines.

System for Powering the BU-51MS from the Booster System (Fig. 185)

This system includes: check valve (12), cylindrical hydraulic accumulator (65), GA-135 pressure relay (56), GA-190B valve (58), 11GF-4 filter (58), and the emergency pumping station (Fig. 188) with its check valves (12). Check valve 671600B is designed such that the cylindrical hydraulic accumulator feeds its fluid supply under pressure only to the BU-51MS.

The check valves at the NP-27T prevent the flow of fluid under pressure from the NP-34/2T pump to the emergency station, which might cause overspeeding of the station and its operation as a motor (for reliability, two valves are installed).

FIRST LINE OF TEXT

B. Elements of the BU-51MS System

Emergency pumping station NP-27T (Fig. 193); this couples a hydraulic piston pump of constant output, and an electric motor D 880, with a reducer.

The station delivers fluid to the system whenever the pressure in it drops.

Basic Data on the NP-27T Station

1. Maximum delivery pressure - 240 kg/cm^2.

2. Required current - for a pressure of 185 kg/cm^2 created by the station, and a temperature of +20° - no more than 50 a.

3. The pressure at the suction ipe should be within the limits 2-3 atm.

4. Output of the station with a voltage of 27 v, input pressure of 2 atm, and delivery pressure 210 kg/cm^2:

--at the beginning of its lifetime: no less than 1.7 liters/minute;

--at the end of its lifetime: no less than 0.9 liters/minute.

The pumping station consists of an electric motor and a pump.

The pump consists of housing (7), liner (8), shaft (1) with rods (5) in a recess, pistons (4) attached to the ends of the rods, universal joint (6), piston block (2), and cover (3). The pump has

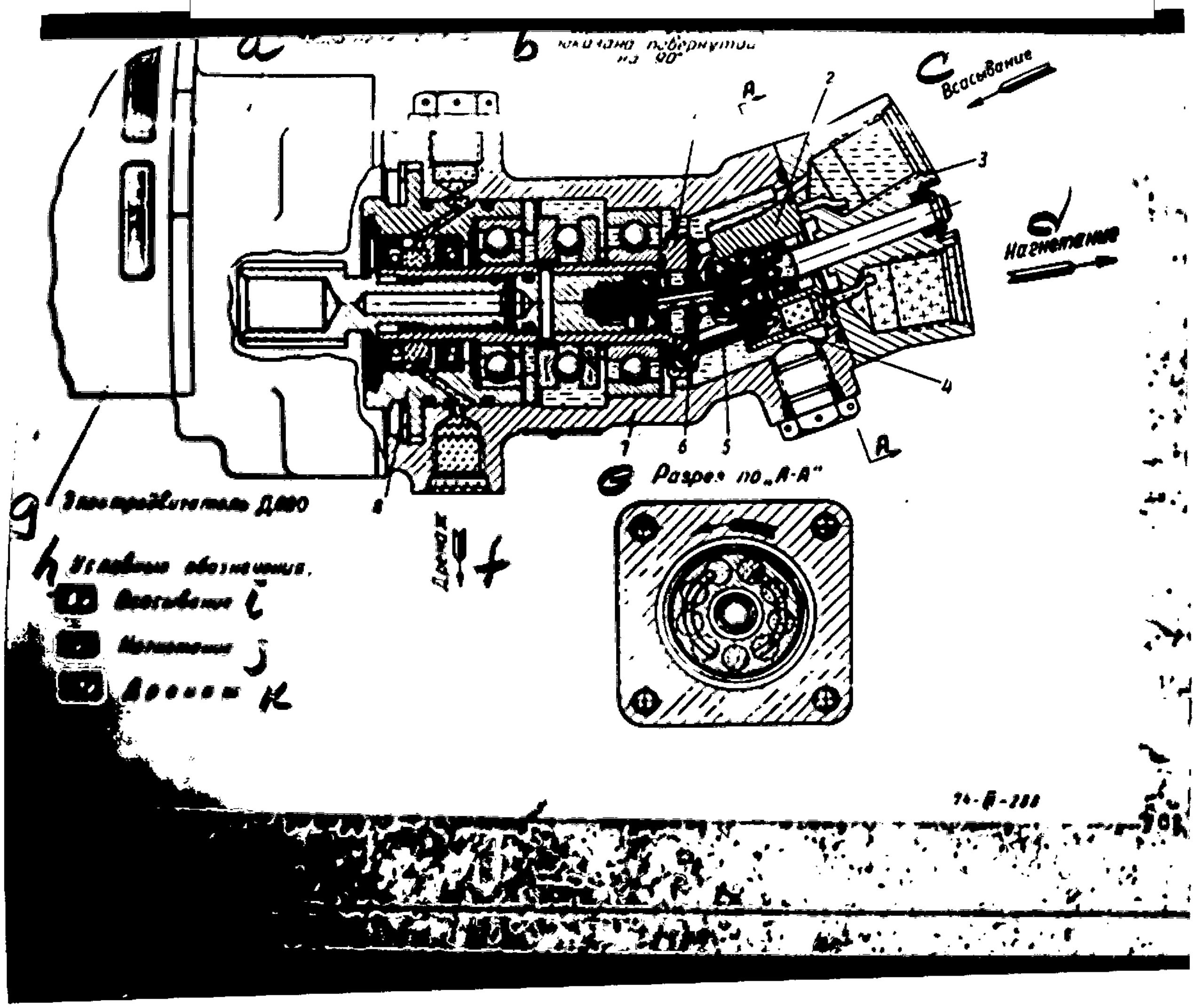


Fig. 193. Emergency pumping station NP-27T.

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1. pump shaft; 2. rotor; 3. cover; 4. piston; 5. rod; 6. universal joint; 7. housing; 8. liner.

a. [illegible]; b. the cover is shown turned arbitrarily 90°; c. suction; d. delivery; e. section A-A; f. overflow; g. D 880 electric motor; h. arbitrary designations; i. suction; j. delivery; k. overflow.

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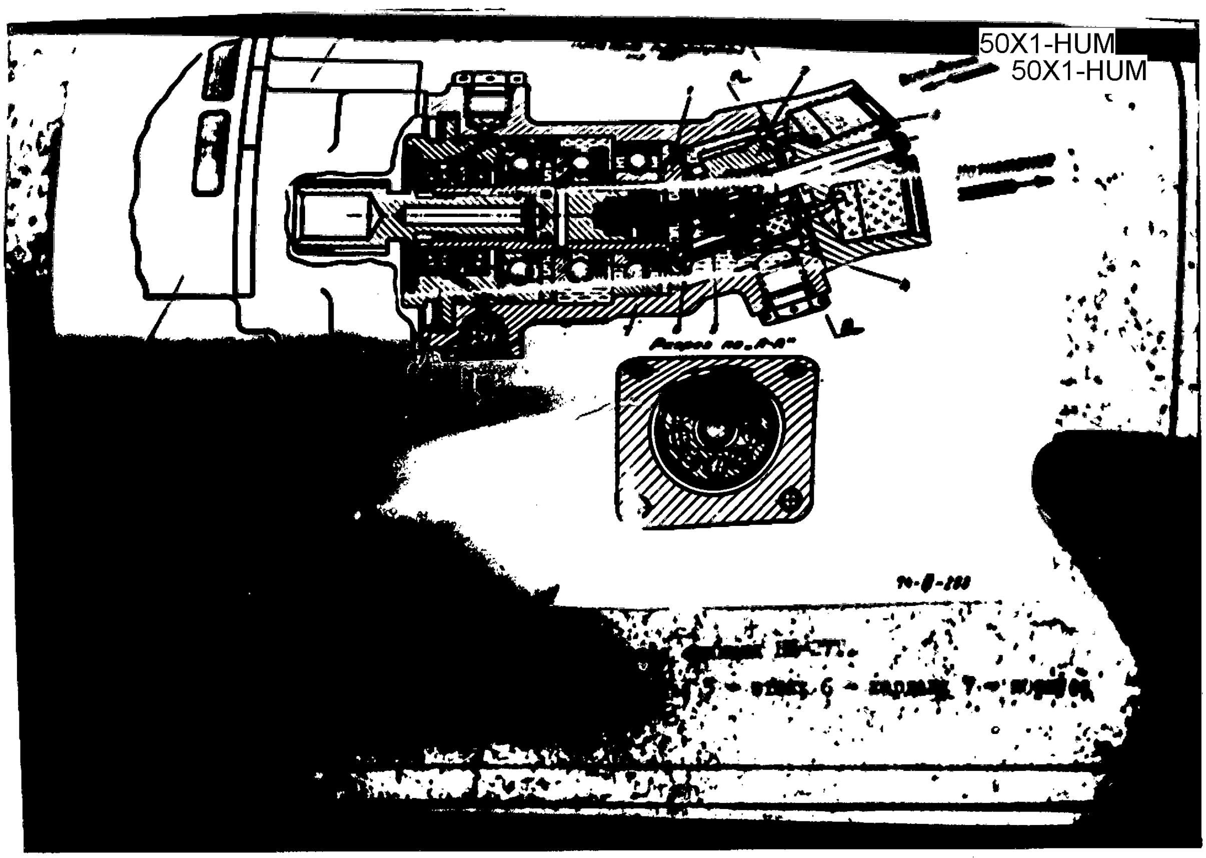

S-E-C-R-E-T

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556

end distribution of the fluid.

The pump is similar in design and operational principle to the NP-34/2T piston pump, except that the piston block is fixed, which does not allow its output to be regulated.

When operating the pumping station it is necessary to carefully check the attachment of the station to the bracket and not allow the coupling bolts to become weak; it is also necessary to check the hermetic sealing of the pipes and the reliability of contact at the point where the current leads are attached.

The pumping station is installed on the reinforcing member beneath the rudder between frames 32A and 33.

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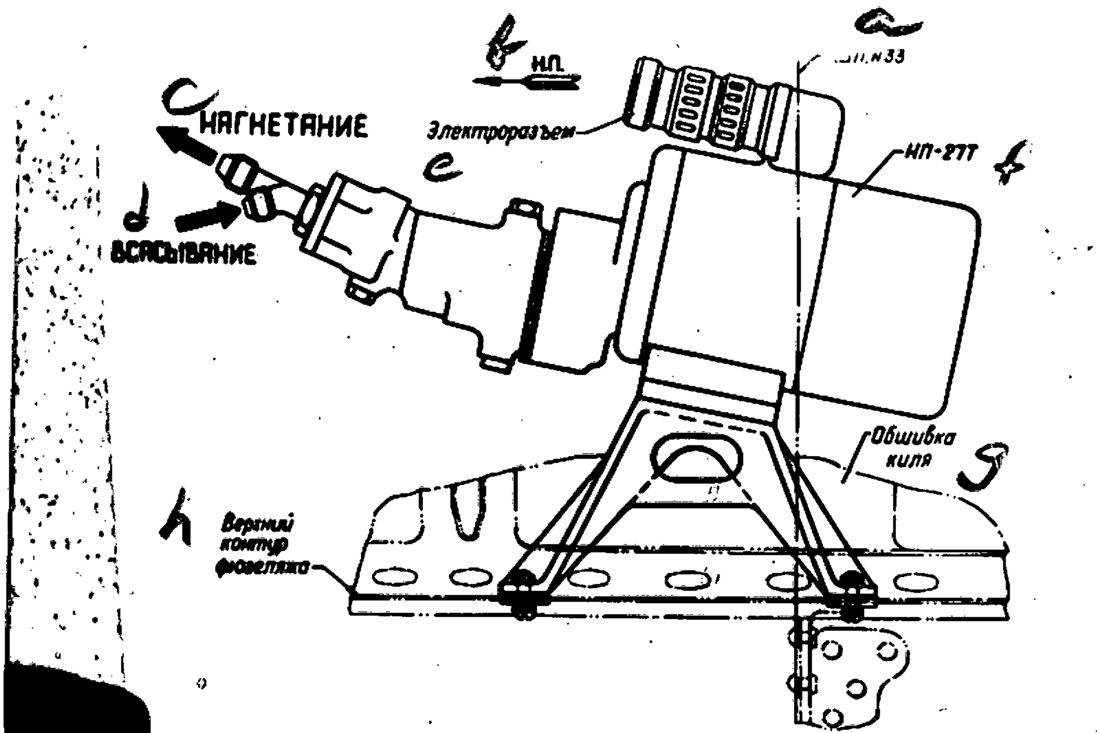

Фиг. 194. Установка аварийной насосной станции НП-27т.

337

Fig. 194. Installation of NP-27T emergency pumping station.

a. frame 33; b. flight direction; c. delivery; d. suction; e. electric plug connector; f. NP-27T; g. rudder skin; h. upper contour of fuselage.

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Control Boosters

The BU-45A booster (Fig. 195) is a hydromechanical element, in which low input pressures from the control system are converted into large output forces by using the energy of the fluid pressure.

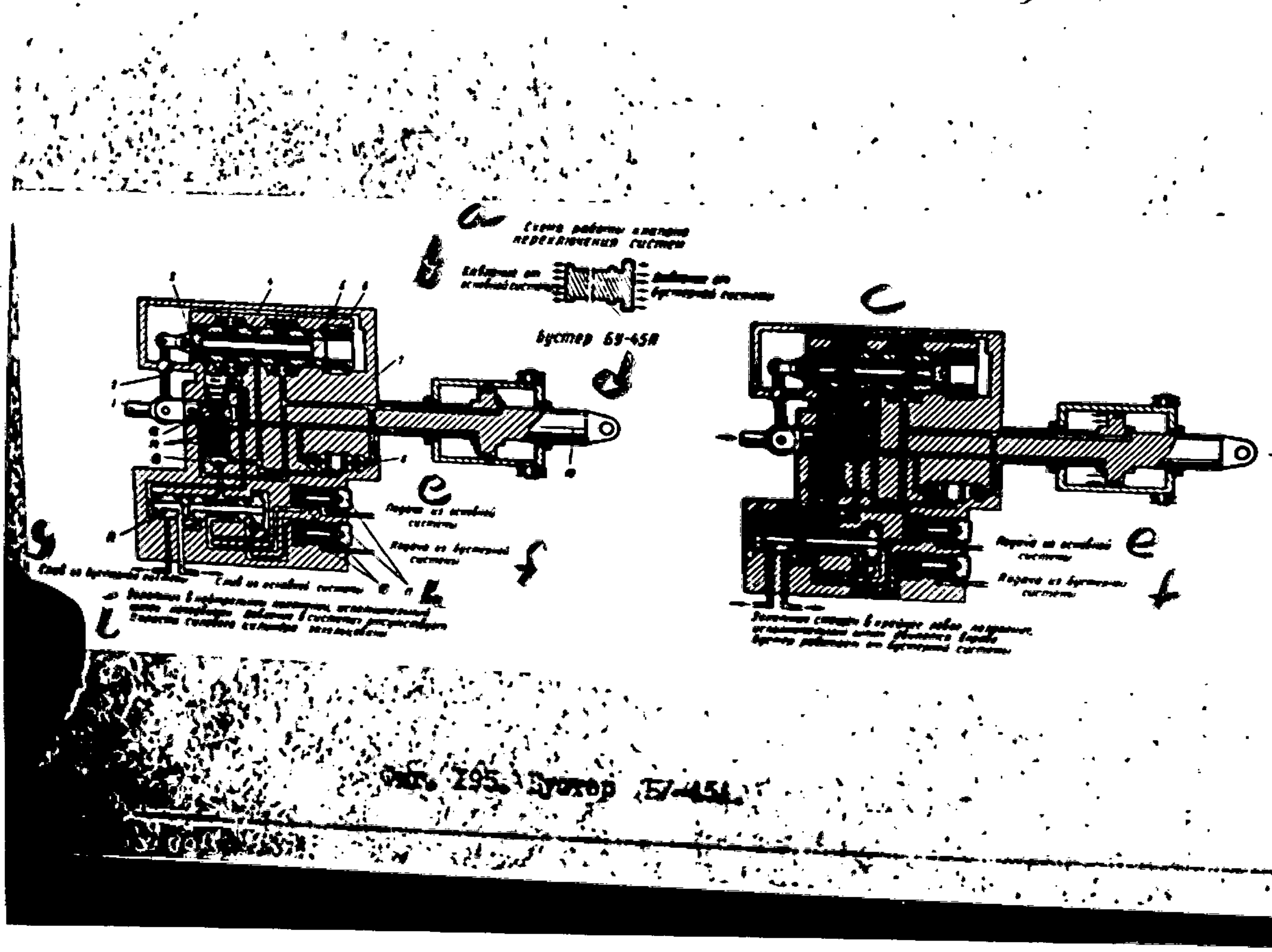

Fig. 195. BU-45A booster.

a. diagram of the operation of the system-switching valve; b. pressure from main system; c. pressure from booster system; d. booster BU-45A; e. feed from main system; f. feed from booster system; g. overflow from booster system; h. overflow from main system; i. slide in neutral position: ~~main~~ actuating rod fixed: no pressure in system: power-cylinder cavities cycling; j. slide in extreme left position: ~~main~~ actuating rod moves to right: booster operates from booster system.

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Fig. 195. BU-45A booster.

1. eye bolt; 2. lever; 3. distributor slide; 4. duplicating slide; 5. bushing; 6. spring; 7. booster head; 8. ~~make-up~~ feed valves; 9. cylinder; 10. cylinder rod; 11. input filters; 12. distributor-slide; 13. anti-sag valve; 14. cycling valve; 15. ~~plug~~ stop; 16. shut-off valve.

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Technical Data for the Booster

1. Maximum force developed by the booster at 210 kg/cm^2 - no less than 1900 kg.

2. Working travel of the actuating rod: 80 mm.

3. Travel of distributor slide: 2 mm

4. Inert zone: 0.2 mm

5. Rate of movement of actuating rod: 100 mm/sec.

The BU-45A booster consists of a distributor and actuating devices.

The distributor device is located in head unit (7); it is a slide (3) which by means of control rods is coupled to the plane's control stick, and also a duplicating slide (4) in the event the main slide is jammed.

The duplicating slide is made in theform of a liner which contains the main slide.

During normal operation of themain slide the duplicating slide is immobile.

If the main slide becomes jammed in some position, when the control stick is moved the duplicating slide begins to move and takes over the functions of the main slide, distributing the fluid. The force on the stick increases in this case due to compression of sreing (6). The duplicating sl'de, during normal operation of the main slide, is immobilized by the above-mentioned

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spring which, by means of two bushings (5), holds the duplicating ~~xxxxxxx~~ slide in the neutral position.

The main and duplicating slides each have four ~~xxxx~~ ribs.

The fluid under pressure moves in the gap between the two middle ribs.

In the neutral position the middle ribs cover the channels for delivery and removal of fluid to the working cylinder and block off the fluid already in the cylinder cavities.

[remainder illegible]

The distributor head of the booster is rigidly coupled to the actuating rod (10) of the main power cylinder; consequently, movement of the actuating rod caoses movement of the distributor head.

When the control stick is moved, the motion is ~~translated~~ transferred to the slide by means of the connecting rod attached to ~~[illegible]~~ lever (2) of the distributor slide. The lever turns relative to a swivel support; consequently the motion of the distributor slide is opposite to the direction of motion of the connecting rod.

[remainder illegible]

is tenths of a millimeter, the time from the moment the control rod stops to the moment the actuating rod stops is very slight. Just as insignificant is the additional movement of the actuating rod after the connecting rod stops, necessary to return the slide to the neutral position.

Smooth movement of the actuating rod with a constant increase in the speed of movement as a function of the movement of the slide is attained by means of flat areas on the working ribs of the slides.

In the neutral position the slots in the liner of the distributor slide are covered by the ribs of the slide, which forms the so-called "inert zone" of the booster.

The design of the BU-45A distributor head provides for a valve to switch the systems; this is a floating slide (12) which moves due to the pressure difference in the systems.

The BU-45A system-switching valve operates as follows:

1. With normal pressure in both systems, the booster is cut into the booster system.

2. When the pressure in the booster system rises to 85 ± 10 kg/cm^2 the booster is cut into the main system.

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3. When the pressure in the booster system rises to 100 ± 5 kg/cm^2, the booster is switched over to the booster system.

If both hydraulic systems become inoperative, or the boosters are cut off from both systems, there is provision for automatic transfer to manual mechanical control.

In this case the distributor slide is stopped in the neutral position by mechanical stop (15), while the cavities of the power cylinder are interconnected to the overflow through cycling valve (14).

With working pressure in the hydraulic system, the ribs of the cycling-valve plunger (14) cover the valves and cut off the cylinder cavities. With a drop in pressure the plunger of the cycling valve is moved by the spring, and opens the valves, interconnecting the cylinder cavities.

The booster in this case operates as a connecting rod in the control system. In order that an instantaneous drop in pressure not cause a sharp decrease in the aerodynamic load on the control stick, ball valves (8) are included in the booster design.

When the pressure drops in the system, the cycling valves are fed, through valves (8), from one of the cavities of the power cylinder, where at this moment the fluid is compressed due to aerodynamic forces on the booster rod.

After the pressure has gradually dropped to 5 kg/cm^2, onlv the cycling valve connectsxthe cylinder cavities, assuring smooth transition to manual control.

Check valve (13) is used to prevent sag of the rod of the booster due to aerodynamic loads and, in addition, to assure the feeding together with the valve, preventing leakage of fluid from the pressure-feed cavity to the booster distributor slide.

[remainder illegible]

<u>BU-51MS booster</u> (Fig. 196). The BU-51MS stabilizer booster differs from the BU-45A aileron boosters in that it has two cylinder-chambers, each of which operates from a different system and has its own distributor device.

The booster is designed to operate on aircraft having two simultaneously operating hydraulic systems.

The hydraulic systems are independent and isolated from one another.

When one of the hydraulic systems becomes inoperative, the booster can operate on the other system.

At the input of each of the hydraulic systems, the unit has an anti-sag check valve.

The stabilizers cannot be manually controlled mechanically through the boosters.

Basic Data on the Booster

1. Maximum power developed by the boosters by means of the actuating rod with a pressure in both systems of 21_ kg/cm^2: 5800 kg.

2. [remainder illegible]

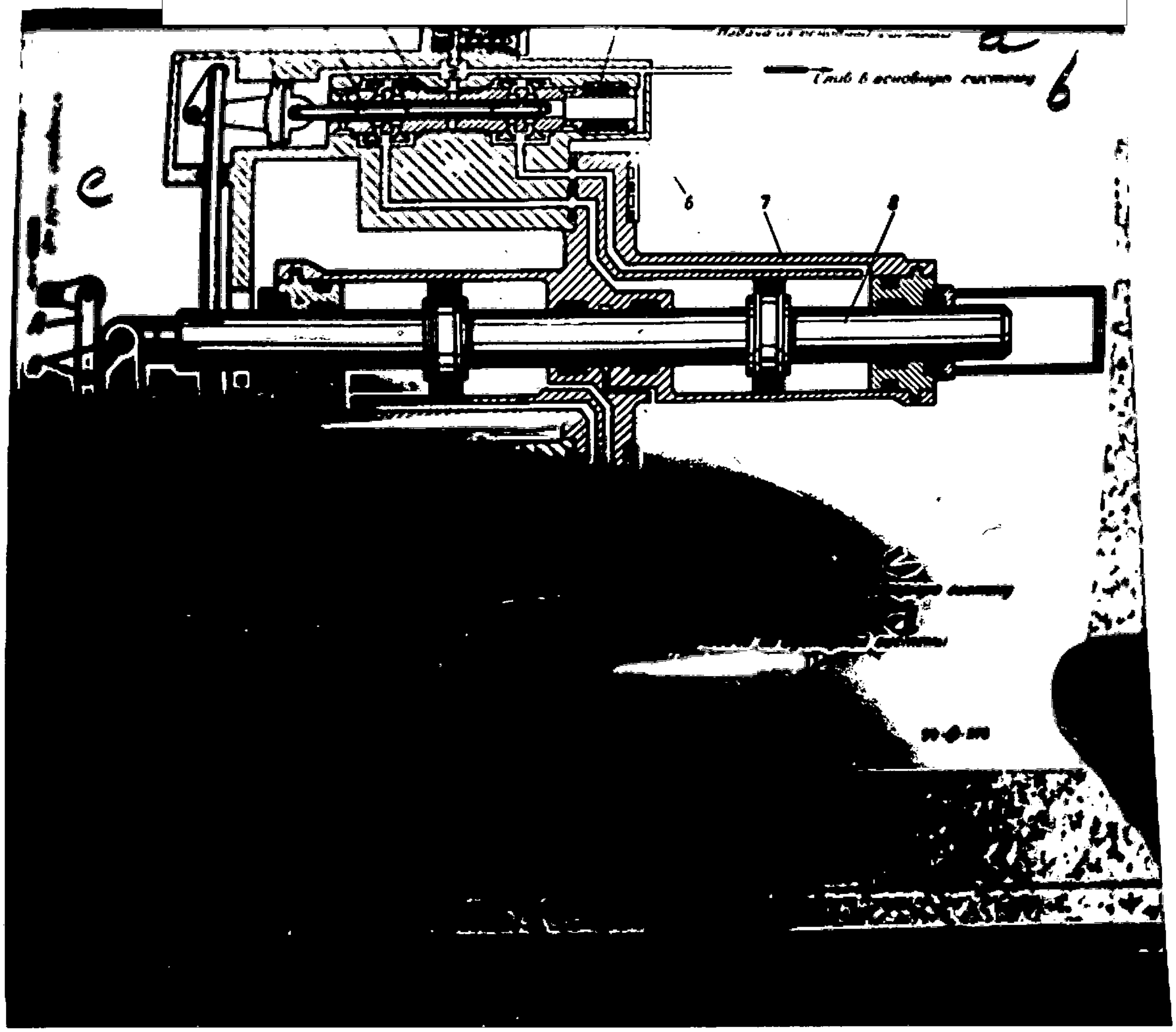

Fig. 196. BU-51MS booster.

a. feed from main system; b. overflow from main system; c. overflow from booster system; d. feed from booster system; e. from control stick; f. illegible.

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Fig. 196. BU-51MS booster.

1. buffer; 2. main distributor slide; 3. duplicating slide; 4. input filter; 5. spring of duplicating slide; 6. bracket; 7. cylinder; 8. power-cylinder rod; 9. sprin for duplicating slide; 10. input filter; 11. duplicating slide; 12. main slide; 13. buffer; 14. system of connecting rods, actuating arms, and levers; 15. anti-sag valve.

Operationally, the BU-51MS booster is a hydromechanical apparatus with servo-control.

The booster has separate distributor and actuating devices.

There are two distributor devices, and the actuating device is a dual cylinder having a common rod with two pistons.

The distributor device consists of main slide (12) and (2), duplicating distributor slide (3) and (11), and a system of levers (14) which actuate the slides.

The distributor devices are locatedm on bracket (6), to which is attached power cylinder (7) whose only movement is a rocking one. [remainder illegible]

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The actuating rod will move while the main slide is displaced relative to the inner slots in the duplicating slide, i.e., lever "A" moves together with the actuating-rod-control handle.

When the control handle and the corresponding lever "A" stop, the actuating rod continues to move.

Then the axle of rotation of lever "A" reaches fixed point "B" and, because of the force of the actuating rod, lever "A" together with the distributor slide begins to move in the opposite direction with respect to the liner. This movement will continue until the through-slot in the distributor device is closed; then the movement of the actuating rod ceases.

[remainder illegible]

The distributor device consists of the main and the duplicating slides and a system of ~~xalwxx~~ ducts which assures delivery and removal of the working fluid to and from the distributor device and the cylinder cavity.

The fluid first enters input filter (4) and (10), and then goes to the distributor devices.

The main distributor slides are located inside the duplicating slides and each have two ribs; they are coupled through ~~xxxxxxxx~~ ducts in the liner and the bracket by the corresponding cylinder cavities.

The duplicating distributor slides also have ribs opposite the grooves in the liners; on both sides of the ribs of the main duplicating slides there are flat spots which assure a smooth increase in the speed of the actuating rod with respect to the travel of the distributor slide.

When the distributor slides are in the neutral position, the ribs of the main and duplicating slides cover the ducts leading to the cylinder cavities, and close them off.

When the duplicating slides operate, the force on the control stick increases, since it is necessary to overcome, during movement of the duplicating slide, the force of springs (5) and (9), in addition to friction.

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To eliminate the influence, on the booster slide, of ~~[illegible]~~ control vibrations, thecontrol stick is counled to the slides through buffers (1) and (13).

The buffer is made in the form of a piston in a liner, with a specific clearance.

When the piston moves, fluid is forced through this clearance, damping the motion.

ATTENTION: It is categorically forbidden to feed pressure to the booster from either system when the oberflow pipes are blocked.
During operation of the booster, no more than 2 cm^3 of fluid should be forced out through the outside packing in an hour.

C. Tank ~~Feed~~ Pressure-Boost System (Fig. 197)

The hydraulic tanks are equipped with a system for ~~feeding~~ boosting the pressure of the working fluid which improves operating conditions of the NP-34/2T pumps and increases the high-altitude performance of the hydraulic system.

[remainder illegible]

S-E-C-R-E-T

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Air entering from the compressor at a pressure of 10-12 kg/cm^2 fills the pressure-boost unit, at whose inlet are installed a check valve and a filter. Behind the pressure-boost unit the air is reduced by the RV-1.5 reducer to a pressure of 1.8-2.55 kg/cm^2 and is fed to the hydraulic tank through the pressure-boost valve. When the pressure in the tank rises to 3 kg/cm^2 the excess air is bled through the safety valve of the pressure-boost valve. The check valves, placed in series in the pressure-feed lines to the tanks, assure hermetic blocking of the cavities of the tank filled with compressed air, and prevent the air from escaping in the opposite direction. To remove the condensate, in order to prevent freezing of the water in the pressure-boost tank and the lines, ahead of the pressure-boost tank, in the left-wheel housing, there is a sump, which is a hollow cylinder with three pipes: pressure-fedd pipe, removal pipe, and lower drainage pipe; the drain pipe is stopped up with a plug having an opening 1 mm in diameter, which permits continual air flushing of the system; this helps to remove moisture from the sump and from the system. [remainder illegible]

50X1-HUM

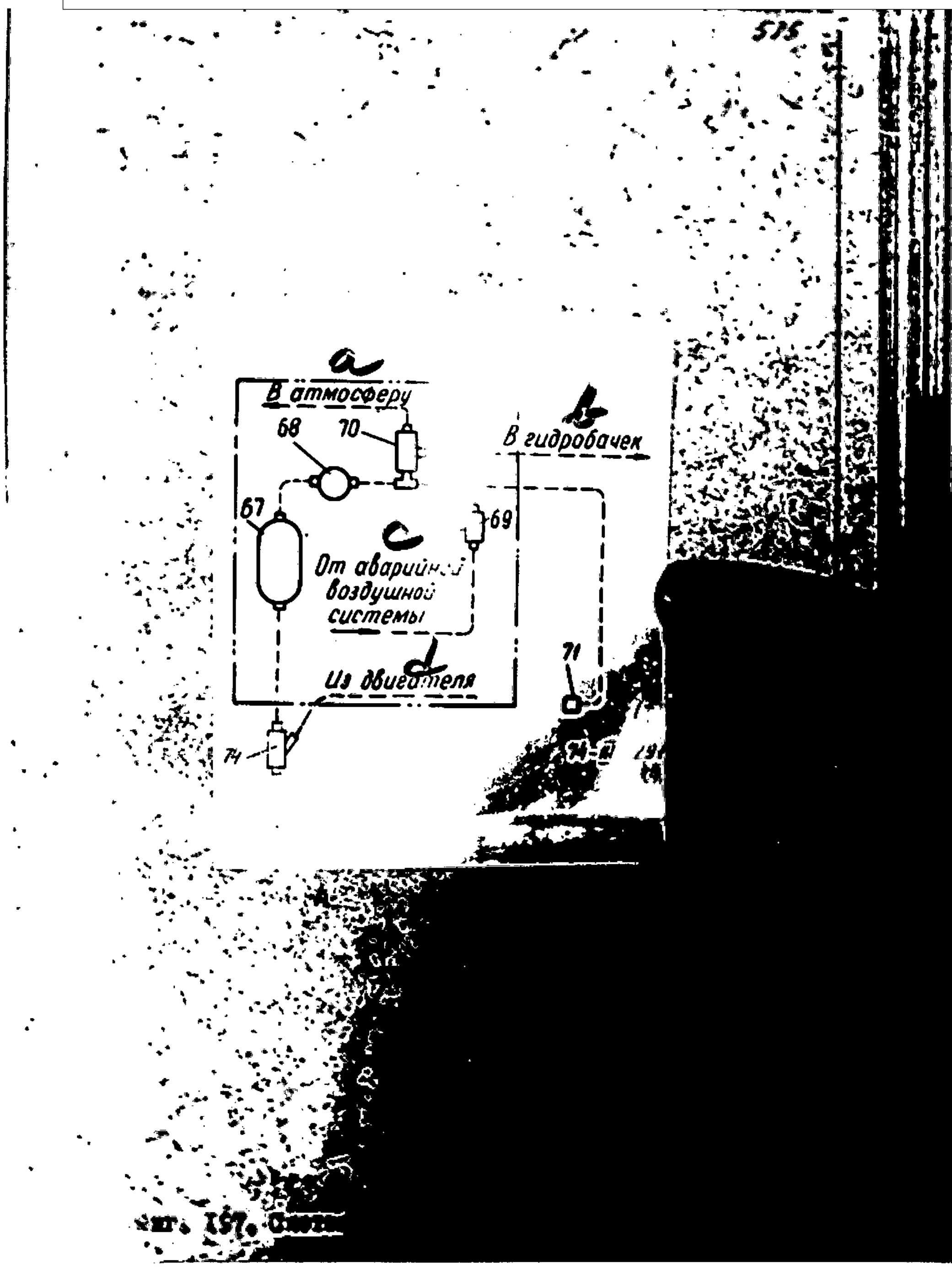

Fig. 197. Hydraulic tank pressure-boost system (positions as in Fig. 146).

a. to atmosphere; b. to hydraulic tank: c. from emergency air system; d. from engine.

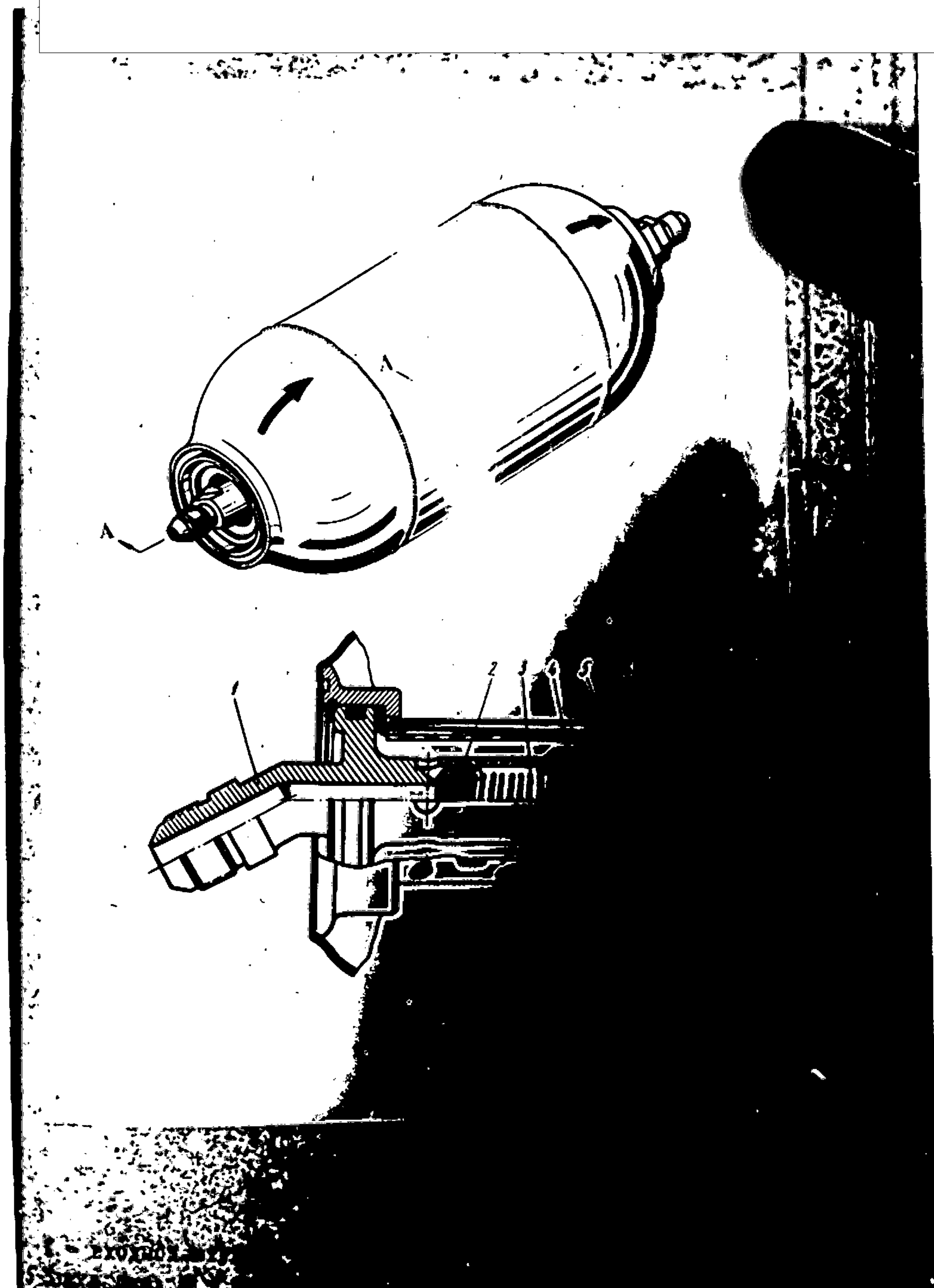

Fig. 198. Pressure-boost unit.

1. inlet pipe; 2. check valve; 3. spring; 4. stop; [illegible] 5. rivet [?]; 6. silk and gauze strainer.

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check valve (2), a silk filter and two gauze strainers.

The tank had a capacity of 1.3 liters and a working pressure of 12 kg/cm^2. The cylinder is made in conformity with the requirements of the Kotlonadzor (boiler inspection) and is periodically checked, every three years, with a hydraulic pressure of 18 kg/cm^2.

The cylinder is welded of AMGI-L1.8 material. In the bottom of the cylinder there is welded a cup containing the inlet and outlet pipes.

The inlet pipe is made of stainless steel; it has a check valve with a spring, and filters.

The filter is flushed with benzine and dried every 25-30 flight hours.

The unit housing has a stencil which contains information on the technical data and the time for the next check.

The unit is installed in the left wheel housing, and is attached with two flexible collars.

The pressure-boost valve (Fig. 199) prevents the air from traveling in the opposite direction when there is a drop in pressure in the pressure-boost line, and also prevents AMG-10 fluid from entering the pressure-boost line. In addition, with a rise in pressure in the tank due to variations in the levels of the fluid or due to irregularities in the RV-1.5 reducer, excess pressure is bled to the atmosphere through the valve's safety device.

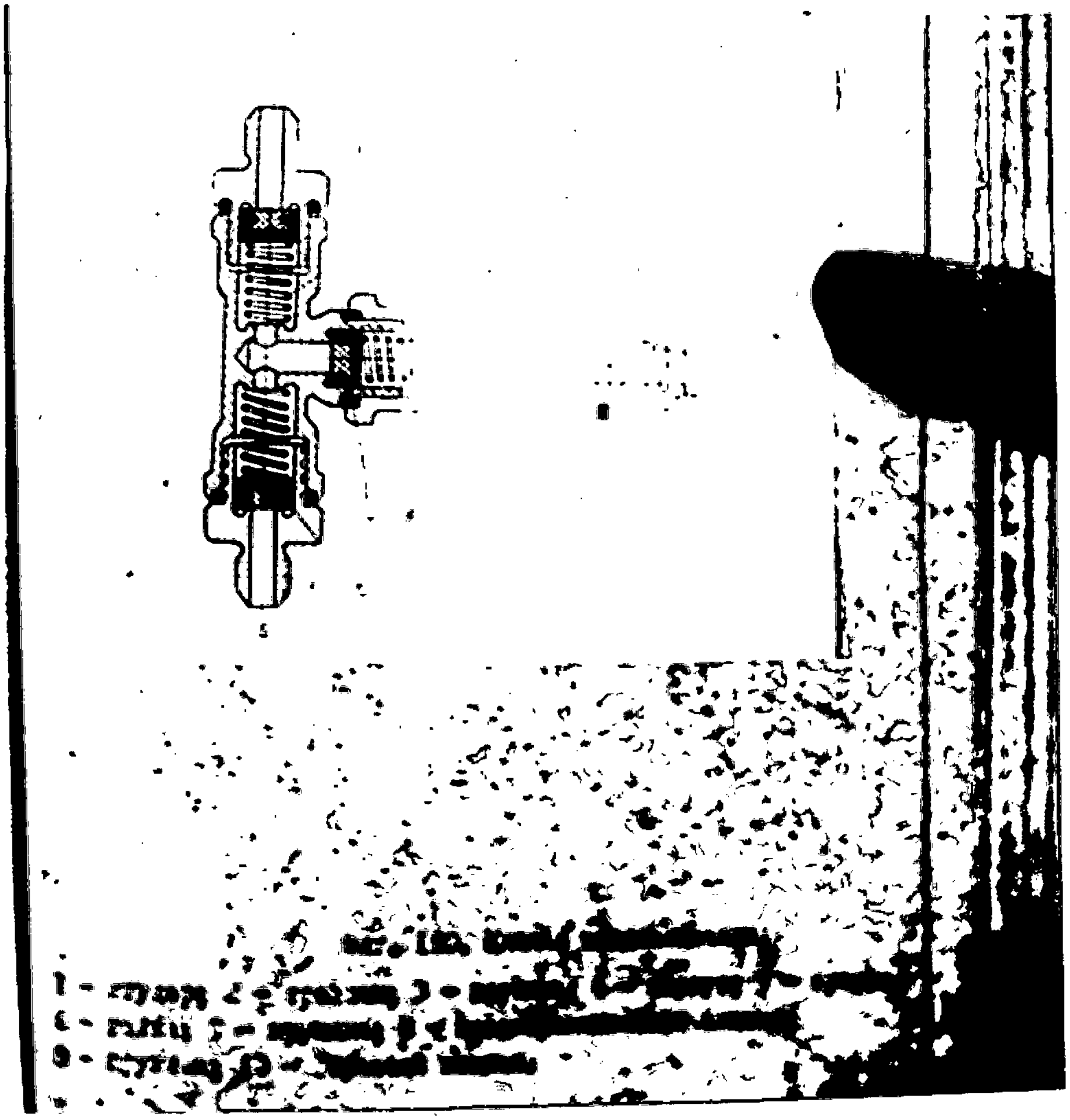

Fig. 199. Pressure-boost valve.

1. pipe; 2. [illegible] T-pipe; 3. spring; 4. housing; 5. cover;

6. nut; 7. spring; 8. safety valve; 9. spring; 10. check valve.

[these were taken from the text, rather than from the figure caption. Translator]

The pressure-boost valve consists of housing (4), cover (5), T-pipe (2), and pipes (1).

The pressure-boost valve includes 3 check valves (10) and safety valve (8); two inlet pipes are connected:

--one (A) to the plane's pressure-boost line; and

--one (Б) to the ground pressure-boost line.

When air comes from either of the two lines, it passes through two check valves, and through on-board pipe (B) of the housing it goes to the tank; in the event of a rise in pressure in the tank, the air pressure (overcoming the force of spring (7)) opens the safety valve and the excess air is bled through pipe (1) to the drainage line into the atmosphere. Bleeding of the pressure begins when pressures up to 2.8 $\pm$ 0.2 kg/cm^2 are reached. The pressure-boost valve is located on the left in the engine compartment, between frames 27 and 28.

<u>Detachable valves</u> (Fig. 200); these are used to assure decoupling of the lines with simultaneous cutting off of the pipes; this prevents flow of fluid from the hydraulic system.

The hydraulic system contains 4 detachable valves: two in the landing-gear system and two in the booster system.

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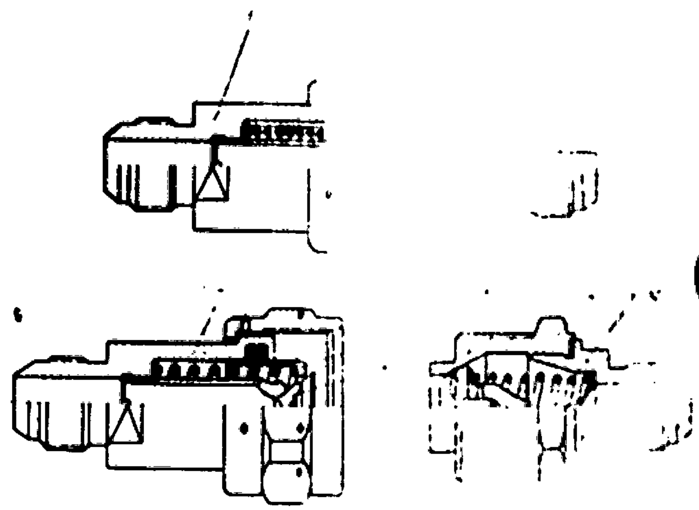
The valves are located near frame 28 (two to the right and two to the left) and are used when dismantling the plane. Each valve consists of two halves, joined together using connector nuts (2). Each of the halves is called a"stop valve" (1) and (3) and in turn consists of housing (4), springs (5) and (9), and heads (7) and (8). The left half (Fig. 200) includes barrel (6); the right half includes pipe (10).

When joined together, the housing of the right halfof the valve moves the barrel to the extreme left. Here hermetic sealing of the valve is assured by a rubber ring, for which there is a slot in the housing (4).

When the barrel is unscrewed (head (8) is unscrewed to the extreme left simultaneously with head (7)), passage is cleared for the fluid, assuring coupling of the pipes which go to the housing pipe (1) on the left and pipe (10) which has been screwed on on the right.

When nut (2) is released, and the halves of the valves are separated, barrel (6) is reseated by the spring in head (7), while head (8) is seated in (4) by spring (9). The ducts are closed and the lines cut off.

The valves, installed in the langi g-gear and booster systems, are similar in design; they differ only in the flow areas of the lines.



[illegible]

Fig. 200/ Detachable valve.

1. stop valve; 2. connector nut; 3. stop valve; 4. housing; 5. spring; 6. barrel; 7. head; 8. head; 9. spring; 10. pipe.

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Pipe
Supply Lines

The elements of the hydraulic and air systems are connected using pipes:

--the delivery part and the working lines behind the valves of the hydraulic system are made of 1Kh18N9T stainless steel;

--the overflow lines are made of AMGM Dural pipes; and

--the air system is made of AMGM pipes.

The pipes are rolled according to xxxxx norms 103AT55 (for the Dural and steel pipes) and 104AT55 (for the stainless steel pipes).

The pipes are connected with the pipes of the elements and with the equipment according to the norms 1000A.

Marking of the Pipes

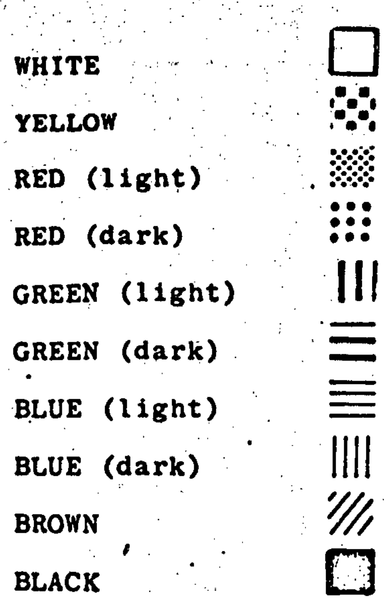
(Figs. 201, 202, 203, 204)

The pipes of the air system are painted black. The overflow pipes of the hydraulic system are painted gray. The stainless steel pipes are not painted.

In the air and hydraulic systems a specific marking of the pipes is used, which simplifies maintenance of the systems.

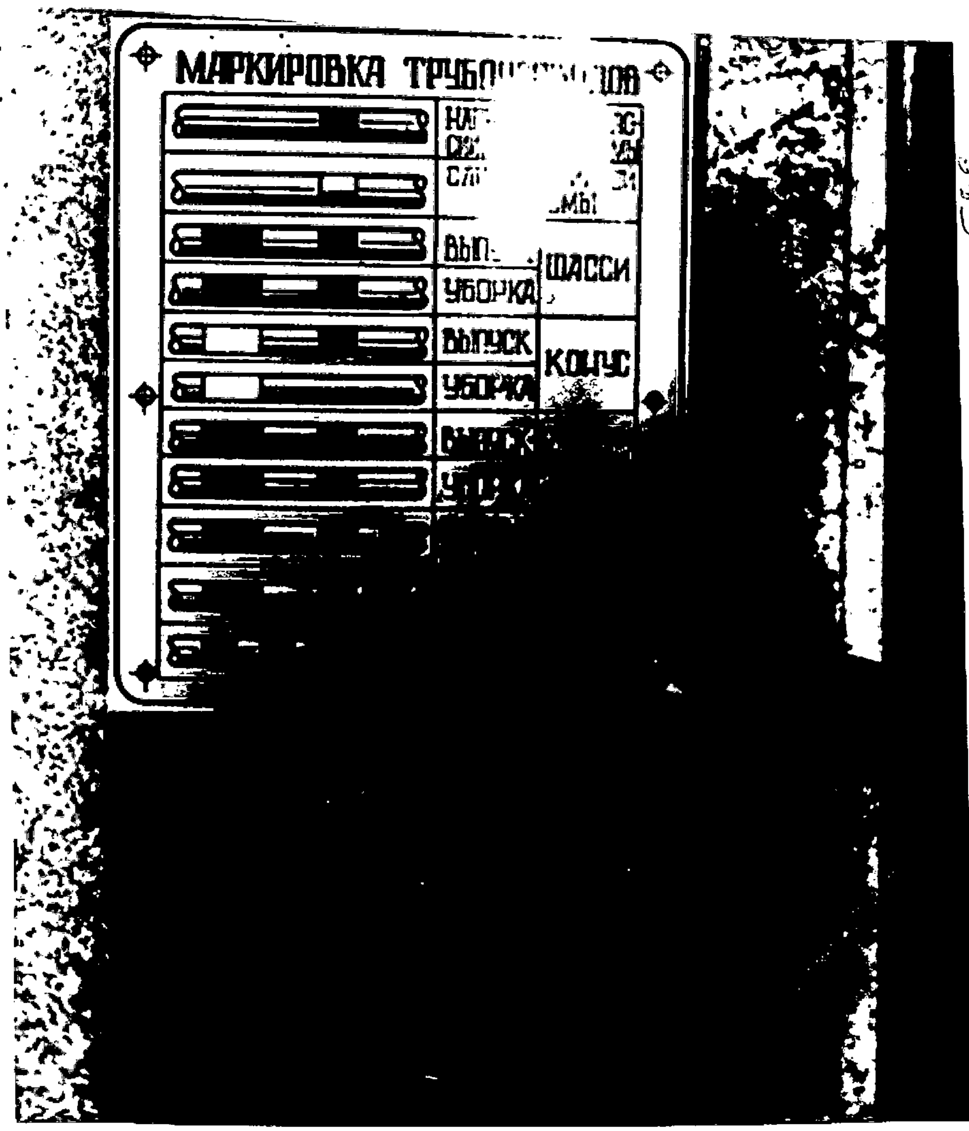
 50X1-HUM

SECRET 582 a
[redacted] 50X1-HUM



50X1-HUM

50X1-HUM



S-E-C-R-E-T

50X1-HUM

[redacted] 50X1-HUM

SECRET

[redacted] 50X1-HUM

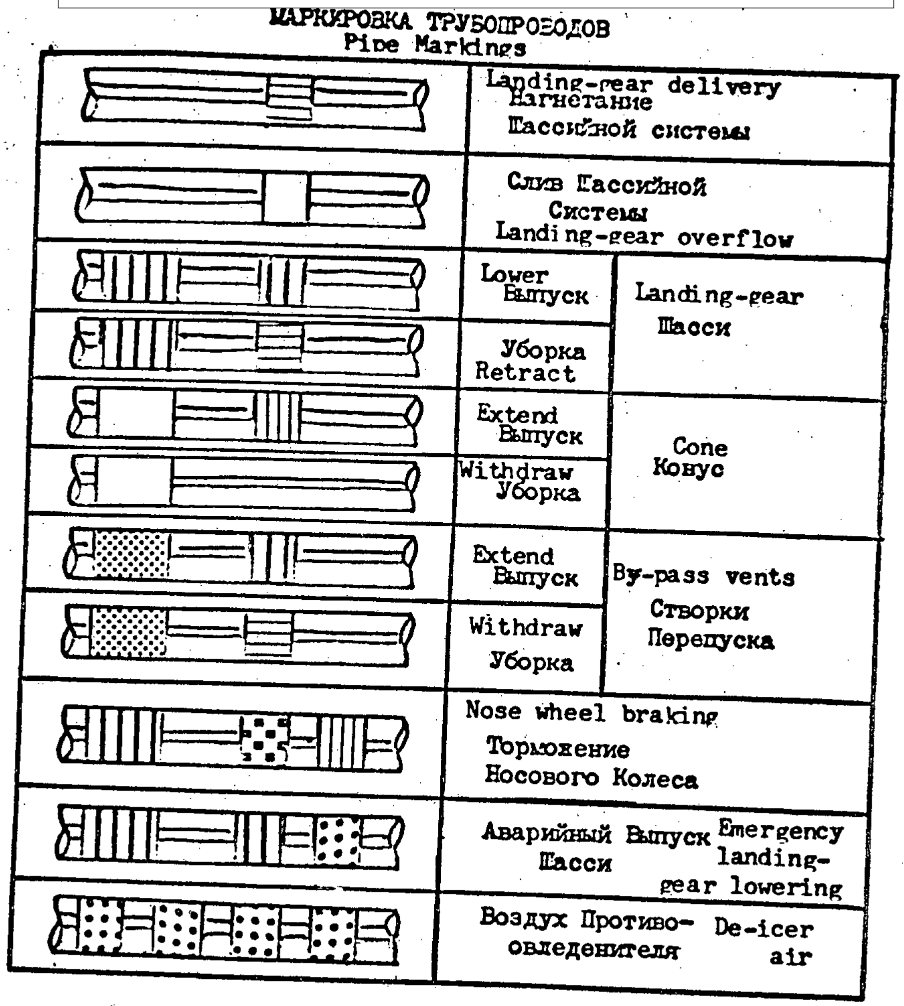
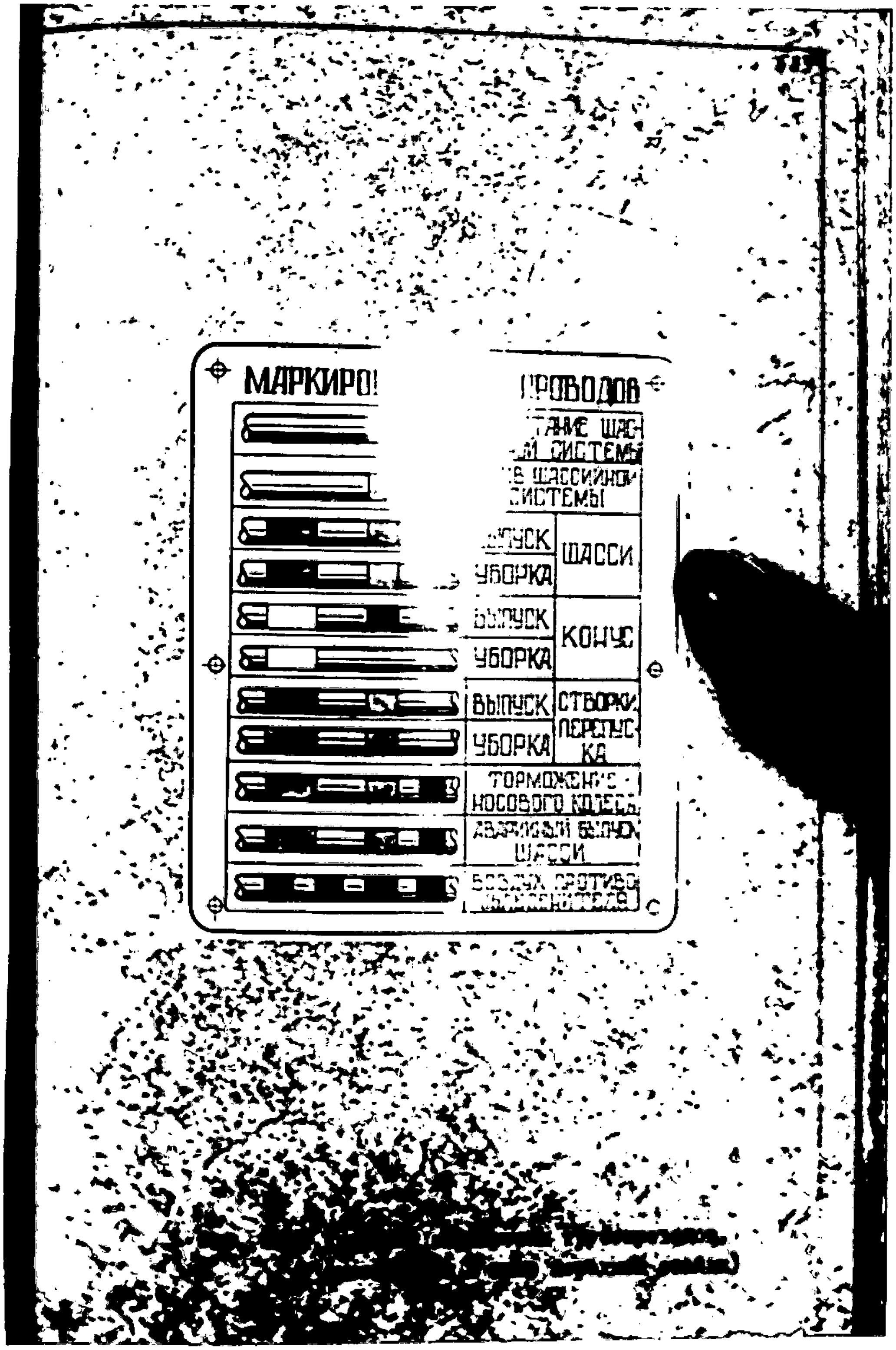


Fig. 201. Pipe-marking information plate (in front landing-gear housing)

[redacted] 50X1-HUM

S-E-C-R-E-T

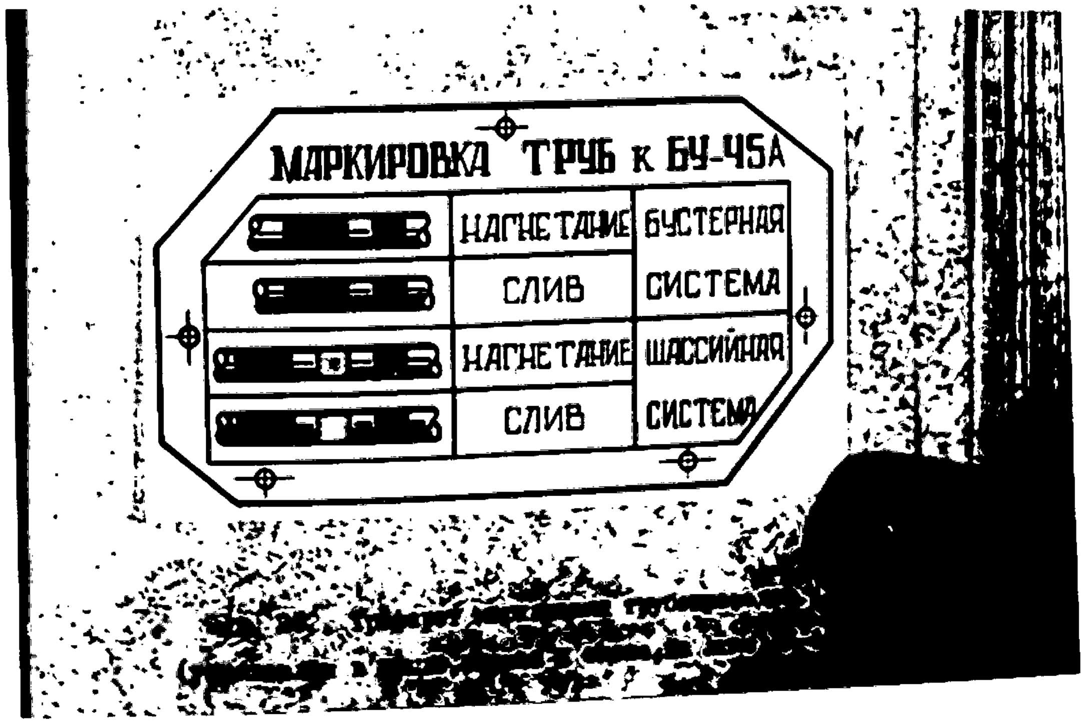
50X1-HUM



S-E-C-R-E-T

50X1-HUM

50X1-HUM



50X1-HUM

МАРКИРОВКА ТРУБ К БУ-45А
Marking of pipe to BU-45A

	Delivery Нагнетание	Booster Бустерная
	Overflow Слив	system Система
	Нагнетание Delivery	Шассийная Landing-gear
	Слив Overflow	Система system

Fig. Pipe-marking information plate

(in wing, left and right, on BU-45A)

50X1-HUM

[redacted] 50X1-HUM

SECRET

[redacted] 50X1-HUM

Pipe markings
МАРКИРОВКА ТРУБОПРОВОДОВ

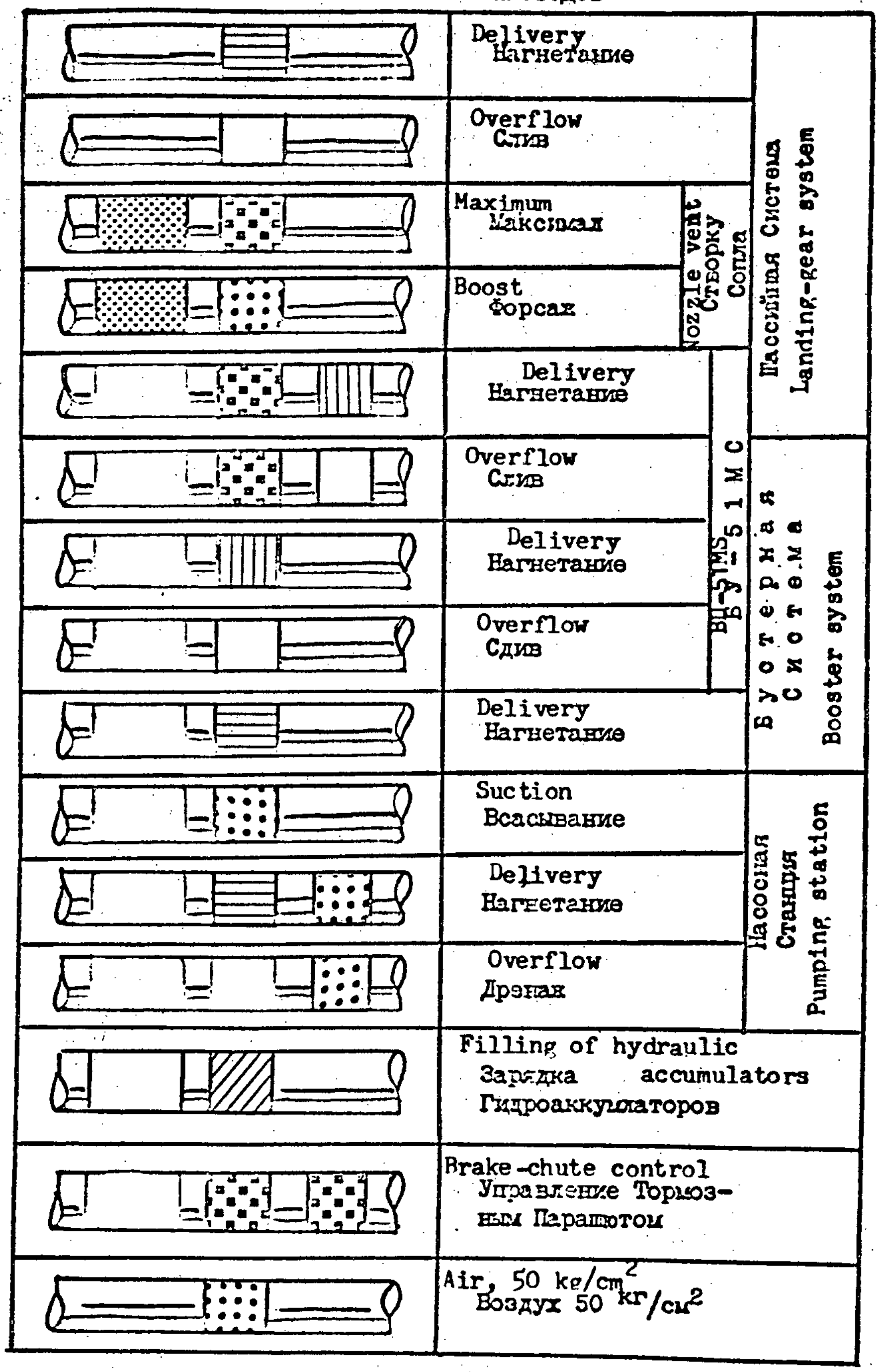


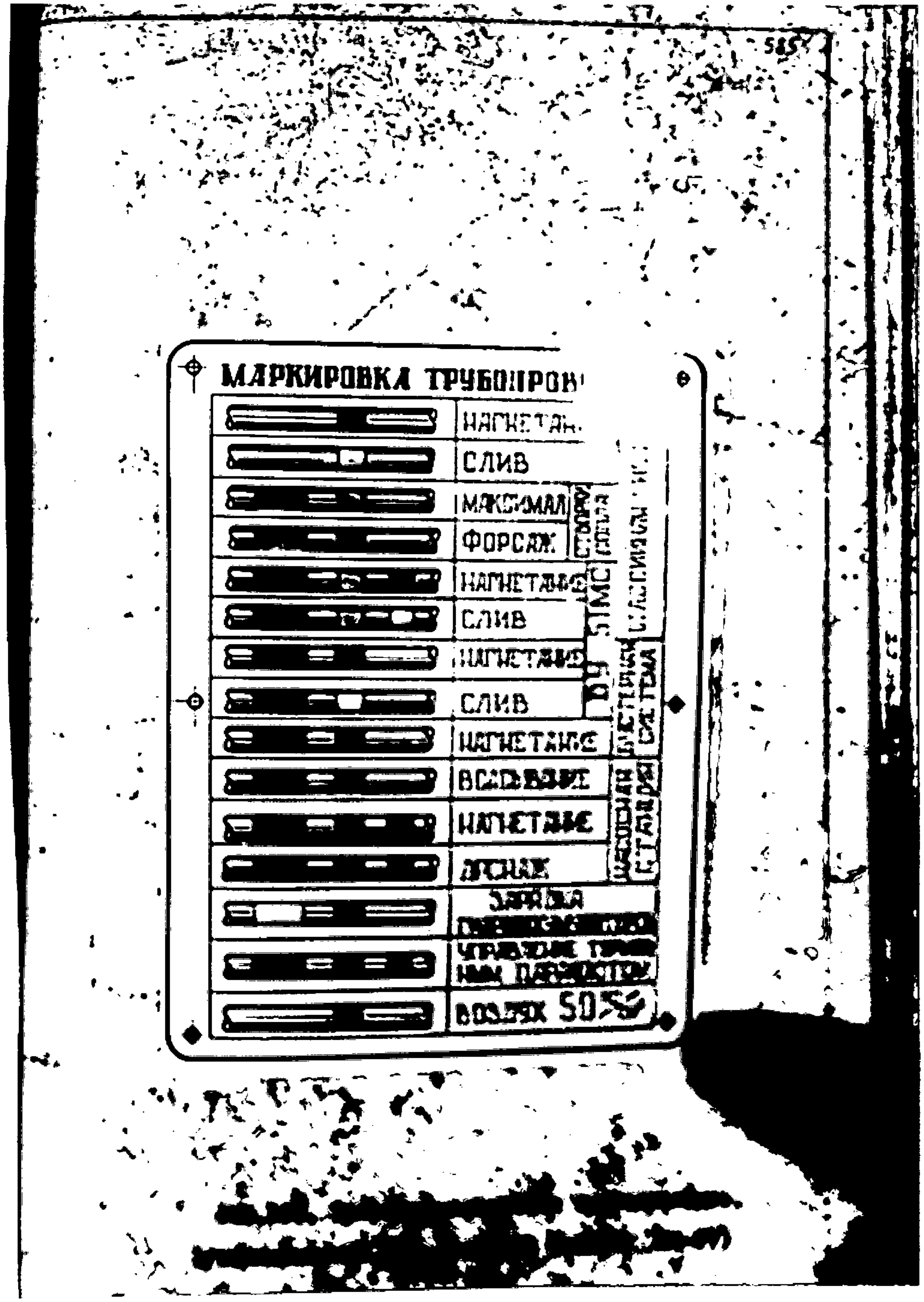
Fig. 203. Pipe-marking information plate

([location illegible])

[redacted] 50X1-HUM

S-E-C-R-E-T

50X1-HUM



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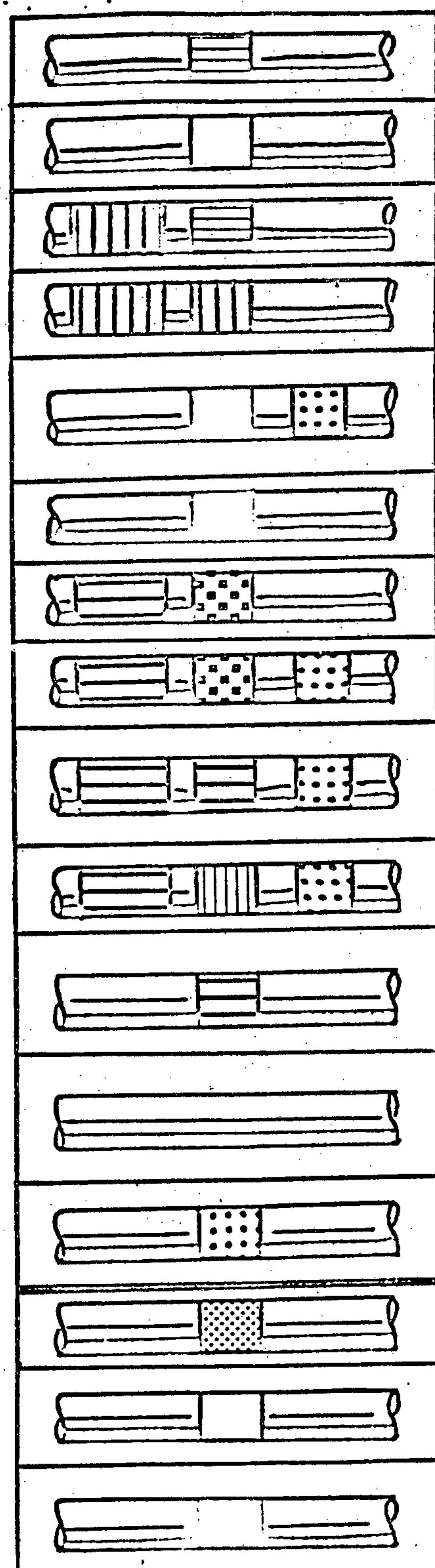
Pipe markings
МАРКИРОВКА ТРУБОПРОВОДОВ



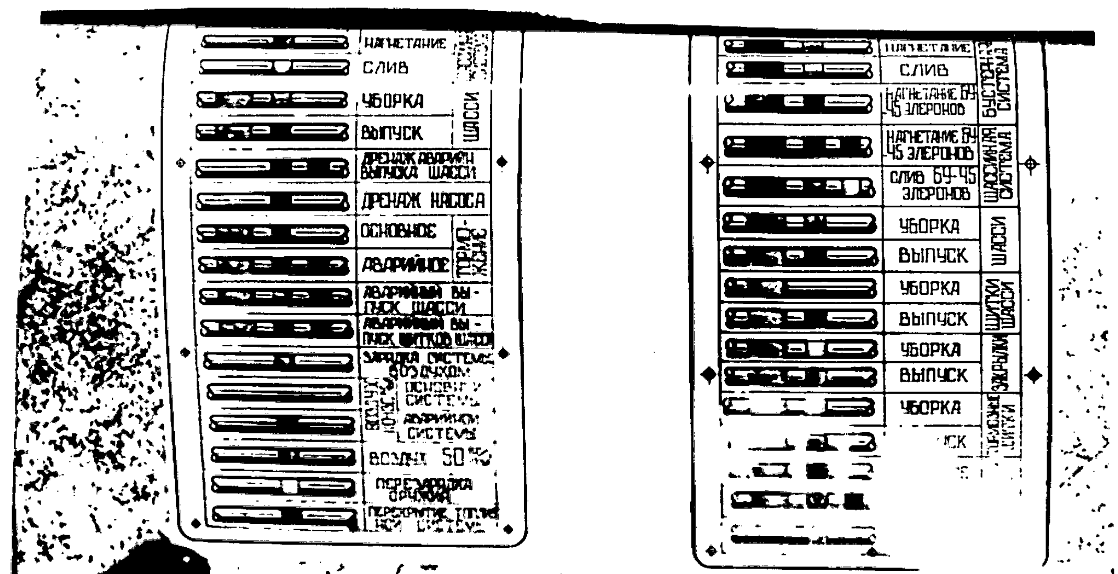
Delivery Нагнетание	Шассийная Система Landing-gear system	
Overflow Слив		
Retract Уборка	Шасси Landing gear	
Lower Выпуск		
Emergency landing-gear overflow Дренаж Аварийн. Выпуска Шасси		
Pump overflow Дренаж Насоса		
Main Основное	Торможение Braking	
Emergency Аварийное		
Emergency landing-gear lower Аварийный Выпуск Шасси		
Emergency landing-gear flap lower Аварийный Выпуск Щитков Шасси		
Filler for air system Зарядка Системы Воздухом		
Air, 110-130 kg/cm^2 Воздух 110-130 $кг/см^2$	Main system Основной Системы	
	Emergency system Аварийной Системы	
Воздух 50 $кг/см^2$ Air, 50 kg/cm^2		
Weapons re-load Перезарядка Оружия		
Fuel-system closing Перекрытие ной Системы		

Fig. 205. Pipe marking information plate (on left and right wheel flaps)

50X1-HUM

50X1-HUM

S-E-C-R-E-T



Фиг. 204. Трафарет маркировки трубопроводов
(устанавливается на лючках в нишах колеса)

586

S-E-C-R-E-T

Pipe markings
МАРКИРОВКА ТРУБОПРОВОДОВ

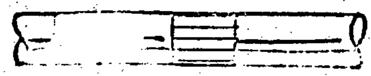
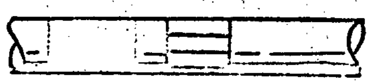
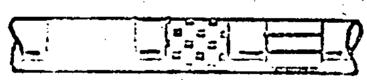
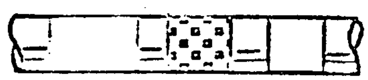
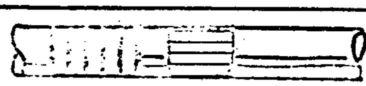
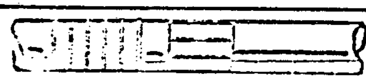
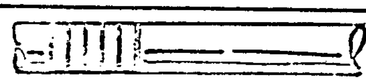
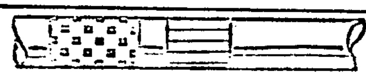
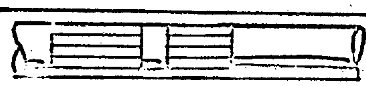
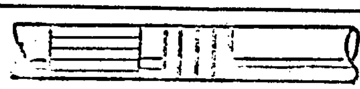
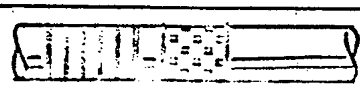
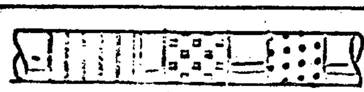
	Delivery Нагнетание	Бустерная Система Booster system
	Overflow Слив	
	Delivery to BU-45 Нагнетание БУ-45 элеронов for ailerons	
	Delivery to BU-45 Нагнетание БУ-45 элеронов for ailerons	Шассийная Система Landing-gear system
	BU-45 overflow Слив БУ-45 элеронов (ailerons)	
	Уборка Retract	Шасси Landing gear
	Выпуск Lower	
	Уборка Retract	Щитки Шасси Landing-gear flaps
	Выпуск Lower	
	Уборка Retract	Закрылки Wing flaps
	Выпуск Extend	
	Уборка Ex Retract	Тормозные Щитки Brake flaps
	Выпуск Extend	
	[illegible]	[illegible]
	[illegible]	
	[illegible]	

Fig. 204 (cont) [see page 586/1]

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The pipes are marked by painting colored bands (arbitrary colors) on the pipes at theconnecting nuts.

The ~~xxxxxx xxxxxxx~~ combinations and ~~xxxxx xxxxxxxxx~~ conditional number of bands are defined by norm~~x~~ 6095s57.

For maintenance convenience, information plates are attached to the plane; these plates give all examples of the markings and their meaning.

The steel pipe is/strength-tested before being installed in the system with a hydraulic pressure of 315 kg/cm^2; the AMGM pipes are tested with a pressure of 75 kg/cm^2.

The pipes are attached together by means of ~~xxx~~ multi-socket blocks, into which the group of pipes is attached by coupling bolts. These blocks can be either suspended or attached. The~~xx~~ suspended blocks are used at ~~xxxxxxxxx~~ specific points to fasten the pipes together, increasing the ~~xxxxx~~ rigidity of the bundle of pipes and preventing the pipes from touching.

The attached blocks are fastened to units of the airframe directly or to intermediate elements (profiles, angle pieces, etc.).

The sockets in the blocks, into which the pipes are inserted, have rubber packing.

There are no flexible rubber hoses in the hydraulic system, ~~xxxxxx~~ with two exceptions; these are two suspection hoses from the tanks to the NP-34/2T pump.

Hoses are used in the air system in those places

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where pressure must be fed through movable units. The hoses are installed at the point of pressure feed to:

--the brake drums of the KT-38 and KT-82M wheels; and

--the pipes mounted in the struts, from the wing lines.

In the first instance, this is because of movement of the wheels when absorbing the shock during landing; in the second case it is because of movement of the strut during retraction and lowering.

Reduction of the number of flexible hoses to a minimum in the hydraulic and air systems increases the operational reliability of the systems.

CHAPTER VI

AIRCRAFT CONTROL

1. GENERAL INFORMATION

The aircraft-control system (Fig. 205) consists of:

- the stabilizer control,
- the rudder control,
- the aileron control.

The stabilizer and aileron control is accomplished by a control lever located in the cabin, while the rudder control is accomplished by foot pedals.

The control lever is connected to the stabilizer and the ailerons, while the pedals are connected to the rudder with the aid of tubular rods, intermediate levers, and actuating arms.

In the stabilizer-control system is hydraulic amplifier BU-51MS, which simultaneously imparts motion to both halves of the stabilizer.

In the aileron-control system are two hydraulic amplifiers BU-45A. Hydraulic amplifiers BU-45A and BU-51MS are inserted into the control system according to the scheme depicted and fully absorb the hinge moments arising on the controls as a result of aerodynamic forces.

For assembly and inspection of the hydraulic amplifiers there are removable hatches in the fuselage and wing covering and a removable back fairing of the rudder fin.

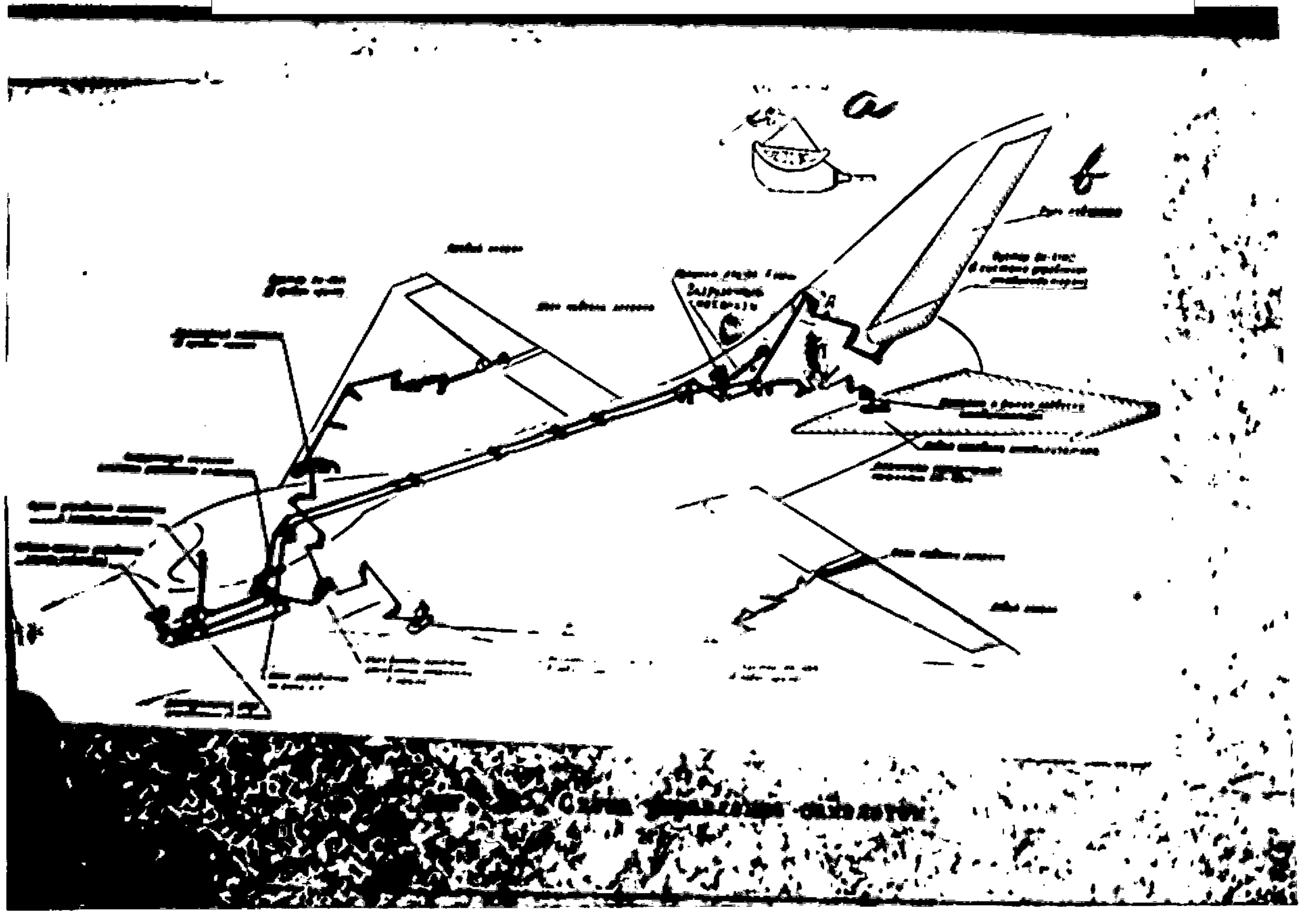

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Fig. 205. Aircraft control.

a) location A

b) rudder

c) loading mechanism

(remainder illegible)

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Spring loading mechanisms are installed in the stabilizer and aileron control systems to imitate the stresses on the control lever.

In order to prevent the efficiency of the stabilizer from being excessively high at velocity regimes close to the velocity of sound and at low altitudes, automatic control ARU-3V is installed in the stabilizer-control system. The automatic control alters the gear ratio from the control lever to the stabilizer to decrease the range of deflection of the stabilizer and from the control lever to the spring loading mechanism to increase the lever load.

Also in the stabilizer-control system is "trimmer-effect" mechanism MP-100M, which acts as an aerodynamic trimmer and removes the stresses from the control lever in the desired direction.

In the aileron-control system the imitation of the aerodynamic loads on the control lever is also created by a spring loading mechanism.

Mounted in the aileron-control system are mechanisms for nonlinear variation of the gear ratio. These mechanisms ensure normal lateral controllability of the plane at high flight speeds when the ailerons become excessively effective.

At the zero position of the stabilizer and the ailerons the control rod is in a neutral position at a distance of 50^{+10}_{-5} mm from the instrument panel. The maximum deflection of the lever backwards over a distance of 220^{+14}_{-24} mm from the neutral position corresponds to a downward deflection of the stabilizer nose of $20^{0} \pm 1$ on the large arm of automatic control ARU-3V and $15^{0} \pm 1$ on the small arm of automatic control ARU-3V. When the lever is deflected forward

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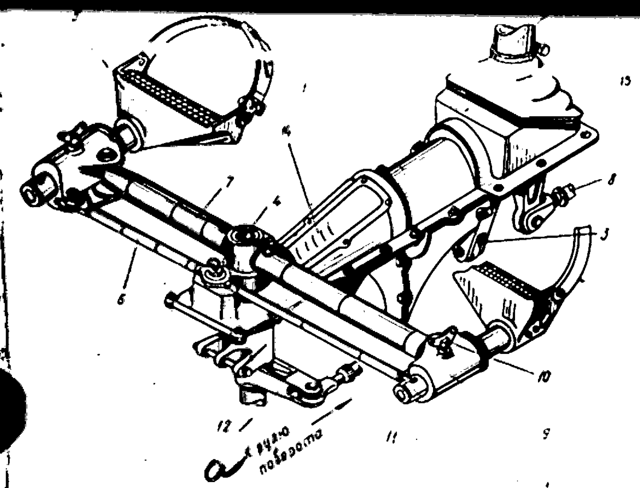
over a distance of 96^{+24}_{-14} mm from the neutral position, the stabilizer nose is deflected upward at an angle of $13^{\circ}{}^{+1^{\circ}}_{-1.5}$ on the large arm of automatic control ARU-3V and $4^{\circ} \pm 1^{\circ}$ on the small arm of the ARU-3V. A deflection of the lever to the right or left of the vertical over a distance of 145 ± 10 mm corresponds to deflection of the ailerons upward or downward by $20^{\circ} \pm 1^{\circ}$ when hydraulic amplifiers BU-45A are switched on; when the BU-45A are switched off the ailerons are deflected respectively by $20^{\circ} - 5^{\circ}$.

<u>The rudder control</u> is rigid and is accomplished by the pilot pressing on pedals connected to the rudder with the aid of tubular rods, actuating arms, and levers. The maximum forward and backward movement of the pedals is 87.5^{+6}_{-3} mm from the neutral position (200 mm on the arm) and corresponds to a deflection of the rudder left or right by an angle of $25^{\circ} \pm 1^{\circ}$. The rudder-control mechanism, like the aileron-control system, contains a nonlinear transmission mechanism.

The control lever and the pedals are mounted on one common electronic bracket, which is located in the cabin.

Sealing devices are installed at the spots where the rods emerge from the cabin.

<u>The central control unit (Fig. 206)</u> is electronic bracket (1) with lugs, openings, and molded ball bearings, rotating in which is a barrel containing control lever (2) and aileron-control lever (3) and axle (4) of main pipe (7) of a parallelogram mechanism containing pedals (5).



Фиг. [illegible]. Центральный узел управления.

[illegible] управления; 3-рычаг управления элеронами; 4 - ось; 5 - педаль; [illegible]
[illegible] тяга к управлению стабилизатором; 9 - боковой кронштейн; 10 - ре-
[illegible] к узлу поворота; 12 - рычаг; 13 - стержень педали; 14 - крышка;

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Fig. 206. Central control unit.

1 – bracket;

2 – control lever;

3 – aileron-control lever;

4 – axle;

5 – pedal;

6 – rod;

7 – pipe;

8 – stabilizer-control rod;

9 – side bracket;

10 – adjustable screw;

11 – rod connecting with rudder;

12 – lever;

13 – pedal bar;

14 – cover;

15 – collar.

a) to rudder

The bracket is bolted to the floor of the cabin and to frame 7a. Mounted on the bracket are stops limiting the deflection of the pedals and the control lever.

The control lever is hinged onto lugs of a chromansil barrel. Bolted to the barrel is aileron-control lever (3).

Rudder-control pedals (5) are bolted on hinges to the forward part of the central unit with the aid of a parallelogram mechanism consisting of pipe (7), rod (6), and axle (4), as well as side brackets (9).

The pedal consists of a footrest, a fluted covering, a duralumin bar, and rubber straps. The footrest, together with the bar, is inserted into side bracket (9) and is held stationary in it with the aid of adjustable retainer screw (10).

The pedals can be adjusted according to the height of the pilot. The adjustment is accomplished as follows. In bar (13) of the pedal, which is rigidly connected to the footrest by two conical bolts, there are six openings with a diameter of 6 mm located at a distance of 10-20 mm from each other.

Depending on the height of the pilot, the pedal, together with the bar, is moved forward or backward relative to the side bracket, and with the aid of a retainer which is inserted in one of the openings the bar is rigidly connected to the side bracket.

Rudder-control rod (11) is connected on the left to lever (12), which is rigidly mounted on the axle of the parallelogram mechanism.

When assembling the plane, the actuating arms and rods of the stabilizer, rudder, and aileron controls are mounted separately in the for[illegible] sections of the fuselage and in the wings.

When joining the forward and tail sections of the fuselage, the stabilizer and rudder control rods are connected to the actuating arms in the region of frame 28 in the forward section of the fuselage with the aid of hinge bolts. Access to these bolts is achieved by removing the back fairing.

When suspending the wings, the aileron-control rods are connected in the region of frame 13 by hinge bolts to actuating arms located in the wings on rib 1. Access to these bolts is achieved by removing the nose of the wing.

In the stabilizer-control system on the actuating arm near frame 11 is a sensor with microswitch KV-9A. The sensor is installed after final adjustment of the control. It serves to block the surge-control vents according to the angle of deflection of the stabilizer.

The sensor closes an electrical circuit when the stabilizer nose is in a downward position from 20^{0+1° to the extreme position during pitching and opens the electrical circuit in the range from 20^{0+1° to the extreme position during diving (nose upward) with the ARU-3V on the large arm.

In this case in the extreme positions of the stabilizer control the margin of movement of the sensor rod should be no less than 2 mm.

The control lever (Fig. 207) consists of three parts: a handle of aluminum alloy, a duralumin pipe, and a lower barrel. The handle is connected to the pipe

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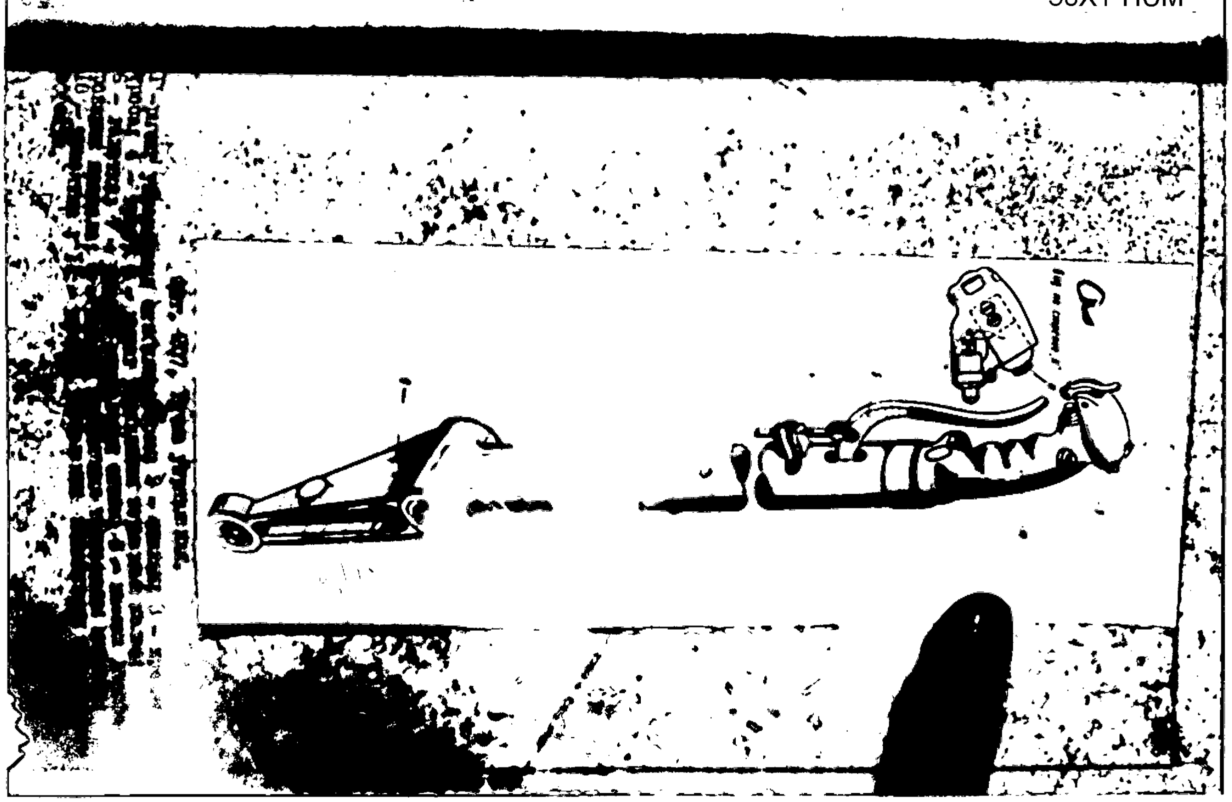

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Fig. 207. Control lever.

1 - stabilizer-control lever;

2 - barrel;

3 - cable attachment;

4 - cable;

5 - lever controlling wheel braking;

6 - ~~[illegible]~~ trigger;

7 - fire-control button;

8 - sight-damping button;

9 - brake-flap control button;

10 - ~~[illegible]~~ handle;

11 - button controlling the trimmer-effect mechanism.

a) view along arrow K

is the stabilizer-control rod.

Three electrical buttons and two-position switch PK-4 are located on the handle of the lever, and an electrical braid is fed in. Switch PK-4 is located in the center of the upper part of the handle and serves to control the trimmer-effect mechanism. Above and forward is the fire-control button (depressed with the aid of a hinged trigger). Below and to the left is the button controlling the air-brake flaps.

Hermetic Sealing of Control Units

In order to prevent contamination by dirt and foreign bodies in the cabin, protective coverings are placed on the control lever, on the aileron-control rod near frame 10, and on a unit located between frames 10 and 11. The stabilizer, rudder, and aileron control rods in the cabin are protected by a special removable casing. Hermetically sealed leads are installed at the outlets of the stabilizer, rudder, and aileron control rods from the cabin. The hermetically sealed lead for the aileron-control rod is on the floor of the cabin, while the leads for the stabilizer and rudder control rods are on a panel beneath the canopy.

The hermetically sealed lead (Fig. 208) consists of a bracket with a flange and lugs with the bracket being rigidly attached to the fuselage; bushings (11) with lugs for shafts (12), inside which the tip of the rod moves; rubber cover (6) and tray (10), which connects by hinges

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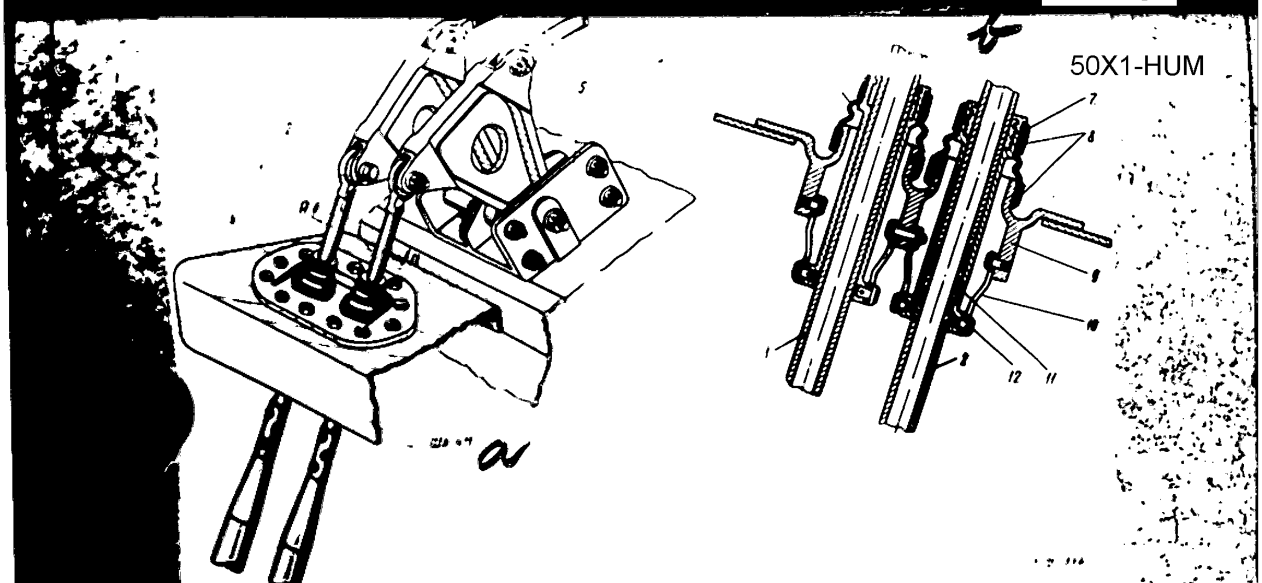

[illegible] узлов управления [illegible] 4 — качалка; 5 — кронштейн [illegible] 9 — кронштейн [illegible]

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Fig. 208. Hermetic sealing of control units.

1 - stabilizer rod;

2 - rudder rod;

3 - actuating arm;

4 - actuating arm;

5 - bracket for attaching actuating arms;

6 - hermetically sealed cover;

7 - gland;

8 - wire band;

9 - bracket for hermetically sealed lead;

10 - tray;

11 - bushing;

12 - shaft.

a) frame 11

b) cross section along A-A

bushing (11) and bracket (9). Cover (6) is placed on bushing (11), and the flange of bracket (9) is attached to it by a wire. For optimum sliding of the rod tip inside bushing (11) the abrading surfaces are lubricated with lubricant (illegible number).

Hermetically sealed fabric covers are placed on the aileron-control rods in the joint between the wing and the fuselage and on the stabilizer-control rods on frame 34.

2. STABILIZER CONTROL SYSTEM

Longitudinal aircraft control (Fig. 209) is achieved by a controllable stabilizer (without an elevator) from the control lever with the aid of a system of push-pull rods and actuating arms through booster BU51MS, which is inserted according to an irreversible scheme and imparts motion simultaneously to both halves of the stabilizer.

The use of a controllable stabilizer instead of an elevator is due to the fact that at supersonic flight speeds the efficiency of an elevator is reduced, i.e., its deflection no longer causes the required change in the lifting force of the horizontal tail surfaces. Moreover, the plane's reserve of longitudinal static stability increases, and the force required on the horizontal tail surfaces in order to balance the plane increases in proportion.

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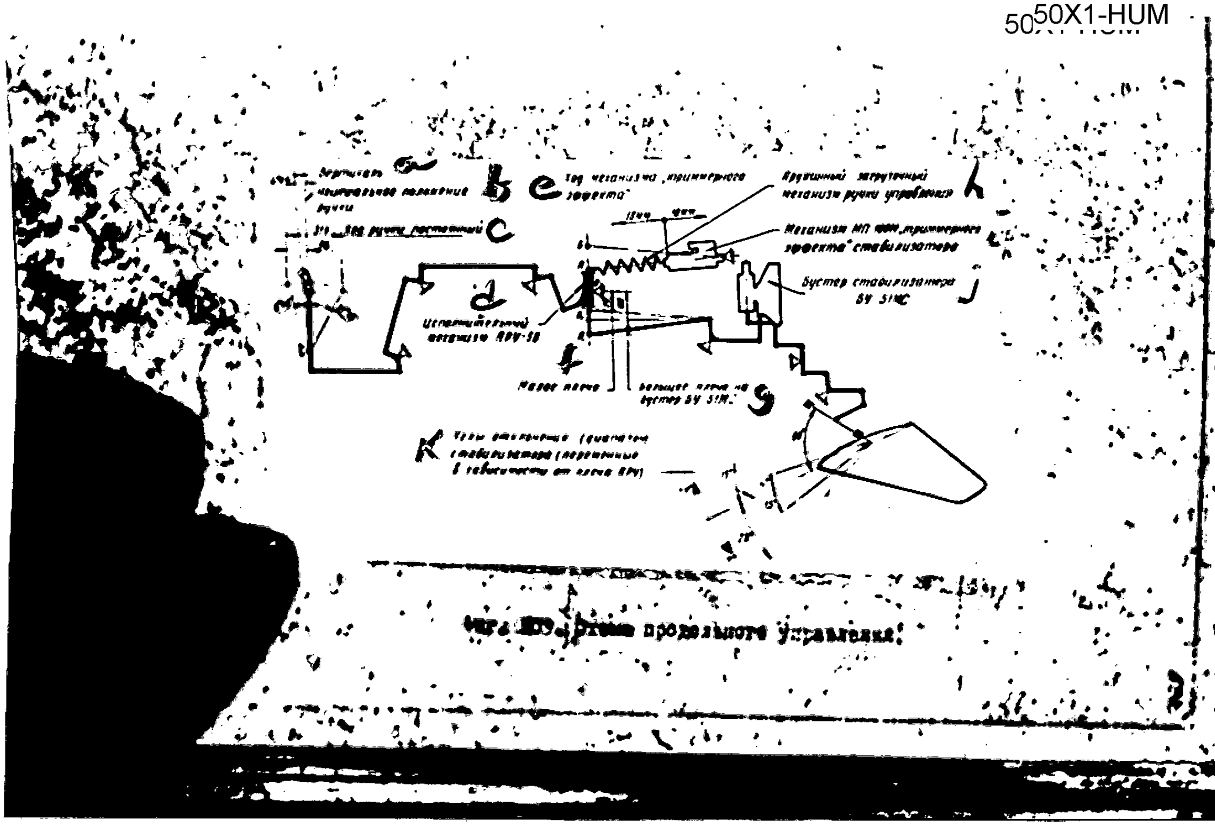

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Fig. 209. Longitudinal control system

a) vertical

b) neutral position of lever

c) path of lever constant

d) actuating mechanism ARU-3V

e) path of "trimmer-effect" mechanism

f) small arm

g) large arm on booster BU-51MS

h) spring loading mechanism of control lever

i) "trimmer-effect" mechanism MP-100M of stabilizer

j) stabilizer booster BU-51MS

k) angles of deflection (range) of stabilizer (varied as functions of the ARU arm)

The ma[redacted] of the plane by means of the elevator is impaired at supersonic speeds, especially at high altitudes. 16CL

The use of a controllable stabilizer instead of an elevator led to an improvement in the maneuverability, owing to a considerable increase in the maximum forces on the horizontal tail surfaces when they are deflected at supersonic speeds and to an increase in the g forces available in these flight regimes.

However, in flight regimes where the efficiency of the elevator was sufficient the efficiency of the controllable stabilizer was found to be too high. In order to reduce the efficiency of the controllable stabilizer in those regimes where it is too high, an ARU-3V automatic control regulator was installed on the plane.

The ARU-3V automatically changes the gear ratio from the lever to the stabilizer, to reduce the range of deflection of the stabilizer, and simultaneously changes the ratio from the lever to the spring loading mechanism, in relation to the impact pressure and the flight altitude in a range from 5000 m to 10,000 m, by varying the size of the arms of the ARU-3V.

Assemblies of the Stabilizer-control System and Their Functions (Fig. 210)

In addition to the control lever, the following assemblies are contained in the stabilizer-control system:

- loading mechanism,
- "trimmer-effect" mechanism MP-100M,

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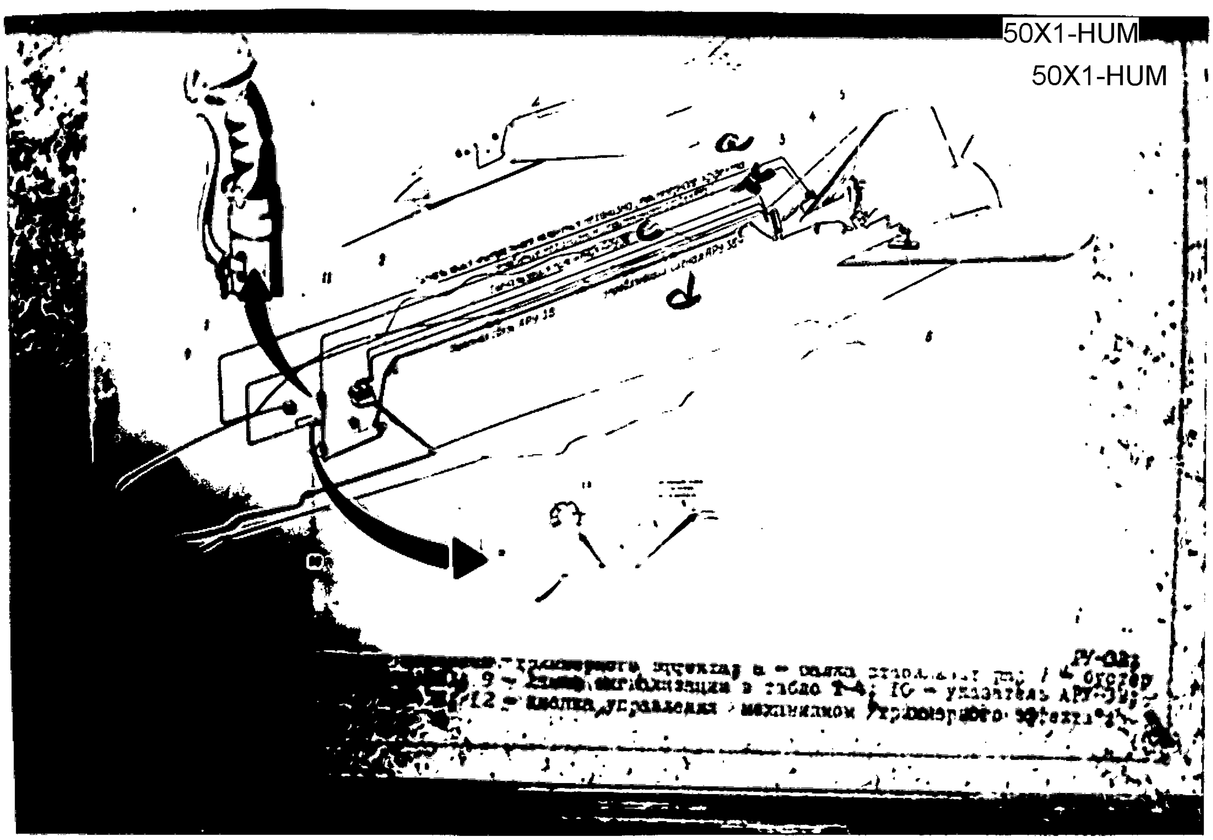

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Fig. 210. Stabilizer-control system.

1 - aircraft-control lever;

2 - control unit of ARU-3V;

3 - actuating mechanism of ARU-3V;

4 - loading mechanism;

5 - "trimmer-effect" mechanism;

6 - stabilizer beam;

7 - stabilizer booster BU-51MS;

8 - tube (number illegible);

9 - signal light in panel T-4;

10 - indicator of ARU-3V;

11 - switches (numbers illegible);

12 - button of "trimmer-effect" mechanism.

a) signaling of neutral position of "trimmer-effect" mechanism

b) control of "trimmer-effect" mechanism

c) signaling of position of ARU-3V

d) control signal of ARU-3V

(remainder illegible)

- booster MU-5IMS;

- automatic control regulator ARU-3V, consisting of a control unit, an actuating mechanism, and a position indicator.

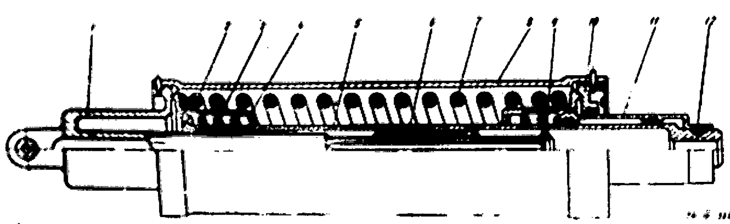
The spring loading mechanism (Fig. 211) is used to imitate the aerodynamic stresses on the control lever in proportion to the angle of deflection of the lever and the flight speed and altitude of the plane.

Structurally the loading mechanism is a cylinder (8) containing axle (1) and hollow rod (5), located between which are three precompressed springs operating under compression.

The small springs are each compressed under 35 kg, while the middle spring is compressed under 42.5 kg. In the neutral position the stresses of the small springs counterbalance each other, and the stress on the rod of the loading mechanism is equal to zero.

Rod (5) of the loading mechanism is connected to the rod of the ARU-3V, while the cylindrical casing is connected to the "trimmer-effect" mechanism.

When the ARU-3V turns, the rod of the loading mechanism enters the cylinder, compresses a small spring, as a result of which the second small spring begins to come loose, and when the rod has moved 0.9 mm a stress of 8.4 kg is created (Fig. 212). When the rod has moved 4.5 mm, the middle spring is compressed at the same time that the second small spring is completely released. When the rod moves further, the middle spring alone is the only one working.



Фиг. 211. Загрузочный механизм управления стабилизатором.

1 - ось; 2 - шайба; 3 - пружина; 4 - опорное кольцо; 5 - шток; 6 - сепаратор; 7 - пружина; 8 - цилиндр; 9 - гайка; 10 - крышка; 11 - втулка; 12 - винт.

Fig. 211. Loading mechanism of stabilizer control.

1 - axle;

2 - washer;

3 - spring;

4 - supporting ring;

5 - rod;

6 - separator;

7 - spring;

8 - cylinder;

9 - nut;

10 - cover;

11 - bushing;

12 - screw.

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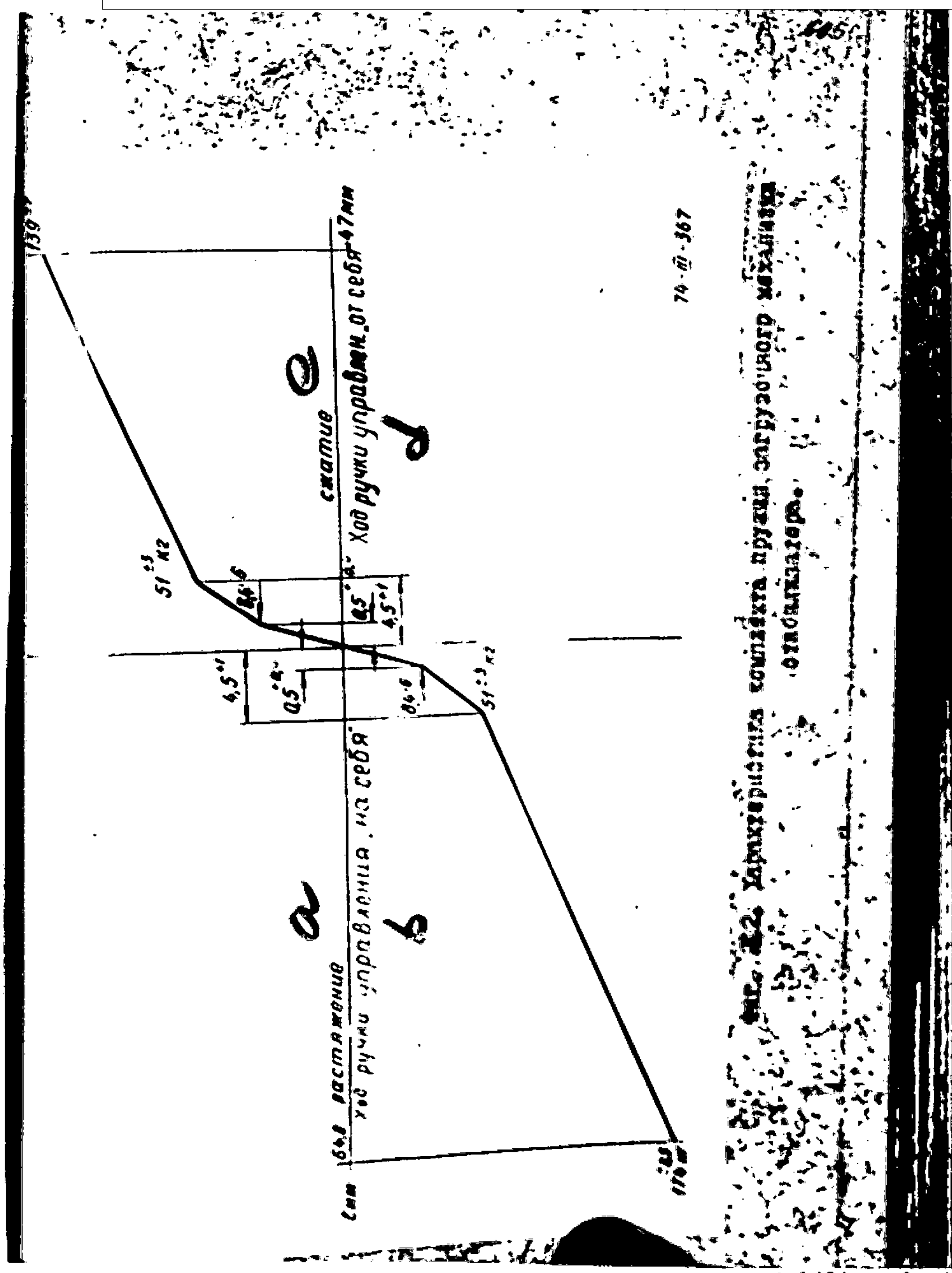

Fig. 212. Characteristic curve of the set of springs of the stabilizer loading mechanism.

a) expansion

b) backward movement of control lever

c) compression

d) forward movement of control lever

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When the ARU-3V is deflected in the opposite direction, the rod of the loading mechanism emerges from the cylinder and forces the spring to work in the opposite direction.

The greater the deflection of the control lever, the greater the compression of the springs and the stress loading the lever.

The loading mechanism is located in the tail section of the fuselage above and between frames 29 and 31A.

The "trimmer-effect" mechanism (Fig. 213) acts as an aerodynamic trimmer by shifting the neutral position of the loading mechanism according to the desire of the pilot, thus making it possible to achieve in flight longitudinal balancing of the plane with respect to stresses, i.e., it removes the stress from the control lever.

The "trimmer-effect" mechanism consists of electrical mechanism MP-100M, a prong, and a safety washer. The housing of the electrical mechanism is attached to a bracket located in the rudder fin in the region of frames 31 and 32, while the rod is attached to an actuating arm connected to the loading mechanism. The rotary motion of the electric motor of mechanism MP-100M is converted by a reduction gear into translational motion of the rod. The rod is retracted or emerges, depending on the direction of rotation of the rotor of the electric motor, and moves the loading-mechanism housing, which is connected to the rod. When the loading-mechanism housing moves by an amount equal to the compression of the springs

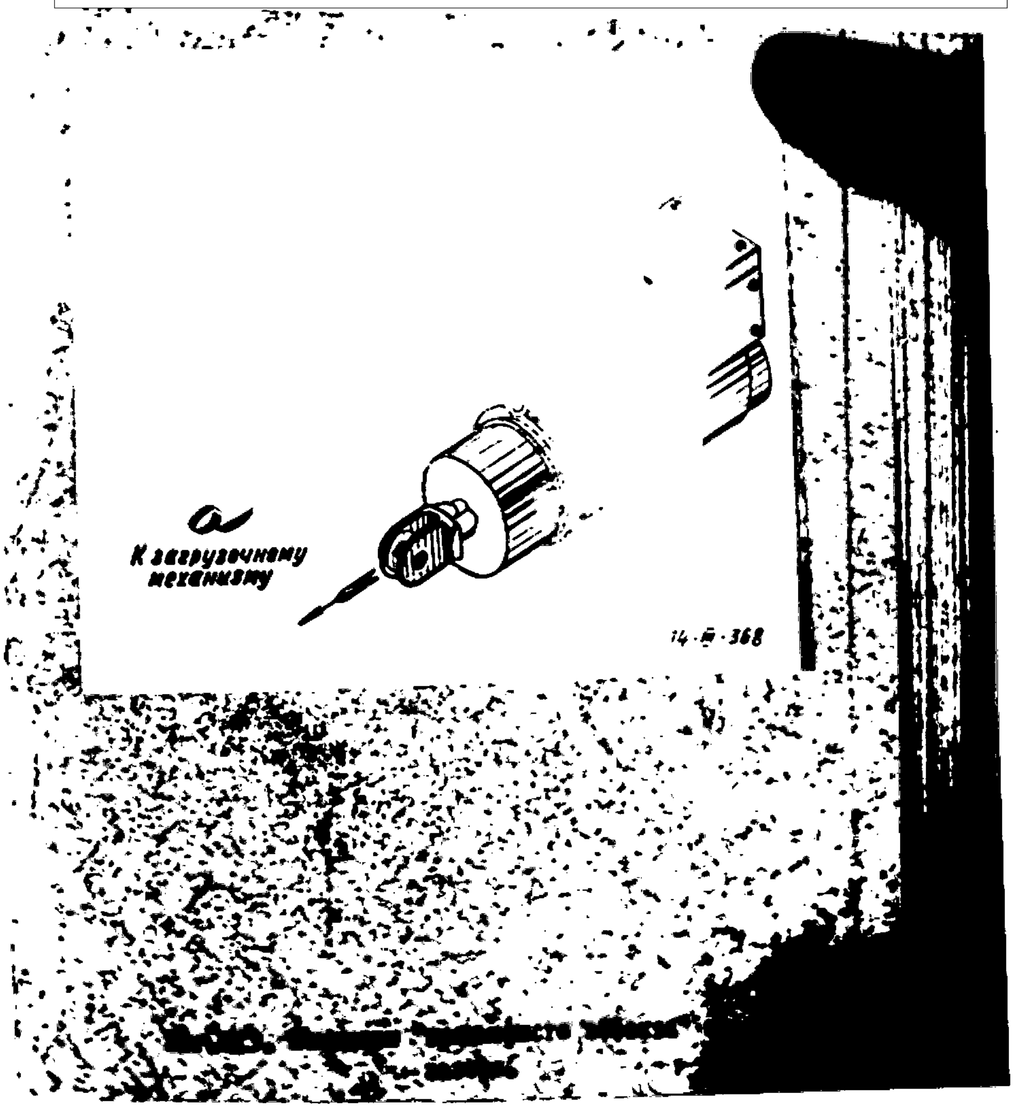

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Fig. 213. "Trimmer-effect" mechanism of stabilizer.

a) to loading mechanism

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"trimmer-effect" mechanism is equal to 16 mm from the neutral position during extension and 10 mm during retraction) the microswitches mounted in the electrical mechanism are actuated and switch off the electric motor in one of the positions. The "trimmer-effect" mechanism is controlled by button PK-4 on the control lever.

When the button "diving" is depressed (with the hydraulic amplifier switched on and with normal pressure in the hydraulic system), the nose of the stabilizer is deflected upward; when the button "pitching" is depressed, the nose of the stabilizer is deflected downward (control lever free). In the neutral position of the rod electrical mechanism MP-100M actuates a microswitch, which turns on a green signal light with the nameplate "Trimmer effect neutral" located on the left side of the instrument panel on board T-4.

Hydraulic amplifier BU-51MS, operating according to an irreversible scheme, is mounted behind a bracket on the beam of frame 34.

The hydraulic amplifier is inserted into the stabilizer-control system with the aid of an actuating arm connected to the hydraulic-amplifier rod and the control rods; connected on the slide-valve side is a rod, which links the BU-51MS to the control lever.

Hydraulic amplifier BU-51MS has two chambers; the feeding of pressure fluid to it is accomplished simultaneously from two hydraulic systems: the booster system and the main system. Each of the systems feeds the pressure fluid into the appropriate chamber of the BU-51MS and also ensures the drainage of the fluid from the chamber. In case of failure of either one of the hydraulic systems, the

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BU-51MS continues to operate on

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one of the chambers, depending on which of the systems is the one out of order.

Included in the booster hydraulic system is emergency pump station NP-27 or (NP-27T), which in case of failure of the hydraulic pump or stoppage of the engine maintains the required pressure in the booster system to ensure the landing of the plane.

The pump station is turned on automatically when the pressure in the booster hydraulic system falls below 165^{+10}_{-5} kg/cm^2. The switching off of the pump station, when the hydraulic pump of the booster hydraulic system is operating, also occurs automatically, if the station attains a constant pressure of no less than 195 kg/cm^2.

In the absence of pressure in either hydraulic system control of the stabilizer becomes impossible, owing to the excessively great stresses on the control lever, stresses which cannot be overcome by the pilot. In this case there is free play of the aircraft-control lever both forward and backward over a distance of approximately 31 mm, using the small arm of the ARU and with the loading mechanism disconnected, owing to the free play in the slide-valve device of hydraulic amplifier BU-51MS (See Chapter V for the design and operation of hydraulic amplifier BU-51MS).

The ARU-3V Automatic Control Regulator

Composition, principle of operation, and control of the ARU-3V

The ARU-3V consists of: a control unit, an actuating mechanism, and a position indicator.

The units of the ARU-3V perform the following functions:

The control unit, receiving the dynamic and static pressure from the Pitot tube, works out a program of control according to the measurement data of the changing velocity-head and altitude values and sends out a control signal to the actuating mechanism.

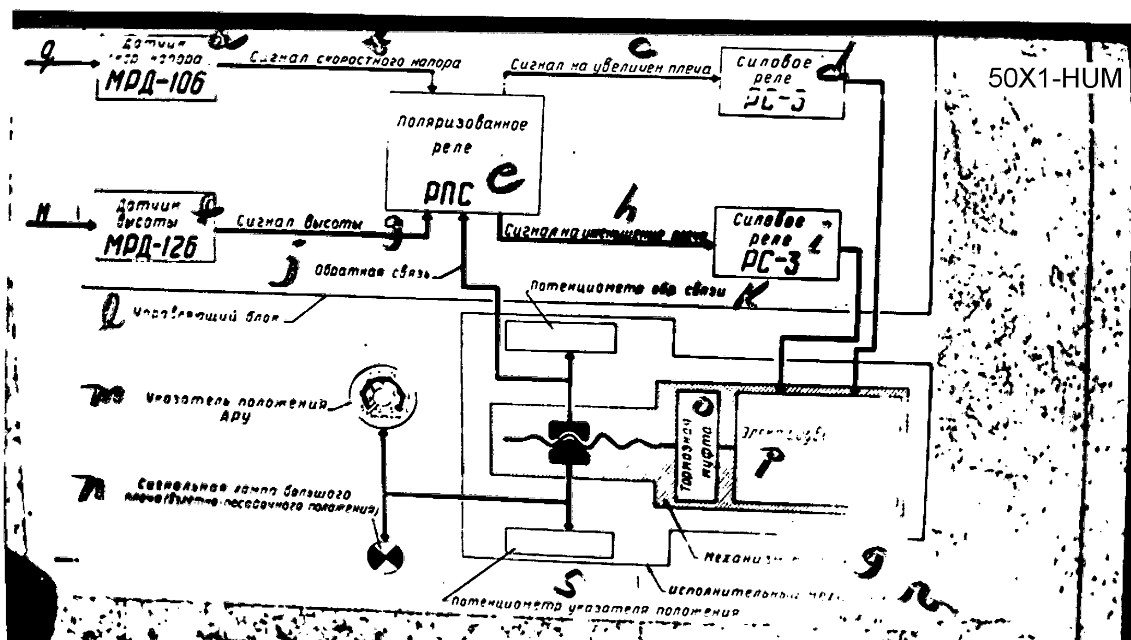
The actuating mechanism turns out a control signal in the form of a movement of the rod to change the gear ratio from the lever to the stabilizer and the loading mechanism and sends a feedback signal concerning the position of the rod to the control unit and the position indicator.

The position indicator informs the pilot of the accuracy of the performance of the program of control according to the velocity head (instrument speed) and flight altitude by converting the electrical voltage received from the potentiometer of the actuating-mechanism rod into the mechanical movement of a pointer.

The units of the automatic control interact according to the scheme shown in Fig. 214.

The units of the ARU-3V, in their turn,

(remainder illegible)


МРД-106
Сигнал скоростного напора
Сигнал на увеличен плеча
Силовое реле
Поляризованное реле
РПС
Датчик высоты
МРД-126
Сигнал высоты
Силовое реле
РС-3
Обратная связь
Управляющий блок
Указатель положения АРУ
Тормозная муфта
потенциометр указателя положения
50X1-HUM

[illegible] агрегатов [illegible]

Fig. 214. Scheme of interaction of units of ARU-3V.

a) velocity-head ~~xxxxxxxMRD-106~~ transducer MRD-106

b) velocity-head signal

c) signal to increase the arm

d) power relay RS-3

e) polarized relay RPS

f) altitude ~~xxxxxxxMRD-126~~ transducer MRD-126

g) altitude signal

h) signal to decrease the arm

i) power relay RS-3

j) feedback

k) feedback potentiometer

l) control unit

m) position indicator of ARU

n) signal light of large arm (takeoff-landing position)

o) braking clutch

p) electric motor

q) mechanism MP-100M

r) actuating mechanism

s) position-indicator potentiometer

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Control unit:

- velocity-head transducer MRD-106, which converts the physical velocity head from the Pitot tube system into an electrical voltage.

- altitude transducer MRD-126, which converts the physical static pressure from the Pitot tube system into an electrical voltage.

- polarized relay RPS, which sums up the velocity-head, static-pressure, and feedback signals and in case of disagreement between them sends out a polar control signal to the power relays.

- two power relays RS-3, which amplify the power between the polarized relay and the electric motor.

Actuating Mechanism (Fig. 215)

- translational-motion electromechanism MP-100M, which converts the power-relay signal into a mechanical movement of the actuating-mechanism rod.

- a feedback potentiometer, which converts the mechanical motion of the actuating-mechanism rod into an electrical voltage, in order to receive the feedback signal fed to the polarized relay.

- a position-indicator potentiometer, which converts the mechanical motion of the actuating-mechanism rod into an electrical voltage, in order to receive the signal fed to the position indicator.

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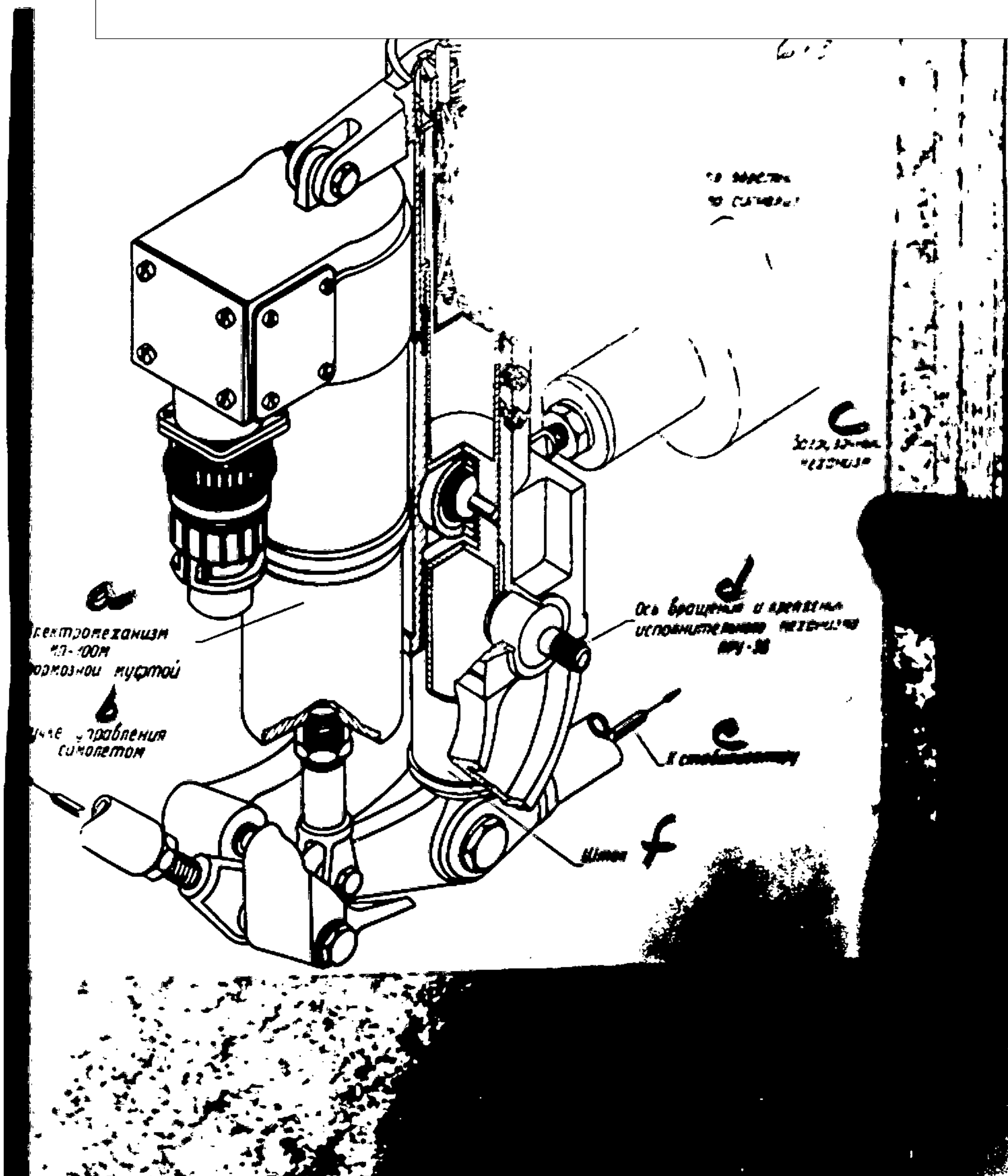

Fig. 215. Actuating mechanism.

a) electromechanism MP-100M with braking clutch

b) to aircraft-control lever

c) loading mechanism

d) axle of rotation and attachment of actuating mechanism of ARU-3V

e) to stabilizer

f) rod

(remainder illegible)

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During the operation of the ARU-3V the elements of the automatic controller interact as follows:

- when the speed or altitude changes (increases or decreases), an electrical voltage from the transducers is fed to the windings of polarized relay RPS,

- when the current accumulated in the windings of relay RPS during a change in speed becomes equal to the actuating current of the polarized relay, the central contact of the relay closes with one of its side contacts,

- the closing of the central contact with the side contact in the polarized relay switches on one of the power relays RS-3,

- the actuation of the relay RS-3 switches on the electric motor of electromechanism MP-100M and simultaneously releases its clutch,

- the electric motor of mechanism MP-100M moves the actuating rod of the ARU mechanism, and this, firstly, changes the gear ratio from the lever to the stabilizer and to the spring loading mechanism and, secondly, moves the runners of the feedback potentiometer and the position indicator,

- an electrical voltage from the feedback potentiometer is fed to the winding of the polarized relay RPS, thus creating in it a current of sign opposite to that of the transducer current,

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50X1-HUM

– the opening of the contacts of relay RPS switches off the relay RS-3, thus cutting off the current from the electric motor of the mechanism MP-100M and its braking clutch, which vigorously stops the actuating rod.

Thus the ARU-3V operates by individual inclusions ("steps") during a smooth change in the velocity head or flight altitude within the limits of the control law.

The number of inclusions in the range of control according to the velocity head and the flight altitude is chosen in such a way that they are felt to a minimum degree by the pilot during the flight, while the regime of operation of the relay devices of the automatic control would be the least stressed.

Special Features of the ARU-3V and Programs for Controlling It

Automatic control ARU-3V has the following special features:

At altitudes below 5000 m the control depends only on the flight speed.

Moreover, at instrument speeds less than 450 km/hr and greater than 1010 km/hr constant values of the gear ratios "lever-loading mechanism" and "lever-stabilizer" are maintained; these values correspond to the minimum or maximum stresses on the control lever and to the maximum or minimum angles of deflection of the stabilizer.

During flights at altitudes ranging from 5000 m to 10,000 m the automatic control operates both from the velocity head and from the flight xxxx altitude.

A correction introduced for the altitude takes into account the changes occurring in the stability and controllability of the plane, when the flight values of the Mach numbers increase and the efficiency of the stabilizer decreases.

With an increase in altitude the range of operation of the automatic controller according to the velocity head decreases.

The lever load decreases, while the deflection of the stabilizer per degree of deflection of the lever increases.

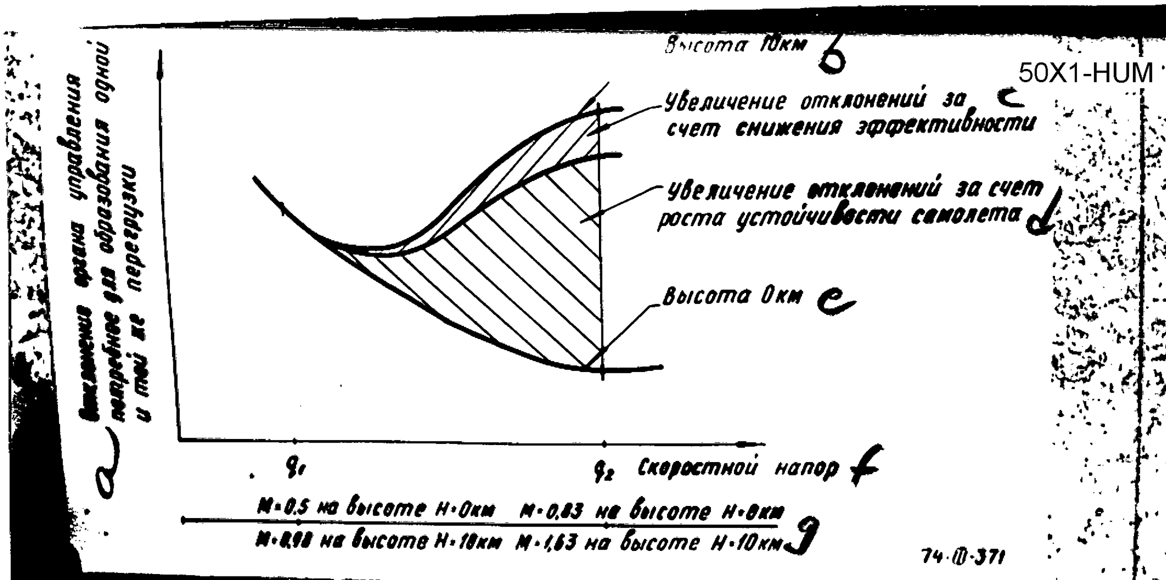
At altitudes above 10,000 m, regardless of the flight speed, and also at instrument speeds less than 450 km/hr, regardless of the altitude, the automatic control is switched off; in this case the gear ratio "lever-stabilizer" corresponds to the minimum lever load and to the maximum angles of deflection of the stabilizer.

The effect of the velocity head, the static-stability reserve, and the stabilizer efficiency on the controllability of the plane is shown graphically in Fig. 216.

It can be seen from this figure that for one and the same large velocity head the control-lever deflections which are required for the creation of a single g and are related to the deflection of the stabilizer during the piloting of the plane depend on the flight altitude, i.e., on the Mach number. Therefore the technique of piloting the plane varies greatly according to the flight regimes.

In the case of a low velocity head the xffxxx flight altitude has little effect on the controllability of the plane.

From Fig. 215 it can also be seen that in order to compensate for the effect of the flight regime on the controllability of the plane it is necessary to carry out the program of control of automatic controller ARU in



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[illegible] скоростного напора, запаса статической устойчивости [illegible] стабилизатора на управляемость самолета.

Fig. 216. Graph showing the effect of the velocity head, the static-stability reserve, and the stabilizer efficiency on the controllability of the plane.

a) control deflection required for the formation of one and the same g force

b) altitude 10 km

c) increasing deflections by decreasing efficiency

d) increasing deflections by increasing the stability of the plane

e) altitude 0 km

f) velocity head

g) $\dfrac{M = 0.5 \text{ at altitude } H = 0 \text{ km}}{M = 0.98 \text{ at altitude } H = 10 \text{ km}}$ $\quad$ $\dfrac{M = 0.83 \text{ at altitude } H = 0 \text{ km}}{M = 1.63 \text{ at altitude } H = 10 \text{ km}}$

relation to the changing value of the velocity head and the flight altitude (or Mach number). Therefore, when the velocity head increases at low altitudes ranging from 0 to 5 km, it is necessary to decrease the arm going toward the booster of the actuating rod of mechanism ARU-3V, as is shown in Fig. 217.

In this figure it can be seen that the law (program) adopted for the control of automatic controller ARU-3V averages the required changes in the arm going toward the booster, these changes being required for the complete compensation of the effect of the velocity head and the partial compensation of the effect of the Mach number at altitudes ranging from 0 to 5 km.

The changes in the arm of the ARU-3V required for complete compensation at an altitude of 7 km and adopted in the law (program) of control are shown in Fig. 218.

Moreover, the law (program) adopted for the control of the ARU-3V averages the complex dependence of the required deflections of the actuating-rod mechanism of the ARU on the velocity head and the flight altitude.

The system of averaging adopted to a necessary extent

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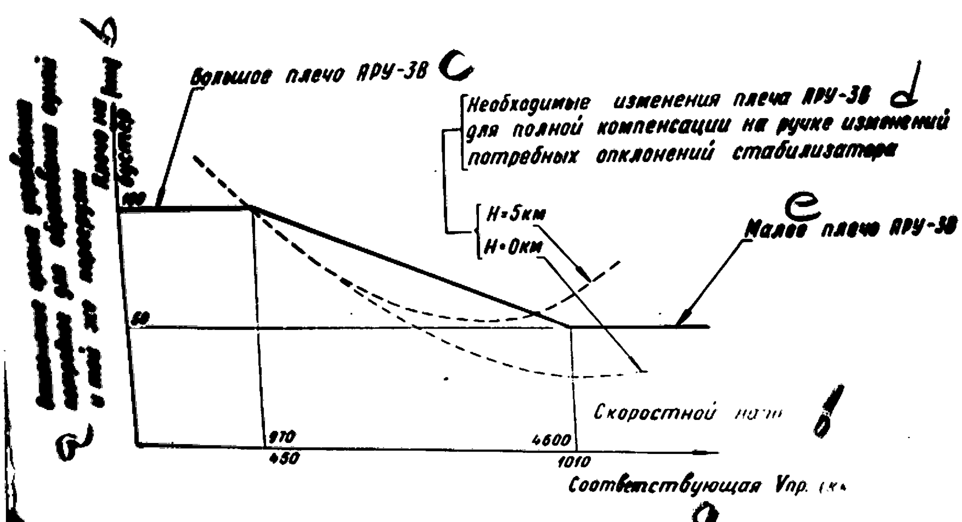

[illegible] 47. [illegible] плеча АРУ-3В на бустер по скоростному напору на высотах от 0 до 5 км.

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Fig. 217. Graph showing the change in the arm of the ARU-3V going toward the booster in relation to the velocity head at altitudes ranging from 0 to 5 km.

a) control deflection required for the formation of one and the same g force

b) arm going to booster

c) large arm of ARU-3V

d) required changes in arm of ARU-3V for complete compensation of changes in the required deflections of the stabilizer

e) small arm of ARU-3V

f) velocity head (kg/m^2)

g) corresponding V_{instr} (km/hr)

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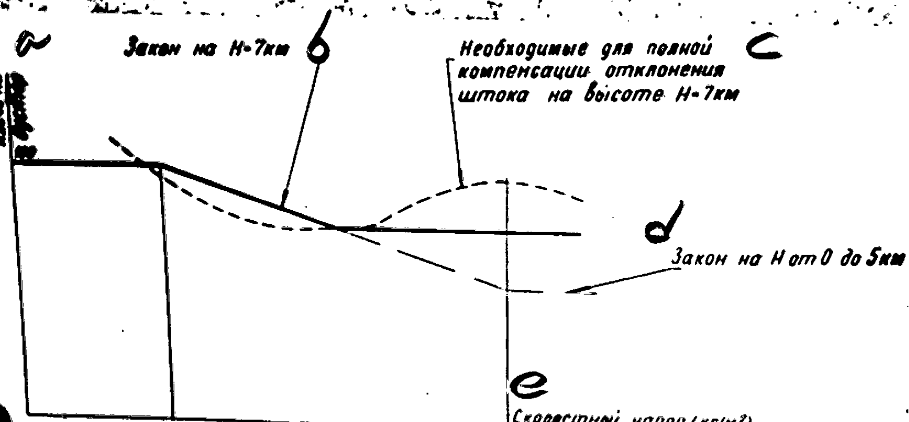

Фиг. 2[illegible]. График изменения плеча АРУ-3В на бустер по скоростному напору на высоте 7 км.

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Fig. 218. Graph showing the change in the arm of the ARU-3V going toward the booster in relation to the velocity head at an altitude of 7 km.

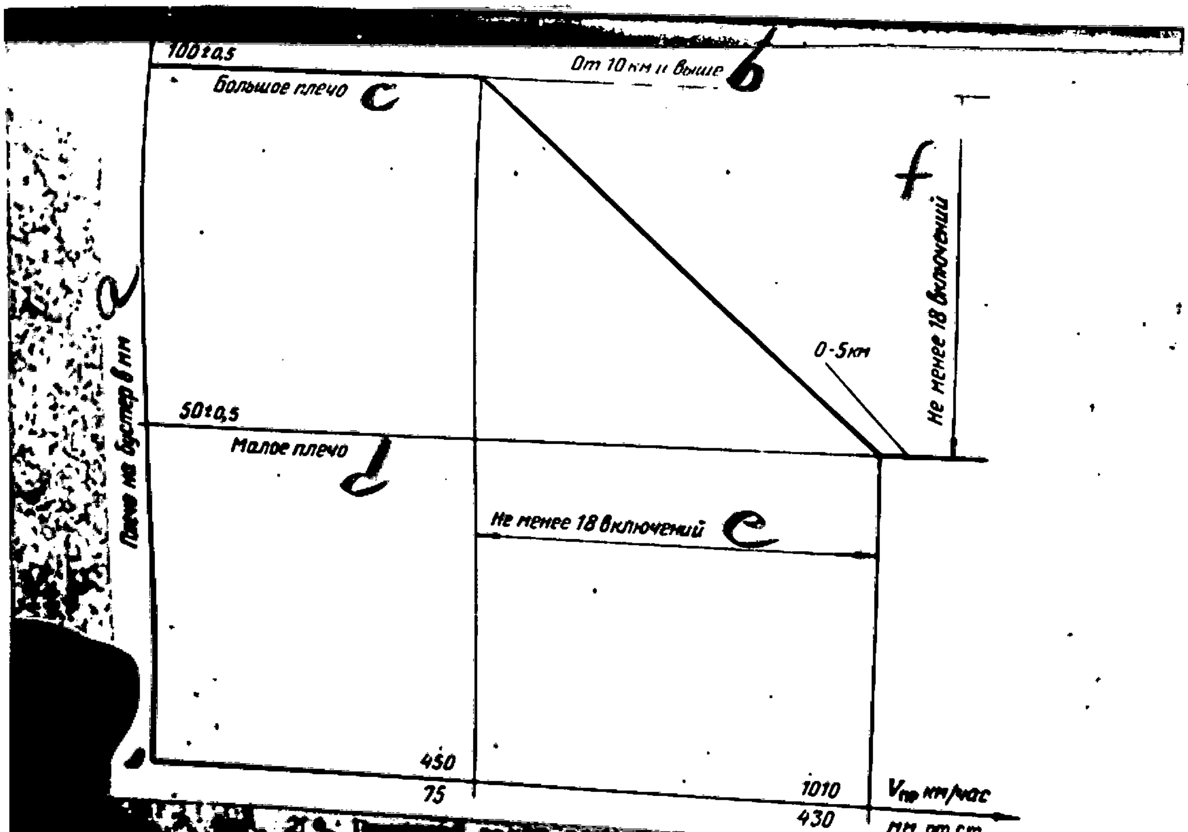
a) arm going to booster

b) law at H = 7 km

c) deflections of rod required for complete compensation at H = 7 km

d) law for H ranging from 0 to 5 km

e) velocity head (kg/m^2)



219. Принятый закон регулирования плеча штока исполнительного механизма АРУ-3В на бустер.

Fig. 219. Law adopted for the control of the arm of the actuating-mechanism rod of the ARU-3V going ~~xxxxxxxxxxxxxx~~ toward the booster.

a) arm going toward booster in mm

b) from 10 km and higher

c) large arm

d) small arm

e) no less than 18 inclusions

f) no less than 18 inclusions

g) V_{instr} km/hr

h) mm Hg

[redacted] 50X1-HUM

booster) a change occurs in the two gear ratios with the path of the control lever remaining invariable:

- firstly, the gear ratio from the lever to the stabilizer, i.e., the range of deflections of the stabilizer is decreased by decreasing the arm going toward the booster (OB_1 instead of OA_1);

- secondly, the gear ratio from the lever to spring loading mechanism, i.e., the lever load is increased by increasing the arm going toward the loading mechanism (OB instead of OA).

As a result of the movement of the rod of the actuating mechanism of the ARU-3V from the large arm to the small one, the dependence of the stabilizer angles on the movement of the lever changes as shown in Fig. 220, while the lever load and the stresses on the lever in a deflected-from-neutral position change as shown in Fig. 221.

From Fig. 223 it can be seen that when the trimmer-effect mechanism MP-100M is in the neutral position, the neutral position of the lever with respect to stresses does not coincide with the neutral position of the lever with respect to the zero angle of deflection of the stabilizer.

This is due to the fact that when booster BU-51MS is switched on with the trimmer-effect mechanism in a neutral position and the control lever on the large arm of the ARU-3V released, the nose of the stabilizer will be deflected downward at an angle ranging from 0.6^0 to 1.9^0 with respect to the perpendicular

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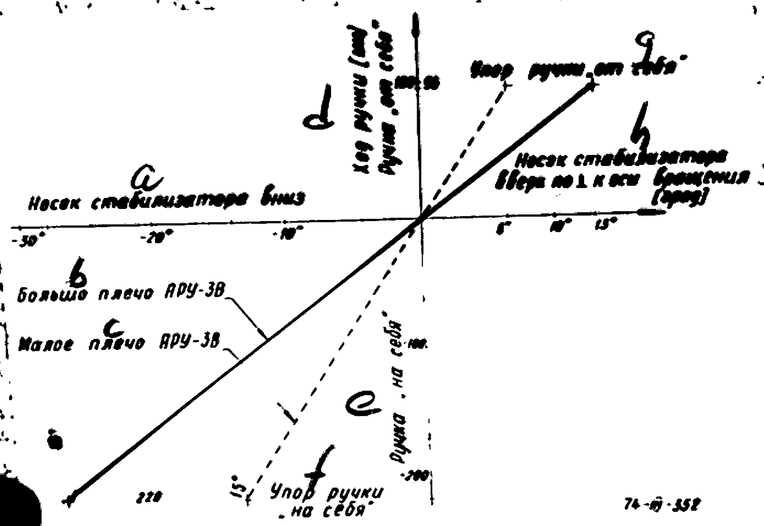

221. График зависимости углов стабилизатора от перемещения ручки.

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Fig. 220. Graph showing the dependence of the stabilizer angles on the movement of the lever.

a) stabilizer nose downward

b) large arm of ARU-3V

c) small arm of ARU-3V

d) path of lever (mm)
lever forward

e) lever backward

f) lever backward stop

g) lever forward stop

h) stabilizer nose upward with respect to the perpendicular to the axis of rotation (deg)

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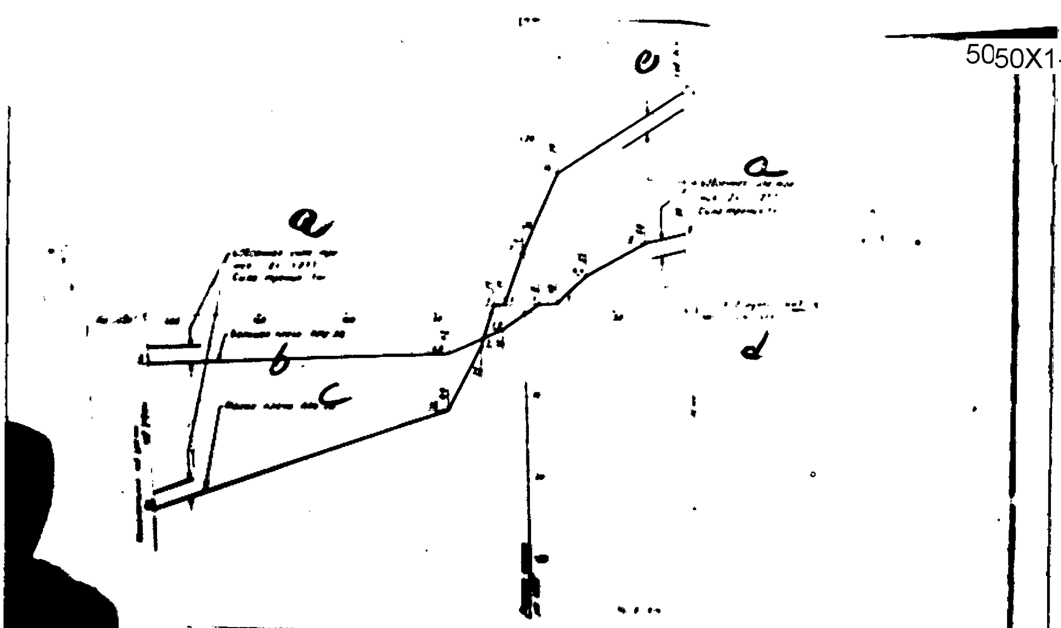

Фиг. [illegible]. График зависимости углов стабилизатора от загрузки ручки и усилий на ней в отклоненном положении от нейтрали.

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Fig. 221. Graph showing the dependence of the stabilizer angles on the lever load and the stresses on the lever in a deflected-from-neutral position.

a) twice the friction force (illegible) friction force (illegible)

b) large arm of ARU-3V

c) small arm of ARU-3V

d) forward path of lever (mm)

e) path 90 m

(remainder illegible)

of burning of the neutral-position signal light from 0.5 to 2 mm along the path of the rod, which corresponds to a movement of the released lever on the large arm of the ARU-3V from 5 to 20 mm and to a burning time of from 0.3 to 1.0 sec during the movement of the rod.

Therefore for accurate setting of the "trimmer-effect" mechanism MP-100M in the neutral position it is necessary to set the rod in the middle of the range of burning of the light (with respect to the burning time).

The working path of the "trimmer-effect" mechanism is equal to 18 mm from the center of the neutral position during extension and 10 mm during retraction.

The range and time (in seconds) of the variations in the stress on the lever during a complete movement of the rod of the "trimmer-effect" mechanism from the neutral position on the large arm of the ARU-3V are shown in Fig. 222; they are shown for the case of the small arm of the ARU-3V in Fig. 223.

The actuating rod of the ARU-3V moves in flight automatically according to a special control law depending on the flight speed and altitude. Moreover, provision is made for manual control of the movement of the rod.

Simultaneously with the movement of the rod changing the voltage on the potentiometer of the position indicator there occurs a (illegible) movement of the indicator arrow in the cabin.

The position indicator of the ARU-3V has two scales: one scale shows the operation of the automatic controller in relation to changes in the flight speed; the other shows the operation of the controller in relation to changes in altitude.

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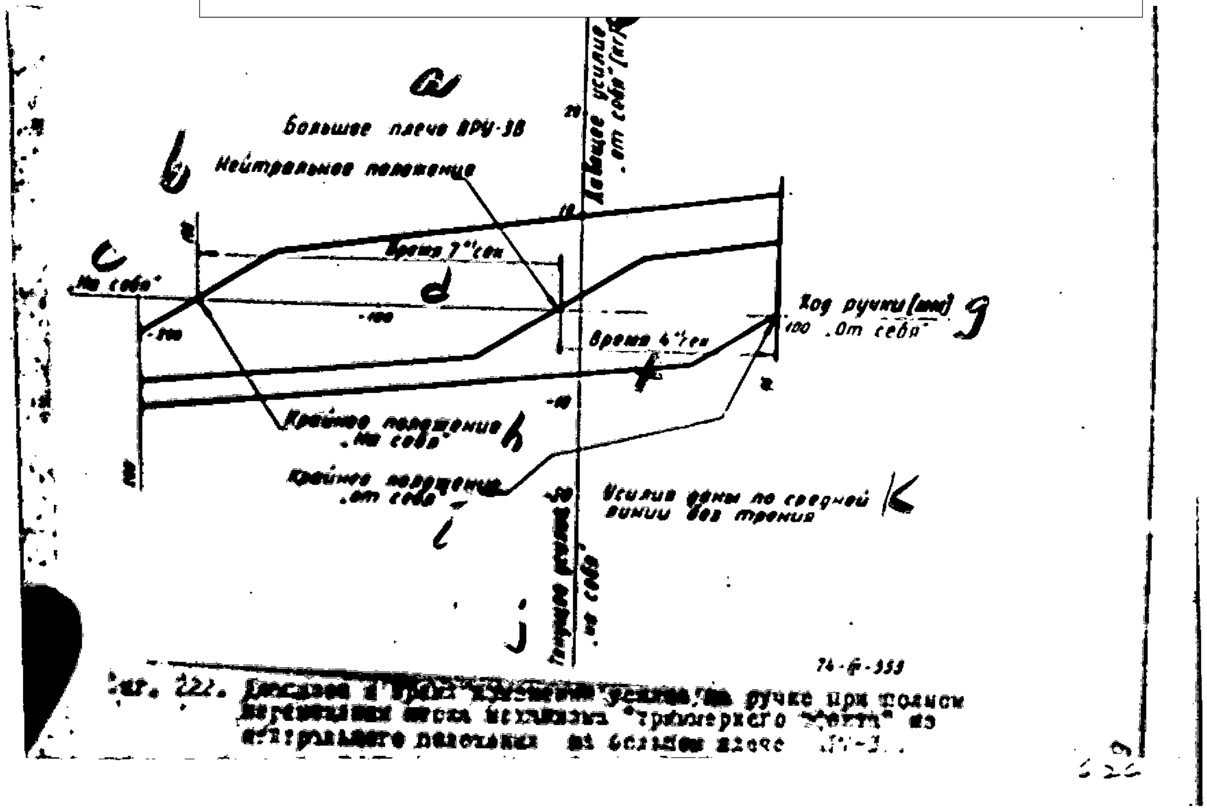

Fig. 222. Range and time of variations in the stress on the lever during a complete movement of the rod of the "trimmer-effect" mechanism from the neutral position on the large arm of the ARU-3V.

a) large arm of ARU-3V

b) neutral position

c) backward

d) time 7^{01} sec

e) foward pressing force (kg)

f) time 4^{01} sec

g) forward path of lever (mm)

h) extreme backward position

i) extreme forward position

j)backward pulling force

k) forces given with respect to an average line without friction

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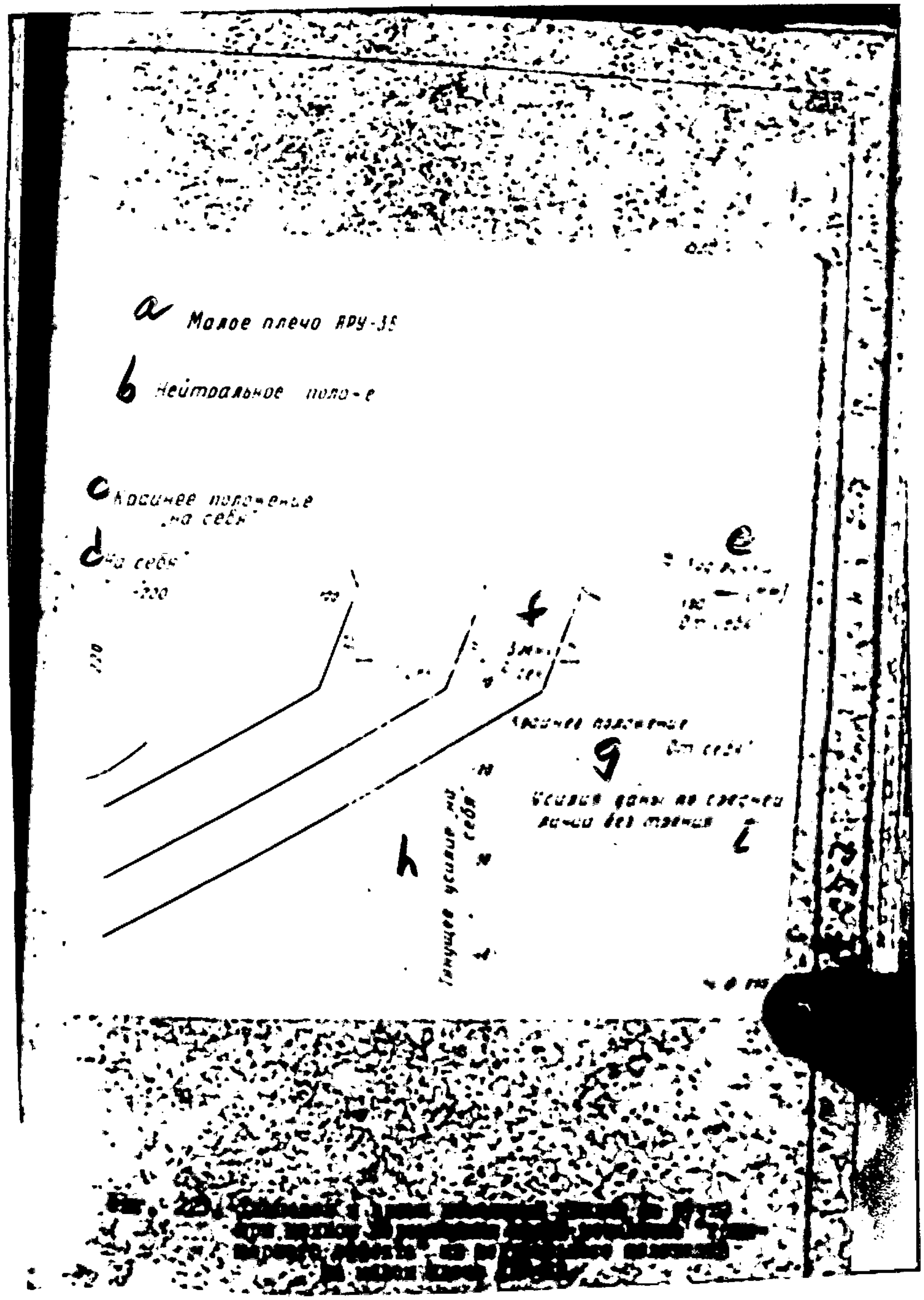

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Fig. 223. Range and time of variations in the stress on the lever during a complete movement of the rod of the "trimmer-effect" mechanism from the neutral position on the small arm of the ARU-3V.

a) small arm of the ARU-3V

b) neutral position

c) extreme backward position

d) backward

e) forward path of lever (mm)

f) time 4^{01} sec

g) extreme forward position

h) backward pulling force

i) forces given ~~xxxx~~ with respect to an average line without friction

S-E-C-R-E-T

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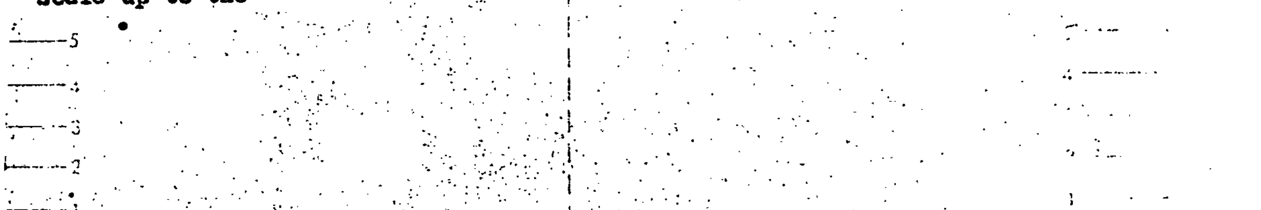
On the outer scale (clockwise) are the speed values; on the inner scale (counterclockwise) are the altitude values.

From the indicator readings the pilot estimates the accuracy with which the assigned control law is fulfilled by the automatic controller in the following way (Fig. 234):

- in flight up to the instrument speed of 450 km/hr (i.e., up to the start of operation of automatic controller ARU-3V) the pointer of the position indicator is on the left stop (position 1 in "1" in Fig. 224).

- in flight at altitudes ranging from 0 to 5 km and at instrument speeds ranging from 450 to 1010 km/hr the pointer of the position indicator moves along the speed scale, and its readings coincide approximately with the readings of the speed indicator; at speeds greater than 1010 km/hr the pointer remains on the right stop;

- in flight at altitudes ranging from 5 to 10 km and at speeds ranging from 450 to 1010 km/hr the pointer of the position indicator moves along the speed scale up to the



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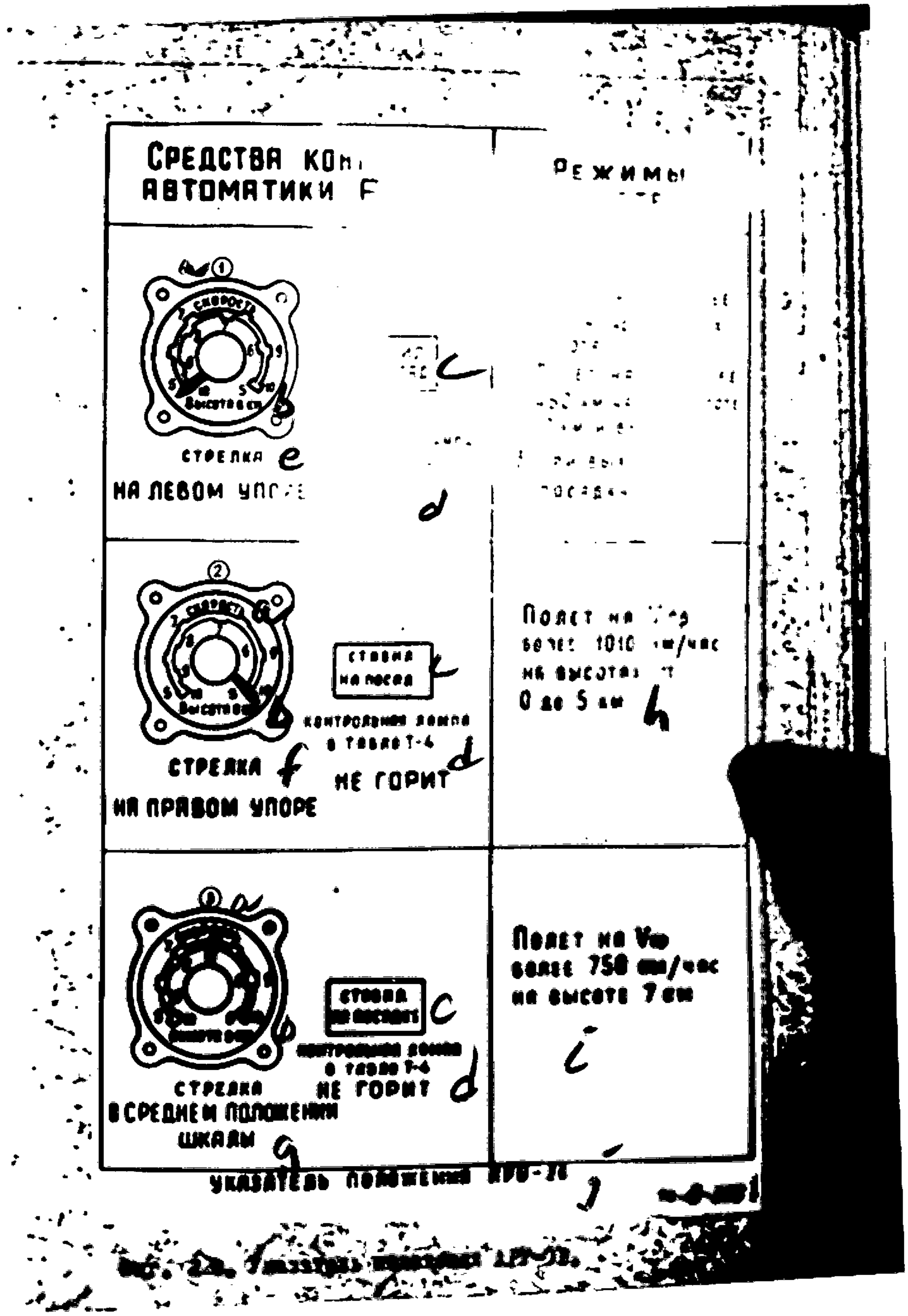

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Fig. 224. Position indicator of the ARU-3V

a) speed

b) altitude in km

c) set for landing

d) control light on board T-4 does not go on

e) pointer on left stop

f) pointer on right stop

g) pointer in middle position of scale

h) flight at V_{instr} greater than 1010 km/hr at altitudes ranging from 0 to 5 km

i) flight at V_{instr} greater than 750 km/hr at an altitude of 7 km

j) position indicator of the ARU-3V

(remainder illegible)

The left stop of the pointer corresponds to the takeoff-landing position of automatic controller ARU-3V (large arm going toward booster) and is monitored, in addition to the indicator, by a green signal light on the T-4 signaling board on the instrument panel.

When the actuating-mechanism rod moves from the position of the large arm toward the small arm, the green light goes out.

The readings of the position indicator, when automatic controller ARU-3V is operating properly, coincide with the readings of the piloting instruments (KUS and VD) only under standard atmospheric conditions (ground temperature +15°C with a static pressure at sea level of 760 mm). In all other cases the readings of the position indicator of the ARU and the readings of the piloting instruments do not coincide, the discrepancies on the altitude scale being particularly noticeable.

Therefore the position indicator of the ARU-3V serve only to give the pilot an overall orientation during the operation of the automatic controller, and a certain discrepancy between the readings of the position indicator and those of the piloting instruments does not indicate improper operation of the automatic controller.

Instruments for Monitoring and Controlling the ARU-3V

The takeoff-landing position of automatic controller ARU-3V, as was mentioned above, is monitored by a green signal light with the inscription "set for landing" on the T-4 board located in the center of the instrument panel. Next to the board is the inscription: "If the light does not go on during landing, switch over to manual control of the ARU".

The position indicator of the ARU-3V is located on the left board of the instrument panel.

In order to switch on the ARU-3V system, it is necessary to switch on the AZS-5 with the inscription "automatic control of ARU-3V" and the AZS-5 with the inscription "manual control of ARU-3V" on the right rear electrical board in the cabin (under a transparent cover).

Switching of the type of operation of the ARU-3V system is accomplished by a two-position switch on the green margin "ARU" of the left board with the inscription "automatic", "manual".

Normal the switch of the type of operation of the ARU-3V system is set in the position "automatic" and is locked in this position by wire KCM-0.3.

The lock prevents takeoff and landing during the manual-control regime of the ARU-3V, when the actuating-mechanism rod is in the takeoff-landing position.

In order to switch on the "trimmer-effect" mechanism MP-100M, it is necessary to turn on the switch "trimmer effect" on the right forward electrical board. In order to switch on the signaling of the central position of the "trimmer-effect" mechanism, it is necessary to turn on the AZS-5 "monitoring lights, signal panel, and signaling of trimmer effect" on the right rear electrical board

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The green signal light of the neutral position of the "trimmer-effect" mechanism with the inscription "trimmer effect neutral" is located on the T-4 board in the center of the instrument panel.

The "trimmer-effect" mechanism is controlled by push switch PK-4 located on the aircraft-control lever.

In order to remove a "pressing" or "pulling" force from the control lever, the button is pressed in a forward or backward direction, as a result of which the "trimmer-effect" mechanism is switched on and the springs of the loading mechanism are released.

Normally automatic controller ARU-3V does not require intervention during a flight

(remainder illegible)

In this case the position indicator and the signal light in the cabin continue to operate, thus allowing the pilot to manually set the actuating-mechanism rod in the position required for flight.

In case of failure of the automatic and manual control circuits of the automatic controller, the stabilizer-control system ensures continuation of the flight and completion of landing on the airfield with the actuating-mechanism rod in any position.

During an on-the-ground check of the manual-control circuits or when the manual-control regime is deliberately turned on in flight,

(remainder illegible)

Rudder Control (Fig. 225)

The rudder-control system is rigid, without hydraulic amplifiers, and consists of eleven tubular duralumin rods, actuating arms, and a mechanism for producing nonlinear changes in the gear ratio. The actuating arms are drop-forged out of aluminum and magnesium alloys. The rods of the rudder-control system pass in the cabin, behind the ejection seat, in the back fairing of the upper part of the fuselage, and in the root part of the rudder fin.

The actuating arms controlling the rudder are mounted together with the actuating arms controlling the stabilizer on the same assemblies, with the exception of the arms in the rudder fin. In the back fairing of the fuselage the rudder-control rods are secured, together with the stabilizer-control rods, in supports.

The rudder is connected by a system of rods to a lever mounted on the axis of rotation of the pedals.

The load from the rudder, arising in the hinges as a result of the action of aerodynamic-force moments, is transmitted to the pedals.

The mechanism for producing nonlinear changes in the gear ratio (Fig. 226) is located in the rudder fin. The housing of the nonlinear mechanism is secured by two bolts to rib 6 and the forward stringer.

The mechanism for producing nonlinear changes in the gear ratio ensures small deflections of the rudder around a neutral position when the pedal strokes are large.

At the end of the pedal stroke

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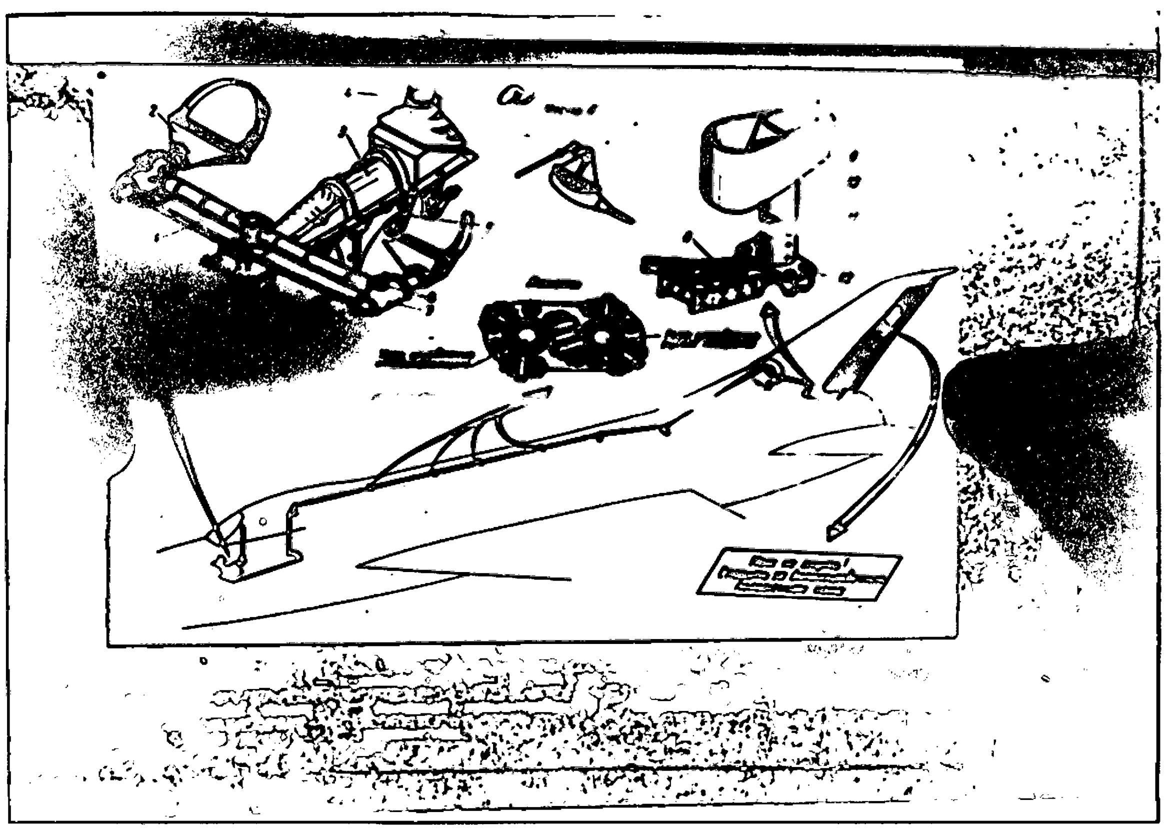

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Fig. 225. Rudder control.

1.- rod;

2 - actuating arm;

3 - bracket;

4 - control lever;

5 - aileron-control lever;

6 - adjustable bolt;

7 - large bracket;

8 - spring;

9 - rudder;

10 - bolt;

11 - lower joint of rudder;

12 - bracket.

a) location A

(remainder illegible)

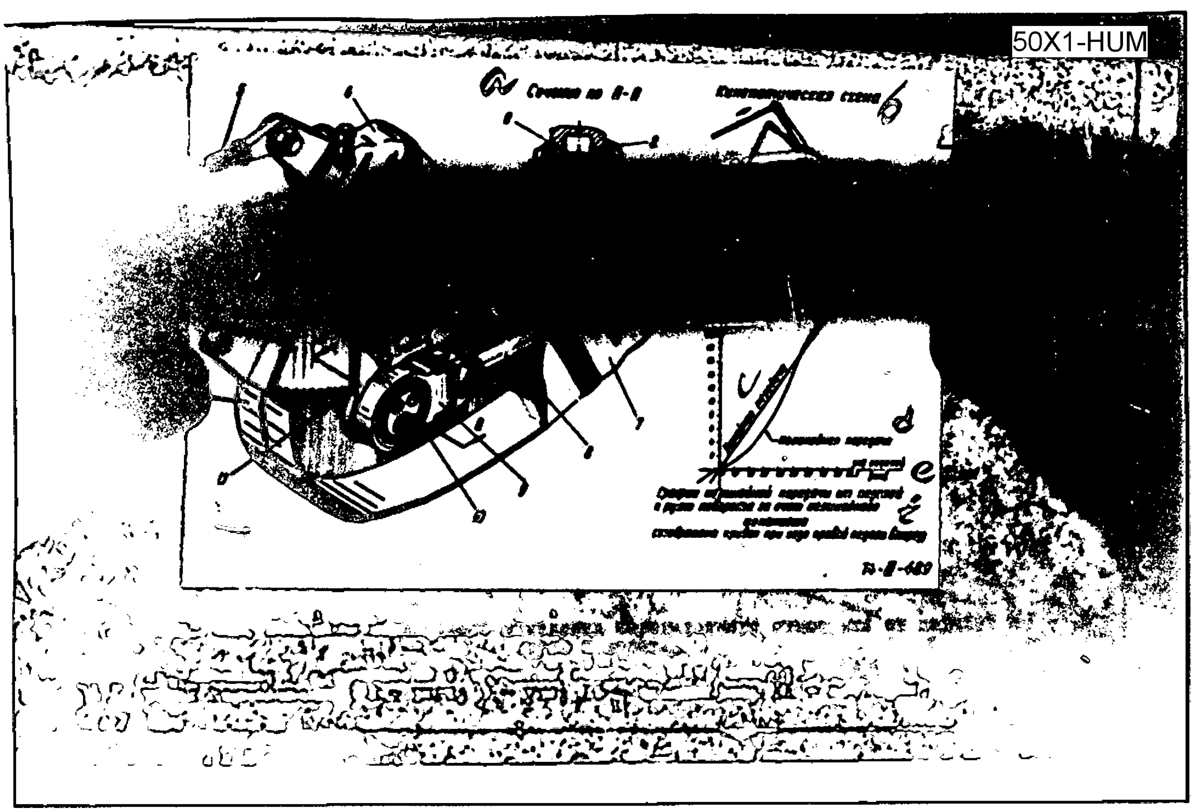

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Fig. 226. Mechanism for producing nonlinear changes in the gear ratio from the pedals to the rudder.

1 - housing;

2 - actuating arm;

3 - bracket with toothed sector;

4 - collar;

5 - rod;

6 - hermetically sealed cover;

7 - hermetically sealed cover;

8 - rod;

9 - lug;

10 - ~~xxxxxxxxx~~ cam gear;

11 - gear.

a) cross section along A-A

b) kinematic diagram

c) linear transmission

d) nonlinear transmission

e) pedal stroke (mm)

f) graph showing nonlinear transmission from pedals to rudder by means of nonlinear mechanism (curve depicted for forward stroke of right pedal) the nonlinearity of the gear ratio changes and in the terminal positions of the pedals approaches linearity. The mechanism thus ensures satisfactory sensitivity of the rudder control at high speeds and decreases the stress on the pedals.

The mechanism for producing nonlinear changes in the gear ratio consists of: welded bracket (3), which has two sectors with threaded teeth, housing (1), actuating arm (2), two gears (11), cam gear (10), lug (9), two hermetically sealed covers (6) and (7), two collars for securing the covers (4), and bolts.

Housing (1) of the nonlinear mechanism is connected to casing (3) by six screws.

Actuating arm (2) is located in casing (3) of the nonlinear mechanism. Coming up to the upper lever of actuating arm (2) is rod (5), which connects the nonlinear mechanism to the pedals through a system of rods and actuating arms. Pressed into the joints of the lower lever of the actuating arm are ball bearings, inside which are inserted the shafts of gears (11). Gears (11) are in gear with the teeth of the sectors of the casing of the nonlinear mechanism and have two-stage shafts, with the aid of which the gears are connected to actuating arm (2) and cam gear (10).

On cam gear (10) is lug (9), which is bolted to the fork of rod (8) of the nonlinear mechanism. Rod (8) of the nonlinear mechanism connects the nonlinear mechanism to the rudder.

The inner cavity of the nonlinear mechanism is protected by hermetically sealed covers (6) and (7).

When the pedals are deflected, the motion is transmitted through the system of rods and actuating arms to the actuating arm of the nonlinear mechanism.

When the actuating arm of the nonlinear mechanism is deflected, the gears are actuated and, rolling around the sectors of the casing, force the cam gear to rotate and actuate the rod connected to the cam gear.

As a result of the cam gear a nonlinearity of the gear ratio is created.

The law of nonlinearity of the operation of the mechanism is ~~xxxx~~ shown in Fig. 226.

Aileron Control (Fig. 227)

The aileron-control system consists of rods, actuating arms, a loading mechanism, two hydraulic amplifiers BU-45A, and two mechanisms for producing nonlinear changes in the gear ratio.

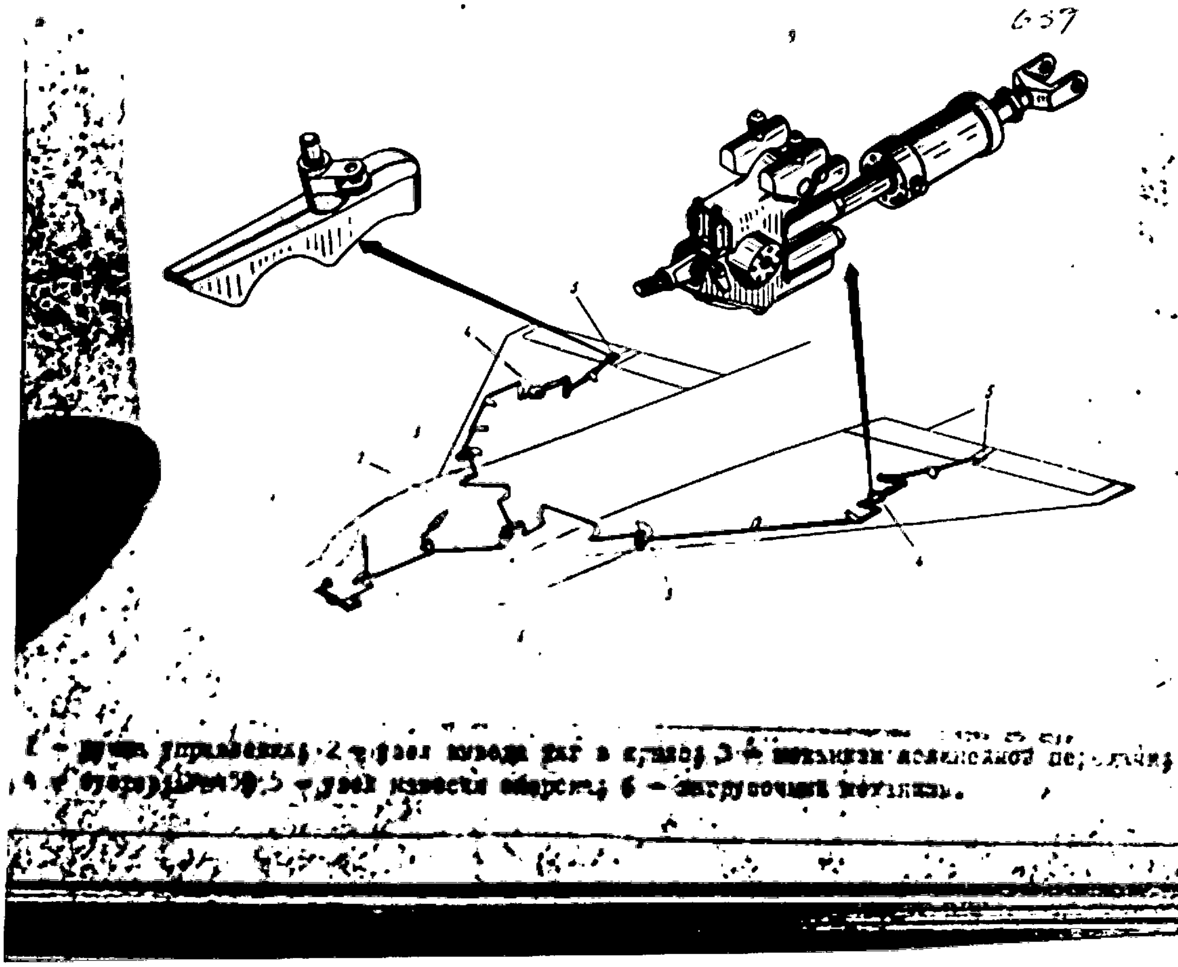

Fig.227. Aileron control.

1 - control lever;

2 - fitting for leading rods into wing;

3 - linear-transmission mechanism;

4 - booster BU-45A;

5 - fitting for suspending aileron;

6 - loading mechanism.

[redacted]

The actuating arms of the aileron control are located in the fuselage and the wings. In the fuselage are 6 actuating arms: three in the cabin and three on frame 13. In each wing there are 7 fittings with actuating arms in the root section up to the 15th nose and in the region of the 6th rib.

Hydraulic amplifiers BU-45A. Are mounted on pivots located on rib 6 in the left and right wings. Access to them is through hatches located in the lower wing covering.

The hydraulic amplifiers are inserted according to an irreversible scheme and operate from the booster hydraulic system or from the main system, i.e., in case of failure of the booster hydraulic system the feeding of the hydraulic amplifiers switches over to the main hydraulic system.

The switching of the feeding of the BU-45A from the booster hydraulic system to the main system occurs automatically when the pressure in the booster system goes down to 85^{+10} kg/cm². When the pressure in the booster hydraulic system rises to 100±5 kg/cm² the feeding of the BU-45A switches automatically from the main hydraulic system to the booster system.

In case the BU-45A is switched off (or both hydraulic systems fail) the hydraulic amplifiers serve as rigid members of the aileron-control system.

The actuating rod of the hydraulic amplifier is connected on the slide-valve side to rods going to the control lever end is connected at the other end to rods going to the aileron. When the aircraft—control lever is deflected to the right

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or left, the pilot moves the slide valve of each hydraulic amplifier, as a result of which the rod of one of the amplifiers is extended and deflects the aileron upward, while the rod of the other amplifier is retracted and deflects the aileron downward.

Hydraulic amplifier BU-45A is of hydromechanical action with a servo control system.

The imitation of the aerodynamic loads on the control lever is created by a spring loading mechanism (Fig. 228), which varies the stress on the lever in accordance with the angles of deflection of the ailerons.

The spring loading mechanism consists of the following basic parts: the cylinder of casing (12) with axle (11), rod (10) with eye bolt (1), freely mounted on which are two barrels (5), two bushings (7), and three springs (two short and one long), connector nut, two reinforcing nuts, and a cover.

The loading mechanism is located in the pilot's cabin, below on frame 11.

The casing of the mechanism is secured to the frame, while the rod is secured to the control actuating arm. When the lever is deflected, the actuating arm turns and pulls or pushes the rod. When the rod moves 2.5 mm, the short spring is compressed, ~~while~~ but when it moves more than 2.5 mm, the long spring is compressed. Prior tightening of the long spring is equal to compression of the short spring. The greater the deflection of the control lever, the greater the compression of the spring, and the greater the stress acting on the lever.

The mechanisms for producing nonlinear changes in the gear ratio (Fig. 229) are located in the wings near rib No. 1 and ensure small deflection of the ailerons around a neutral position when the lever movements are large. At the end of a lever movement the nonlinearity of the gear ratio changes. The mechanisms thus ensure satisfactory sensitivity of the lateral control of the aircraft at high speeds with the BU-45A turned on (the lateral control is simplified in those regimes where the efficiency of the ailerons is too great) and comparatively easier control on sections with 33 1/3% deflection of the ailerons from the neutral position when the hydraulic systems are not operating.

The mechanism for producing nonlinear changes in the gear ratio consists of two brackets (5) and (10), two actuating arms (1) and (8), stirrup (3), and two rods (4) and (9).

Coming up to actuating arm (1) is a rod connecting the mechanism to the control lever. Connected to the upper part of actuating arm (1) is link (3) connected to actuating arm (8) and rod (9). Rod (9) connects the mechanism to the aileron through hydraulic amplifier BU-51A. The deflection of actuating arm (1) actuates link (3), the end of which, being connected to rod (9), forms a nonlinear-transmission-of-motion curve on the aileron.

The law of nonlinearity of the operation of the mechanism is shown in Fig. 230.

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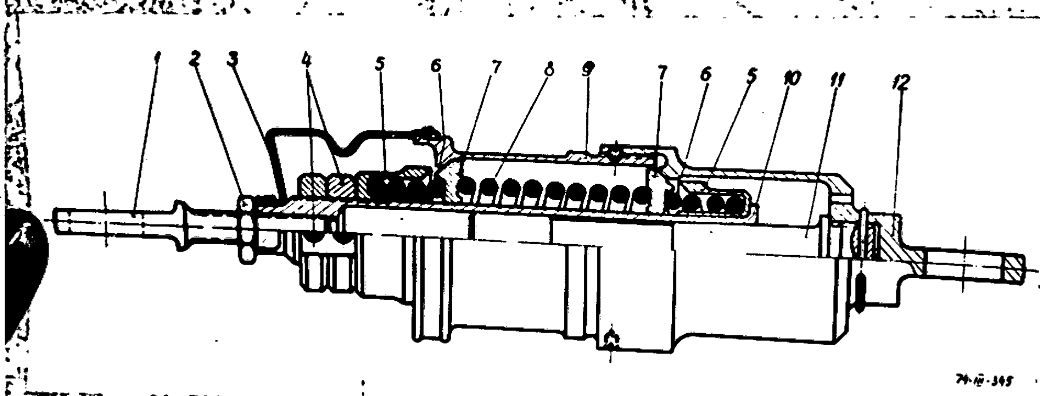

Фиг. 22[illegible]. Загрузочный механизм управления элеронами

1 – ушковый болт; 2 – гайка; 3 – [illegible]; 4 – гайка; 5 – стакан; 6 – пружина; 7 – упорная шайба; 8 – пружина; 9 – корпус; 10 – [illegible]; 11 – ось; 12 – корпус.

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Fig. 228. Loading mechanism of aileron control.

1 - eye bolt;

2 - nut;

3 - cover;

4 - nut;

5 - barrel;

6 - spring;

7 - thrust washer;

8 - spring;

9 - casing;

10 - rod;

11 - axle;

12 - casing;

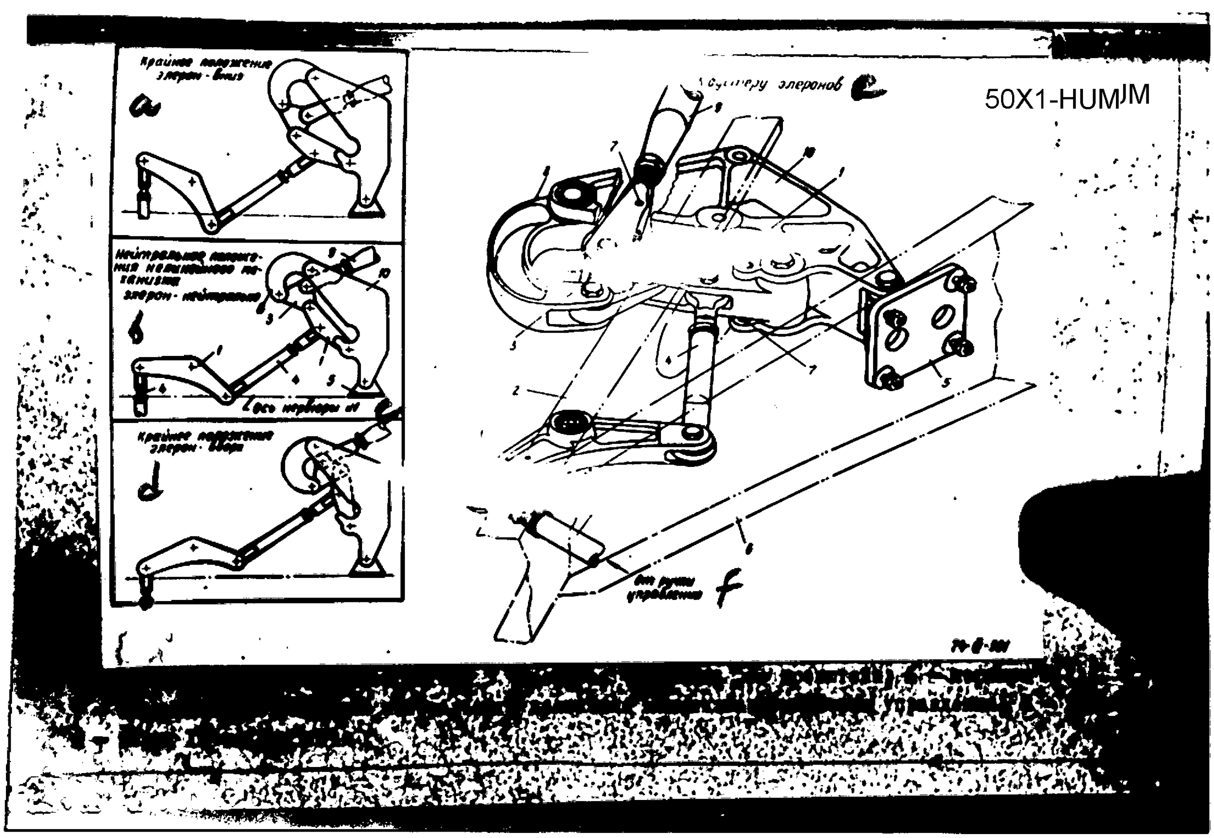

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Fig. 229. Mechanism for producing nonlinear changes in the gear ratio.

1 - actuating arm;

2 - forward stringer;

3 - stirrup;

4 - rod;

5 - bracket;

6 - rib I;

7 - openings for retaining the neutral position of the control mechanism;

8 - actuating arm;

9 - rod;

10 - bracket.

a) extreme position
aileron downward

b) neutral position of the nonlinear mechanism
aileron neutral

c) axis of rib No. I

d) extreme position
aileron upward

e) to aileron booster

f) from control lever

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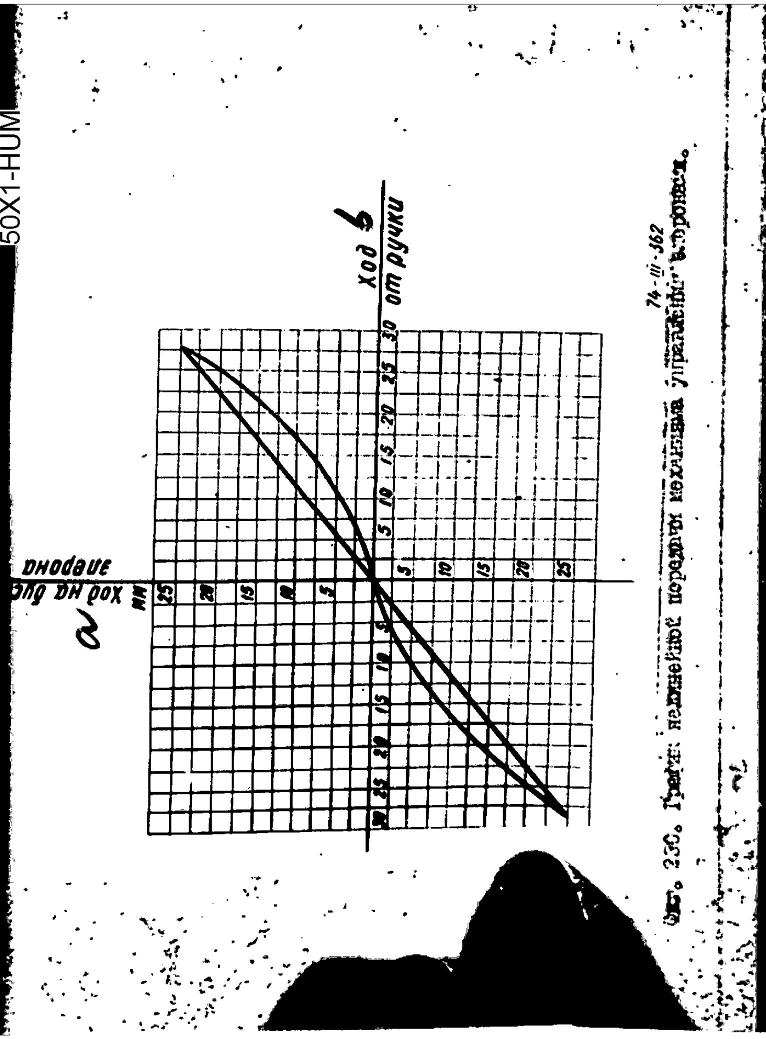

Fig. 230. Graph of the nonlinear transmission of the aileron-control mechanism.

a) movement toward aileron booster

b) movement from lever

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CHAPTER VI

FIRE-FIGHTING EQUIPMENT

The fire-fighting equipment is used for signaling and extinguishing fire in the neighborhood of the engine.

The system of fire-fighting equipment is shown in Fig. 231. It contains:

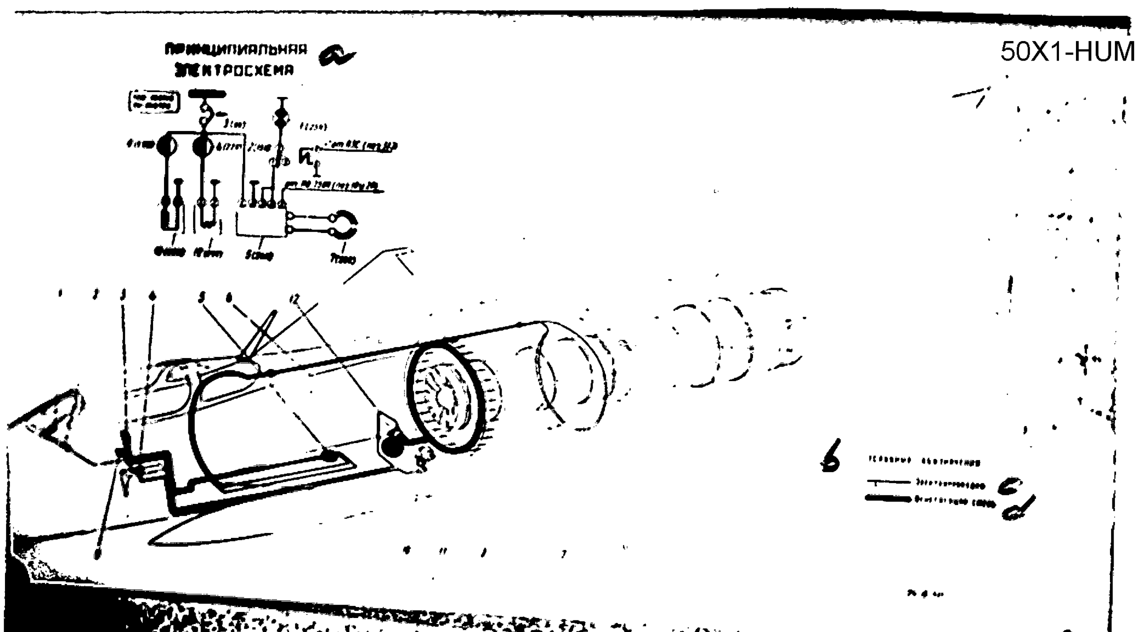
- ionization fire alarm IS-2M,

- two-liter balloon (5) 2OS-2-1S with explosive charge (12) inserted into its lock head.

The balloon is located on the lower beam of the fuselage in the region of frame 21.

- steel distributing collector (8) with openings 1.7 mm in diameter, located on frame 22,

- an electrical system, which informs the pilot of the presence of a flame source and actuates the fire-fighting equipment.



Фиг. 23. Противопожарное оборудование.

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Fig. 231. Fire-fighting equipment.

a) skeleton electrical diagram

b) legend

c) electrical wiring

d) fire-extinguishing mixture

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Fig. 231. Fire-fighting equipment.

1. Signal light.
2. Signal-panel-light control relay TKYe-56PD
3. Automatic network defense AZS-5
4. Fire-extinguishing button 205KS
5. Electronic amplifier IS-2M
6. Fire-fighting balloon 20S-2-1S
7. Sensors of ionization fire alarm
8. Distributing collector
9. Button of engine shutoff valve 20-MS
10. Electropneumatic valve 695000M
11. Shutoff valve of fuel system
12. Explosive charge of fire-fighting balloon 20S-2-1S.

The sensor of the alarm is heat-resistent metal pipe (7) located on special ceramic insulators.

There are two such sensors in the system. They are located on frame 29 symmetrically to the right and left of the axis of the plane.

The principle of operation of the IS-2M is based on the ability of a flame to conduct electric current. This property is due to ionization accompanying the chemical reaction occurring the formation of the flame.

Therefore alarm IS-2M is actuated only if a flame appears. It does not react to a mere increase in the temperature of the surrounding medium.

In case of the appearance of flame in the gap between sensor (7) and the mass of the fuselage the air gap becomes electrically conducting and closes an electrical circuit (of electronic amplifier 5) of which it (the gap) is part.

Electronic amplifier (5) is included in the system for the purpose of amplifying the current passing through the ionized air gap, since the latter is a large resistance in the circuit.

The primary transformer winding of electronic amplifier (5) is fed a 115 v, 490 cps ac current from converter PC-750A.

The wire-gauze leads of the amplifier are connected to sensors (7) of the alarm. In the presence of a flame in the space between the sensors

~~[illegible]~~
the plate current increases up to a value at which the relay feeding the voltage from the aircraft network to signal light (1) with the inscription "Fire" is actuated. The voltage is fed through AZC (3) with the inscription "Fire equipment. Deicer", which must be turned on before the flight.

This same AZS feeds a voltage to shutoff valve (10), which can be shut off in case of fire by depressing button (9), which was described in detail in the description of the fuel system (see Chap. III).

As can be seen from the aforesaid, the role of alarm IS-2M is limited to merely giving a signal.

Upon receipt of the signal "Fire" the pilot must depress button (4) on the left panel with the inscription "Fire extinguisher".

When button (4) is depressed, explosive charge (5) in the head of balloon (12) containing a fire-extinguishing fluid under a pressure of about 150 atm explodes (see Fig. 232). The gases forming as a result of the burning of explosive charge (5) pass underneath piston (4); the latter turns by means of its rod lever (6) located on semicircular axle (7).

Lever (3) rests with its free end on semicircular axle (7). When axle (7) turns, lever (3) acquires freedom to rotate. As a result, valve (2), which is under the constant action of spring (8), which tends to raise the valve, opens and permits the fire-extinguishing fluid to flow out into collector (8) (see Fig. 231) and then through openings in the collector into the space between the engine and the fuselage.

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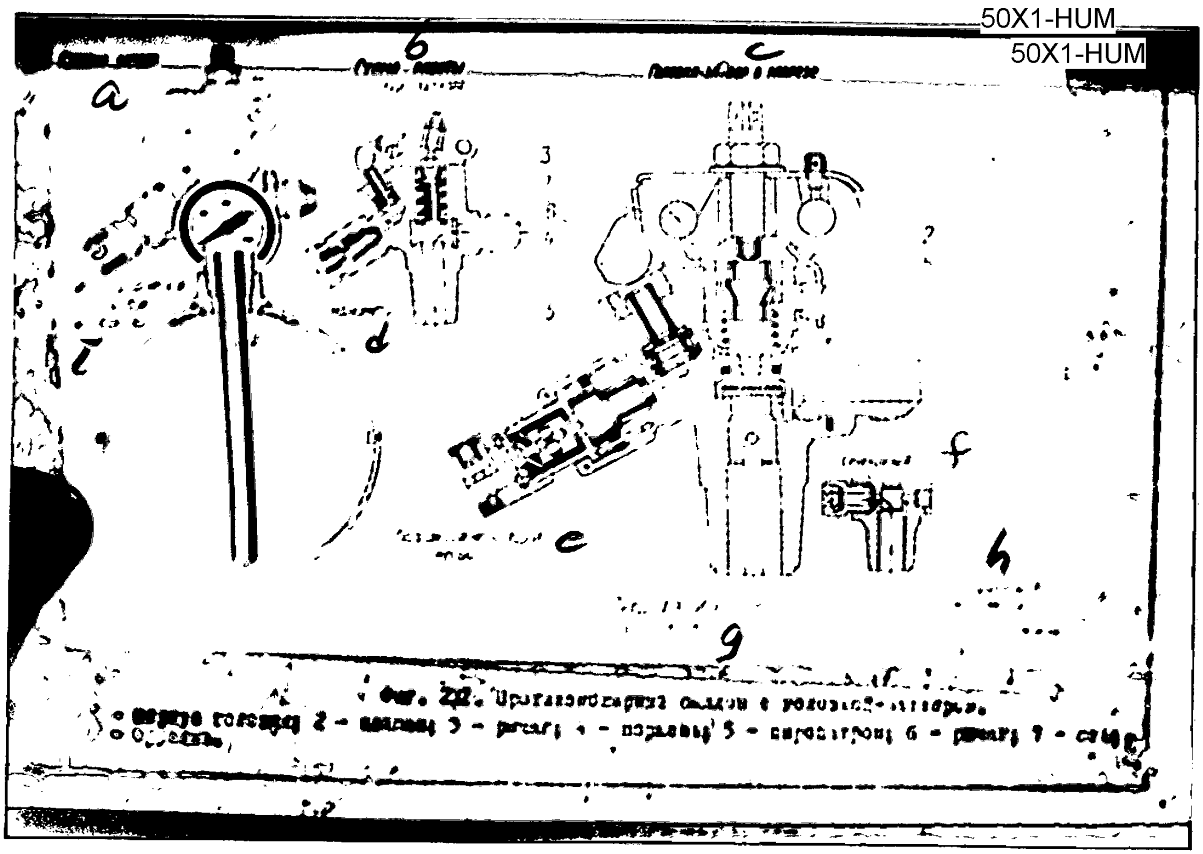

Fig. 232. Fire-fighting balloon with lock head.

1 - casing of head;

2 - valve;

3 - lever;

4 - piston;

5 - explosive charge;

6 - lever;

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7 - axle;

8 - spring.

a) lock head

b) operation of lock head

c) cross section of lock head

d) manometer

e) balloon containing fire-extinguishing mixture

f) cross section through A-A

g) safety device

h) connecting pipe for manometer

i) (illegible)

Located on the lock head is a 250 atm(gage) manometer and a safety device. If the pressure in the balloon increases to above 200 ± 20 atm (gage), a membrane in the safety device bursts, and the gaseous component of the mixture is discharged into the atmosphere. The working pressure of the fire-extinguishing mixture in the balloon is 150 atm (gage).

The fire-fighting balloon and the pipeline of the fire-fighting system are painted red on the outside.

As was mentioned above, if the fire signal lights up and the fire-fighting equipment is actuated, the pilot must shut off the pipeline feeding fuel to the engine by depressing "Fire valve" button (9) (Fig. 231) covered by a cap. When this button is depressed for 3-4 seconds, electropneumatic valve (10) is actuated and feeds air from the on-board air system into the cylinder closing the shutoff valve; the feeding of fuel to the engine ceases.

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CHAPTER VIII

VENTILATION, PRESSURIZATION, AND AIR-TEMPERATURE CONTROL

1. General Information

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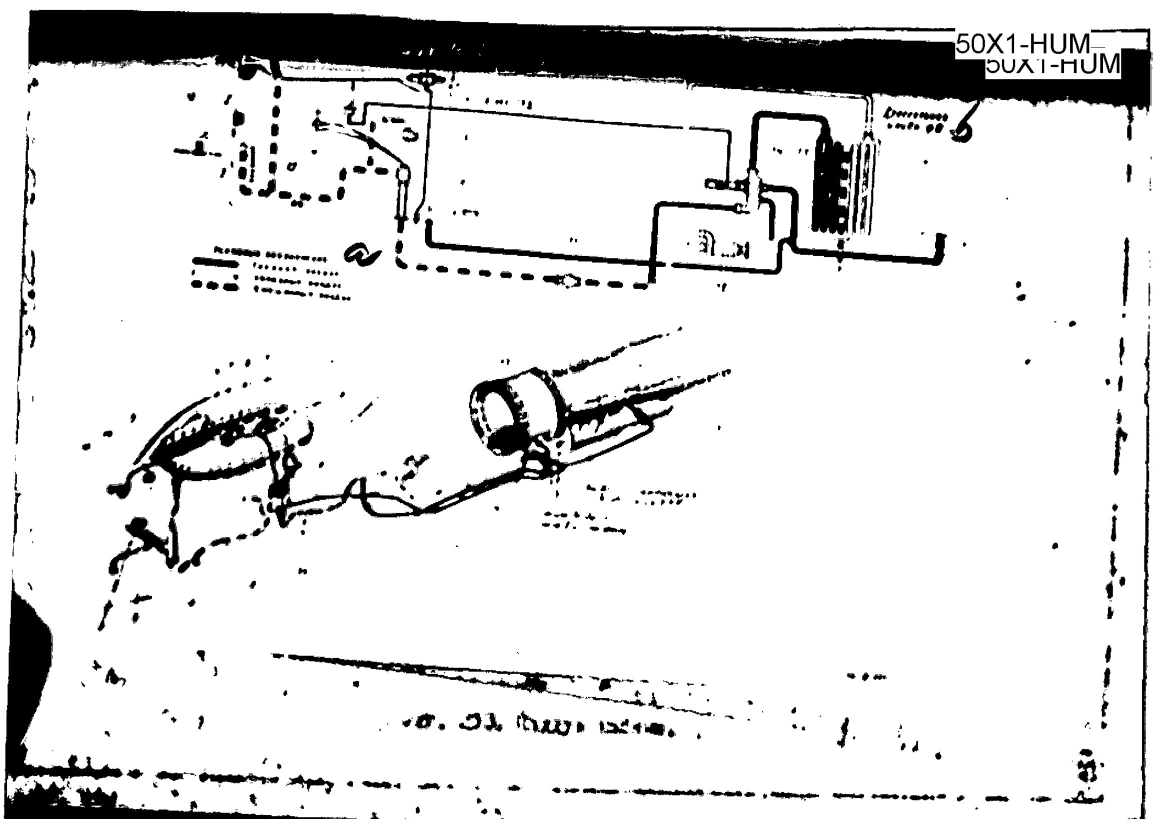

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Fig. 233. Pressurization of cabin.

a) legend

b) throttle plate F8

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Fig. 233. Pressurization of cabin.

1. Pressure regulator 2013V;
2. Safety valve PK;
3. Altitude and pressure-drop indicator UVPD-20;
4. Collector for ventilation of movable part of canopy;
5. Collector for ventilation of pilot's legs;
6. Four-position switch;
7. Control lever of cabin valve;
8. Cabin feed valve;
9. Temperature regulator TRTVK-45M;
10. Limiter of air feed to collectors;
11. Pressurization check valve 783M;
12. Turbocondenser unit 477 (477D);
13. Air-air radiator;
14. Electrical air-distributor valve;
15. Bleeding of air from engine;
16. Connecting pipe for on-the-ground ventilation of cabin;
17. Pressure-control valve 520B.

electrical air-distributor valve unit 525 (14), temperature regulator TRTVK-45M (9), air-air radiator (13), turbocondenser unit 477 (12), pressurization check valve 783I (11), cabin feed valve (3) with remote control (7), limiter of air feed to collectors (10), and altitude and pressure-drop indicator UVPD-20 (3).

For on-the-ground ventilation of the cabin there is a special pipe (16) and an electrical connector, to which a hose and an electrical connector from special airfield installation PK-1 are connected.

The on-the-ground ventilation is turned on by a switch located on the horizontal part of the right panel. On the switch is the inscription "on-the-ground ventilation of cabin".

Before the flight pipe (16) and the electrical connector are closed by special plugs.

The pipes used in the system are 27 x 25, 34 x 32, and 42 x 40 made out of AMTM and 26 x 25, 15 x 14, and 27 x 25 made out of C20. In order to connect the pipes to each other, a connecting pipe is welded to one end of the pipe, while a nipple with a connector nut on it is welded to the other end. The pipes are connected to the engine collector and the turbocondenser by a flange-type joint and are connected to the air-air radiator by a loose joint. The pipes (illegible) are coated with lacquer FP-9, covered with one layer of heat-insulation material (number illegible), and are wound around by wire LAO. The pipes are secured to the aircraft framework

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by means of collers.

2. Principle of Operation of the System.

The system contains three feed pipes through which hot, cold, or mixed air is fed into the cabin.

Air is fed into all three pipes from the engine compressor through distributor valve 525 (14).

The valve is controlled electrically by remote control by switch PZPN-20, which has four positions: hot, cold, automatic, and neutral. The switch with the inscription "heating of cabin" is located on the horizontal part of the right panel.

When the switch is set in the position "hot", the distributor valve feeds air into the cabin directly from the engine compressor, bypassing the cooling devices.

When the switch is set in the position "cold", the distributor valve feeds into the cabin air which has already been cooled in air-air radiator (13) and turbo-condenser (12).

When the switch is set in the position "automatic", the distributor valve feeds into the cabin mixed air in the necessary proportion.

Part of the air from the engine compressor is fed directly into the cabin feed pipe, while the remaining

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part is directed into this same pipe through air-air radiator (13) and turbocondenser (12). The air temperature is maintained automatically by heat regulator TRTVK-45M (9) within the limits of the assigned value set on its scale.

When the switch is set in the position "neutral", the control of the feed system is shut off.

Hot, cold, or mixed air enters the cabin through feed valve (8), which has two positions: open or closed.

The valve is remote-controlled by cable. It is opened before starting the engine. During partking on the ground the valve should be set in the position "closed".

The pressure in the cabin is maintained by an assortment of equipment ARD-57V, which ensures free ventilation of the cabin at altitudes ranging from 0 to 2000 m. The excess pressure in the cabin at this altitude with a maximum air flow of 550 kg/hr is no more than 30 mm. At altitudes ranging from 2000 m to 9000-12,000 m the excess pressure gradually increases and at an altitude of 9000-12,000 m amounts to 220 ± 10 mm. Above 9000-12,000 m a constant excess pressure of 220 ± 10 (0.3 atm (gage)) is maintained in the cabin.

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In case of failure of the pressure regulator the excess air is discharged through safety valve PK, which is calibrated for a pressure of 240^{-3} mm.

The pressure drop between the cabin and the atmosphere, as well as the altitude, is controlled in the cabin by the instrument UVPD-20.

3. Description of Certain Units of the Cabin Feed System

Assembly ARD-57V consists of two units: command instrument — pressure regulator 2013V and actuating valve 520B. These units are installed in the cabin separately and are connected to each other by a special pipe with a (illegible).

A skeleton diagram of the operation of the ARD-57V is shown in Fig. 234.

The air flow through the pressurized cabin is ensured by pressure-control valve 520B.

The size of the opening of this valve is automatically maintained so as to ensure the law of maintenance of the pressure in the cabin in relation to the flight altitude for the given air flow.

Up to 2000 m the valve is open; cavities A, B, G, and D communicate with the atmosphere. Correspondingly the pressure in the pressurized cabin will be approximately equal to atmospheric pressure (more accurately: the pressure will exceed atmospheric by an amount equal to ratio between the elasticity of spring (17) and

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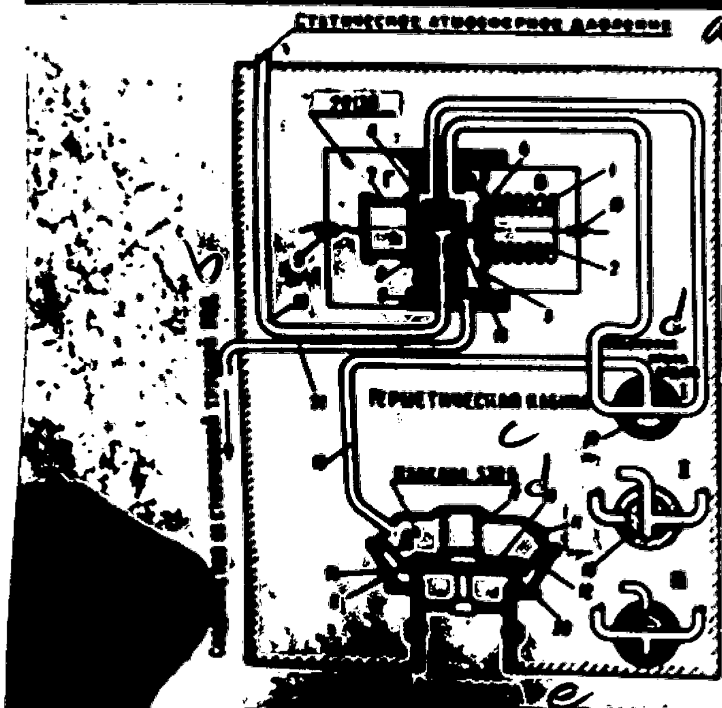

Положения крана регулятора

I-Положение „Включено"
Кран включен для полета. От 0 мм до 2 мм - вентиляция. От 2 мм до 9÷12 мм нарастание избыточного давления до 220±10 мм рт ст
от 9÷12 мм постоянное избыточное давление 220±10 мм рт ст

II-Положение „Проверка"
Кран включен для работы кабины на земле при постоянном избыточном давлении 220±10 мм рт ст

III-Положение „Выключено"
Кран выключен для проверки кабины на герметичность, выход воздуха из кабины закрыт

Фиг. 234. Регулятор давления [illegible]

[illegible] 2 – пружина; 3 – [illegible]; 4 – клапан; 5 – [illegible]; 6 – [illegible]; 7 – пружина; [illegible] 9 – винт; 10 – [illegible] 11 – [illegible]; 12 – мембрана; 13 – винт; 14 – опорный диск; 15 – трубка; 16 – [illegible] 17 – пружина; 18 – отверстие в регуляторе; 19 – трубка; 20 – [illegible]; 21 – трубка.

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Fig. 234. Pressure regulator ARD-57V

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1 – bellows;

2 – spring;

3 – membrane;

4 – valve;

5 – capillary;

6 – membrane;

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7 – spring;

8 – valve;

9 – screw;

10 – valve;

11 – nozzle;

12 – membrane;

13 – screw;

14 – bearing disk;

15 – pipe;

16 – ~~xxxxx~~ valve plate disk;

17 – spring;

18 – opening in regulator;

19 – pipe;

20 – valve;

21 – pipe.

a) static atmospheric pressure

b) connects with static pipe of PRD

c) pressurized cabin

d) (illegible)

e) atmosphere

STOP HERE

f) Positions of Regulator Valve

I – position "turned on"
valve turned on for flight. From 0 to 2 km – ventilation. ~~xxxx~~ From 2 km to 9-12 km – increa[se] in excess pressure up to 220±10 mm. From 9-12 km – constant excess pressure of 220±10 mm.

II – position "check"
valve turned on for operation of cabin on ground under constant excess pressure of 220±10 mm.

III – position "turned off"
valve turned on for pressurization check of ~~xxxx~~ cabin. Air outlet from cabin closed.

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the effective area of membrane (12).

Up to 2000 m the pressure in cavity D is equal to atmospheric pressure, i.e., valve (4) of the controller is open and is connected with the atmosphere through the static-pressure tubes.

At the same time, under the action of the insignificant pressure from the cabin on membrane (12), valve (20) opens.

In order for the valve to open, the cabin pressure has only to overcome the force of spring (17).

Nozzle (11) is used to decrease the flow of air through the command instrument in order to increase the accuracy of its operation; by choosing the diameter of the nozzle it is possible to control the rate of change of the pressure in the cabin at given vertical speeds.

As the atmospheric pressure decreases (with increasing altitude), the force acting on bellows (1) decreases, as a result of which the bellows expands and begins to cover valve (4).

At 2000 m bellows (1) opens so much that valve (4) closes opening (18), and the absolute pressure is controlled as follows: as soon as valve (4) closes, the pressure in cavity A begins to increase as a result of the feeding of air into the cabin with exhaust valve 520B closed. This pressure will act on membrane (3) and bellows (1). Under the action of the pressure difference between cavities A and B

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the bellows will contract and will reopen valve (4). The air ~~fxxx~~ will emerge from cavity A into the atmosphere through pipe (19), and the pressure in cavity A, ~~xxx~~ ~~xxxxxquently~~

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and consequently in cavity D, decreases.

The ratio between the pressure in cavity D and the pressure in cavity E will be lower, and valve (20) will open and release air from the cabin into the atmosphere until the given pressure is reached.

The process of control of the absolute pressure will repeat itself in this way up to an altitude of 9000-12,000 m. With a further rise in altitude, starting from 9000-12,000 m, when an excess pressure of 220 ± 10 mm is attained, the excess-pressure control unit goes into operation, and valve (8) opens, i.e., the difference between the pressures acting on membrane (6) reaches a value which creates a force greater than the force of spring (7).

Thus, starting at altitudes higher than the above-mentioned ones, a constant pressure differential will be maintained between cavity B and the atmosphere.

This constant pressure differential between cavity B and the atmosphere ensures a constant excess pressure of 220 ± 10 mm in the pressurized cabin.

In cases of rapid descent of the plane the atmospheric pressure of the air may exceed the pressure in the cabin. Then membrane (12) of valve 520B will be pressed against valve plate disk (16). Under the action of an atmospheric pressure exceeding the cabin pressure valve 520B will open, and air will enter the cabin from the atmosphere. The lever of three-way valve (1[illegible] can be set in three positions:

I - in the position "turned on" for normal operation of the regulator.

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II - in the position "check" for checking the excess pressure in the cabin on the ground.

III - in the position "turned off" for checking the pressurization of the cabin on the ground.

The ~~positio~~ valve position "check" is not used on the plane.

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Safety valve PK (Fig. 235) is used to prevent the cabin from exploding when the pressure in it exceeds the permissible limit. When the excess pressure in the cabin reaches 240-245 mm, the valve opens and drives out the excess air.

The valve consists of a housing, a ring-shaped plate with a rod, and a spring. The spring tension is controlled with the aid of a washer and a nut which is screwed onto the rod of the valve plate.

Electrical air-distributor valve, unit 525, serves to receive air from the engine compressor and to distribute it through the hot or cold lines or through both lines simultaneously.

The distributor valve is connected electrically to thermoregulator TRTVK-45M.

The valve is controlled electrically by remote control by a switch with the inscription "heating of cabin" located in the cabin on the horizontal part of the right panel.

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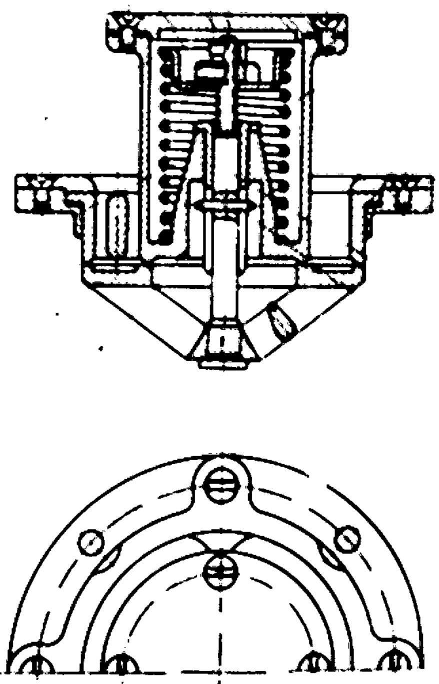

Фиг. 23[illegible]. [illegible]

1 – корпус; 2 – [illegible]; 3 – [illegible]; 6 – [illegible]; 5 – [illegible];
6 – [illegible]; 7 – [illegible]; 8 – [illegible]; 9 – [illegible]; 10 – [illegible];
11 – [illegible]; 12 – [illegible]; 13 – [illegible]; 14 – [illegible]; 15 – [illegible]

S-E-C-R-E-T

50X1-HUM

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Fig. 235. Safety valve.

1 - housing;

2 - valve;

3 - spring;

4 - washer;

5 - gasket;

6 - cover;

7 - nut;

8 - safety nut;

9 - screw;

10 - bushing;

11 - gasket;

12 - flange;

13 - ring;

14 - rod;

15 - pin.

FIRST LINE OF TITLE

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The switch has four positions: hot, cold, automatic, and neutral.

Structurally the distributor valve consists of two main parts: an electrical mechanism with a reduction gear and a distributing device.

The distributing device has four connecting pipes for the inflow of hot air, the outflow of hot air, the outflow of cold air and a drainage pipe for the outflow of air into the atmosphere for the puspose of limiting the flow of hot air into the cold line, since the pressure in the hot line is greater than the pressure in the cold line.

The distribution is accomplished by three shutoff flaps turned by an electrical mechanism via a lever mechanism.

The lever mechanism is mounted on the axles of the flaps and on a special axle and is connected through a fork to the guide of the electrical mechanism , by which it is brought into rotational motion.

When a certain temperature is reached on the scale of thermoregulator TRTVK-45M, its bimetallic spiral, depending on the air temperature in the cabin, closes the contacts of the electrical circuit of the distributor valve, which, rotating, turns the valve flaps into a position such that the air entering the cabin maintains the required temperature in the cabin.

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50X1-HUM

Thermoregulator TRTVK-45M is used to automatically maintain the air temperature in the cabin within the required limits.

The thermoregulator consists of a bimetallic spiral, a movable contact, two stationary contacts, an electromagnetic feedback coil, a dial, and a spark quencher.

With the aid of the dial air temperature in the cabin can be set within limits (16-26°C). Normally the dial is set at 16°.

With the aid of an ejector pump the bimetallic spiral is cooled by air taken from the main pipe after the feed valve. If the air temperature in the cabin exceeds 16°, the bimetallic spiral, elongating, closes the movable and the stationary contacts and switches on an electric motor, which turns the flap of the distributing valve to make it feed cooled air into the cabin.

At temperatures below 16° the bimetallic spiral contracts and, closing the movable and stationary contacts, switches on the electric motor, which turns the flap of the distributing valve to make it feed hot air into the cabin.

In order to reduce temperature fluctuations, the thermoregulator has an electromagnetic feedback coil connected to the potentiometer of the electrical mechanism. One end of the potentiometer and the feedback coil is under "plus" and the other under "minus", while the potentiometer slider is connected to the other end of the feedback coil.

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The potentiometer slider, turning to the right or left together with the flaps of the distributing valve, varies the voltage on the ends of the feedback coil.

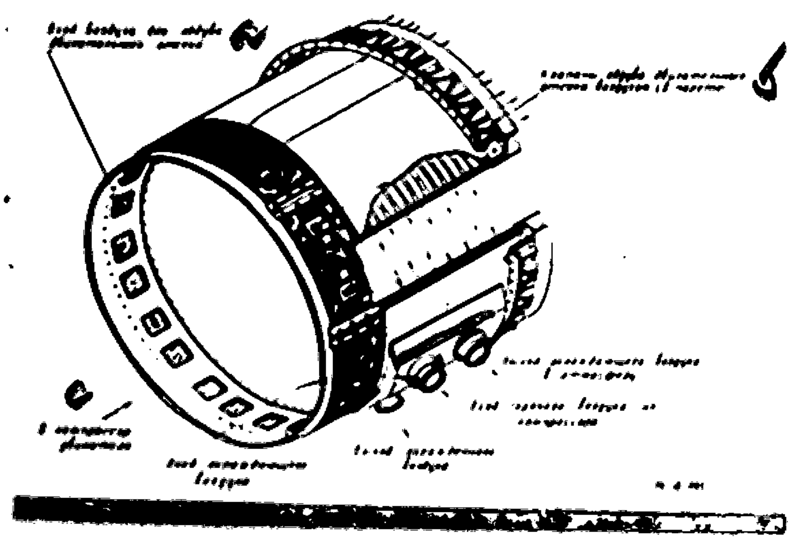
The more the valve flap turns to the left, i.e., the more hot air is directed into the cabin, the greater the voltage on the ends of the feedback and the greater the attraction of the movable contact. The movable contact, attracted to feedback coil, breaks the circuit and switches on the electric motor a little bit before the temperature in the cabin reaches 16°.

(For detailed description of air-distributor unit 525 and thermoregulator TRTVK-45M see description of supplier factories).

Air-air radiator (Fig. 236) is used to cool the air before it enters the turbo-condenser. It is a double-walled cylinder, to the inside of which a corrugated sheet is roller-welded.

Hot air from the distributor valve enters the air-air radiator; the air passes between the wall of the air duct and the corrugated sheet and flows out to the turbo-condenser.

The hot air in the radiator is cooled mainly by the air which passes through the duct into the engine (the inner wall of the radiator is cooled).



Фиг. 236. Воздухо-воздушный регулятор.

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Fig. 236. Air-air radiator.

a) air inlet for cooling of engine compartment

b) valves for air-cooling of engine compartment (in flight)

c) to engine compressor

(remainder illegible)

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Moreover, the air is taken from the engine duct through openings in the radiator, flows into the radiator and around the corrugated sheet, and emerges through a stub pipe into the atmosphere.

The cooling air moves into the atmosphere under the action of the pressure differential in the air-intake duct.

After passing through the air-air radiator, the hot air gives up more then 80% of its heat.

Turbocondenser unit 477 (477D) is used to cool the air entering the pressurized cabin of the plane. It is located in the cold-air line behind the air-air radiator.

The turbocondenser consists of two main parts: a turbine and a ventilator connected to each other by a common shaft mounted on two ball bearings.

The principle of operation of the turbocondenser is as follows: compressed air from the engine compressor, passing through the air-air radiator, arrives at the turbine nozzles with a temperature of up to $75^{0}C$ and a pressure of up to 4 kg/cm^2.

In the nozzles the potential energy of the air is converted into kinetic energy. From the nozzles the air passes at great speed onto the turbine blades and sets them rotating.

Thus the kinetic energy of the air is converted into mechanical work of the turbine.

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The power developed by the turbine rotor is removed by the ventilator. The air, having performed its work on the blades of the turbine disk and having lost 90% of its initial speed acquired in the turbine nozzles, flows off the blades with its speed, pressure, and temperature reduced.

The cooled air is directed through an outlet pipe into the cabin-feed line.

Check valve in pressurization system 783I admits air through only in one direction (from the engine to the cabin); in case of stoppage of the engine or damage to the pipeline it shuts off the feed line and prevents leakage of air from the cabin.

On the valve housing is an arrow indicating the direction of motion of the air.

Cabin feed valve (Fig. 237) is located in the cabin and has two fixed positions of the lever (90^0 angle between them): open and closed.

The valve is remote-controlled by cable with the aid of control lever (1) mounted in the cabin on the right panel.

A sector on control lever (2) is connected by cable (3) to the roller of feed valve (4).

The valve consists of a housing with two connecting pipes and steel flap (11). The axle of the flap (6) is connected to roller (4) by guide (7) and rod (8).

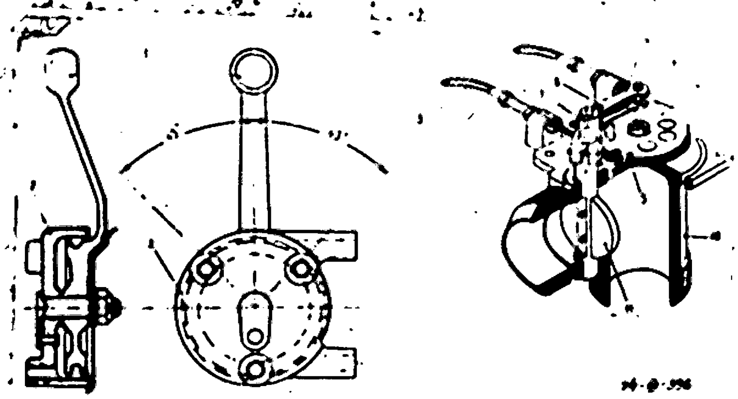

Рис. 237. [illegible]

1 – [illegible]; 2 – [illegible]; 3 – трос в боудене, 4 – ролик; 5 – [illegible]; 6 – [illegible]; 7 – [illegible]; 8 – [illegible]; 9 – [illegible]; 10 – перекрывной кран; 11 – [illegible]

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Fig. 237. Cabin feed valve.

1 - valve control lever;
2 - control housing;
3 - bowden cable;
4 - roller;
5 - cylinder;
6 - axle;
7 - guide;
8 - rod;
9 - spring;
10 - shutoff valve;
11 - flap;

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[redacted] 50X1-HUM

The valve housing is made of duralumin, while the flap and the axle are made of steel.

The valve operates as follows:

When the control lever is turned in one of the positions: "open" or "closed", the cable connecting the lever to the roller on the valve moves and actuates the axle together with the flap, which turns through an angle of ± 45°, thereby providing the air with a passage into the cabin or, conversely, shutting off this passage.

4. Installation of the units of the system of ventilation, pressurization, and temperature control of the air in the cabin.

The units and assemblies of the system are located in the forward part of the fuselage (Fig. 233) in the following places:

- valve 520B of air-pressure regulator ARD-57V and safety valve PK (2) - in the cabin on frame 6.

- pipe for bleeding air from the engine compressor (15) - on the left in the lower part of the engine near frame 26.

- air distributor valve unit 525 (14) - below on frame 22.

- temperature regulator TRTVK-45M (9) - in the cabin near frame 11 on the left.

- pressure regulator 2013V (1) - between frames 10 and 11 on the panel beneath the canopy on the right.

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Air-air radiator (13) - between frames 21 and 22.

Pipe leading the cooling air out of the air-air radiator - in the hatch between frames 21 and 22 to the left of the axis of symmetry below.

- Turbocondenser unit 477 (477D) (12) - below on the right between frames 14 and 15.

- check valve in the pressurization system 783I (11) - below between frames 12 and 13.

- cabin feed valve (8) - (illegible) on frame 11.

The lever controlling the cabin feed valve (7) - in the cabin on the right panel near frame 8.

- Collector for air supply to hinged portion of canopy (4) - in the cabin.

- Collector for ventilation of pilot's legs (5) - in the cabin below near frame 6.

- Limiter of air fed to collectors (10) - in the cabin on the left under the floor near frame 7.

- Altitude and pressure-drop indicator UVPD-20 (3) - in the cabin on the instrument panel.

- Four-position switch for controlling the cabin feed system (6) - on the right panel.

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