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INFORMATION REPORT INFORMATION REPORT

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YE-6T AIRPLANE

TECHNICAL DESCRIPTION

BOOK III

DESIGN

PAGES 1 - 222

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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 37F 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.

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

The fuselare 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.

-5-

The cockpit enclosure canopy is streamlined, affording the pilot a good view ahead and to the sides. The canopy is designed so that the forward part can be opened on the groupd, or ejected if necessary during 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 m², 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°.

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 x"full boost."

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

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 xmkm 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.

The main system serves the following purposes: to brake the wheels, lift and pressurize the canopy, release the canopy in an emergency, recharging, closing 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-51MB stabiliser 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 fedd 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 serves 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.

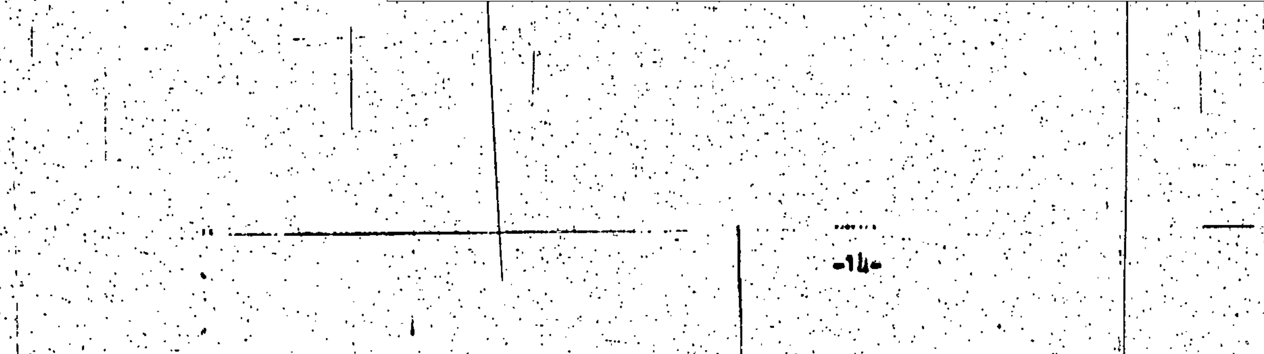

Fig. 4. Exploded view of the plane.

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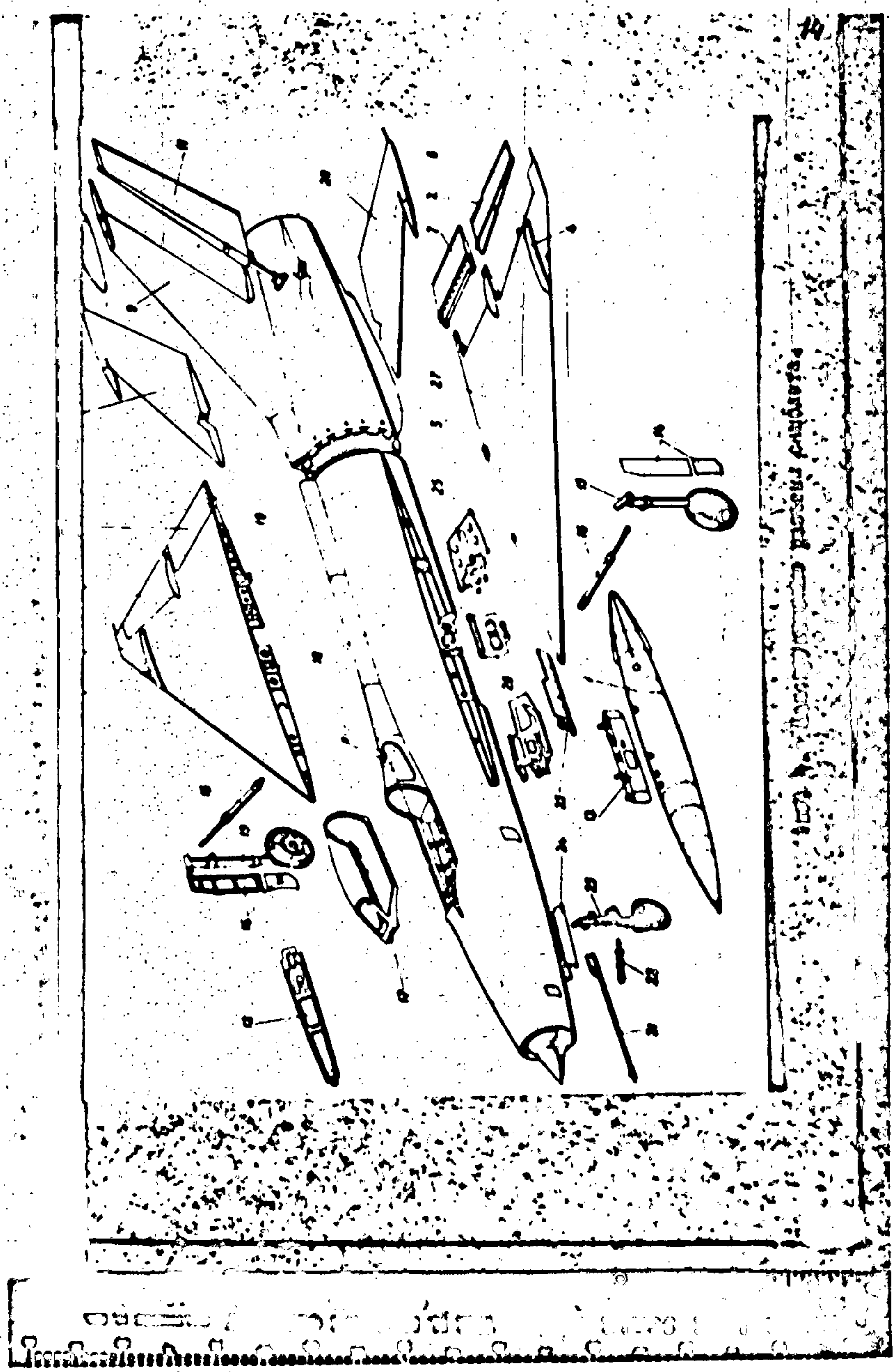

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Fig. 4. Exploded view ofthe plane.

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 stabiliser.
9. Vertical fin.
10. Tip of vertical fin.
11. Rudder.
12. Cowling.
13. 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 stabiliser.
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 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.

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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

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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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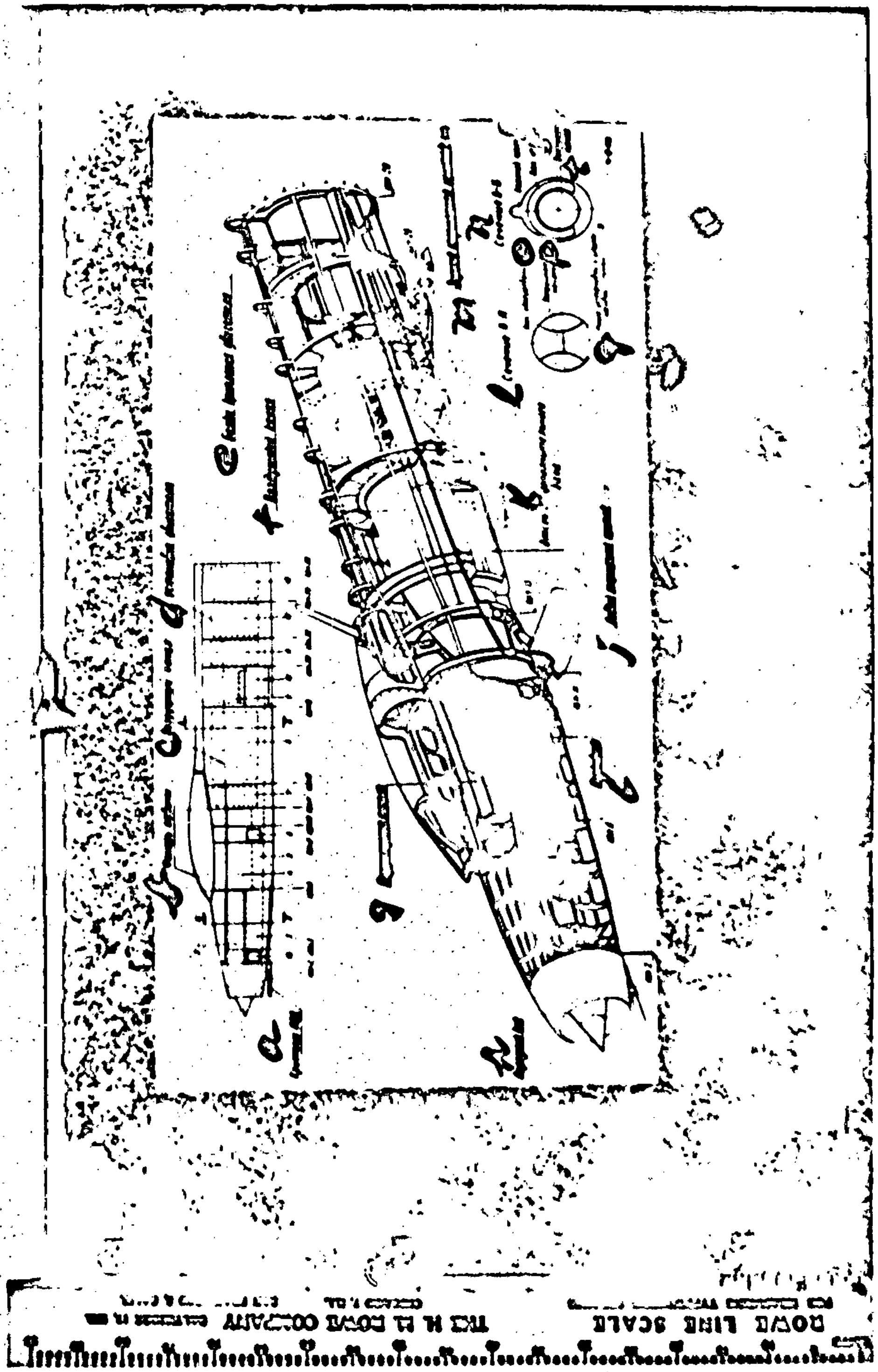

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cabin both sections converge into a common duct to feed air to the engine compressor.

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 ~~removed~~ 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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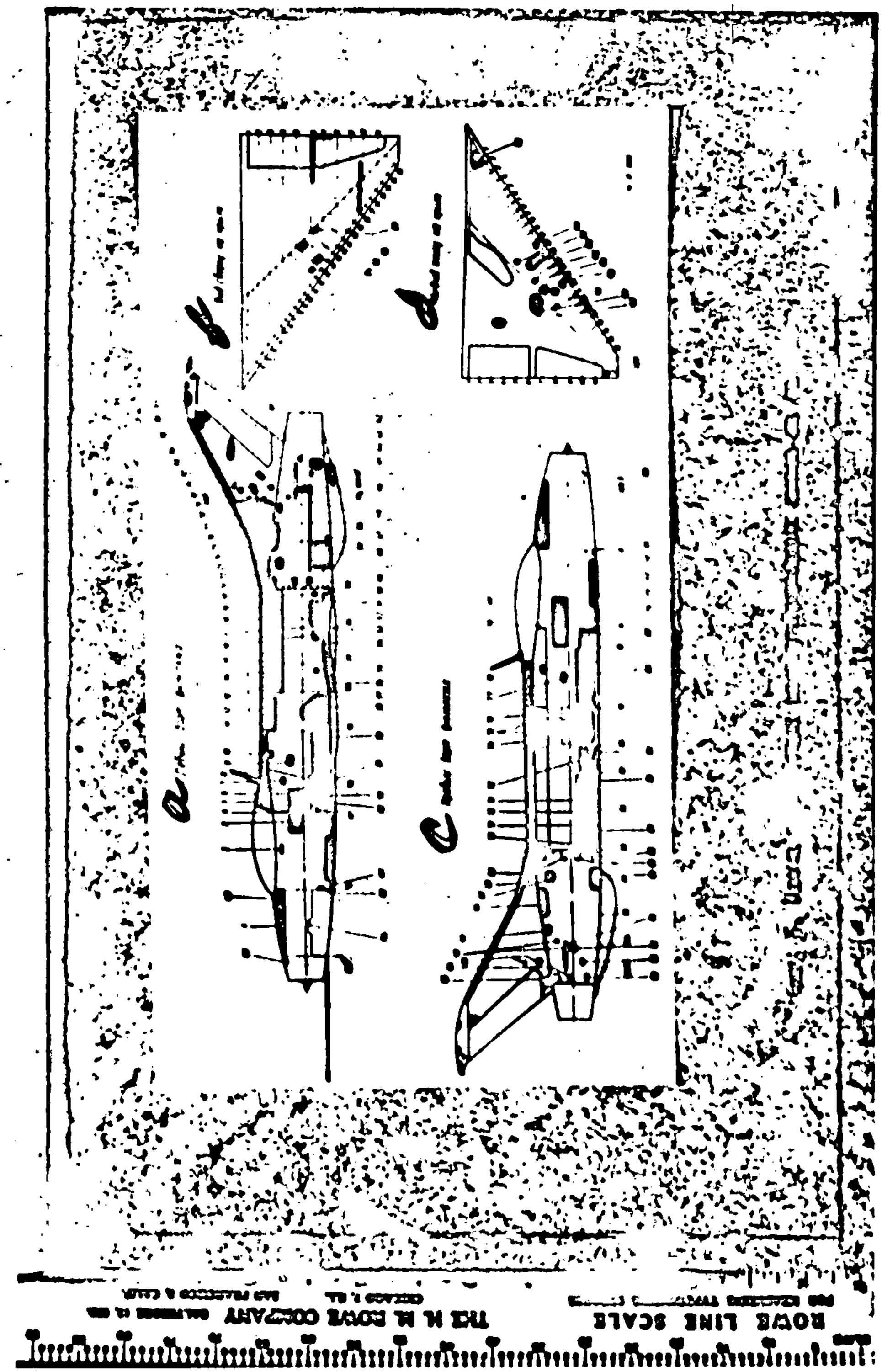

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Fig. 6. Diagram of the location of the operational hatches on the aircraft.

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;

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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. Stabiliser 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. Rxx 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;

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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; 99. Air cylinders; 101. Kerosene fill; 102. Electrical separation of carrier; 104. Aileron actuating arm; 105. Access to BAND ....;

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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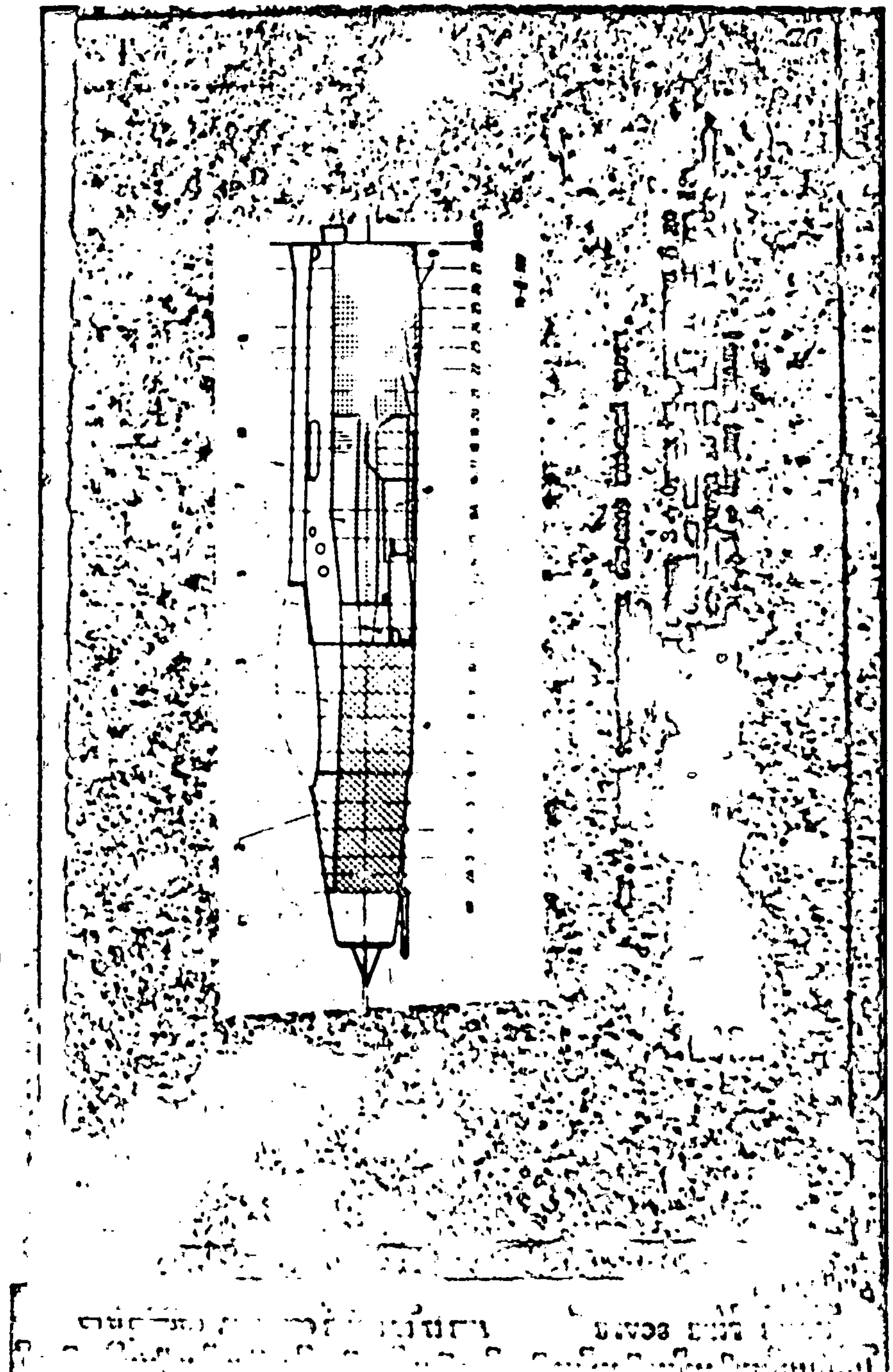

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Fig. 7. Diagram of technological compartments of the nose section of the fuselage. 1) nose nacelle; 2) forward upper compartment; 3) compartment from frames 6 to 11; 4) side panels; 5) compartment from frames 11 to 13; 6) bottom panel; 7) side panels from frames 13 to 20; 8) side panels from frames 20 to 28; 9) bottom panel; 10) upper panel.

Design of Node Section of Fuselage (Fig. 7)

The nose section of the fuselage, to facilitate assembly, is divided into the following compartments and panels: the noses 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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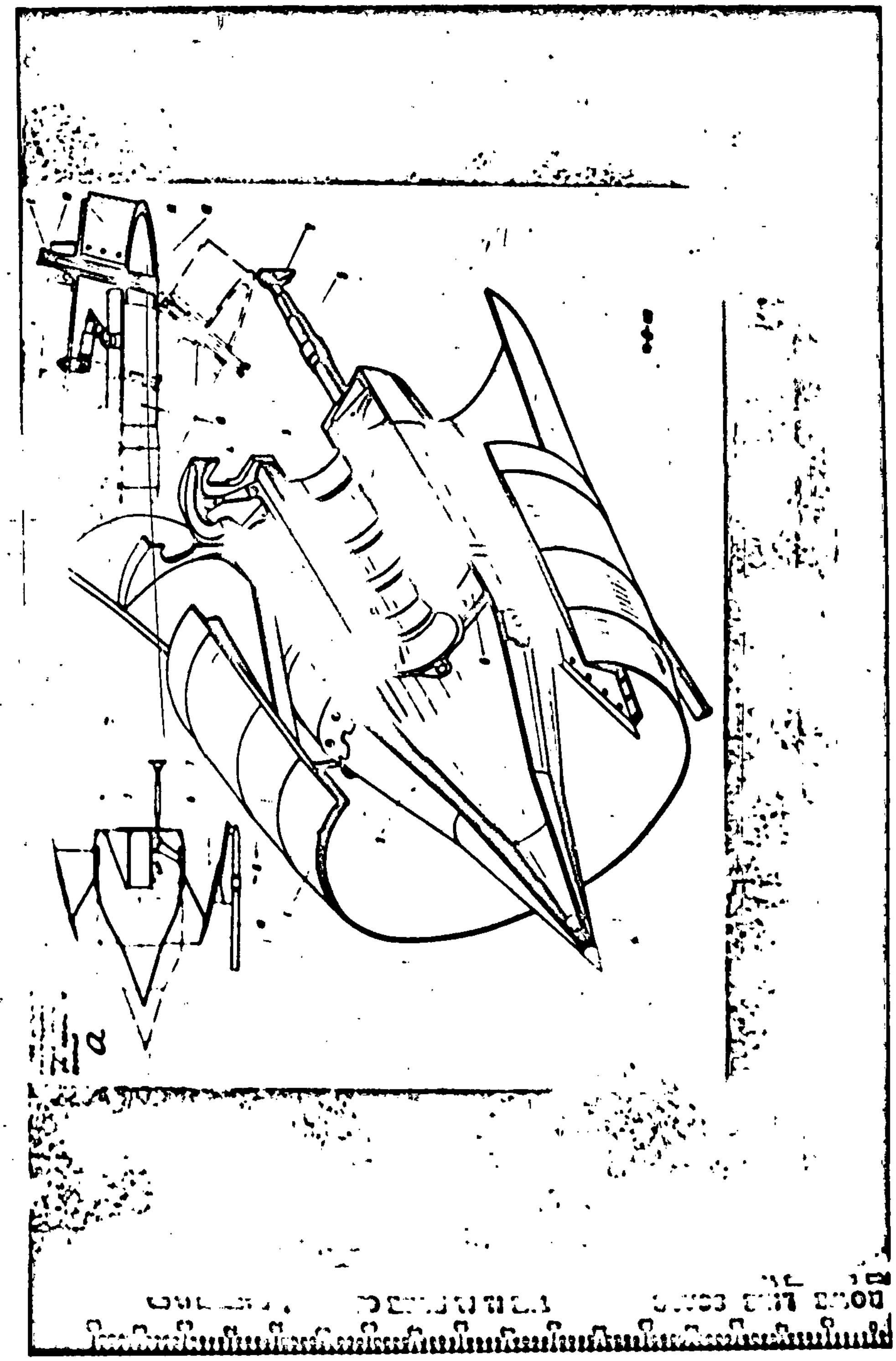

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Fig. 8. Nose nacelle with ~~moving~~ telescoping cone. a) diagram of the three-position cone (the two outer surfaces are shown).

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.

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 of 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 unit 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.

The cantilever 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:

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 pressurisation hose. Sheet D-16 is the material for the main elements and the covering.

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

The cockpit is pressurized by means of a U-30M pressuriser.

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 that contains the lock for locking the front landing gear in the retracted position.

Frame 6 is a main frame, a 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, the 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 base 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~~ Elektron, 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 is 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.

To 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 ofthe drop tank.

At frame 16, to the trusses are attached two angle plates made of SZOKhGSA 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 SZOKhOSA 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 xxxxxx 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 S20KhGSNA 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 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 3ZOKhGSNA 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.

Frame 25 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 SZOKhOSNA 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 ZOKhOSNA 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.

[redacted]

The frame is a rim of V-95T molded angle iron with a S20KhOSA reinforcing angle plates 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 S20KhOSNA 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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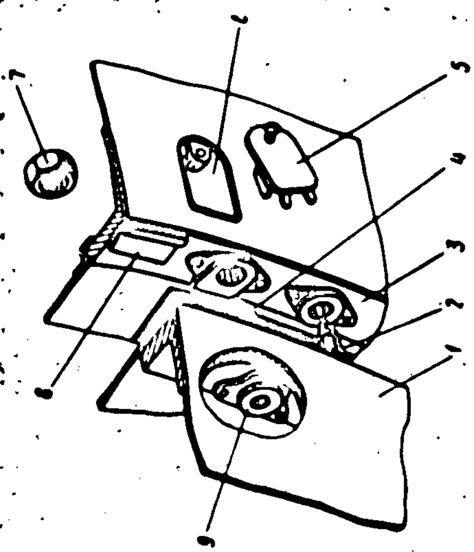

Рис. 7. Узел стыковки носовой и хвостовой частей фюзеляжа.

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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.

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 accomplishdd 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.

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 S20KhGSNA 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.

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

R. p. 44 There are special air-inlet ducts at frame 31A for engine blow-off.

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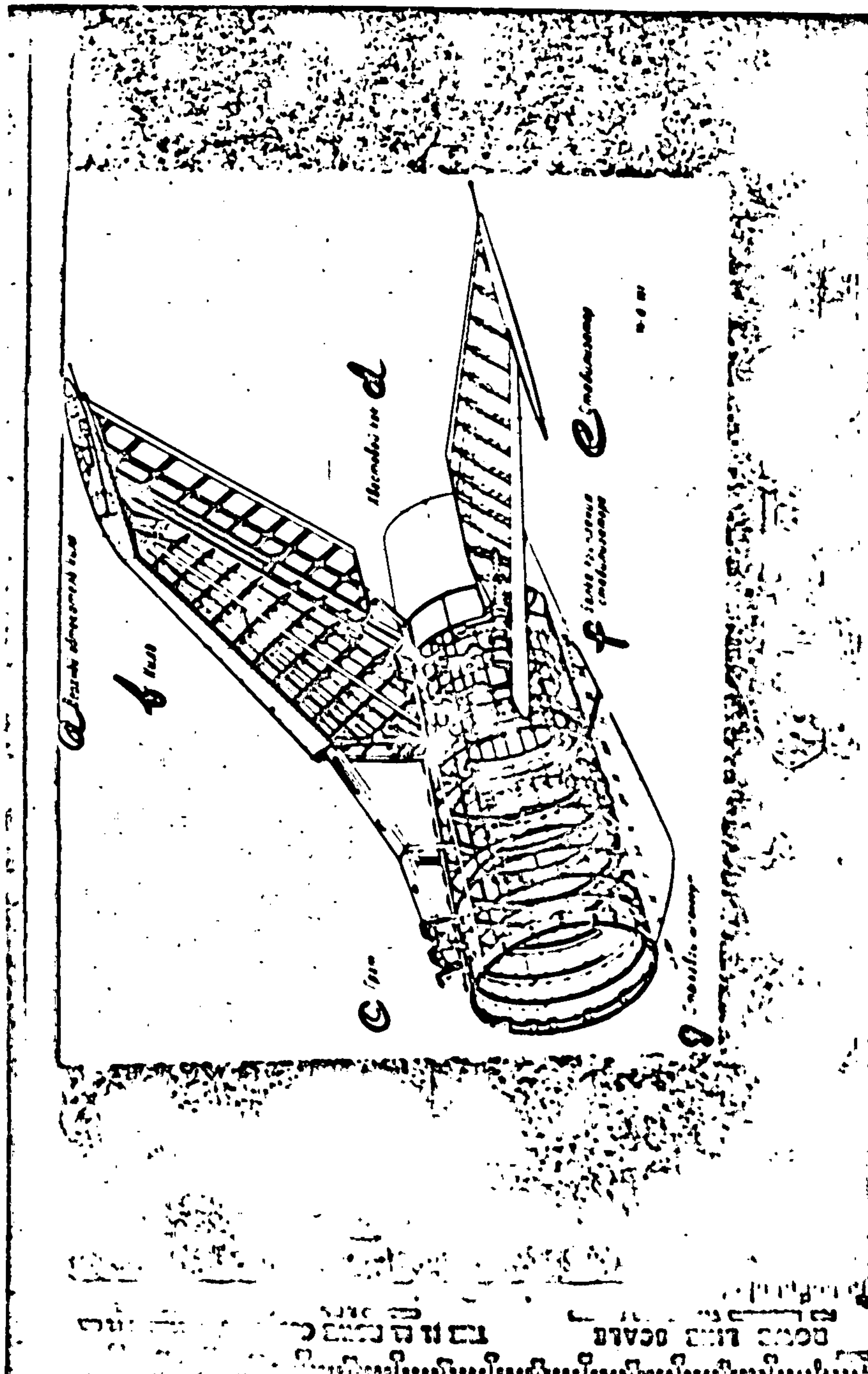

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Fig. 10. Framework of tail section of the fuselage and the tail.

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

[redacted]

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 pressurised 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 of 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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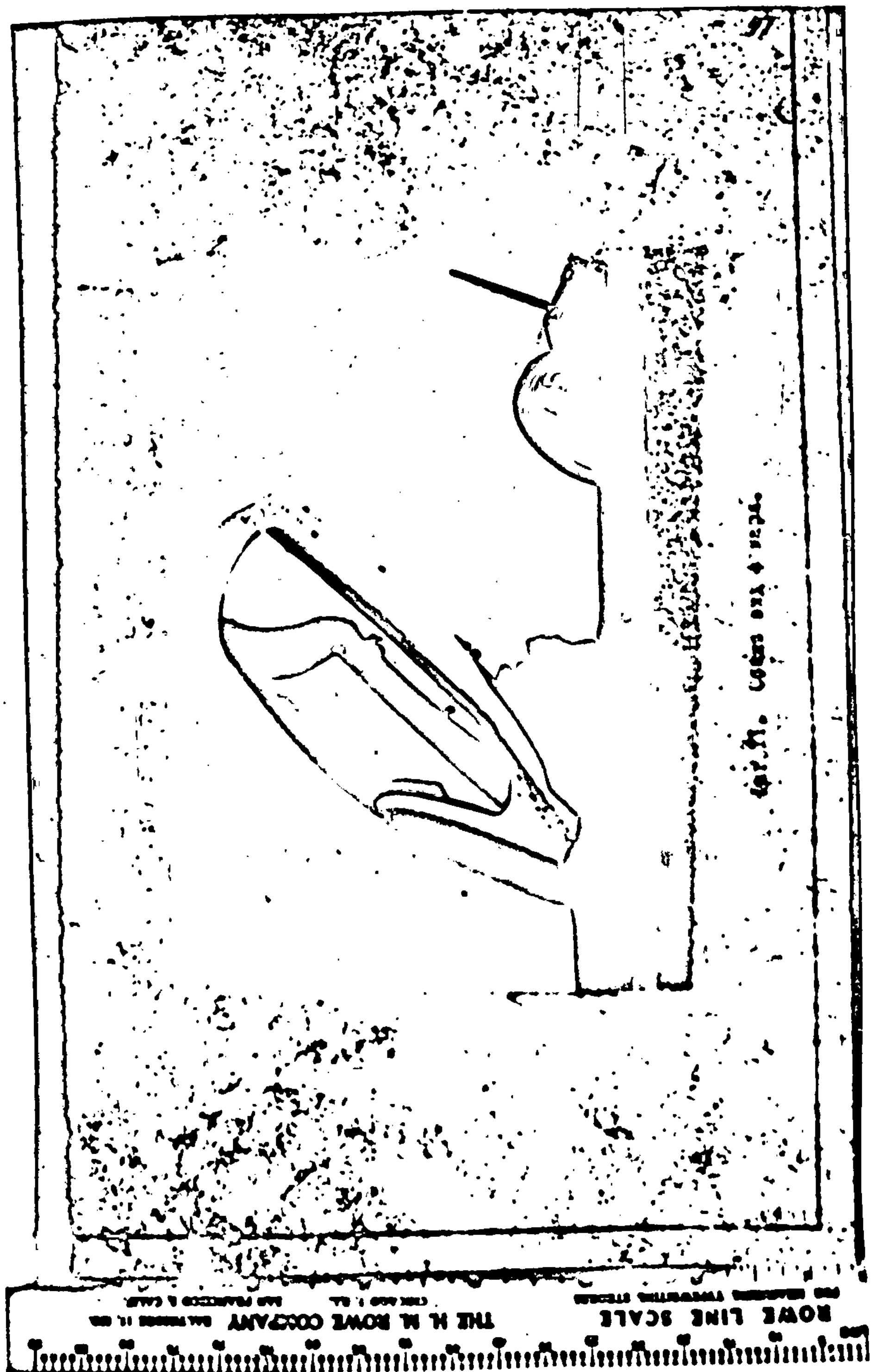

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Fig. 11. General view of the canopy.

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-10M-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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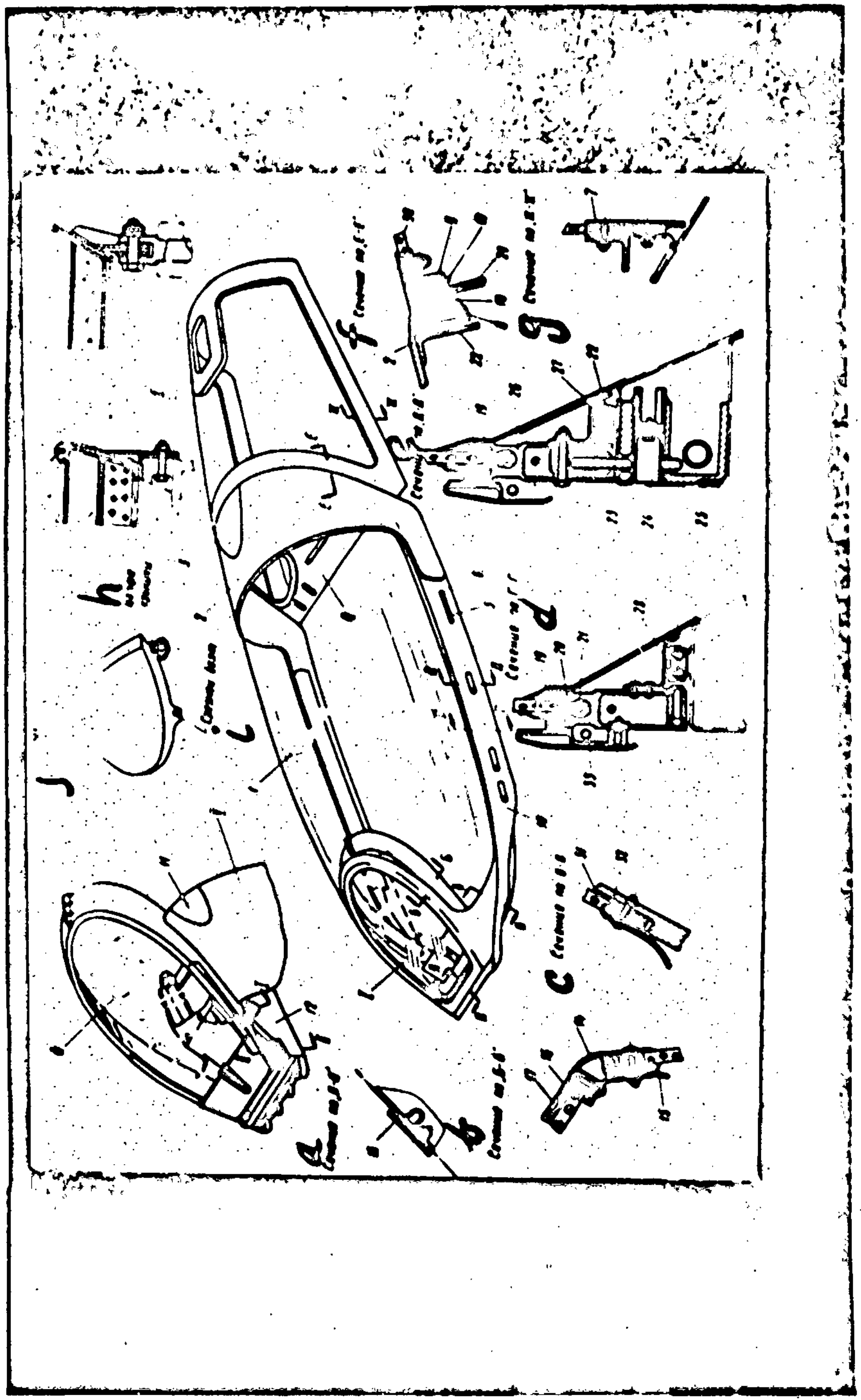

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Fig. 12. Canopy design. a) cross section at "A-A"; b) cross section at "Б-Б"; c) cross section at "B-B"; d) cross section at "Г-Г"; e) cross section at "Д-Д"; f) cross section at "E-E"; g) cross section at "Ж-Ж"; h) cover pin; i) shear bolt; j) ~~[illegible]~~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

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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 transparent 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;

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21. rod; 22. pressurization hose; 23. canopy loop; 24. pintle for operating frame; 25. operating frame; 26. Molded mi 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 xmxaxm 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 frames 11. Along the outside edge it is xtxtxhxd 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. 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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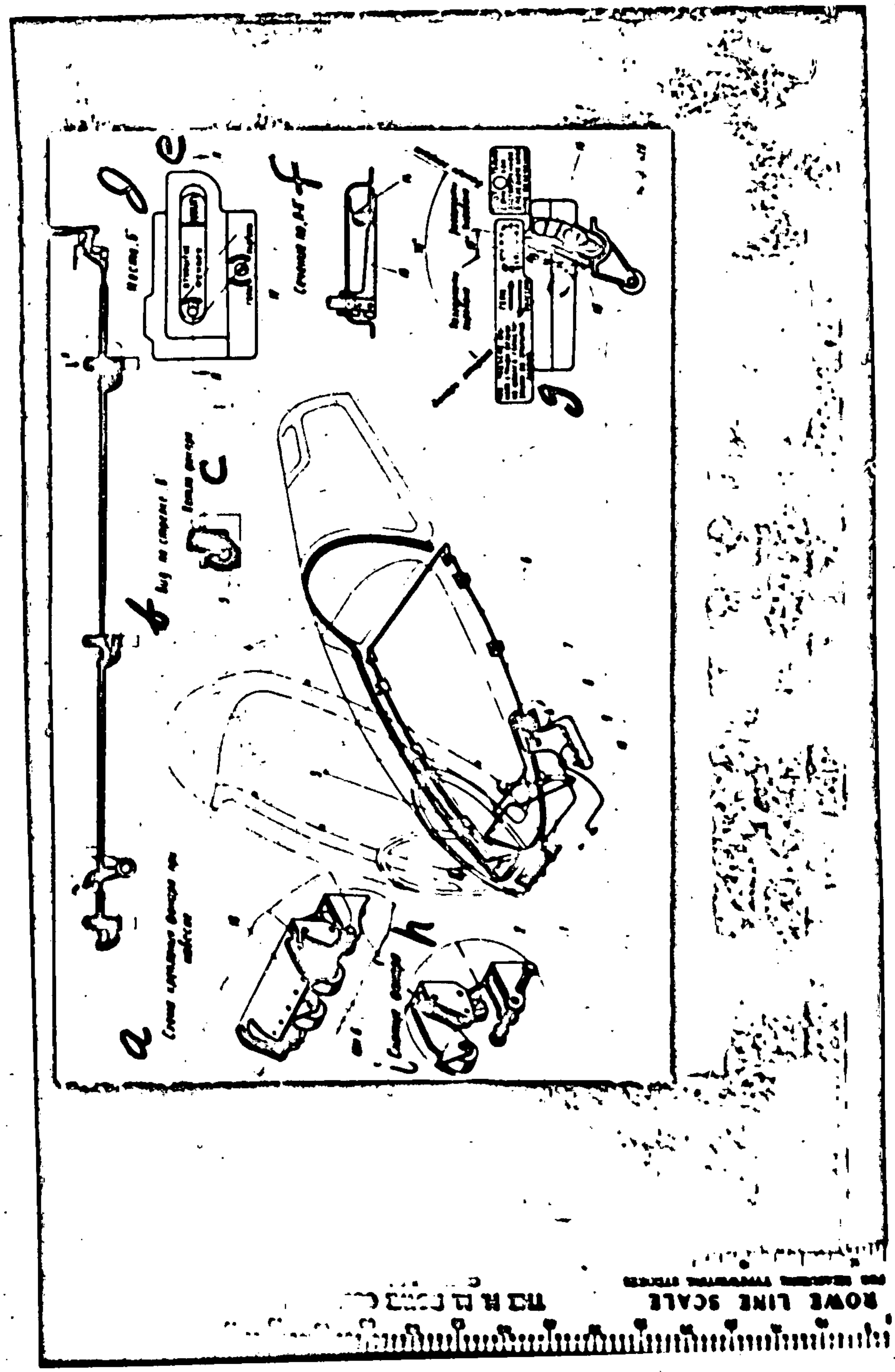

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Fig. 13. Pressurization system and canopy control.

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.

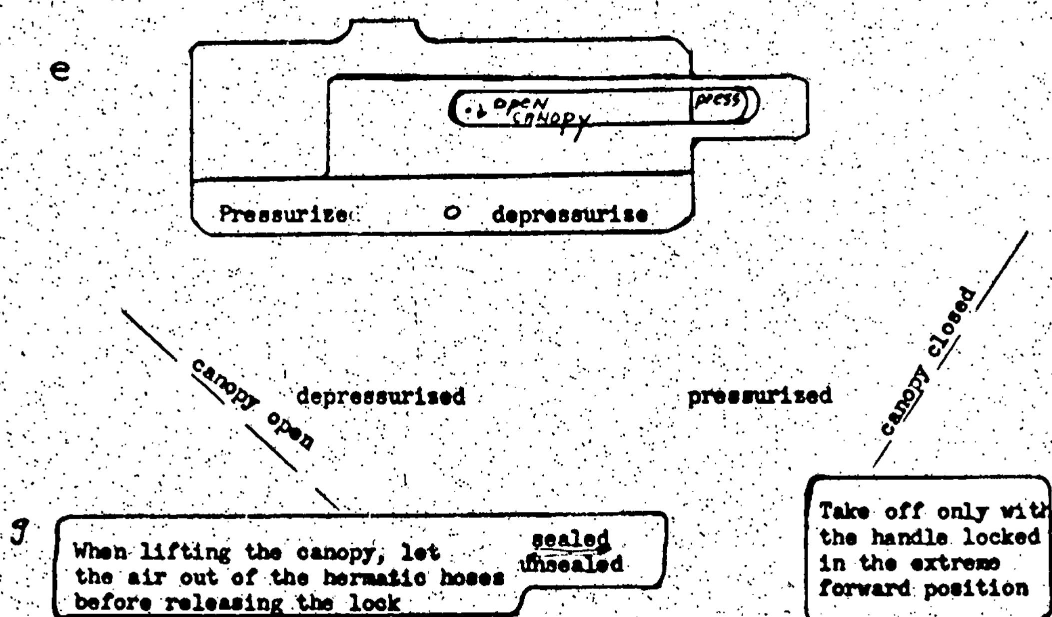

Fig. 13. Pressurisation and canopy control system.

1. canopy suspension bracket; 2. canopy lift cylinder; 3. canopy operational lock; 4. pressurisation hose; 5. catch 6. push-pull rod; 7. dribble 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. pressurisation push button; 16. inside handle; 17. slotted shaft ~~with~~ spline for pressurising the ~~xxxxx~~ canopy from the outside; 18. swivel lock.

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The canopyis affixed in the lowered position by six locks (3) located in the 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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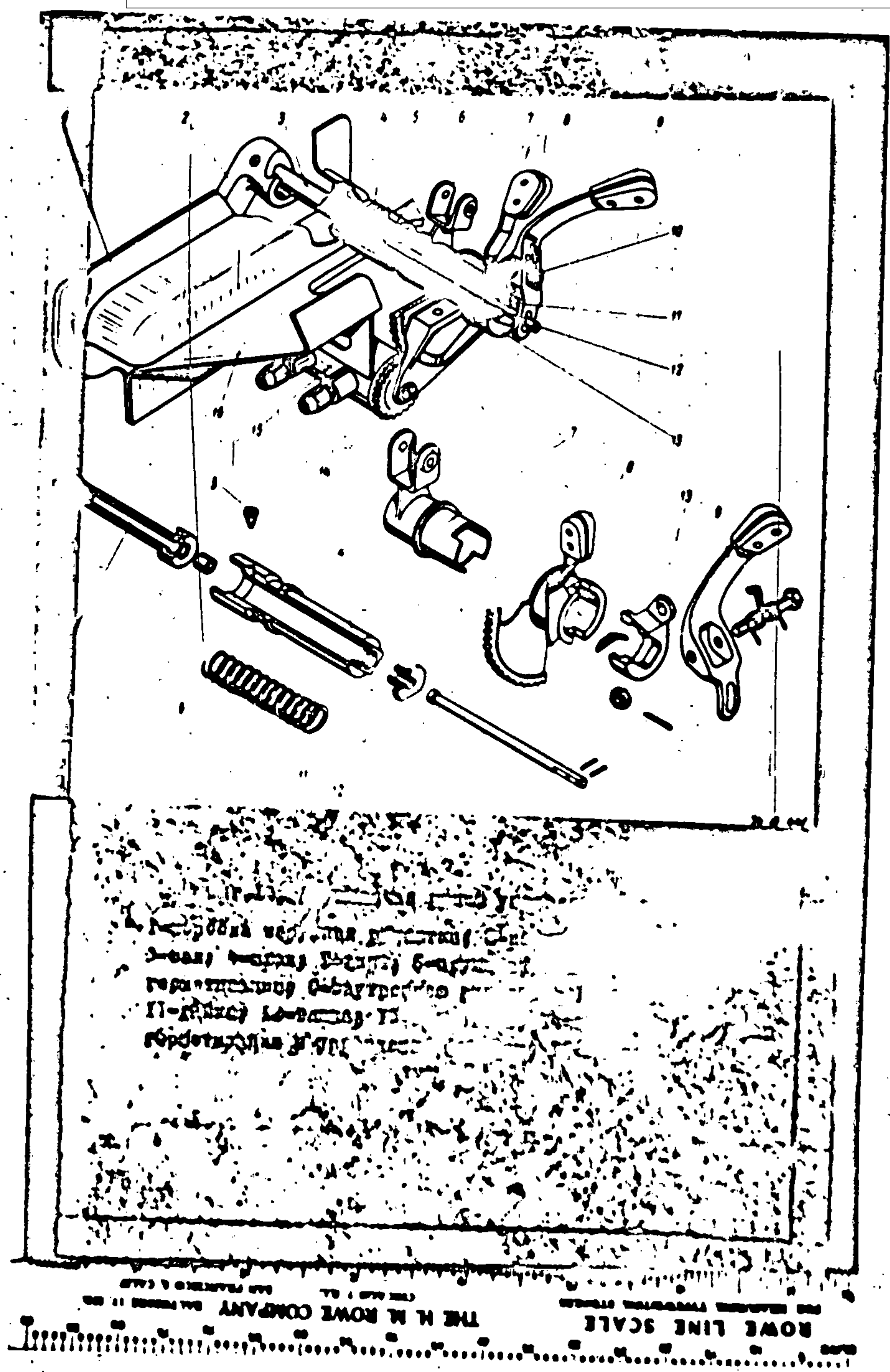

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Fig. 14. Two-position canopy-control handle.

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.

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 hear frame No. 7[?]. Canopy control valve itx (11) is attached to the panel of the canopy control handle.

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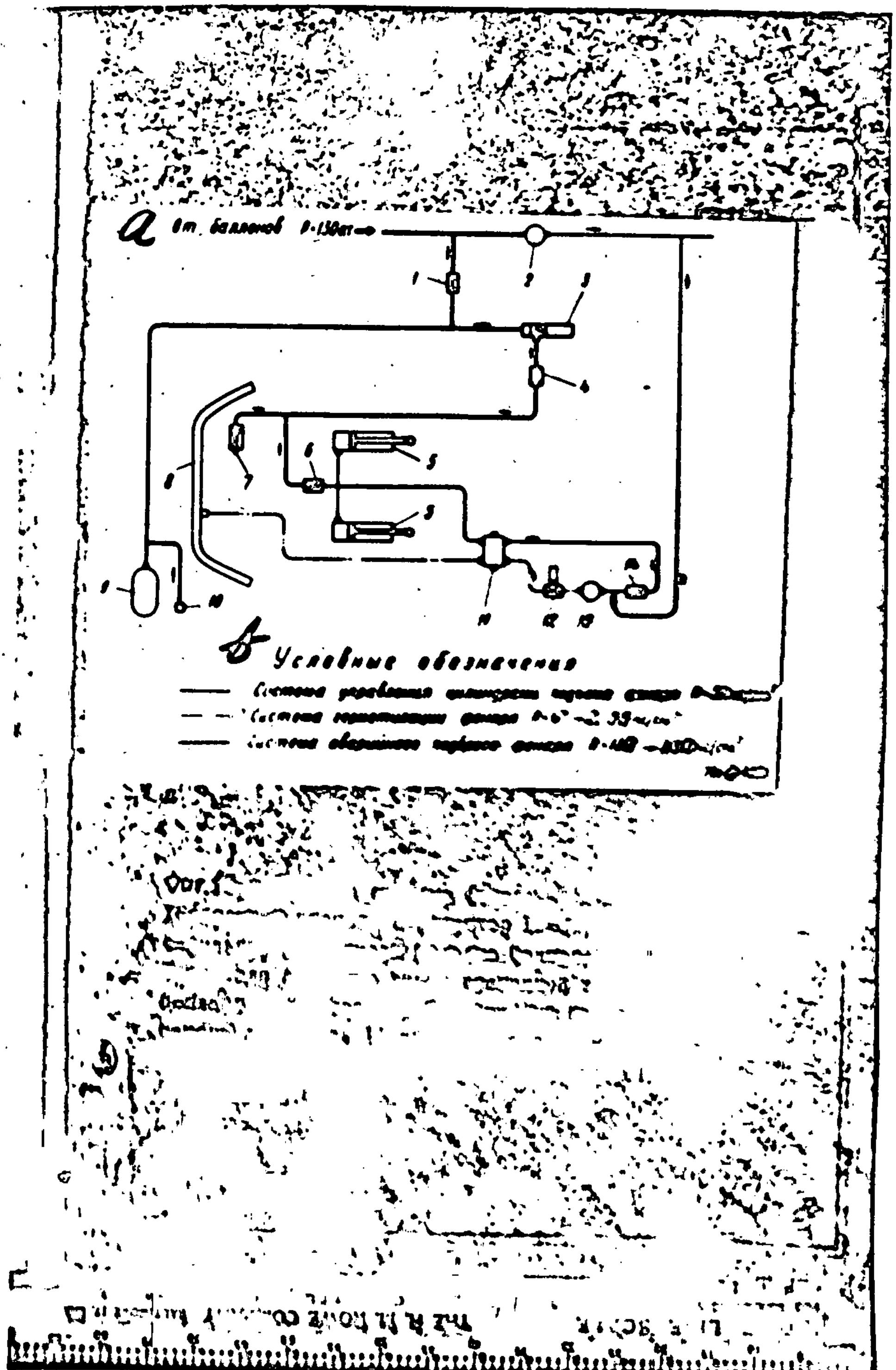

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Fig. 15. Canopy ~~hydraulic~~ air system. a. from cylinders, p = 130 atm; b. designations: ——— - system for control using canopy-lift cylinders, p = 50 kg/cm²; —·— - canopy pressurization system, p = 1.7-2.55 kg/cm²; ━━━ - canopy emergency removal system, p = 110-130 kh/cm².

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 13o-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 pressurised from the outside using a screwdriver.

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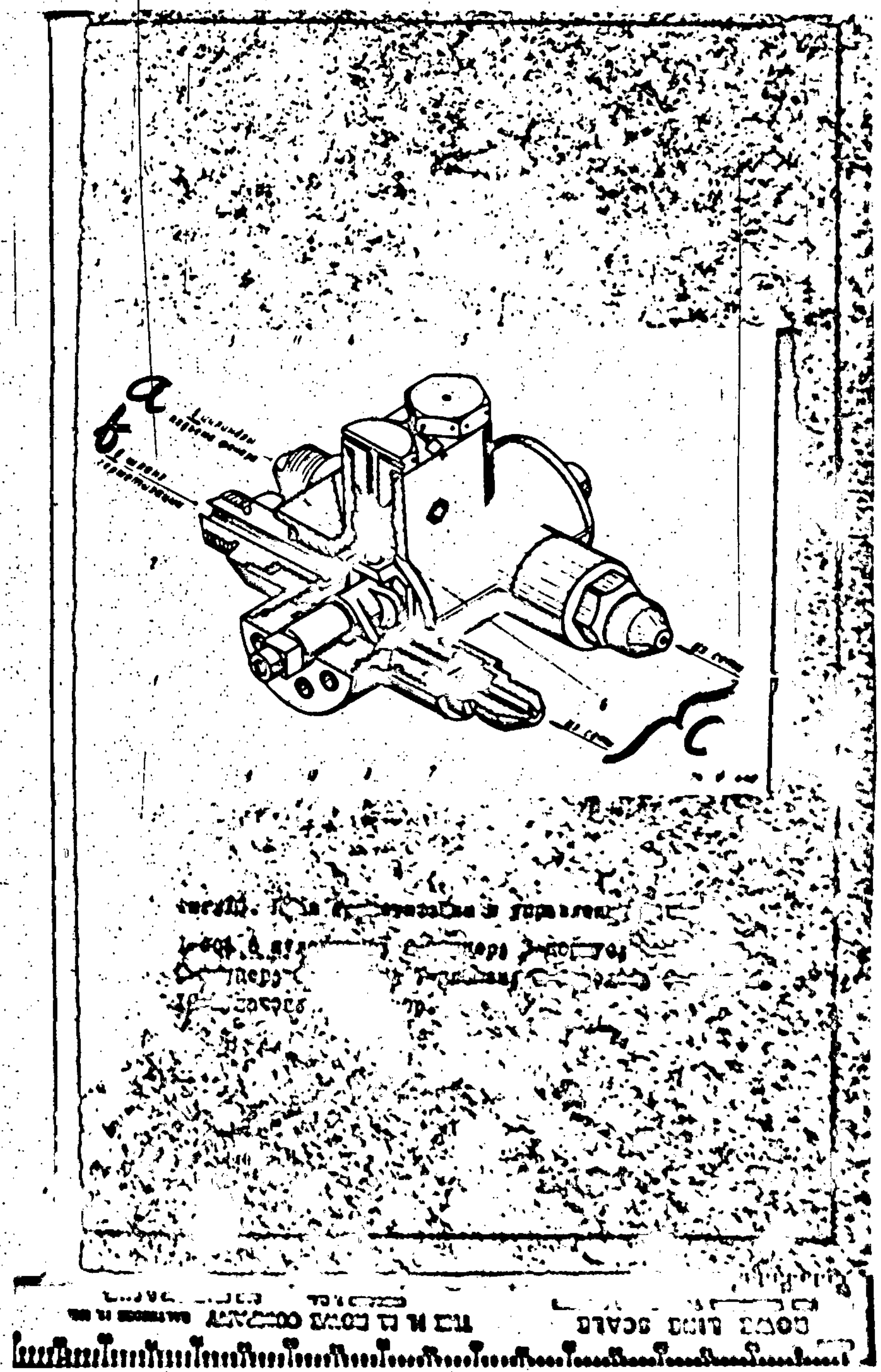

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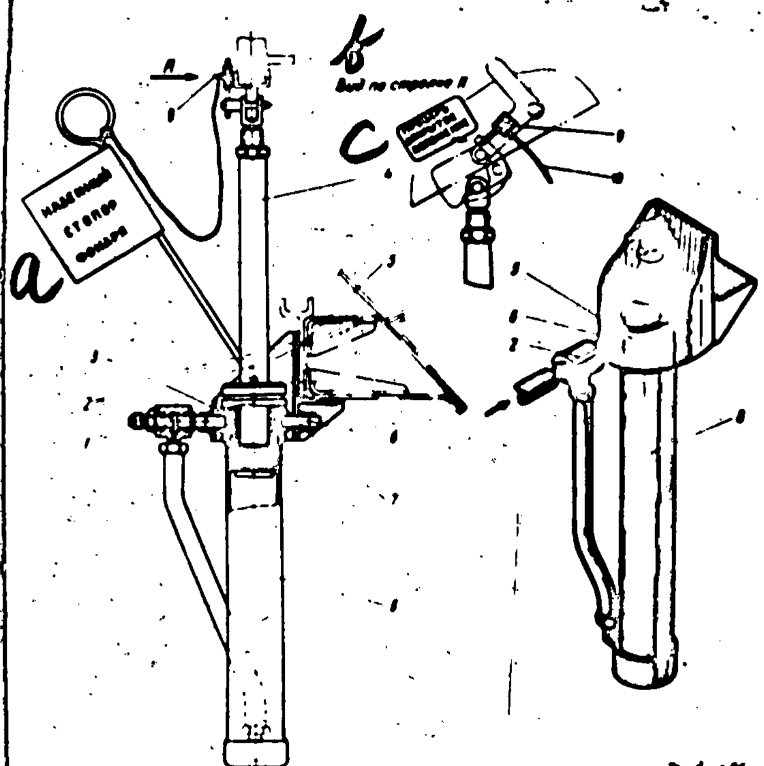
Fig. 16. Pressurization and canopy control valve.

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 pressurisation hose.

c. From supply.



Фиг. 17. Цилиндр подъема фонаря.

1 – штуцер; 2 – поворотный штуцер; 3 – [illegible]; 4 – шток; 5 – кронштейн [illegible] цилиндра; 6 – болт; 7 – штифт; 8 – цилиндр; 9 – стопор аварийной системы; 10 – шнур.

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 look.

b. view at "A"

c. check closed position.

[redacted]

.... 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 ~~xxxxxx~~ 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~~xx(2)x~~ valves (3) with rubber washers, springs (4), cover (5), and plug (7).

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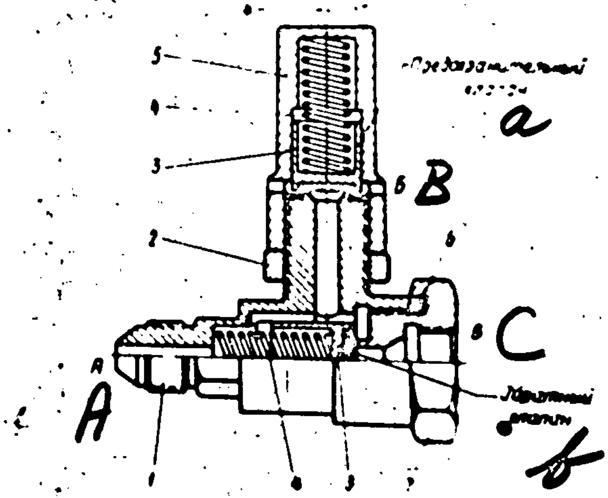

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Fig. 18. Air valve.

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 the air escapes intothe atmosphere through pipe "B."

Emergency Valve
(Fig. 19)

The emergency valve serves to pass air from the emergency hydraulic system to the canopy release cylinders and to the cylinder that closes the 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 unscrew pipe (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.

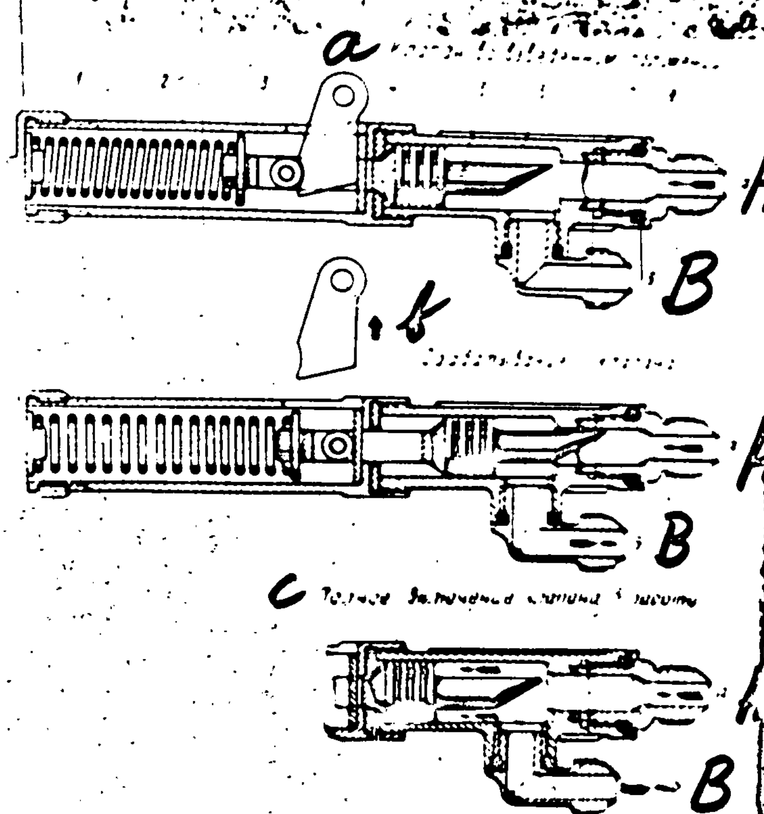

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Fig. 19. Emergency valve (membrane valve).

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)

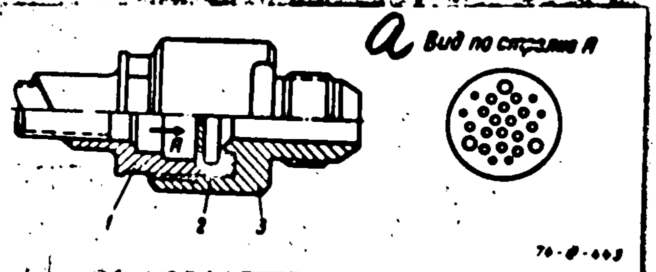
The filter serves to trap the fragments from the ruptured membrane of the emergency valve; it consists of body (1), ~~grid~~ mesh (2), and cover (3).

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 pressurised, only the handle moves in the first 15°. Then the handle begins to turn the pressurisation 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


a
Вид по стрелке А
1
2
3

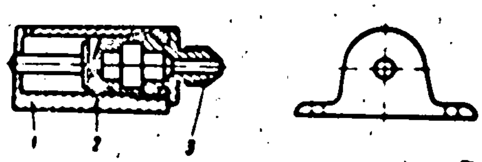


Fig. 20. Filter. 1. body; 2. mesh; 3. cover. a) view at A

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

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

[redacted]

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 ~~xxxxx~~ 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 pressurisation 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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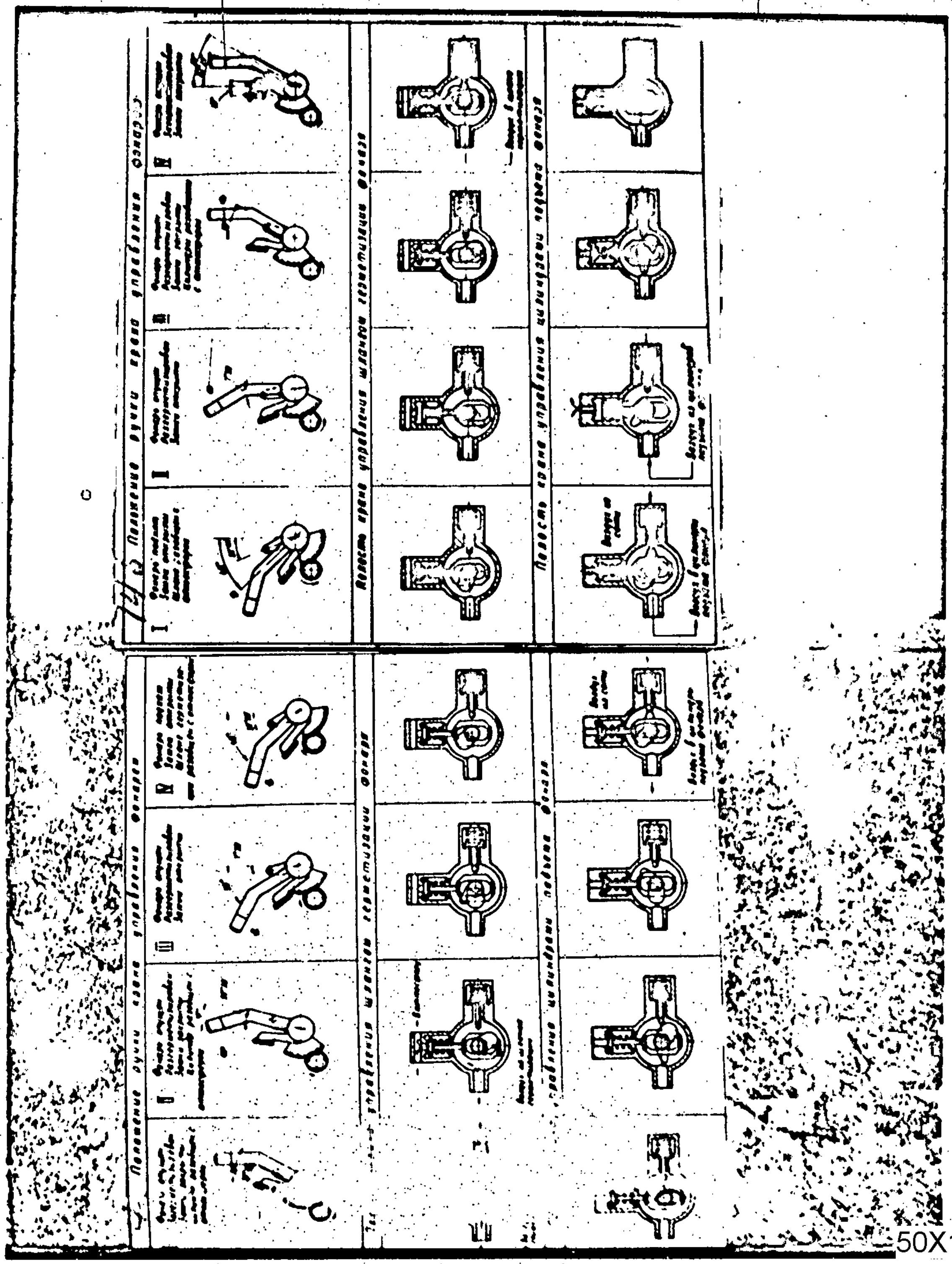

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74a

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

74a

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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 ~~and~~ 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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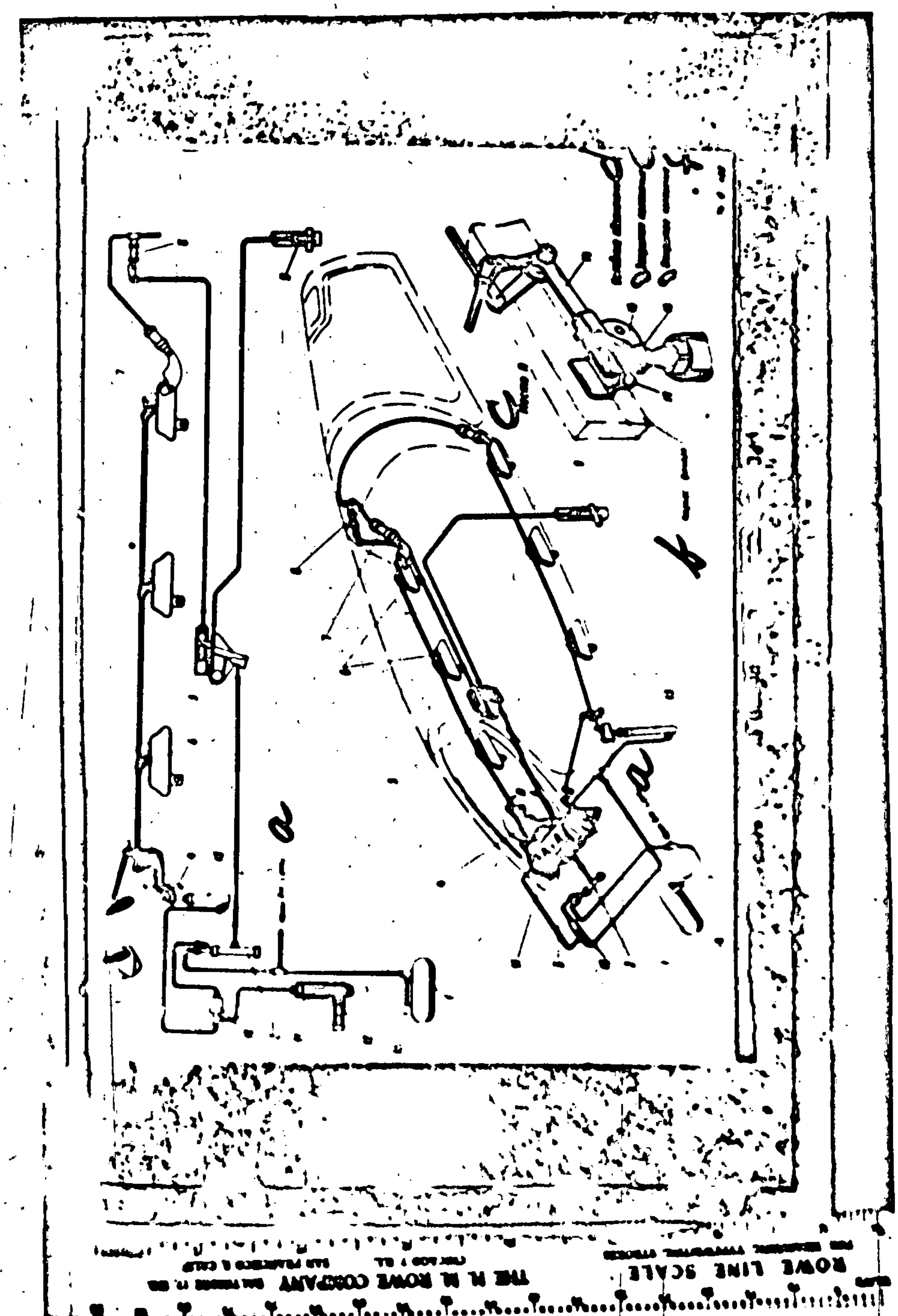

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Fig. 23. Emergency canopy ejection system.

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

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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.

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 pyrotechnic system for opening the emergency 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 x 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.

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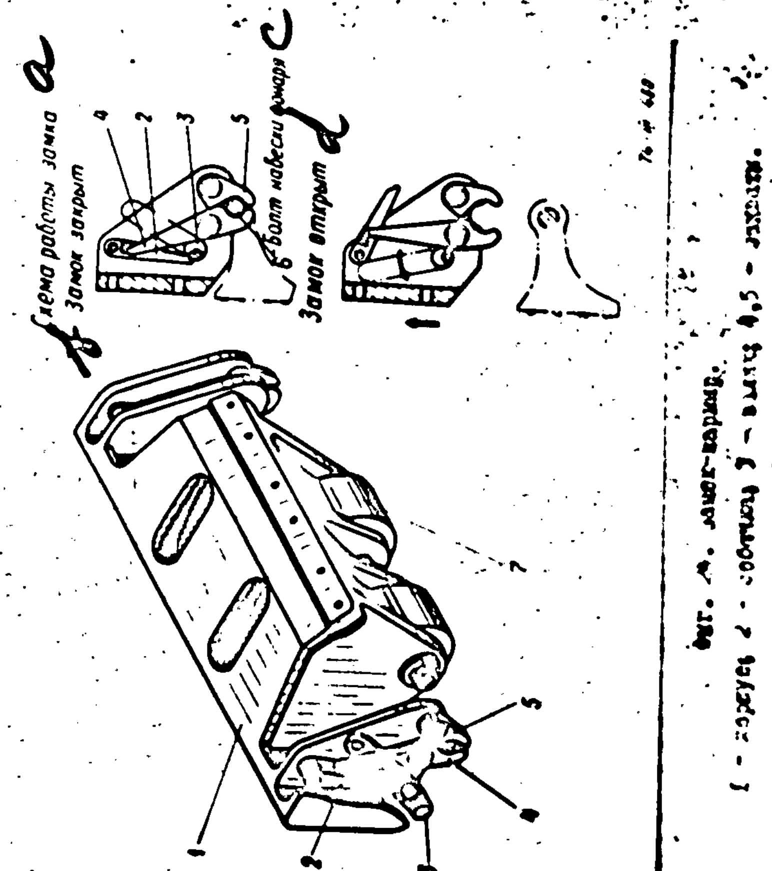

Фиг. 24. Замок-карман.
1 - корпус 2 - собачка 3 - валик 4,5 - захваты.

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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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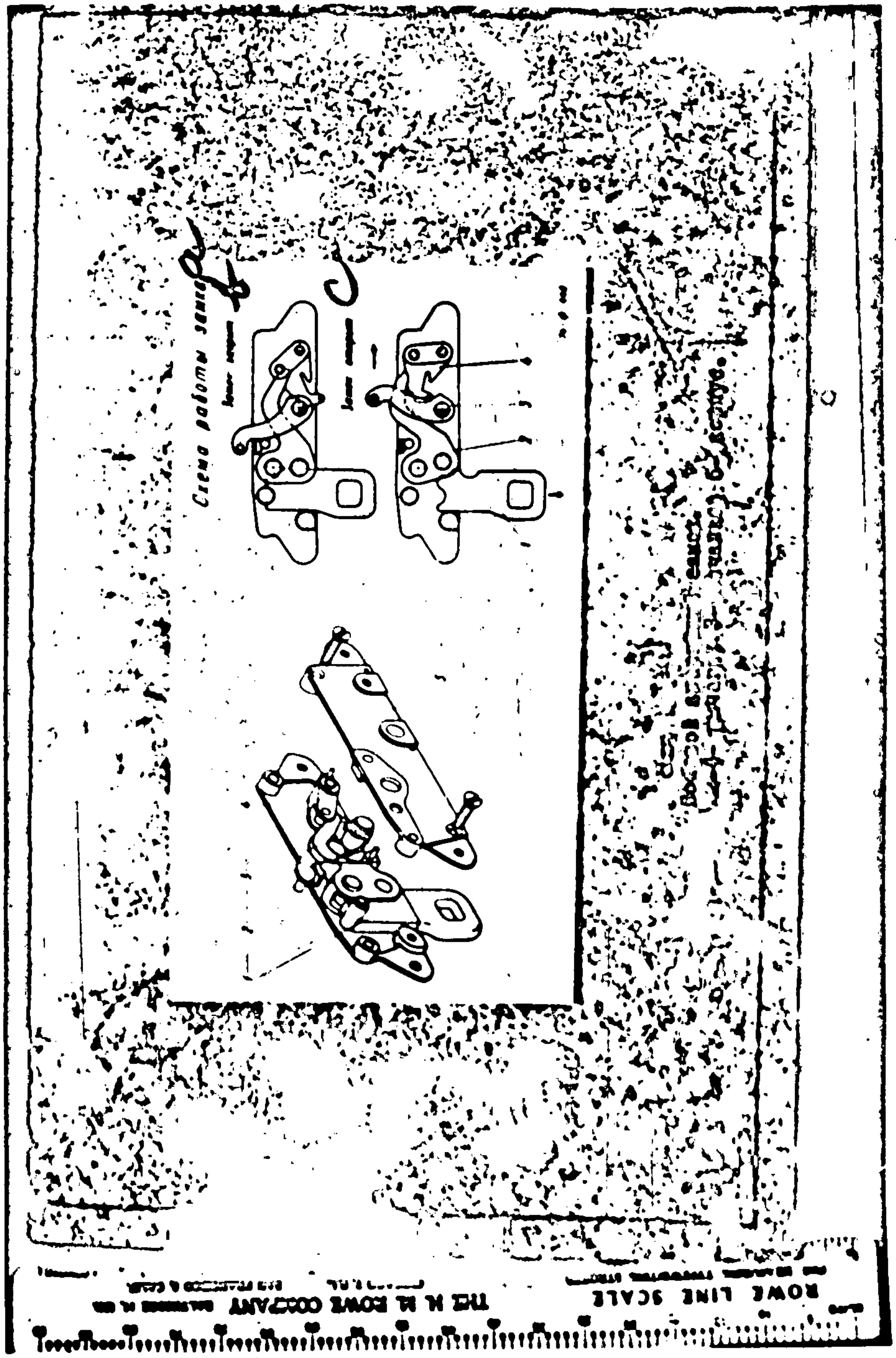

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Fig. 25. Side emergency lock. 1. loop; 2, 4. levers; 3. actuating arm; 5. housing.

a. Diagram of lock operation.

b. lock closed.

c. lock open.

[redacted]

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

The lift cylinder rod is attached to the canopy framework by means of bracket (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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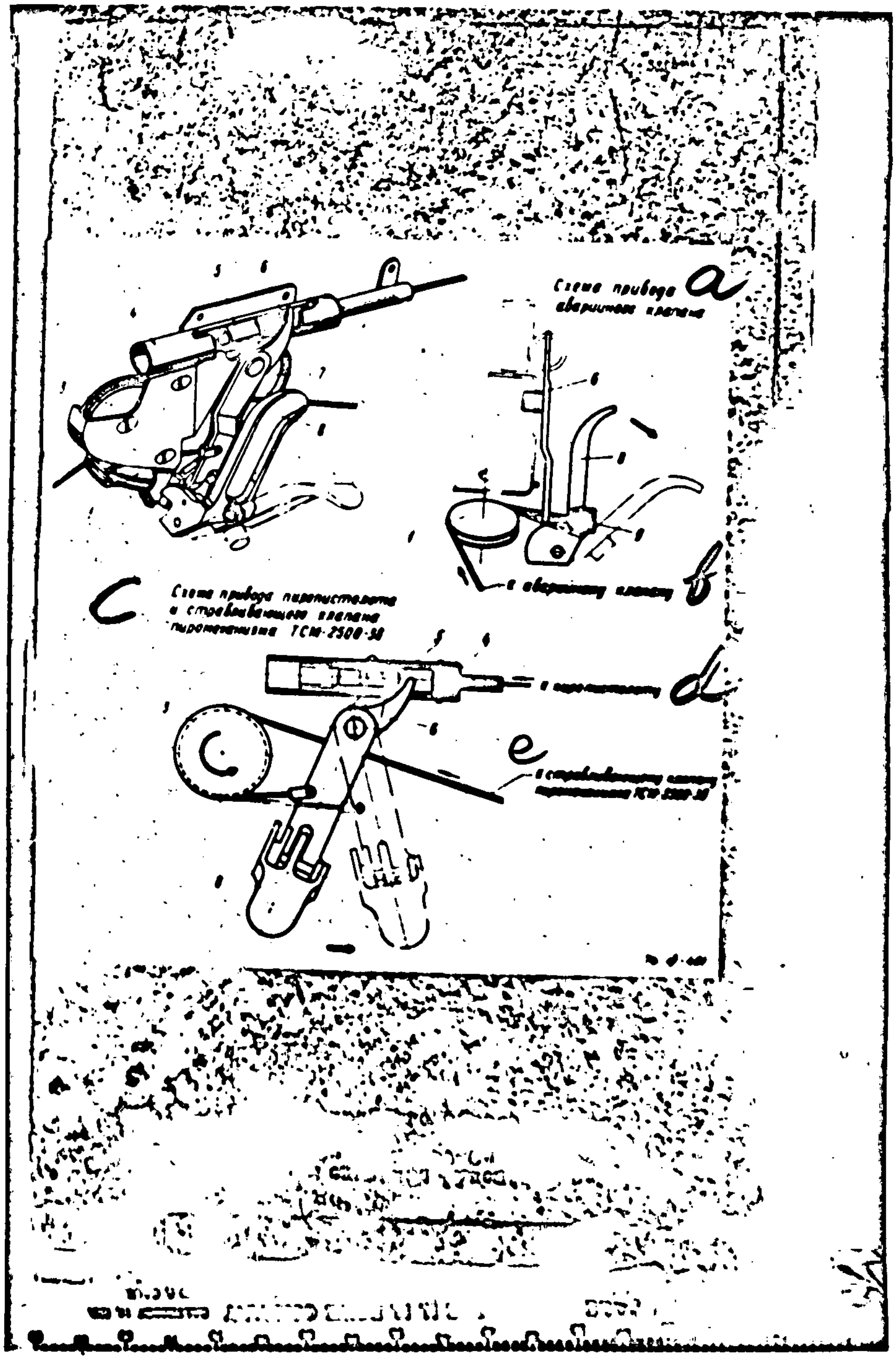

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Fig. 26. Emergency Canopy Release Handle. 1, 3. rollers; 2. cover; 4. pyropistol drive mechanism; 5. plunger; 6. lever; 7. bracket; 8. hinged handle; 9. bushing. a. diagram of emergency valve gear; b. to emergency valve; c. diagram of the pyrotechnic pistol ~~xxxx~~ 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.

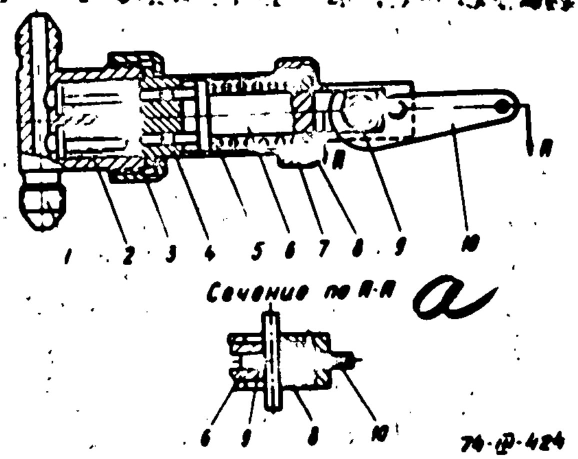
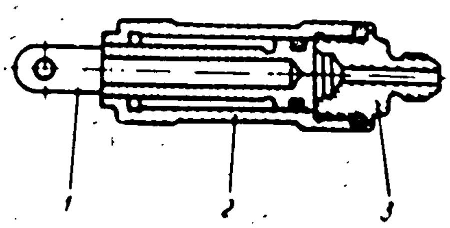


Рис. 27. Пиропатроны.
1-корпус; 2- пиропатрон ПП-1 "Рокет"; [illegible]
[illegible]
5-боек; [illegible] -стойка; 9-ролик;
10-спусковой рычаг.



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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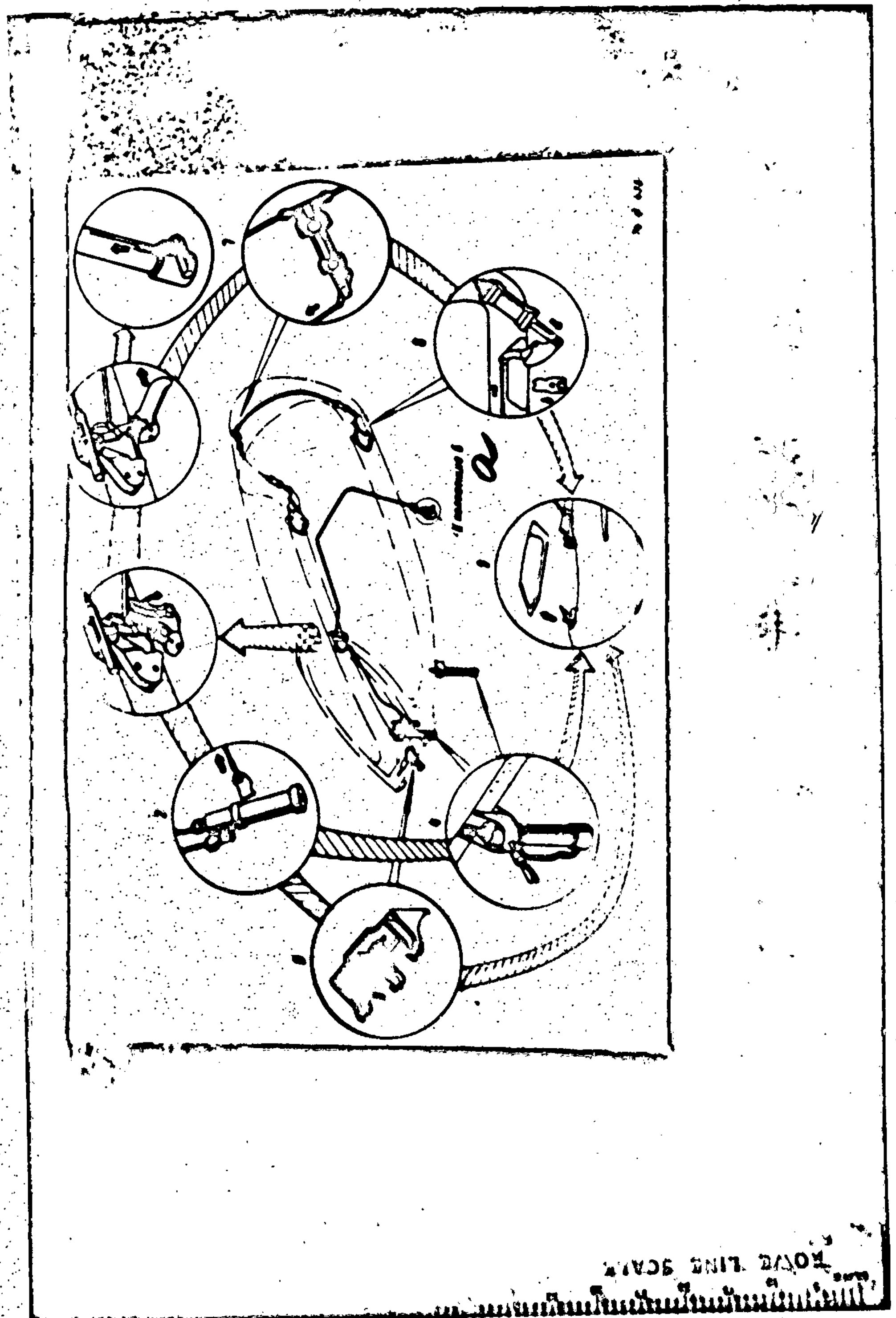

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Fig. 29. Emergency canopy release process. a. to position 6.

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5. System of Canopy Retention by the Seat (Fig. 30)

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); ~~thereby~~ 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).

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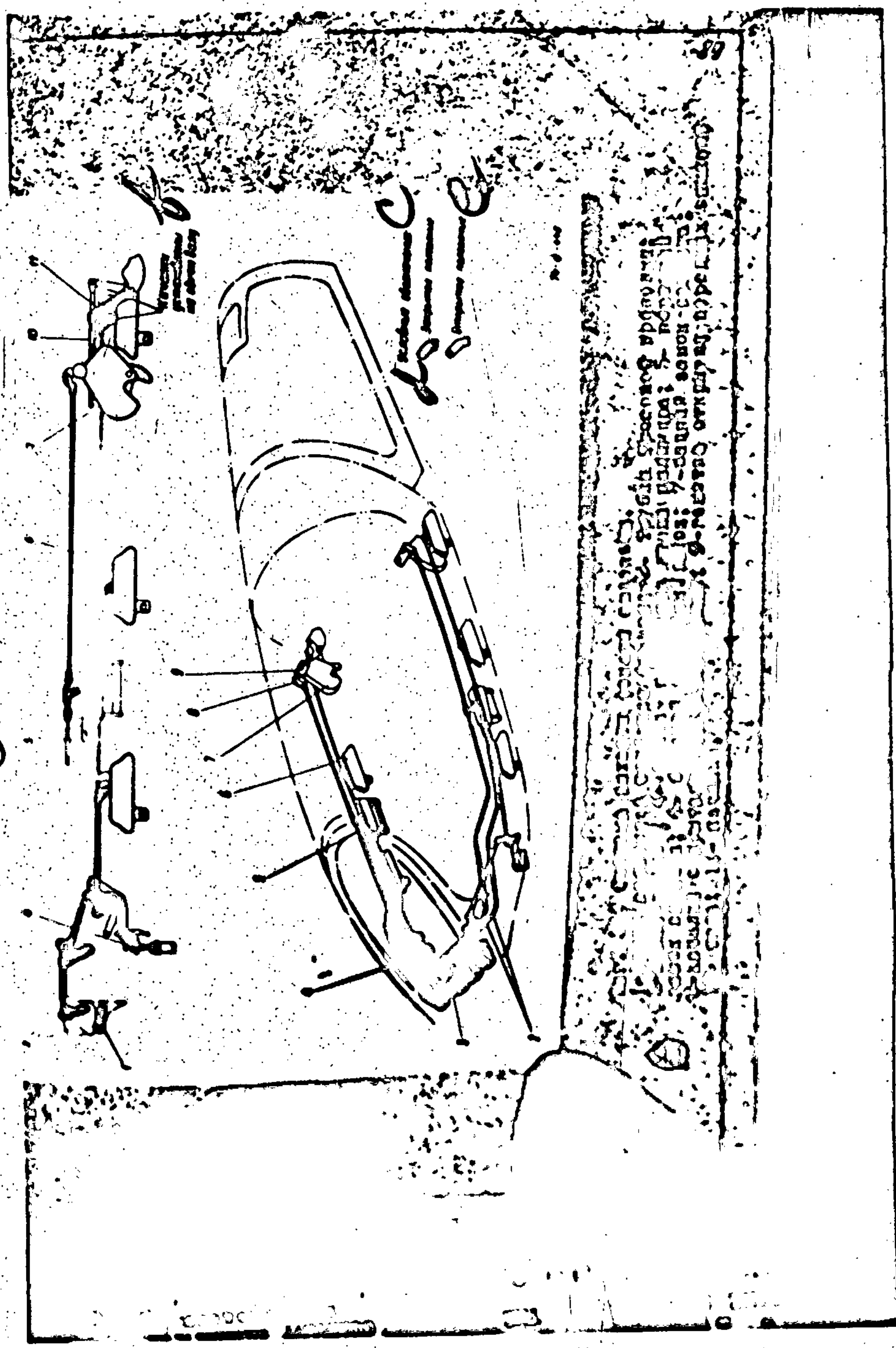

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Fig. 30. System for Canopy Retention by the Seat.

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; x0x 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; 2 e. open position.

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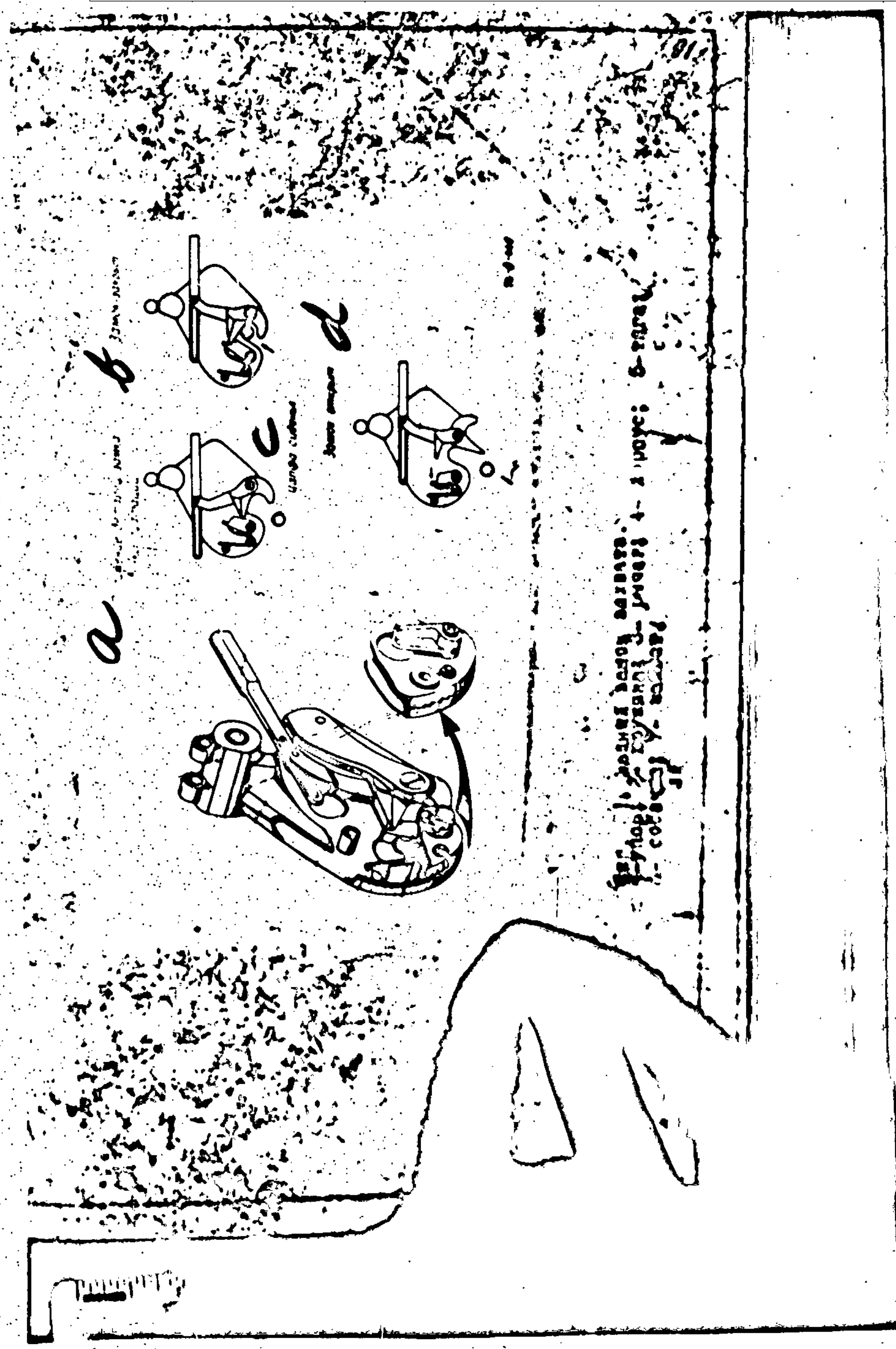

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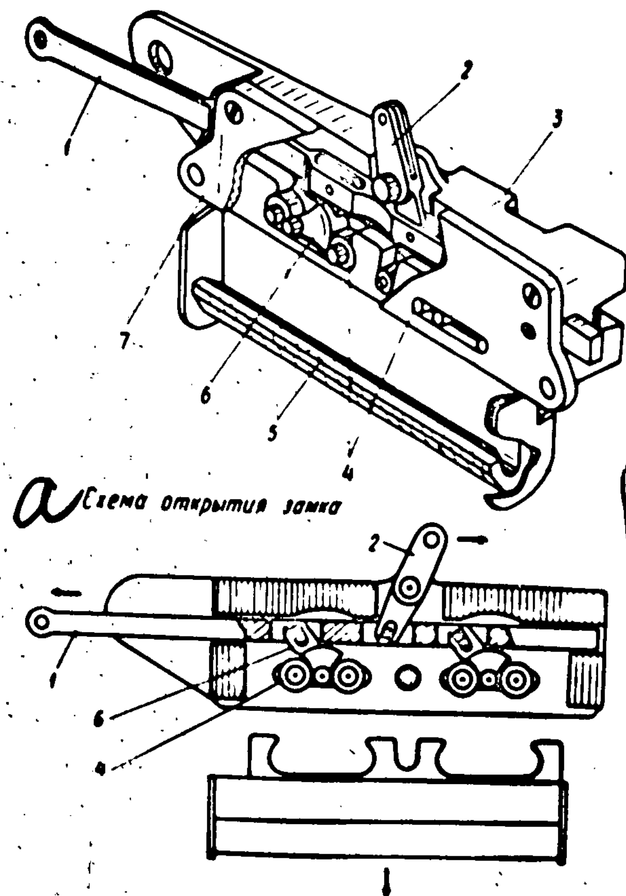
Fig. 31. Rear retention lock. 1. stop; 2. spring; 3. lever; 4. housing; 5. connecting rod; 6. arresting device; 7. retainer.

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



Фиг. 53. [illegible]

1 - тяга; 2 - [illegible]; 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.

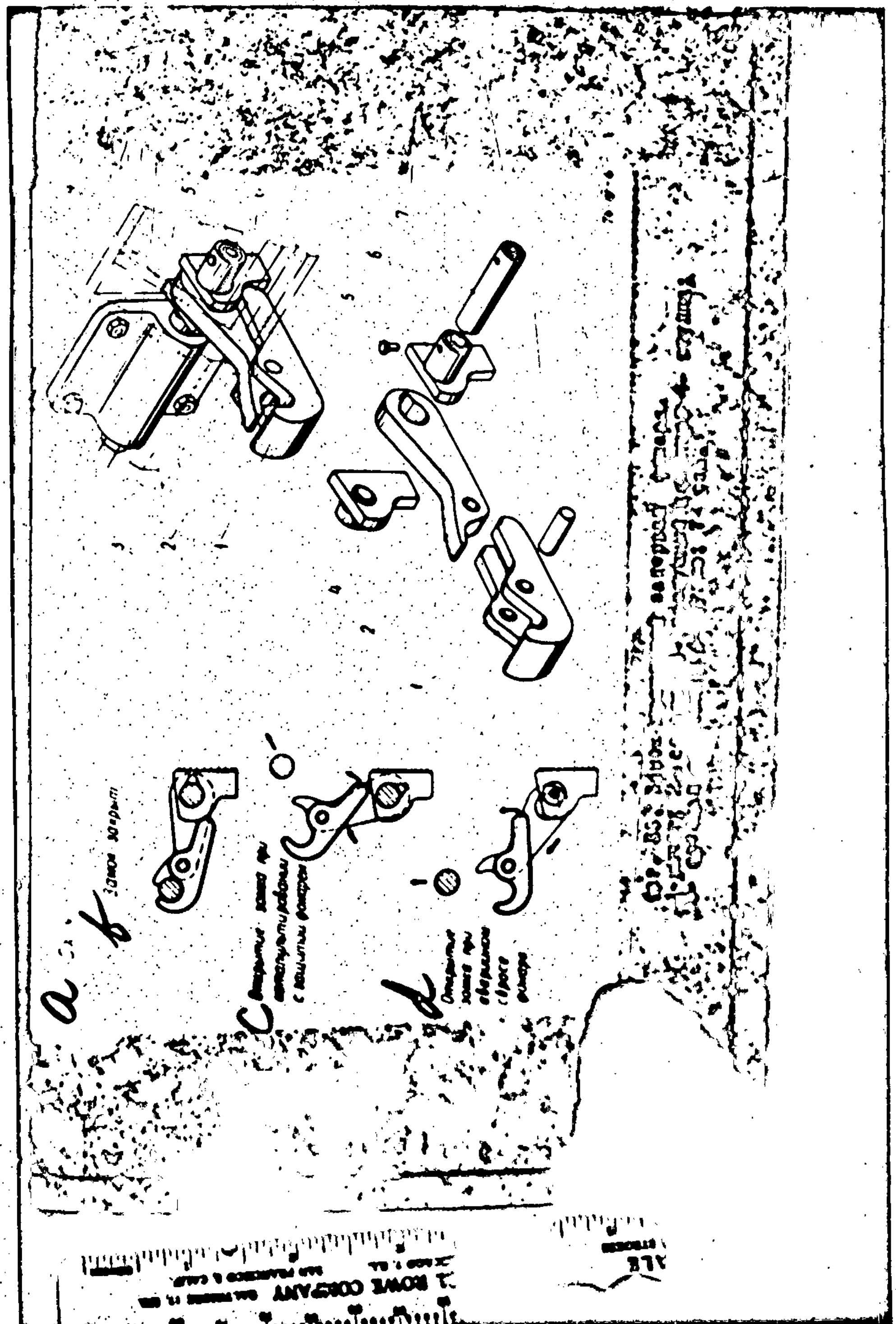


Fig. 33. Canopy time-delay lock. 1. lever; 2. connecting link; 3. air cylinder; 4. bushing; 5. shear rivet; 6. ~~bearing~~ bushing; 7. axle.

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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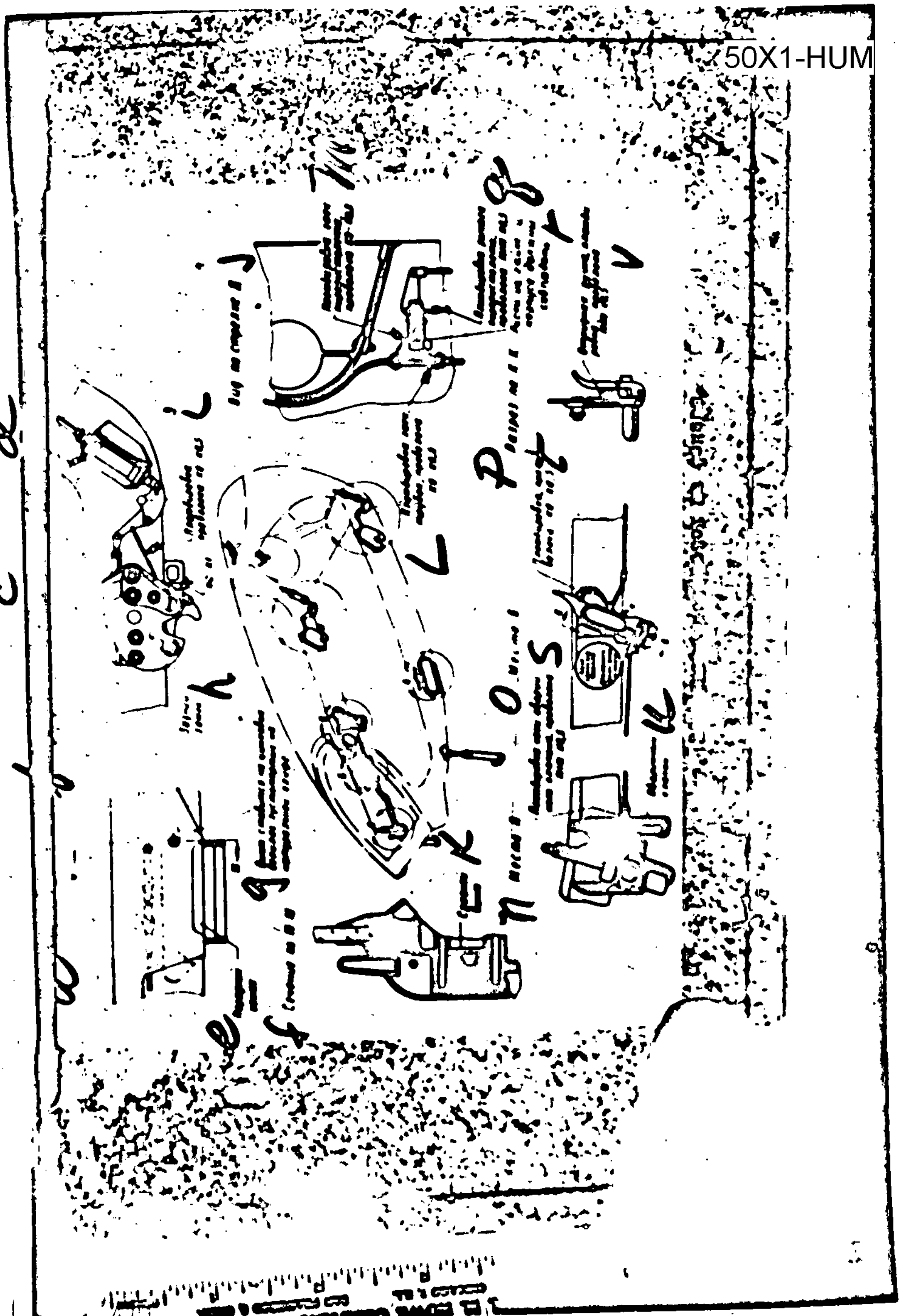

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Fig. 34. Diagram of locking pieces on thecanopy.

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 tie 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.

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 ~~x~~ 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 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 ~~xxx~~ 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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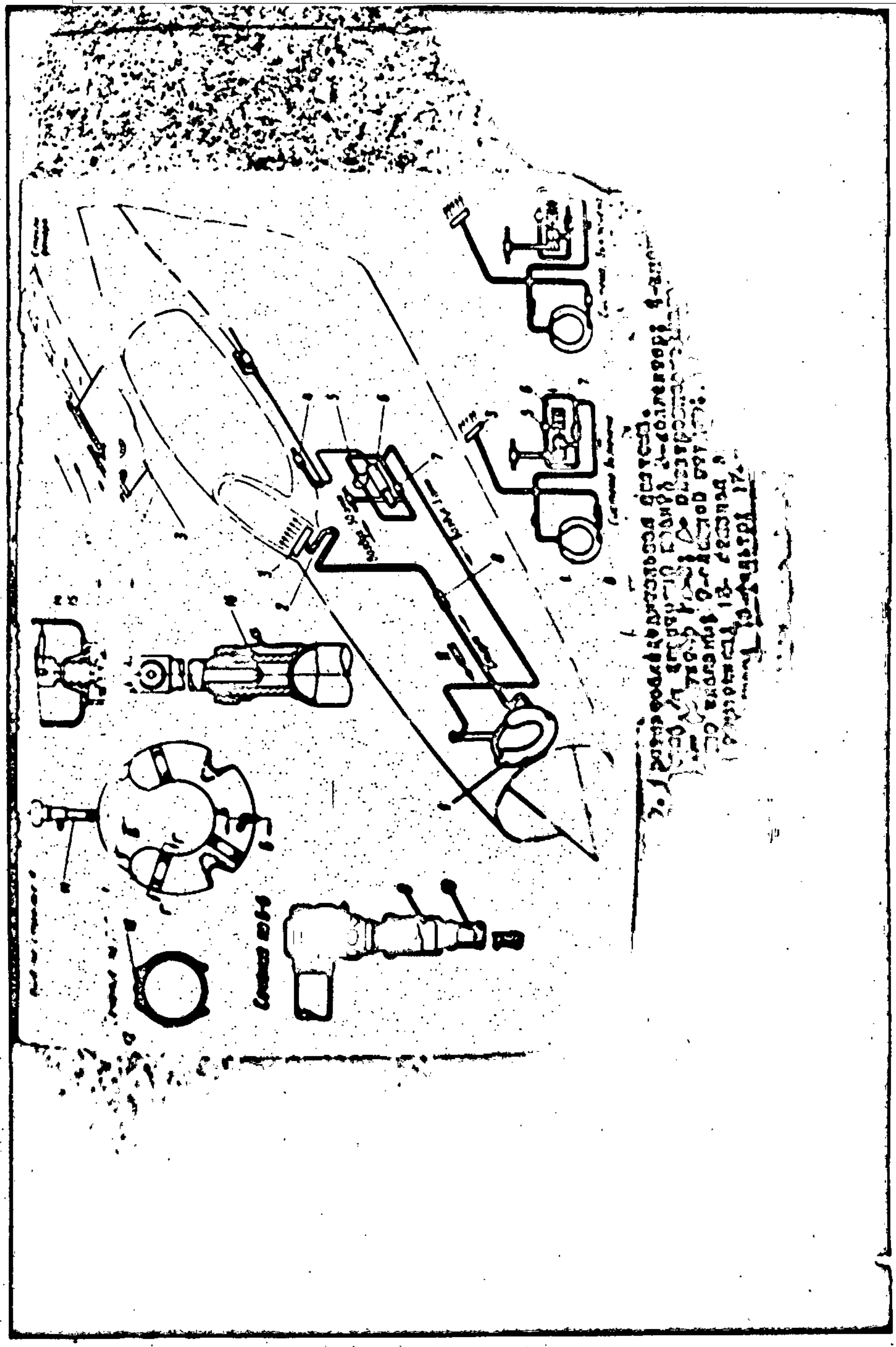

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Fig. 35. De-icing system.

1. small alcohol tank; 2. _____ hose; 3. collector; 4. button; 5. reducer RV-3;

6. xabxx 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]

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B. ~~EX~~ 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 ~~mx~~ 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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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 ~~xxxxxxx~~ 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 onthem:

--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;

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

--emergency pyromechanism firing device~~x~~ 215F [?] and ~~xxxx~~ 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 ~~xxx~~ rollers ride on ~~xxxxx~~ 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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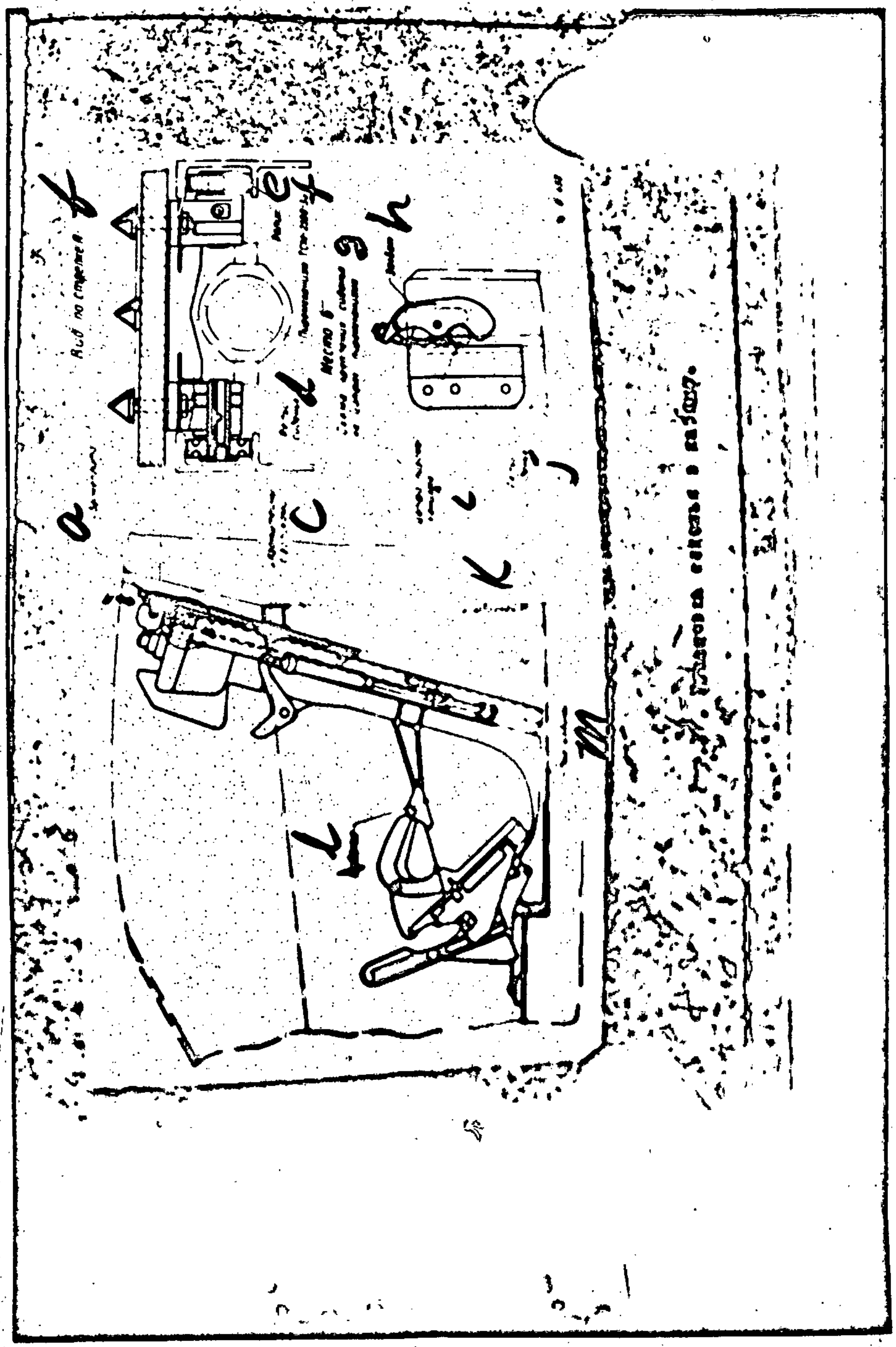

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Fig. 37. Placement of seat in cockpit.

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

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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.

Basis 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]
--~~gamma~~ 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 [?]

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[redacted]

--useable pyrotechnic cartridges:

for TSM-2500-38 pyromechanism PK7-7M

for 215P pyromechanism 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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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

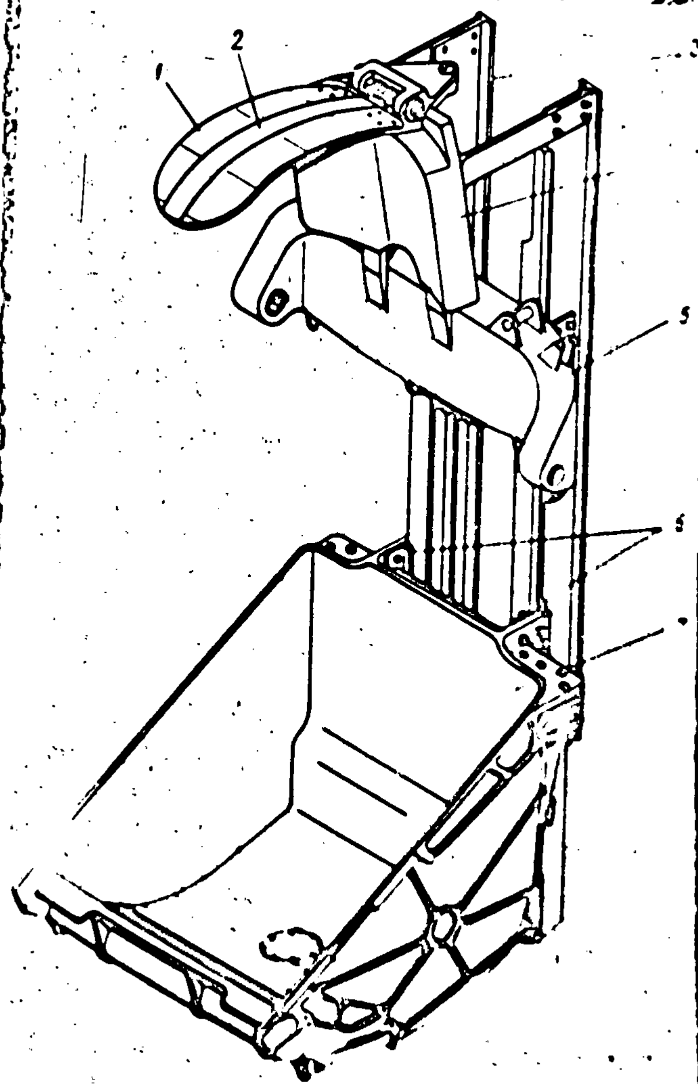
1
2
5
5

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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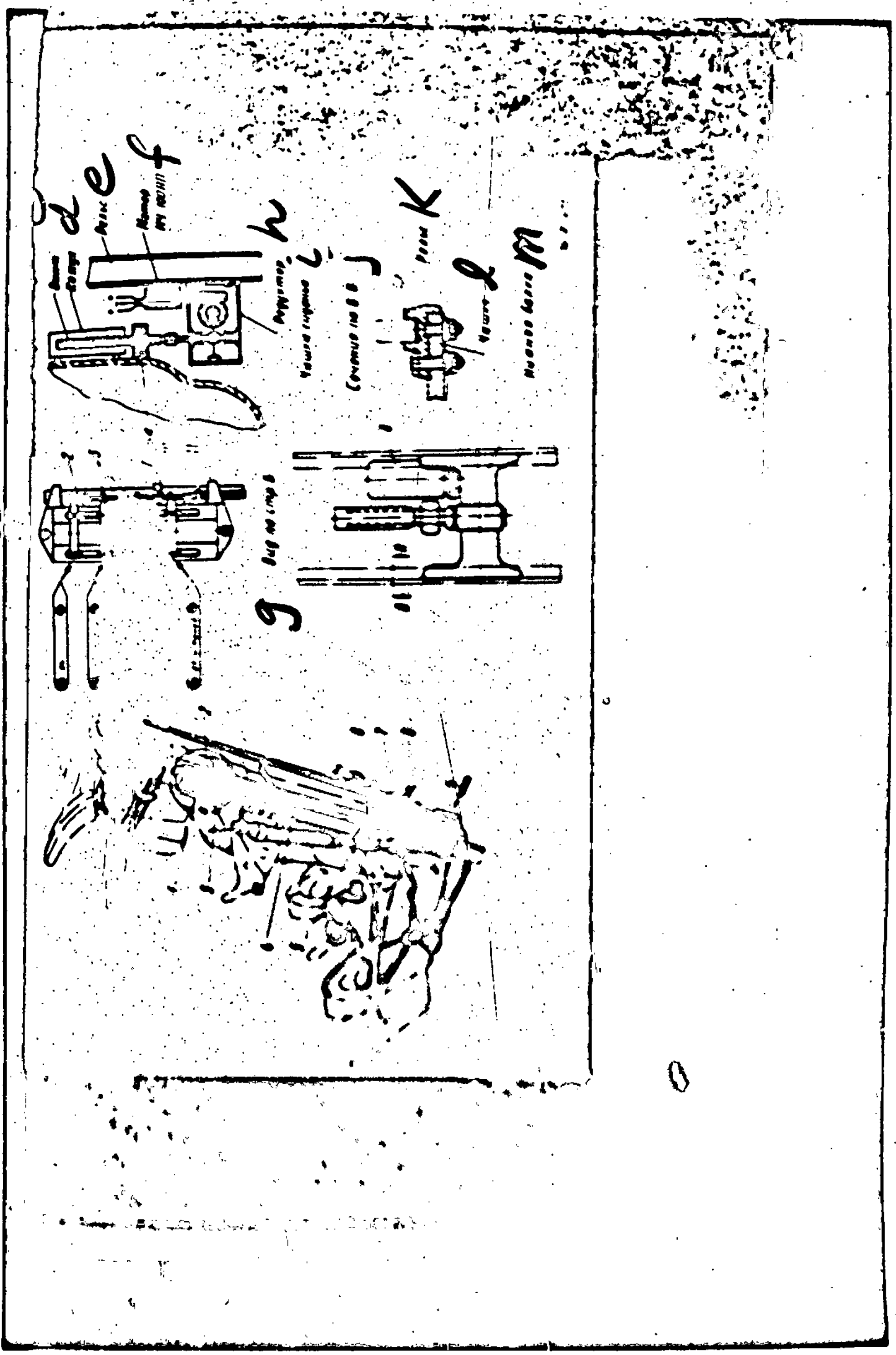

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Fig. 40. (caption illegible)

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

[redacted]

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

Thebucket 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]

[redacted]

When adjusting the seat for theheight of the p'lot, the minimum possible clearance between the canopy glass and the pilot's pressurised 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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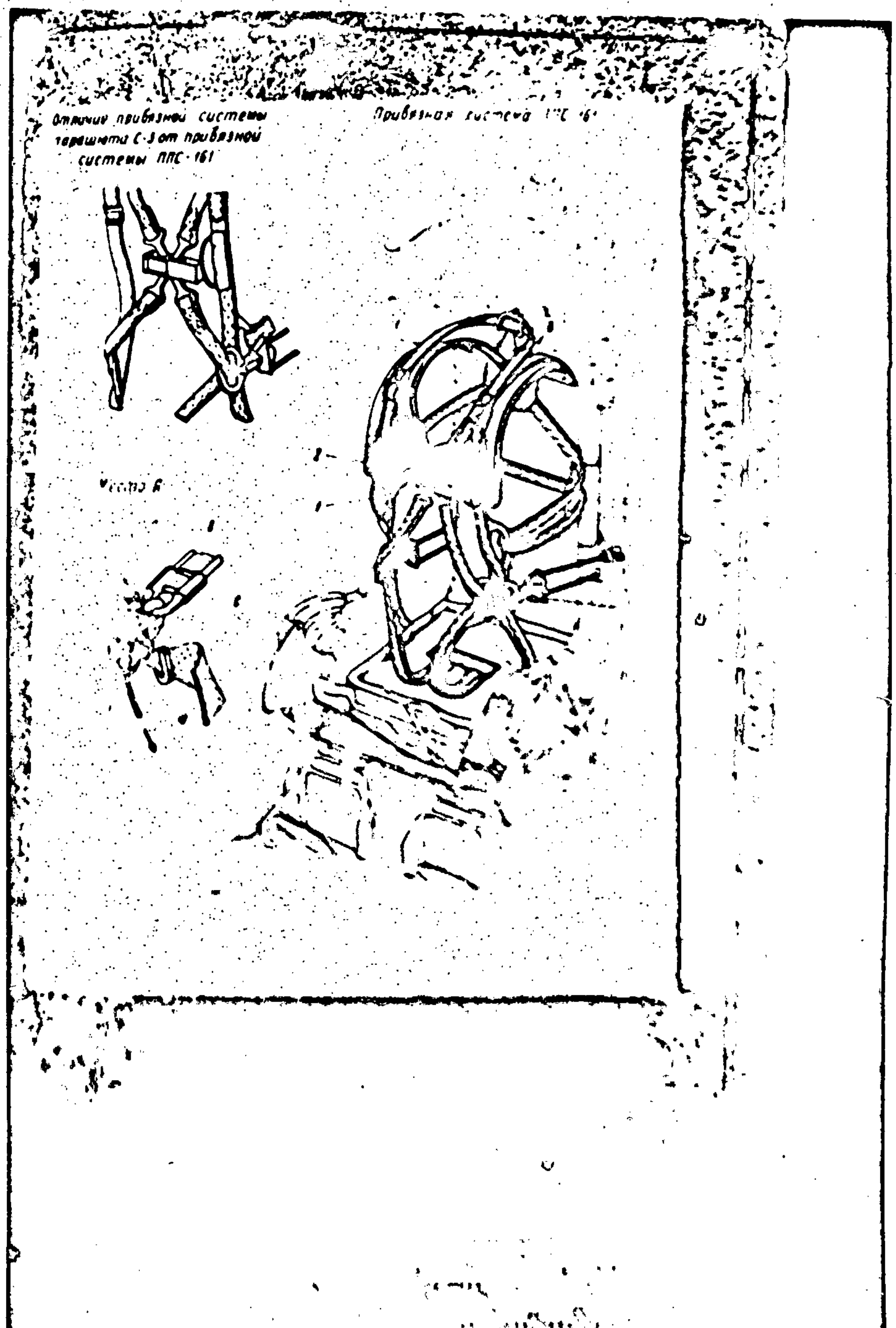

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Fig. 41

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

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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 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/.

(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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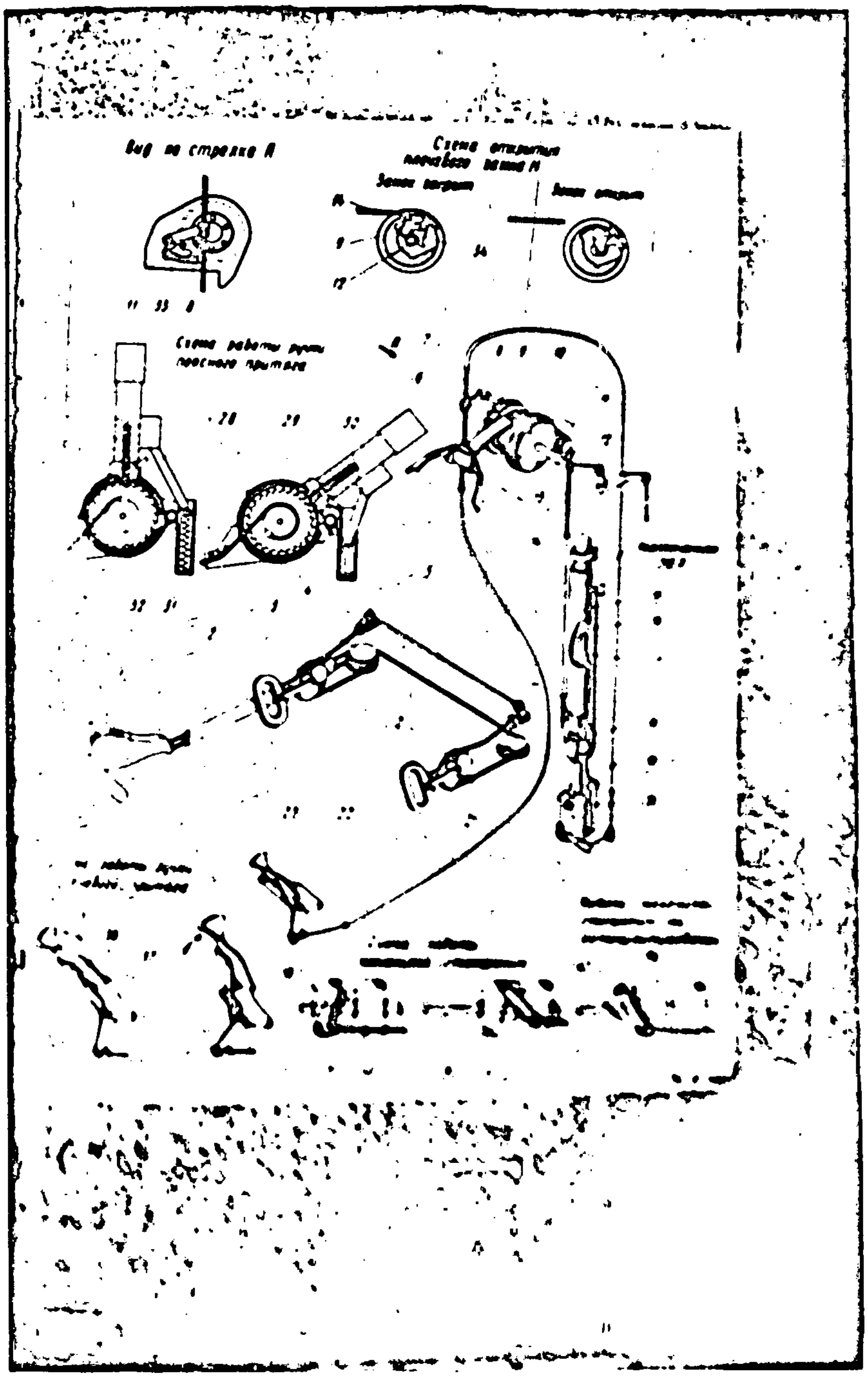

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View along arrow A

Method of opening shoulder lock 11

Lock closed | Lock open

Method of operating the handle of the waist attachment

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Method of operating the handle of the shoulder attachment

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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;

28 - plunger;

29 - 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

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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 - ~~xxxx~~ 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,

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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.

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 (I). 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 ~~xxxxxxx~~ safety clip (3). The fire-control line is led to the starting lever (4).

In the normal position the starting lever is ~~xxxxx~~ prevented from being accidently actuated with the aid of bolt (5), ~~xxxxx~~ the head of which enters the groove of the safety lever. When only ~~xx~~ 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 lever and [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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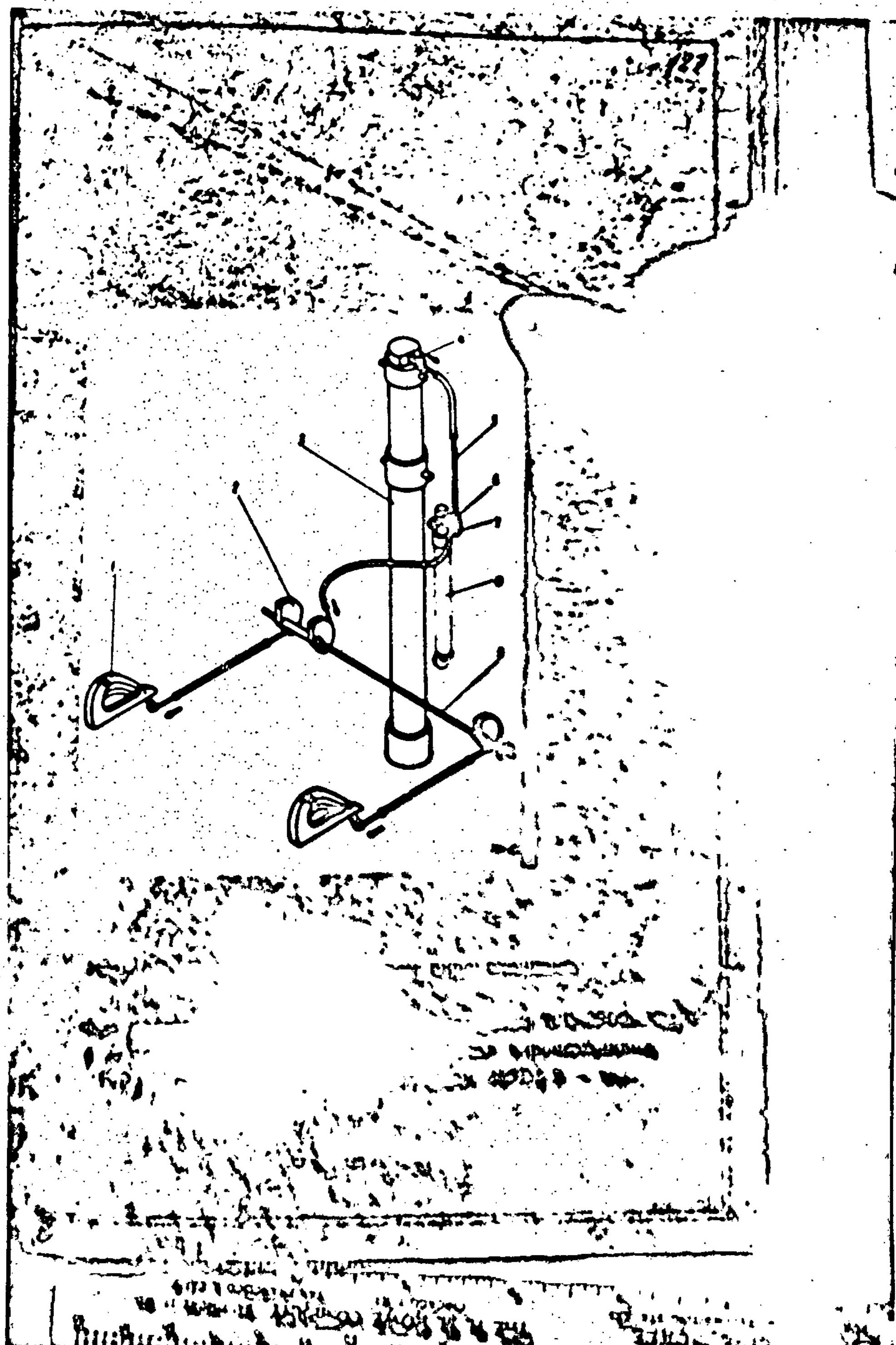

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Fig. 43. (illegible)

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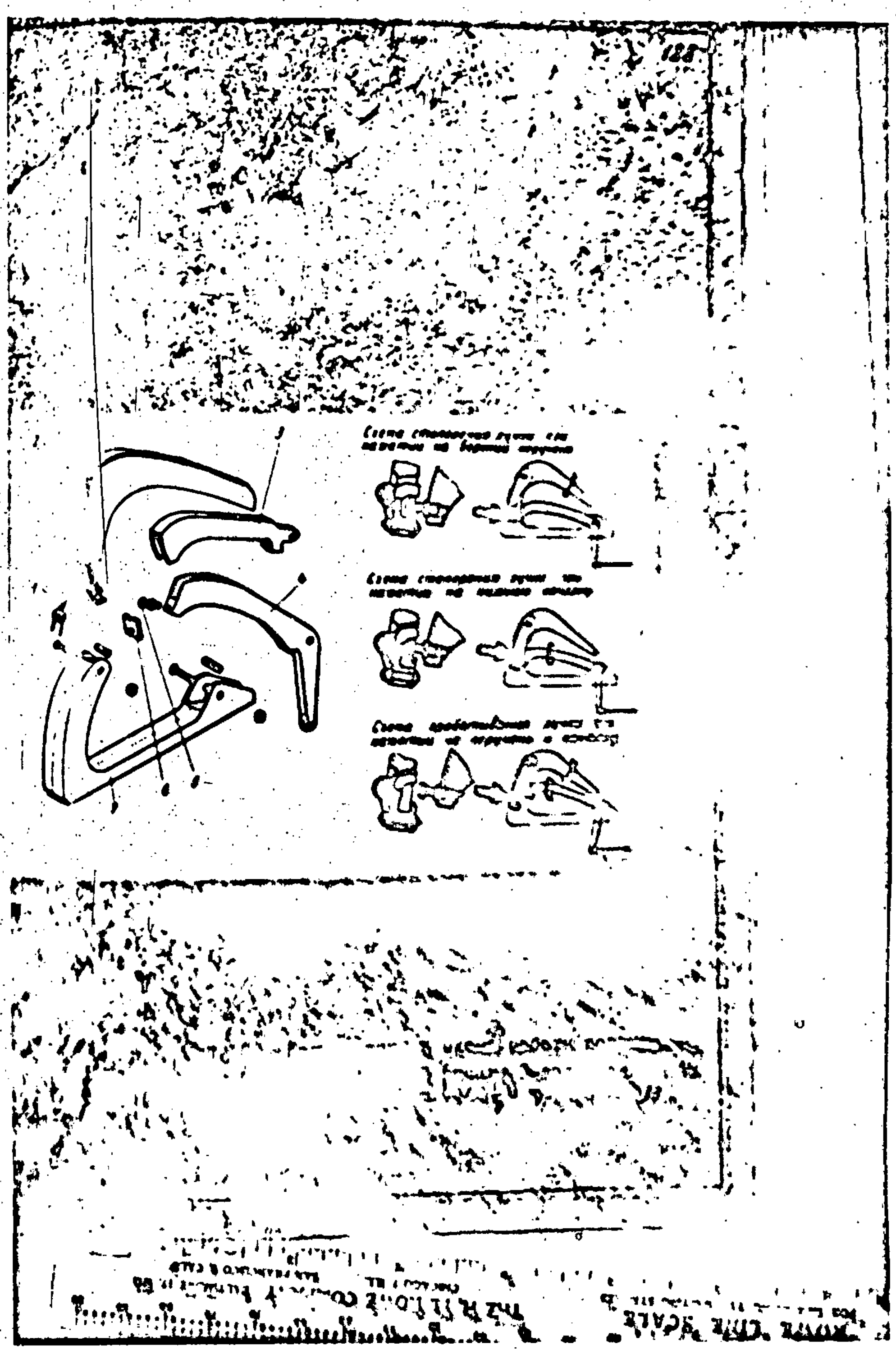

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Fig. 44.

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/

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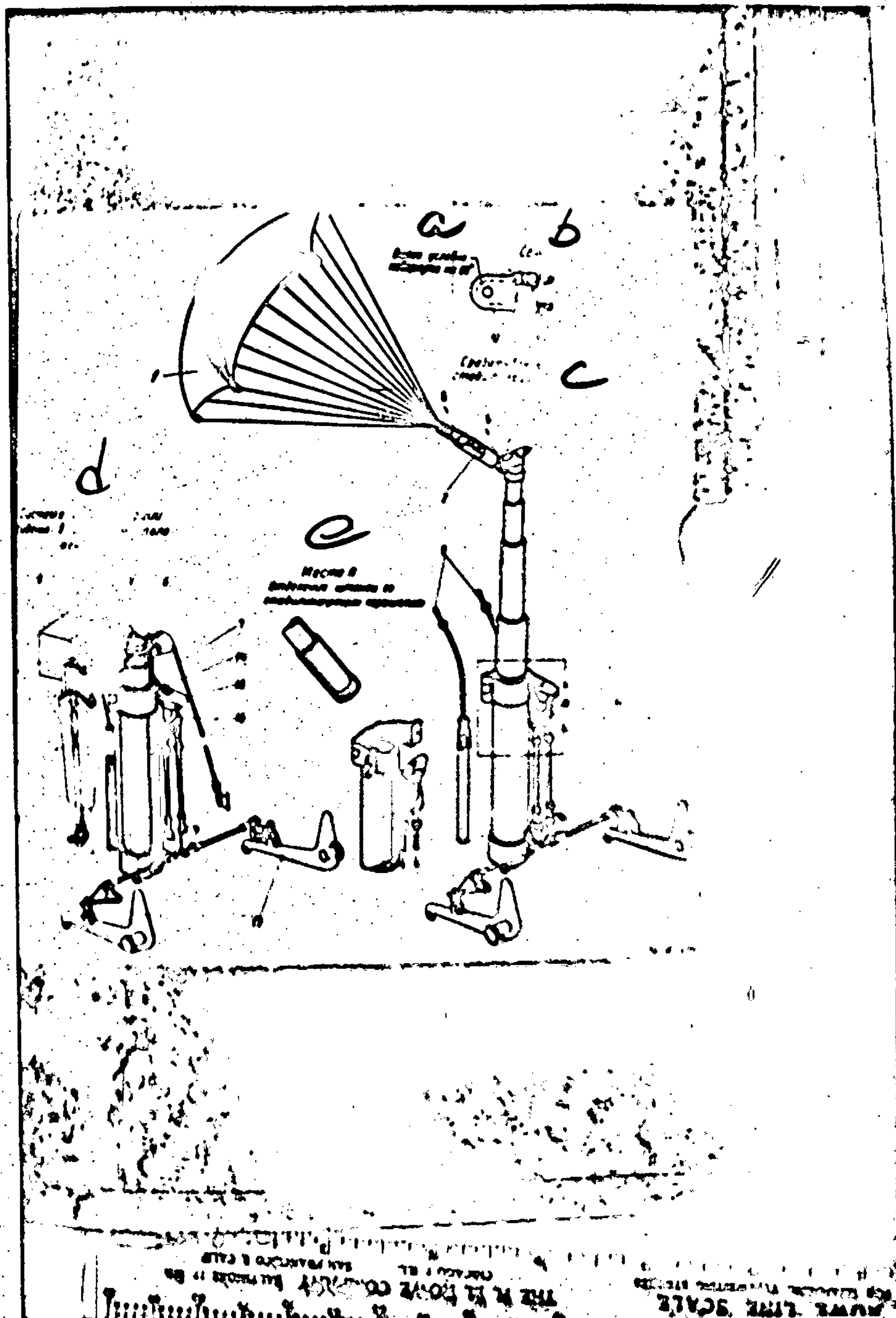

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Fig. 45. Stabilization system of seat.

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

b) Cross section

c) Stabilization triggering

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

e) Position A
Separation of bar from stabilizing parachute

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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.

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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, drawing apart, knocks off the 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.

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 tube of pyromech[illegible] is removable and is attached with the aid of collar /14/, which [illegible]

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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

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the inner tube, the piston, and the stabilizing parachute is separated from the seat.

8. Leg-clamp system /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 ~~/2/~~ /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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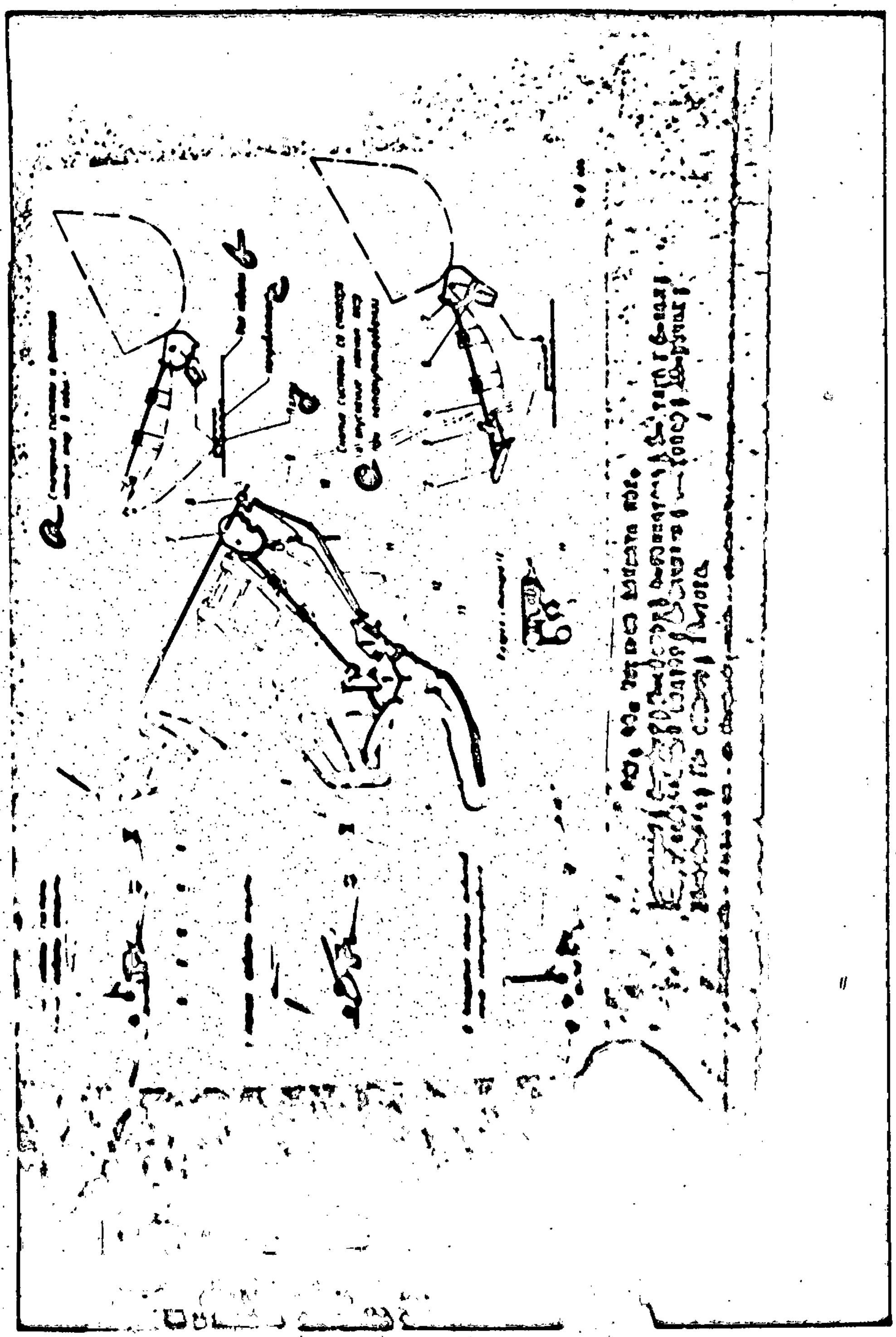

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Fig. 46. Leg-clamp system.

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 push rod ~~plunger~~ /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.

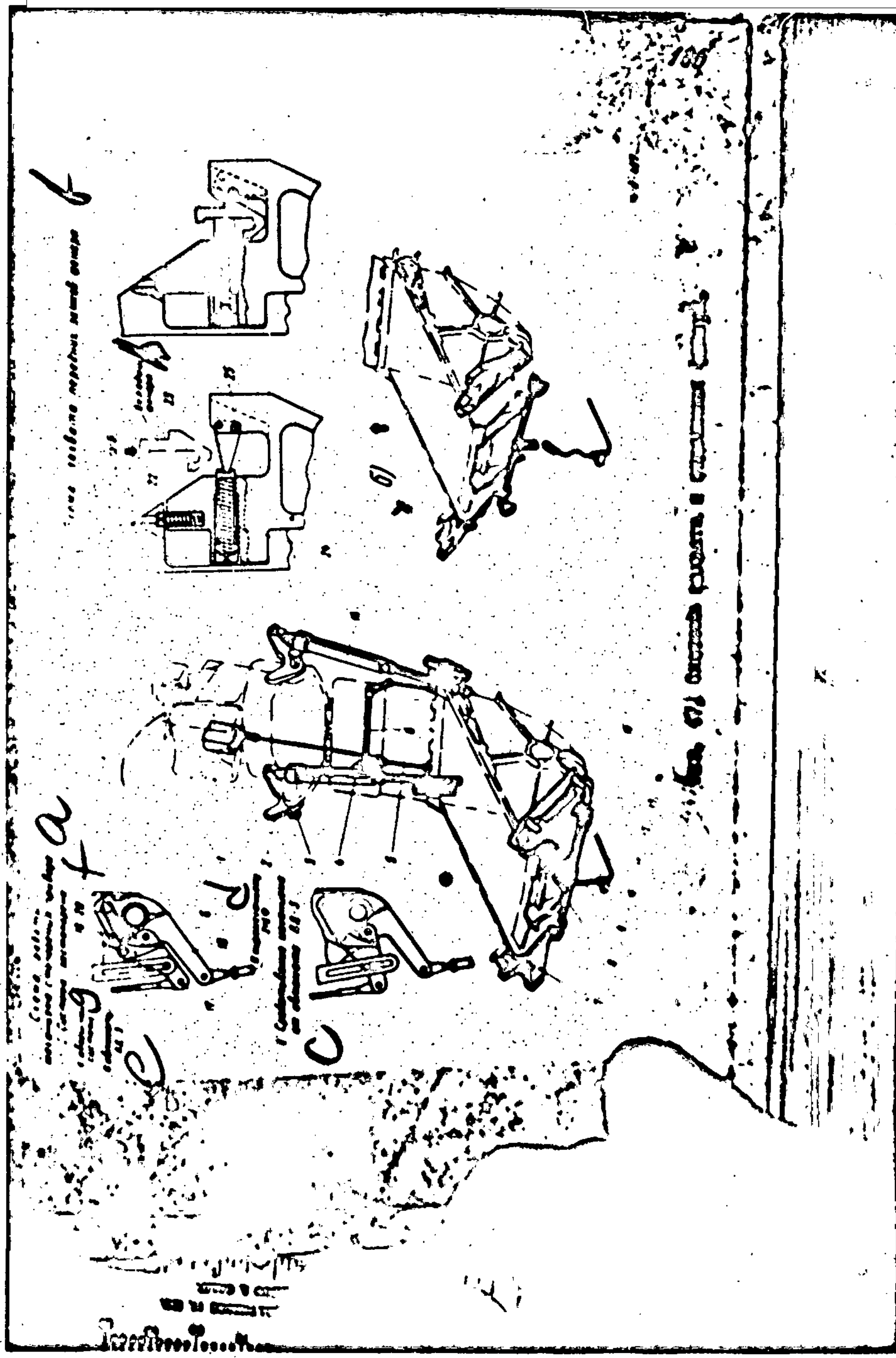
In the descended position the supports are immobilized by stop /9/. If the clamps should close accidently, they can be ~~xxxxx~~ opened by pressing catch /11/ against the pin of stop /12/.

9. System of Clamping and Seperating Canopy

/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 215P

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 ~~xxxxx~~ [bushings] of the forward clamp locks enter during clamping of the canopy.

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

During operation the supports are pressed against the seat ~~cord~~ [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 strike against the triggers ~~which open~~ controlling the opening of canopy 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 detainers of the rear canopy clamp lock and rotates it on the seat pivots. When the canopy rotates through ~ 100-120°, 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 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 (closing) socket. When automatic machine AD-3 is actuated, lever /17/ is deflected, the pin emerges from the (closing) socket, and actuating arm /18/ rotates.

[redacted]

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 pulling out locking rod /12/. 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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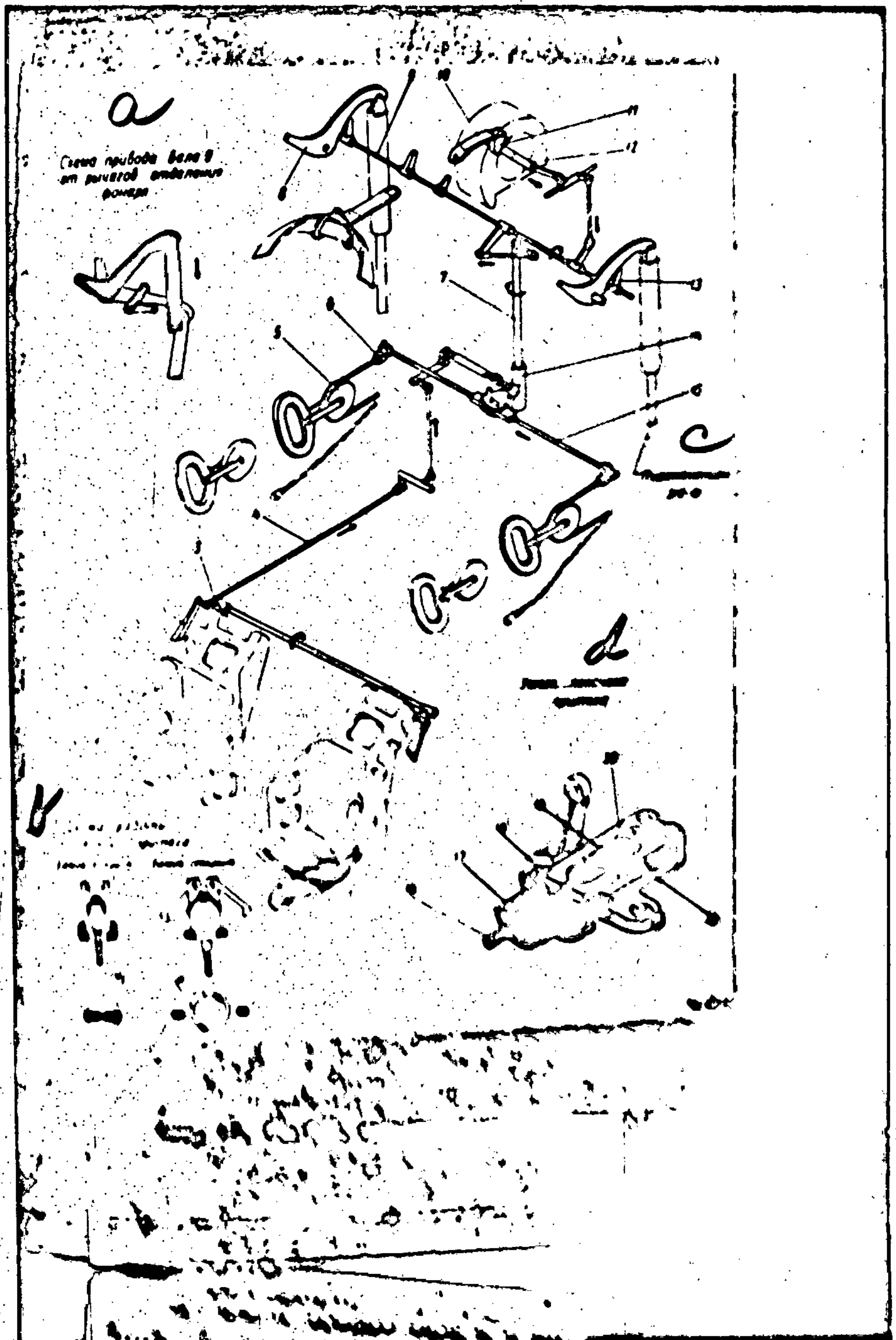

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Fig. 48. System for opening the harness locks and leg clamps.

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

(remainder illegible)

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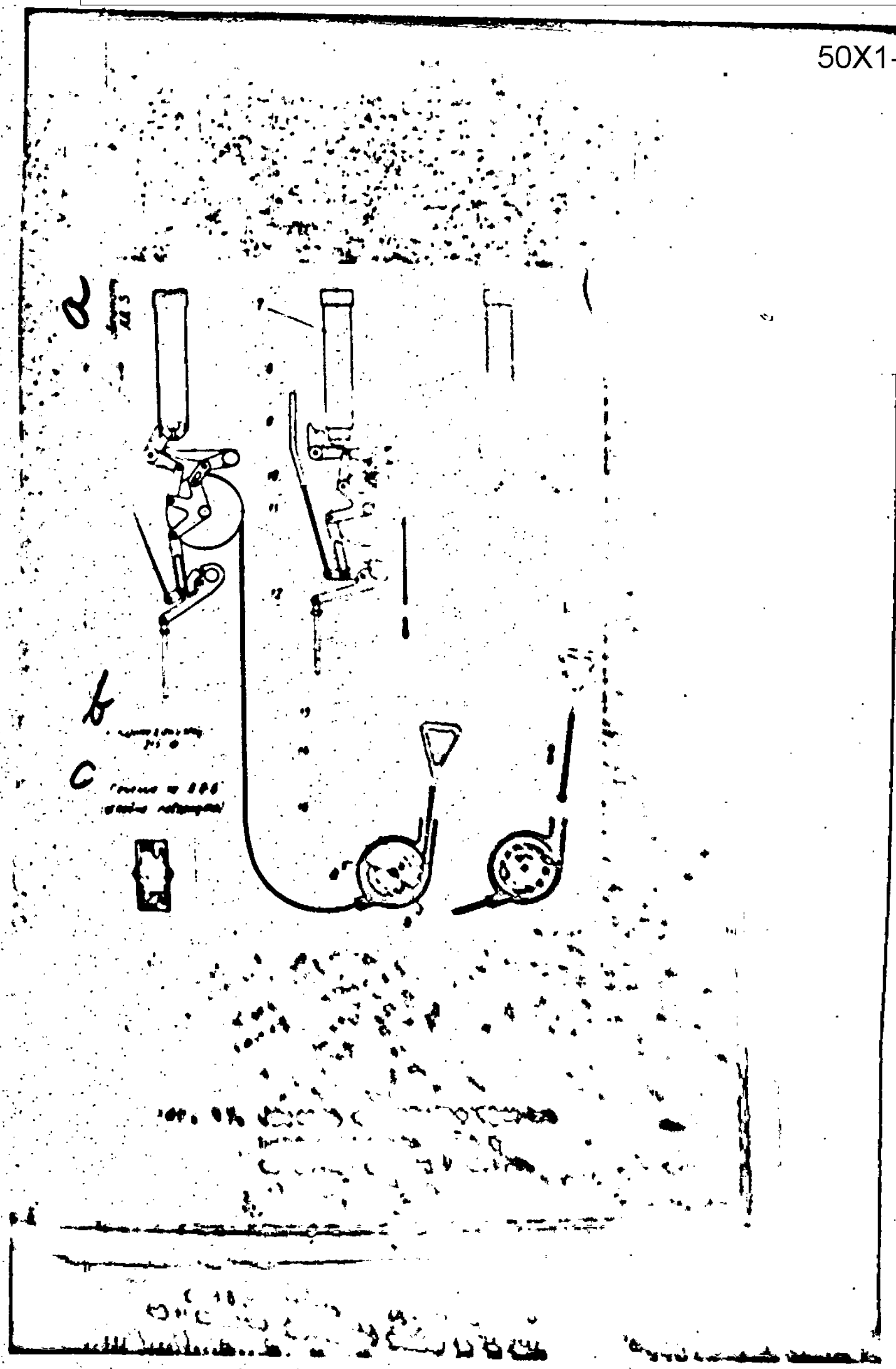

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Fig. 45. Emergency system for driving pyromechanisms 215F and opening harness locks.

a) automatic machine AD-3

b) to pyromechanism 215 F

c) cross section at A-0-5

(remainder illegible)

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Fig. 49. Emergency system for driving pyromechanisms 215P 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, 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 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)

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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 locations ~~stopping pieces~~ are given in accordance with the stop marking.

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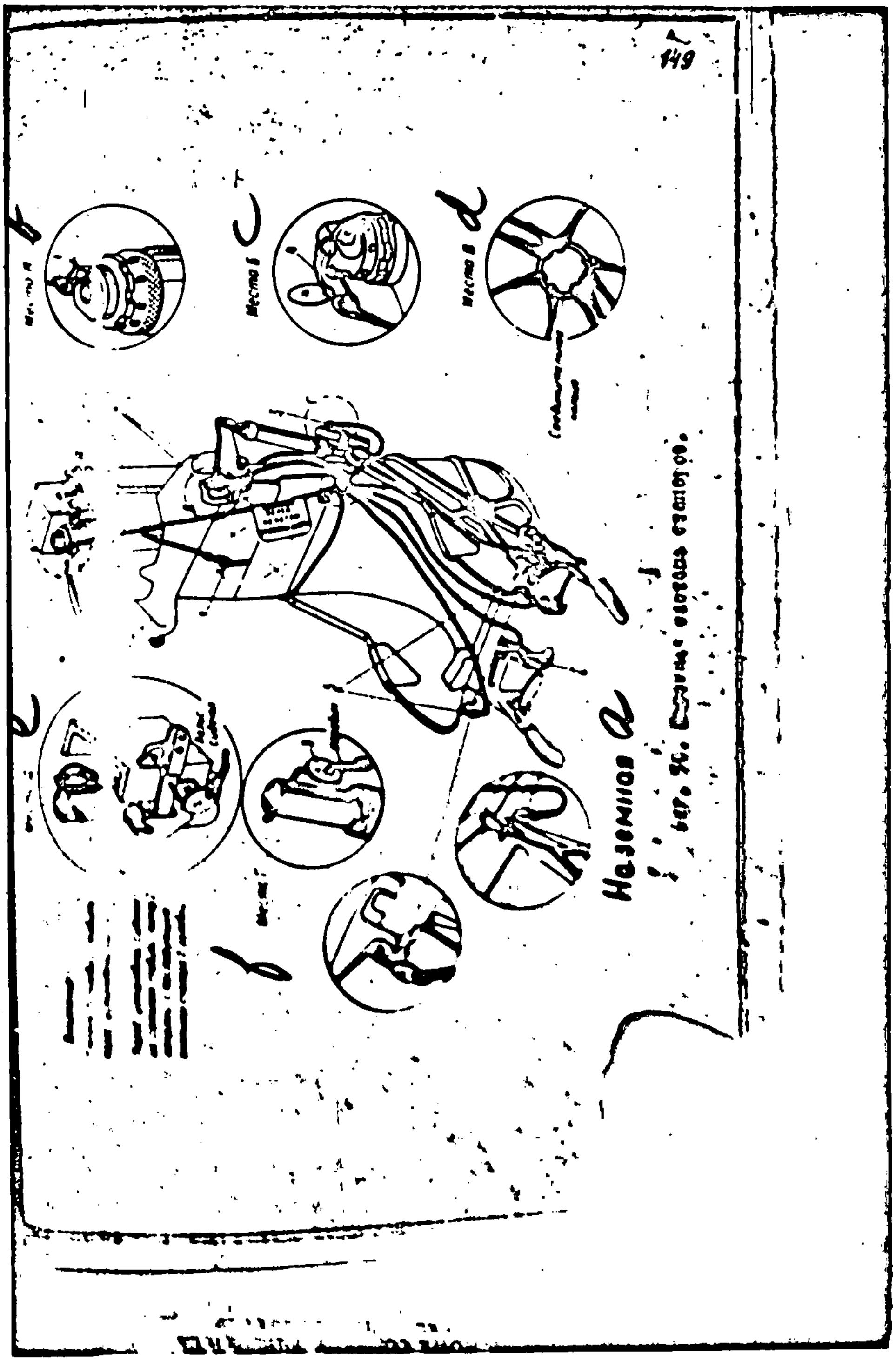

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Fig. 50. Ground system of stops

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

f) location E

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50X1-HUM

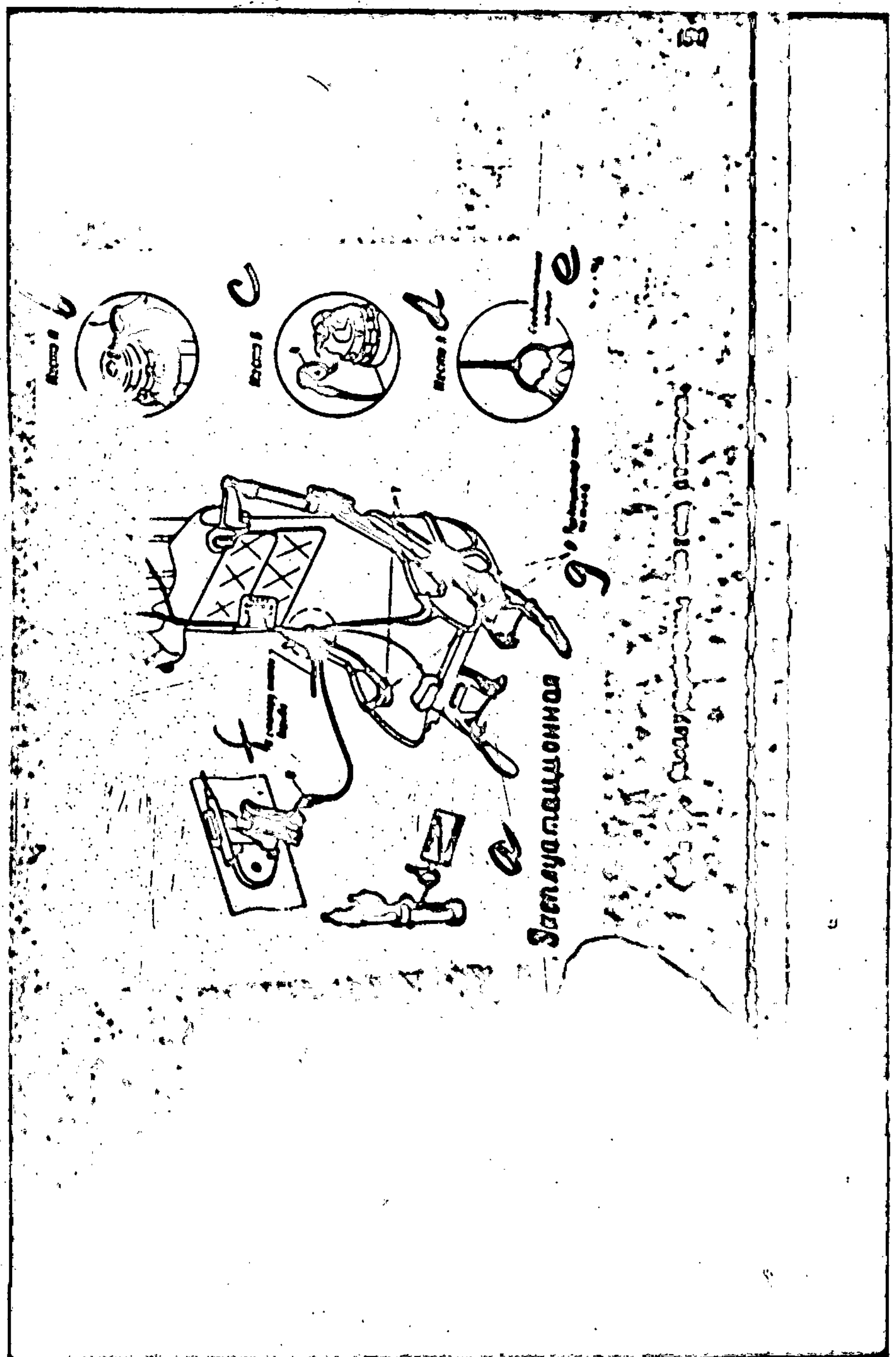

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Fig. 51. Operational stop system.

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

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

g) safety housings

[redacted]

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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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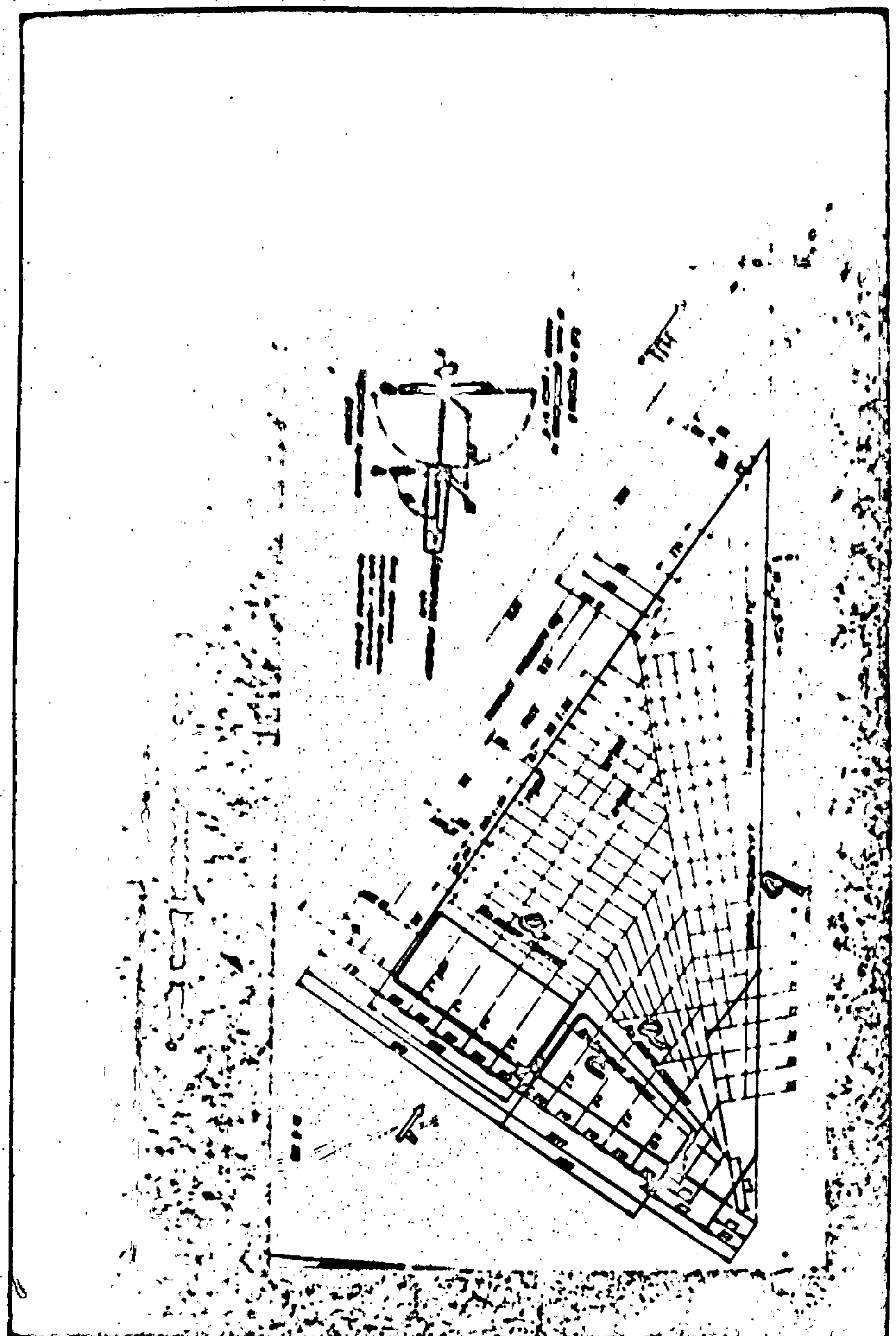

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Fig. 52. /illegible

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 ~~xxxxxx~~ 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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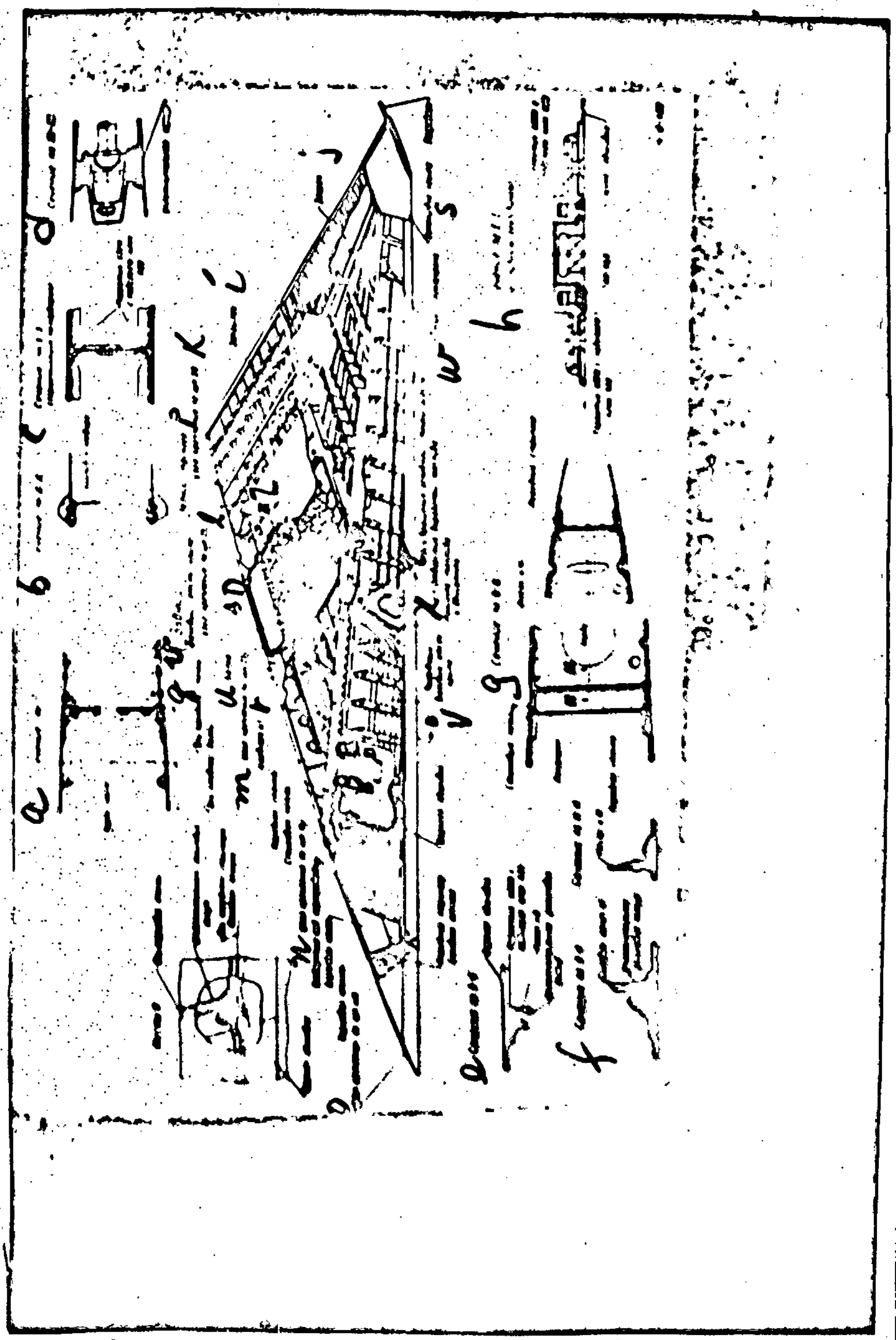

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Fig. 59. Wing framework.

a- cross section at points O - O

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

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<u>The forward stringer</u> 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.

<u>The rear main stringer</u> 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 ~~xxx~~ drop forging out of 30KhGSNA steel with subsequent ~~xxxxxxx~~ 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 ~~cold~~-forging out of ~~xxxxx~~ 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, ML5-T4 by cold-forging, hot-forging, and casting.

The ribs have grooves for the stringer.

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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 ~~xx~~ nose fuel-tank section both above and below is made, ~~xxxxxxxxxxxx~~ together with the rigidity ribs, out of D15T sheet metal by ~~xxxxxxxxxxxx~~ chemical milling.

Wing Fuel Tanks

In each wing cantilever there are two fuel tanks.

Tank 1 is in the ~~xxx~~ 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 ~~x~~ U30 CW sealer with a sublayer of ~~glxxx~~ 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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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 30KGSA 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.

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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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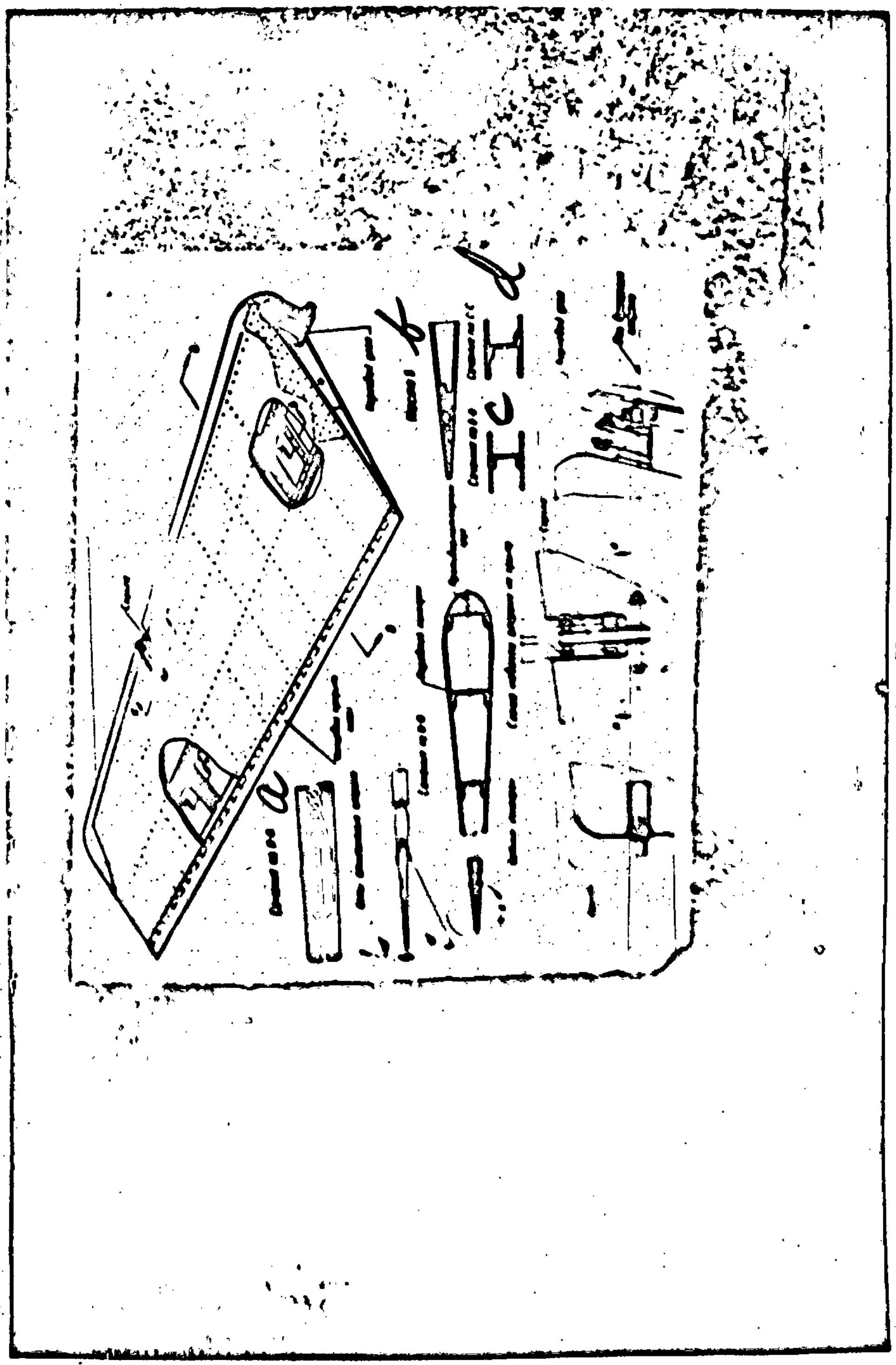

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Fig. 55. The aileron.

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, consists of a horizontal and a vertical empennage, and has a symmetrical profile.

The horizontal empennage has a sweepback angle of 55°.

The area of the suspended part is 3.94 m²; the setting angle of the stabilizer is 0°; the dihedral angle V = 0.

Deflection angles of the stabilizer:

a) along the flow: nose upward +7°30'

nose downward -16°30'

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

nose upward +13°

nose downward -28°

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 m².

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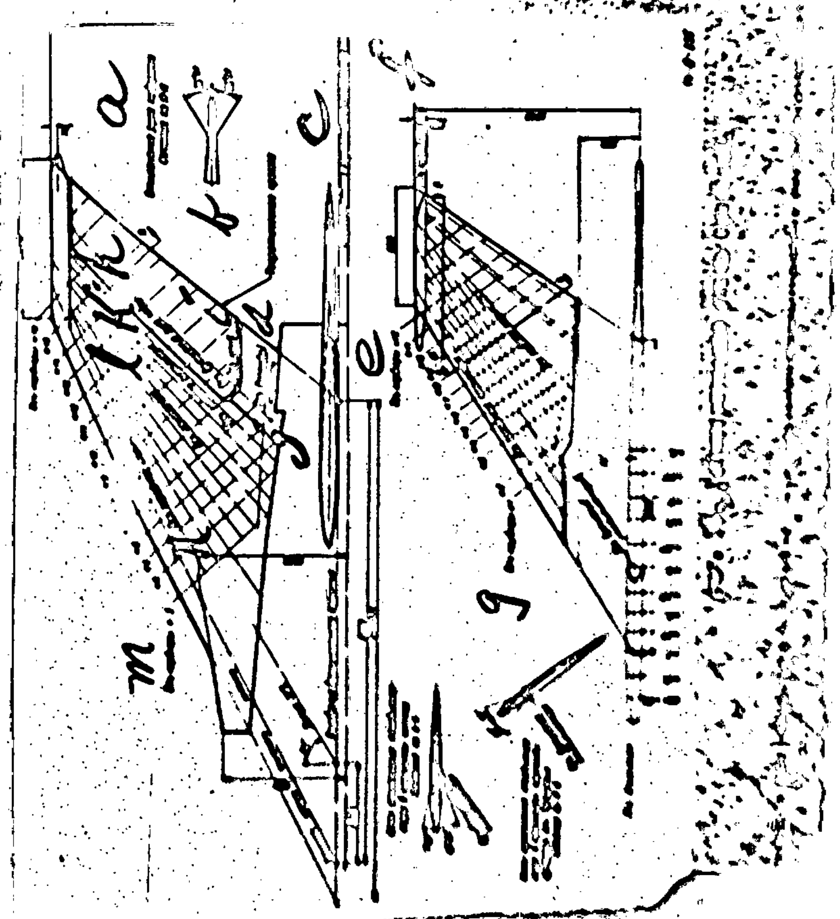

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Fig. 56. Geometrical layout of empennage.

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.

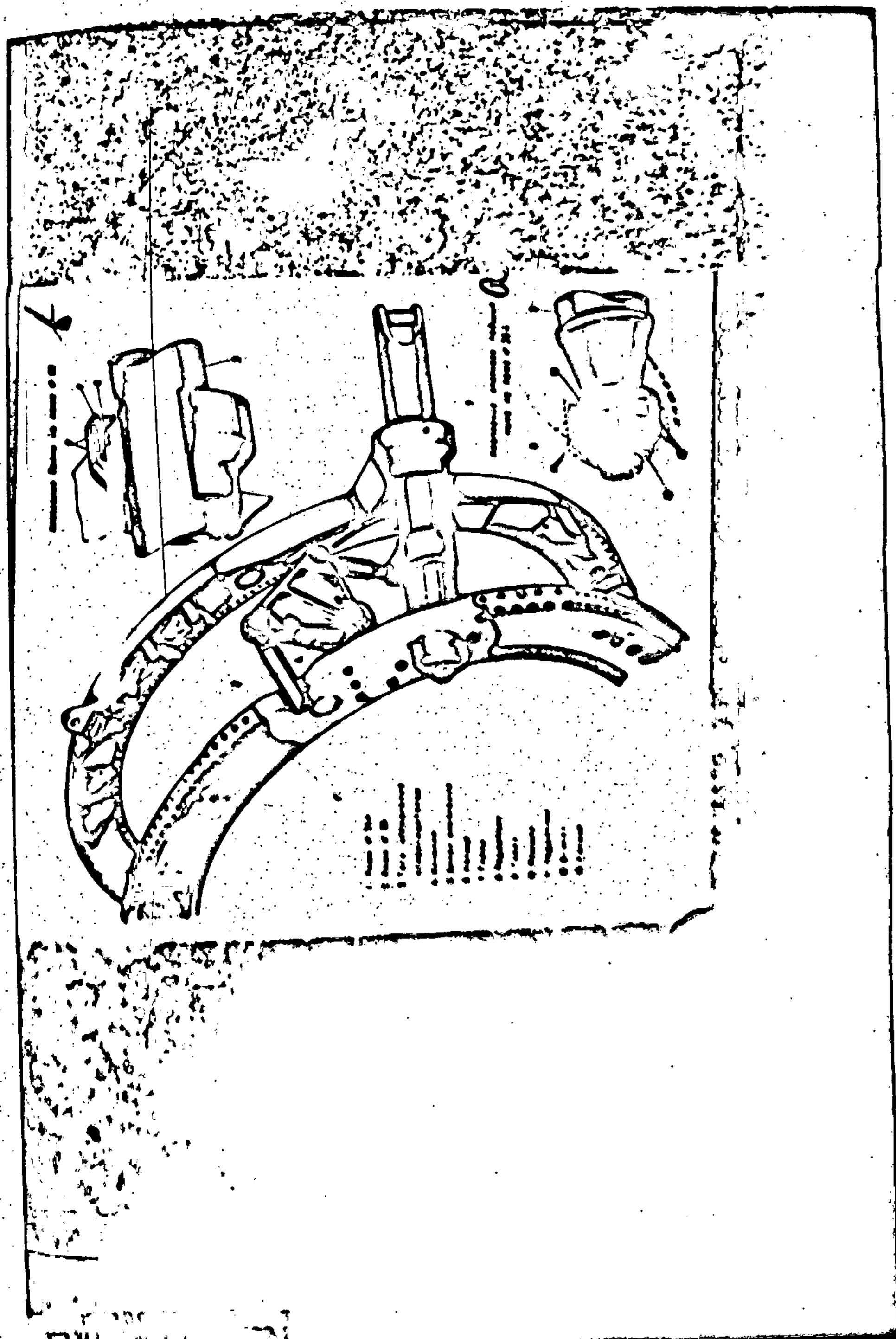

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Fig. 57. /Caption illegible/

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

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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 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

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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

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<u>Rudder</u>

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 ~~xxxxxx~~ stability of the plane in flight.

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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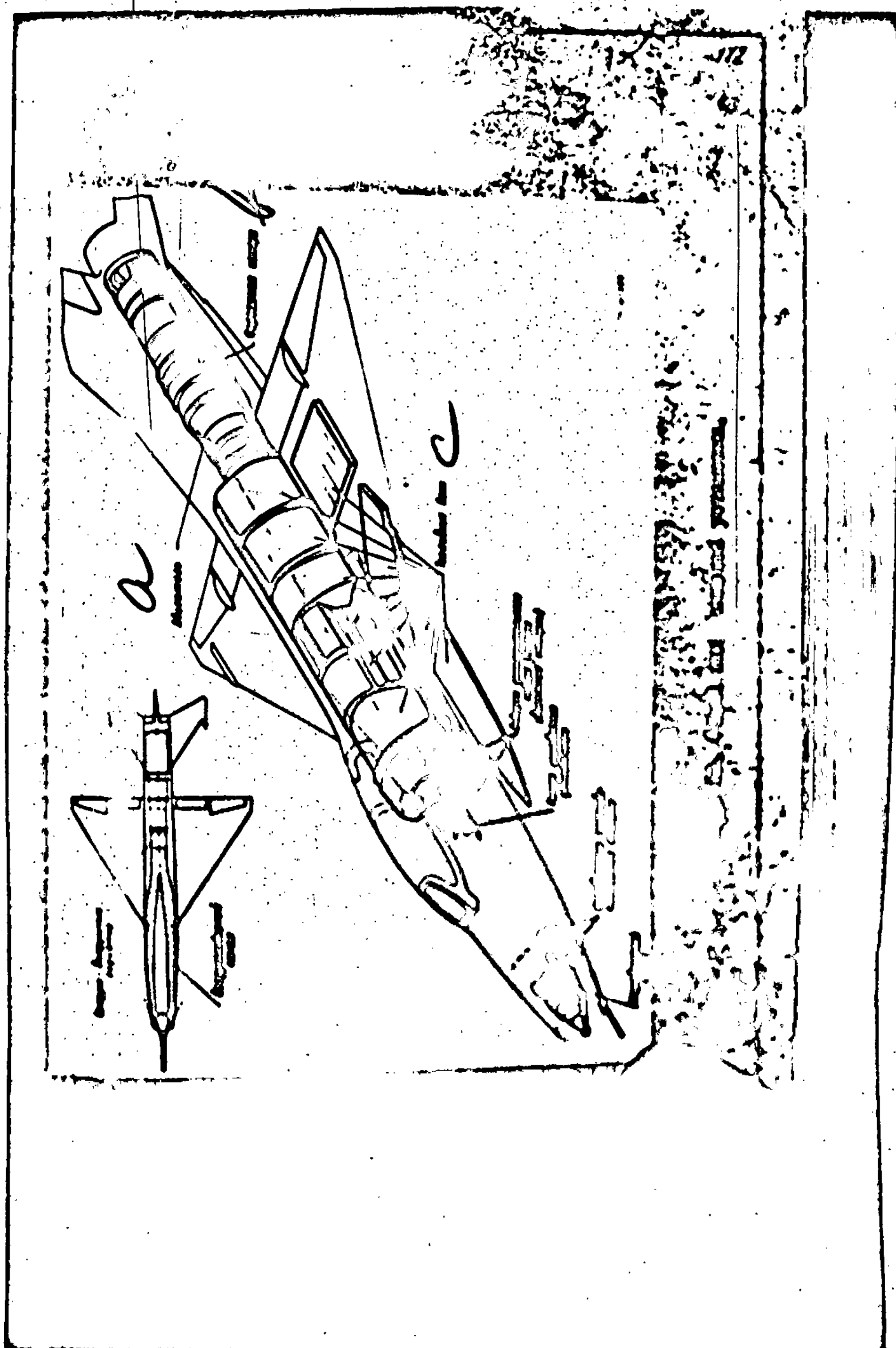

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Fig. 58. Over-all view of power plant.

a) engine b) afterburner c) fuel tanks

(remainder illegible)

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

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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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[redacted]

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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.

[redacted]

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 DT8-1

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 fuel tank.

3. <u>Installation of the Engine and the Afterburner in the Plane</u>

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 ~~from~~ 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 ~~xxxxx~~ downward slope, while from frame (illegible) to the outlet of the nozzle it moves with a small upward slope.

<u>Attachment of Engine</u>

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 ~~xxx~~ o 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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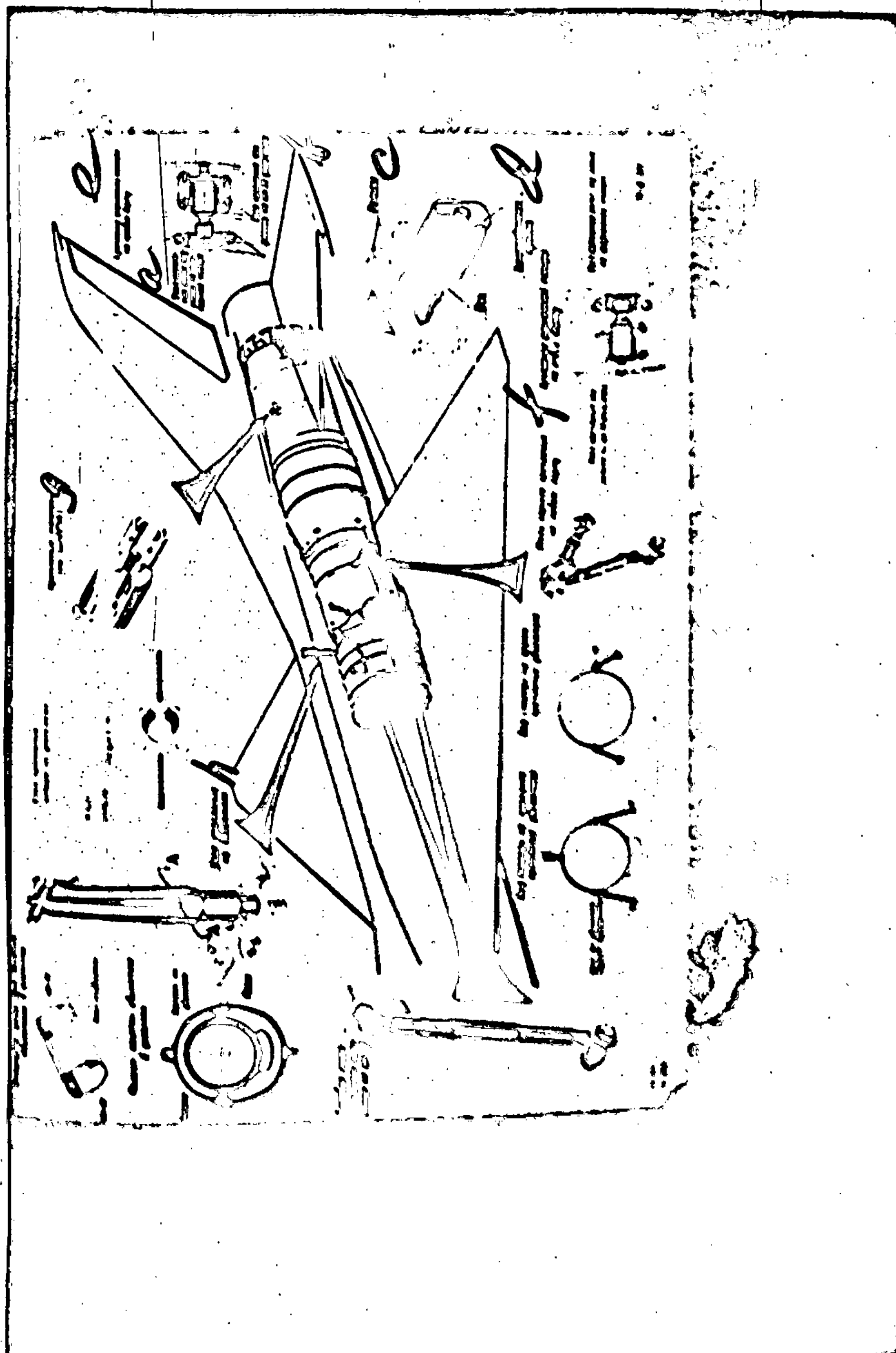

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Fig. 59. Attachment of engine and afterburner.

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 ~~xigix~~ starboard side

f) attachment of afterburner on port side

g) attachment on starboard side

h) attachment to the engine

(remainder illegible)

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)

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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

(remainder illegible)

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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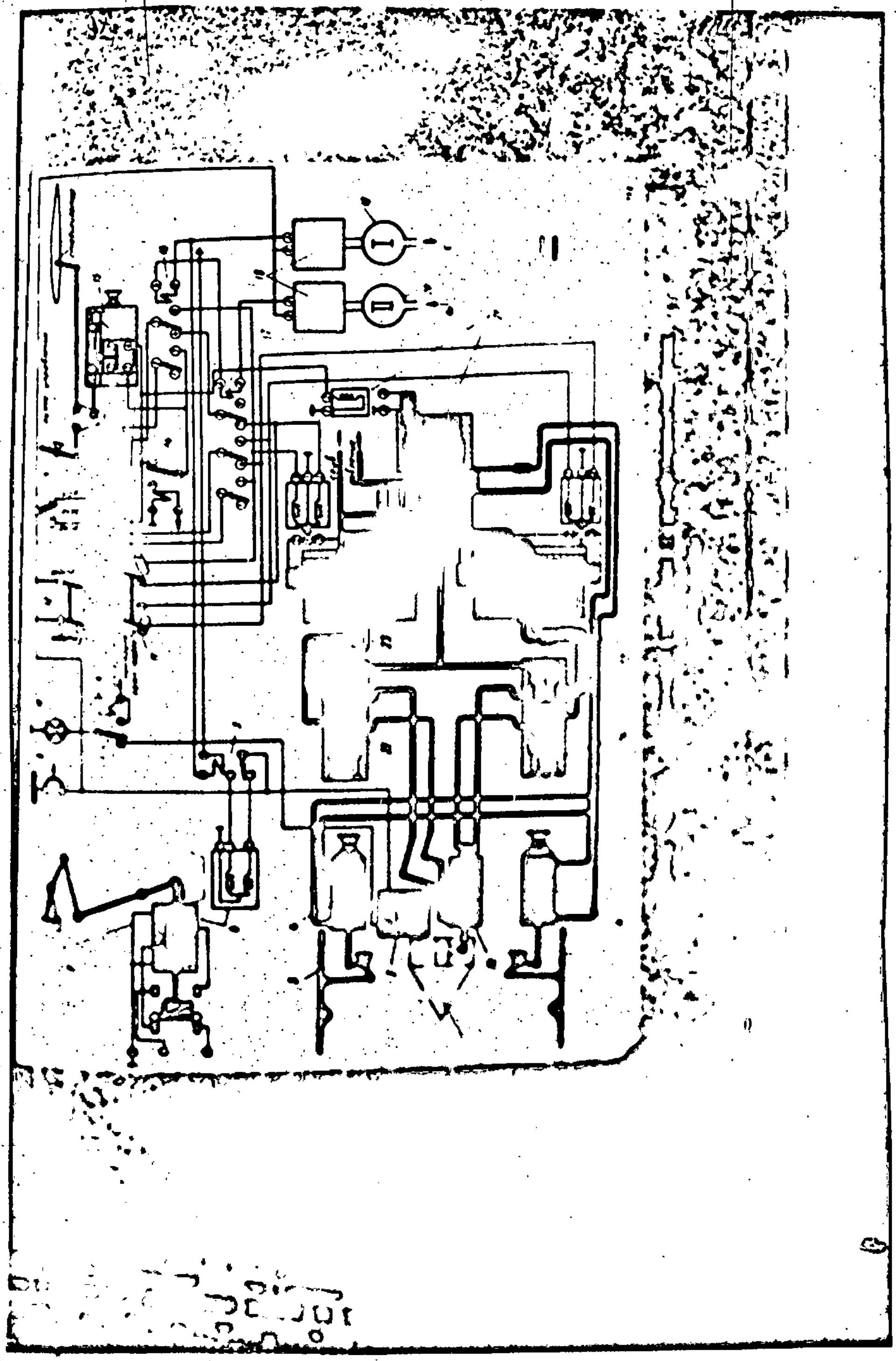

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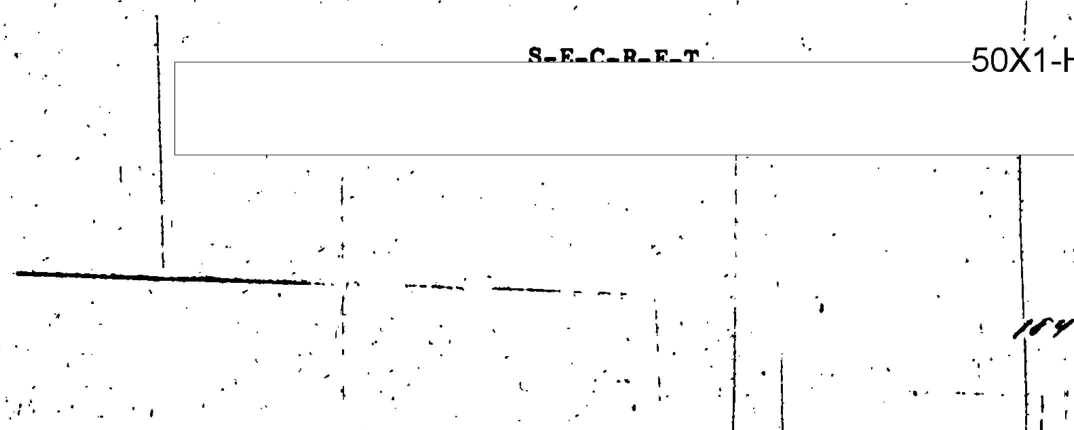

Fig. 60. System for controlling cone and surge-control valves.

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" ABS-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 VT360202OSI (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)

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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. ~~Sixpxxxx~~ 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

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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 (reminder 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 ~~xxxxxxxx~~ 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

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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 left panel must be set in the position "manual", while the 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 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 ($M = 1.5$ 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 ~~hydraulic~~ 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 ≥ 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 ≥ 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 . . .

(remainder illegible)

"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 comes from the outside of the radiator and through plate valves /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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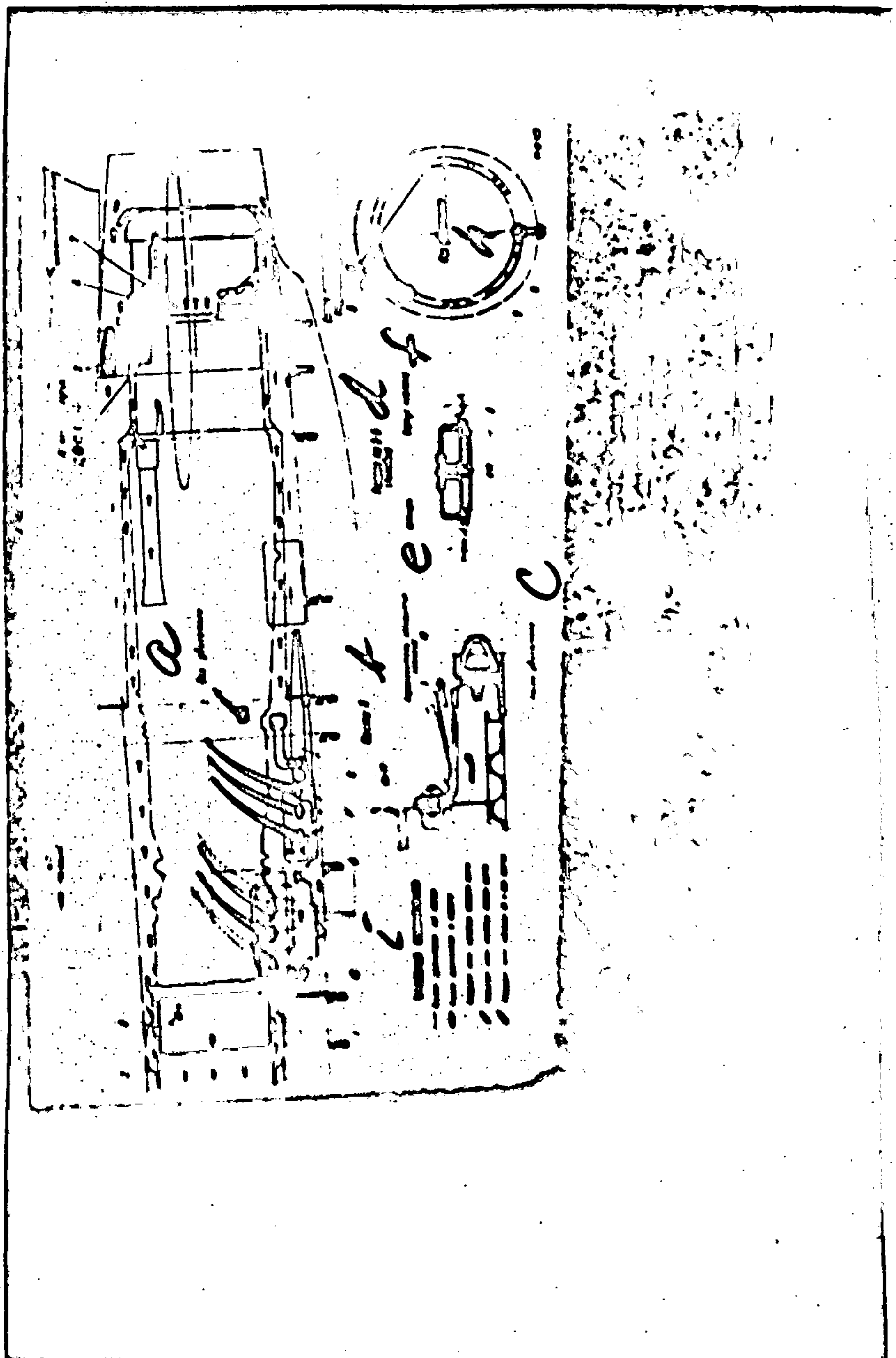

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Fig. 61. Design for blowing air through the engine compartment.

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

4) ~~xxxxxxxxxx~~ pipe 5) ~~xxxxxxxxxx~~ pipes 6) casing 7) illegible

8) ~~xxxxxxxxxx~~ 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 plate valves (9) 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 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 laying the 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 pipelines in frame 29 are closed by cover plates.

9. Ventilation and Drainage of Engine

The 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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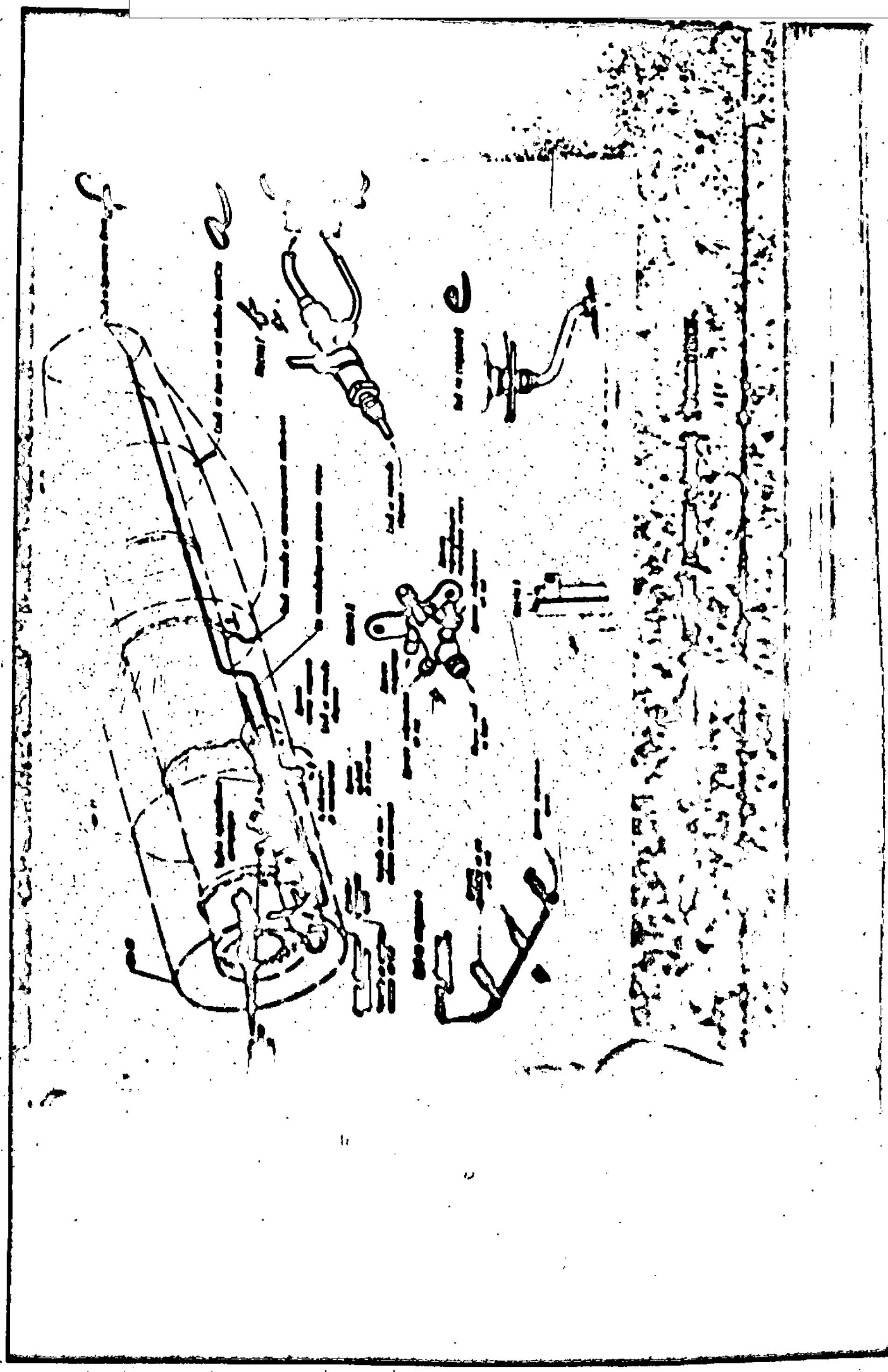

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Fig. 62. Air blowing and drainage of engine.

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

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The joint between the pipe and the hatch is telescoped and is sealed by a rubber xingx 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 xixxxixix 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 xixpx of the engine is combined in groups and led out of the fuselage at xtxxpixxxxx five places.

The first fixgxt 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 XPxfixxxt 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 in 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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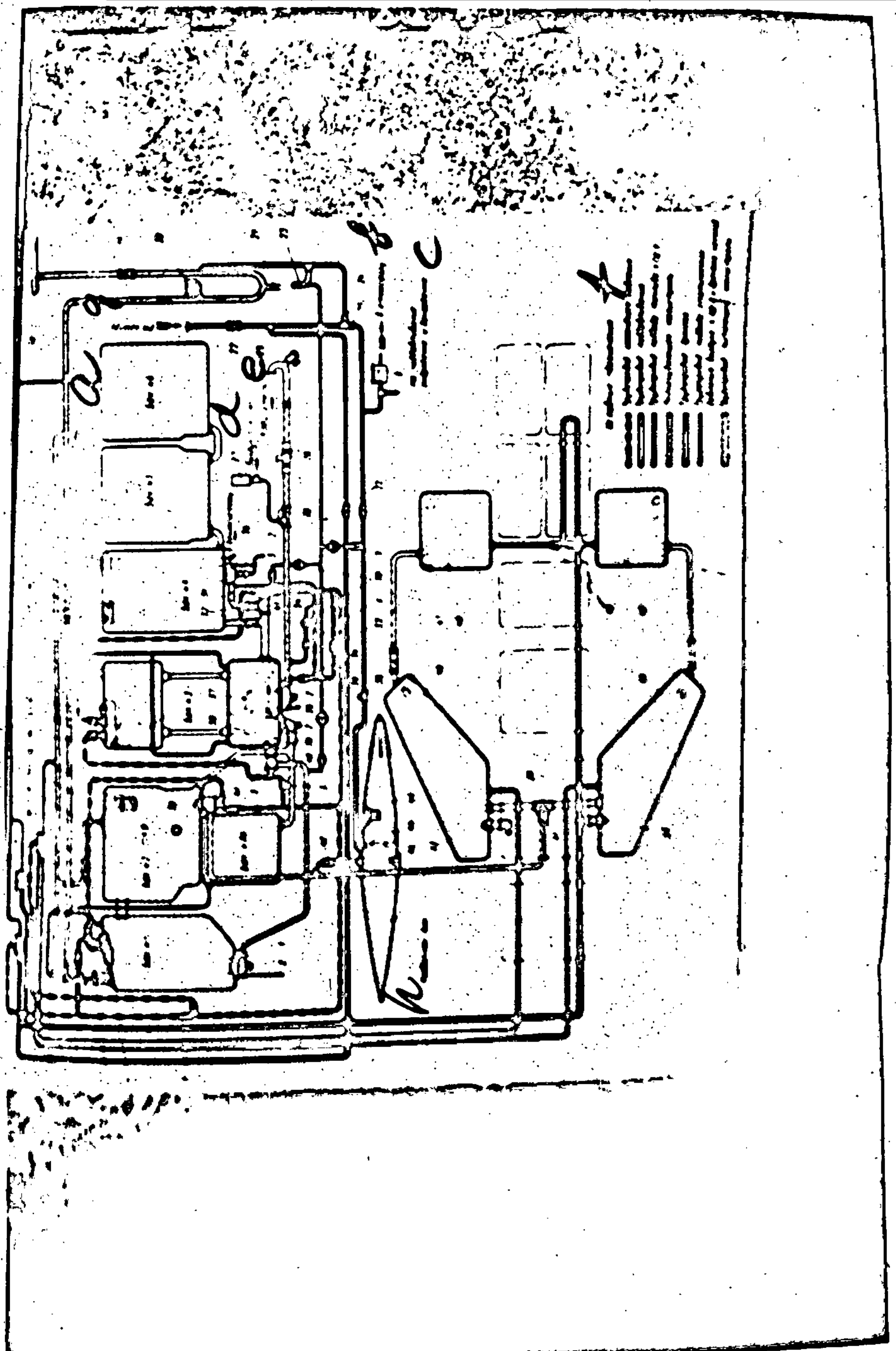

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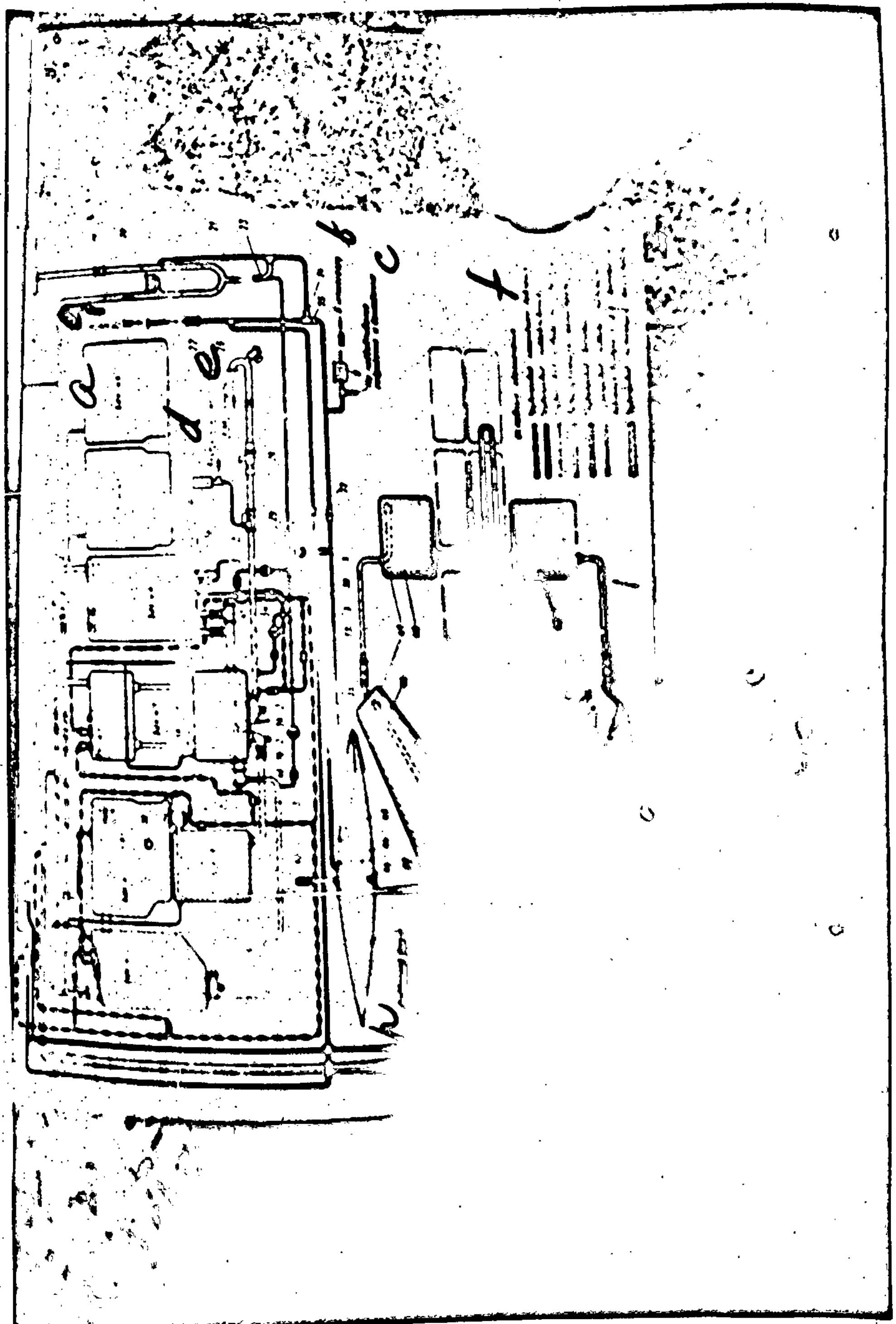

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Fig. 63. Title illegible

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 83-1637;

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;

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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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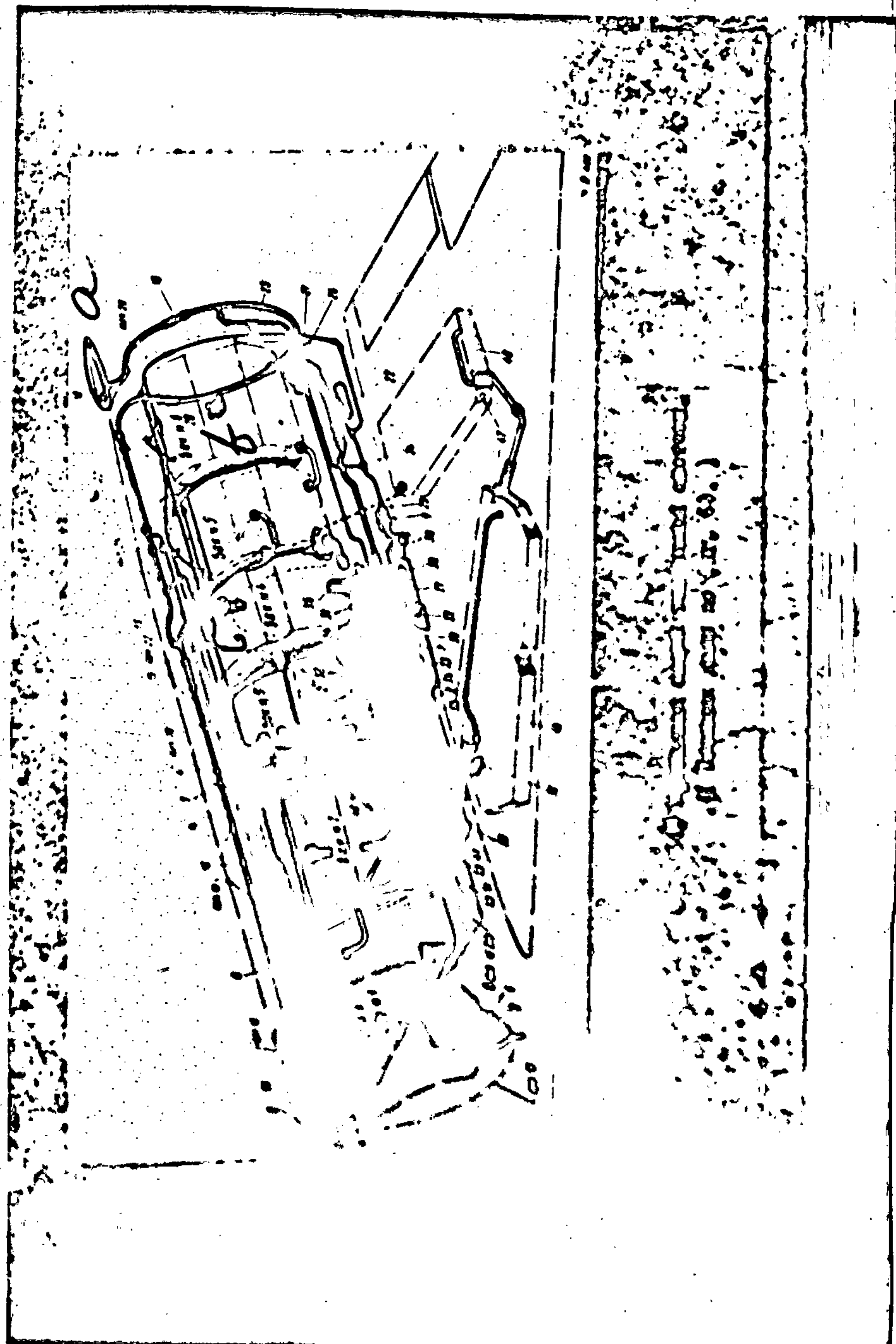

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Fig. 64. Assembly diagram of fuel system.
((illegible) the same as in Fig. 63)

a) frame b) tank

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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.~~ main.

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 ~~xxxxx~~ behind the special valve.

The opening and closing of all special valves (41) is done wit [illegible] 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] pressure [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. ~~xxxxxx~~ 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 ~~xxxxxxxxxx~~ 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 ~~xxxxxxxx~~ 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 ~~xxxxx~~ 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 ~~xxxxxxxxxxx~~ 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

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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) number illegible is located

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The ______ joining of the tanks to the drainage duct, as well as the location of the duct itself, is such as to prevent fuel from overflowing 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 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 ~~the~~ 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~~ 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 ~~xxxxx~~ 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

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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, a 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 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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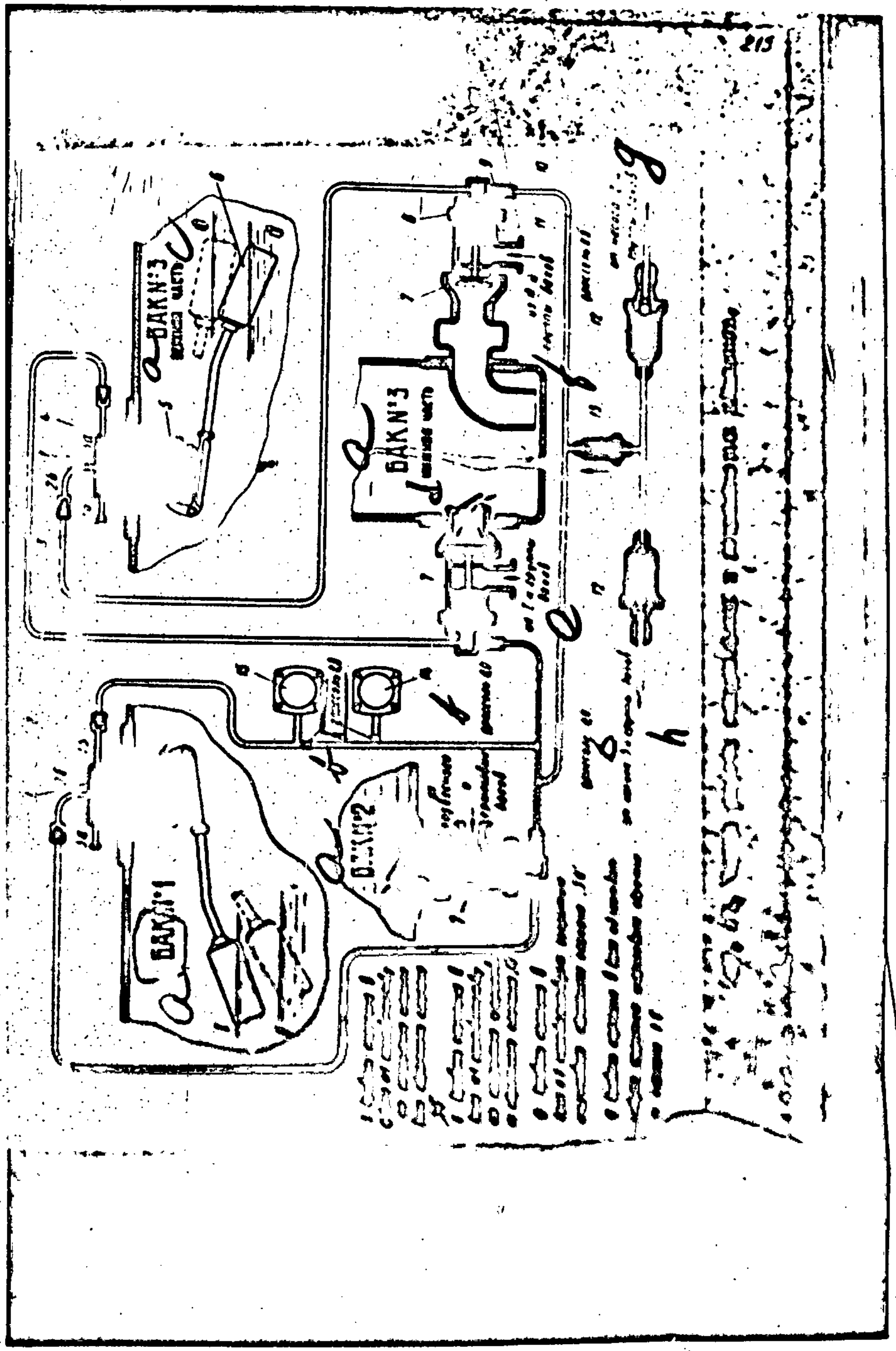

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Fig. 65. Operation of special and float valves.

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

2/6

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 connecting pipe of the float valve will increase, membrane (8) in the 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 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 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.

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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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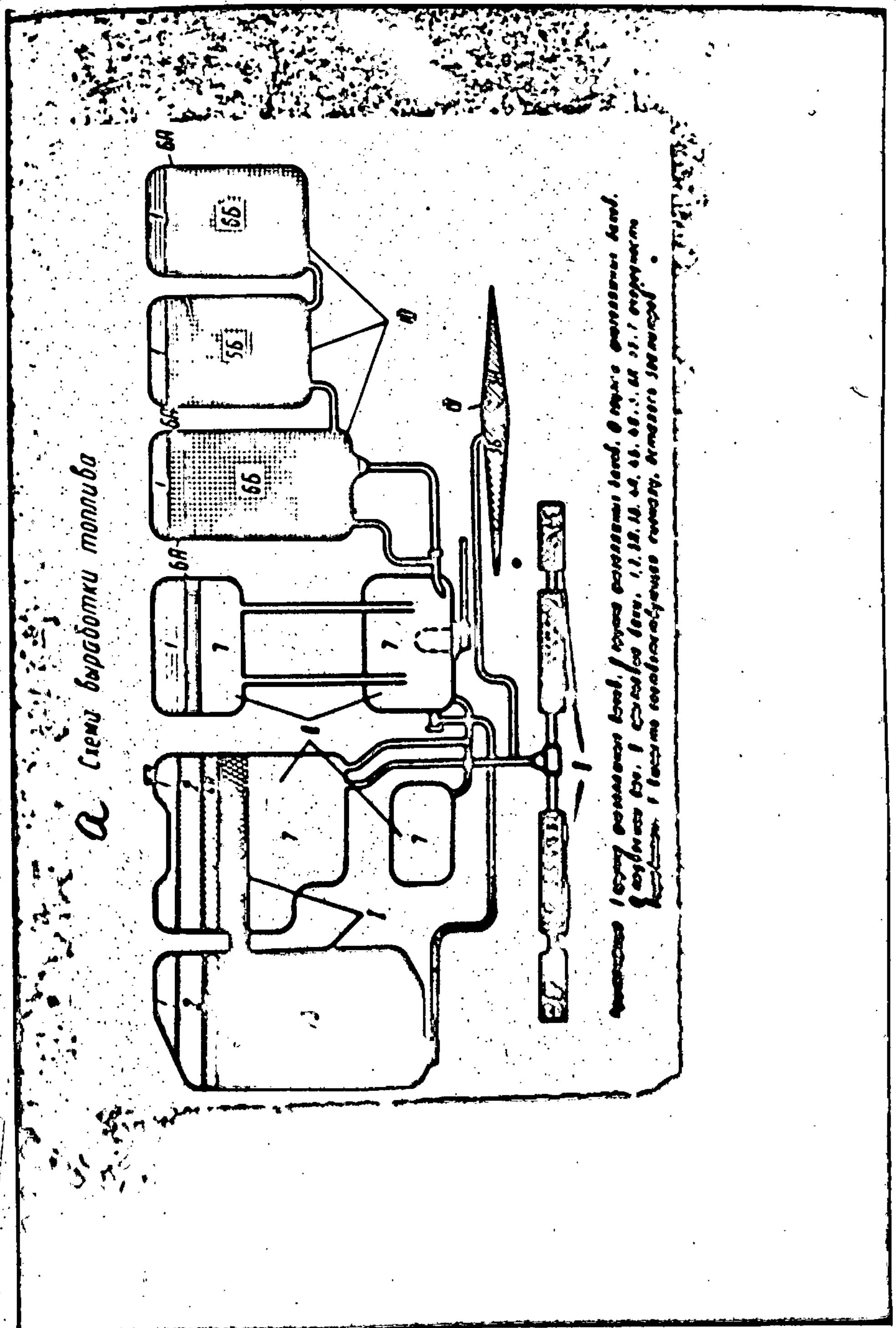

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Fig. 66. (Title illegible)

a) fuel-delivery system

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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 1a 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 [illegible] 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 ~~thx~~ 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 ~~xxx~~(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 (23), which connects with the drainage-system tank.

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

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