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AIR FLOWMETER

Model ЛРБК

DESCRIPTION AND OPERATION INSTRUCTION

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CONTENTS

I. PURPOSE

The УРВК air flowmeter (compensated)(Fig.1) is designed to measure a quantity of air supplied to the pressurized cabin.

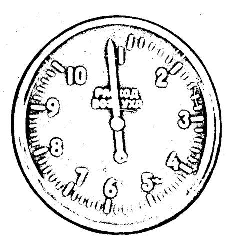

Fig. 1. External View

II. D E S I G N

The instrument mechanism is mounted on the cast aluminium base (1) (Fig.2). Attached to it by the nut (3) and the lower centre (2) is the diaphragm (4) the inner chamber of which is connected to the wide part of the Venturi tube by means of the tube (5) and connection (6).

The narrow part of the Venturi tube is connected with the instrument via the connection (7). Due to the pressure difference between the wide and narrow parts of the Venturi tube the diaphragm is expanded.

The reciprocated movement of the upper centre (8) is converted into rotating movement of the shaft (11) by means of the rod (9) and arm (10).

The rotation of the shaft (11) is transferred to the shaft ([illegible]) through the bent arm (12), rod (13) and fork (14), and then via [illegible] sector ([illegible]) to the pinion (17) on which the pointer (18) is [illegible] Mounted on the pinion is the hairspring (19) which keeps all [illegible] of the mechanism tight against one another.

The aneroid assembly is attached to the shaft (11) by the [illegible] centre (21).

Soldered to the moving centre (39) of the aneroid [illegible] the bent arm (12) passing around the aneroid assembly and [illegible] at the fixed centre side.

The arm (12) is hinged to the rod (13).

To prevent unbending of the bent arm is the arm ([illegible]) [illegible] the pin (23), connecting the rod to the bent arm, is [illegible] ([illegible]) for balancing the shaft (11) is attached to the shaft [illegible]

The pinion rotates in two bearings (25), and each of [illegible] in the bearings (26).

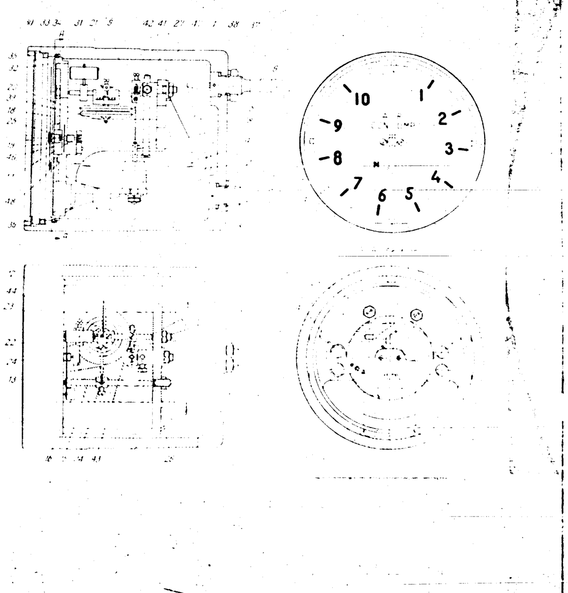

Fig.2. Air Flowmeter Design

Key to Fig. 2.

1 – Base
2 – lower centre;
3 – nut;
4 – diaphragm;
5 – tube;
6 – connection;
7 – connection;
8 – upper centre ;
9 – rod;
10 – arm;
11 – shaft;
12 – arm;
13 – rod;
14 – fork;
15 – shaft;
16 – sector;
17 – pinion;
18 – pointer;
19 – hairs;
20 – aneroid assembly;
21 – centre;
22 – arm;
23 – pin;
24 – weight;
25 – bearing;
26 – bearing;
27 – stop;
28 – adjusting screw;
29 – adjusting screw;
30 – case;
31 – snap ring;
32 – dial;
33 – glass;
34 – sealing ring;
35 – threaded ring;
36 – gasket;
37 – nut;
38 – gasket;
39 – centre;
40 – screw;
41 – screw;
42 – clamp;
43 – screw;
44 – screw;
45 – screw;
46 – plate;
47 – screw;
48 – bracket.

The bearings (26) are mounted in the adjusting screws (28) and (29); the bearings in the screws (29) are located eccentrically respective to the screw axes.

Adjustment of the sector and pinion meshing is performed by rotation of these screws.

The mechanism is placed in the case (30) and secured by the snap ring (31). The dial (32) is graduated from 1 to 10 abstract units of air consumption. Each abstract unit is marked with figure.

All figures and main scale points are painted with constantly luminous material.

The case from the face is covered with the glass (33); the rubber sealing ring (34) provides for air tightness of the case.

The glass is secured in the case by the threaded ring (35) under which the gasket (36) is placed.

The connections (6) and (7) are secured by the nuts (37).

The rubber gaskets (38) are placed under the connections to provide the case air tightness.

III. TECHNICAL DATA

1. Measurement range is from 1 to 10 abstract units of air consumption which correspond to the pressure values given in the table.

Table 1.

Scale points	Absolute pressure in static system, mm.Hg.			
	760.0	590.0	443.0	295.3
	Excessive pressure in dynamic system, mm.Hg.			
1	3.9	5.0	6.7	10.0
2	15.5	20.0	26.7	40.2
3	34.9	45.1	60.1	90.4
4	62.0	80.1	107.0	160.5
5	96.1	125.0	167.0	251.0
6	139.5	180.2	240.5	
7	189.9	245.3	330.5	
8	248.0	320.4	427.5	
9	314.0	405.5		
10	387.5	500.6		

2. Instrument error at a normal room temperature does not exceed ±1.5 scale divisions.

3. Instrument readings variation (hysteresis) at a normal room temperature does not exceed the allowable reading error.

4. The instrument operates within an ambient temperature range from +50 to -60°C.

5. The instrument withstands the overload pressure of 735 mm.Hg. for 1 min.

6. The instrument reliably operates at a vibration of 1.5 g. within a frequency range from 20 to 80 c.p.s.

7. The instrument withstands a vibration of 1.5 g within a frequency range from 20 to 80 c.p.s.

8. The static system is so airtight that at an absolute pressure of 295+3 mm.Hg. in the instrument case the pressure drop does not exceed 5 mm.Hg. per 1 min.

9. The dynamic system of the instrument is airtight at an excessive pressure corresponding the instrument maximum reading.

10. Weight of the instrument (without mounting parts) does not exceed 400 gm.

The instrument overall dimensions are given in Fig.3.

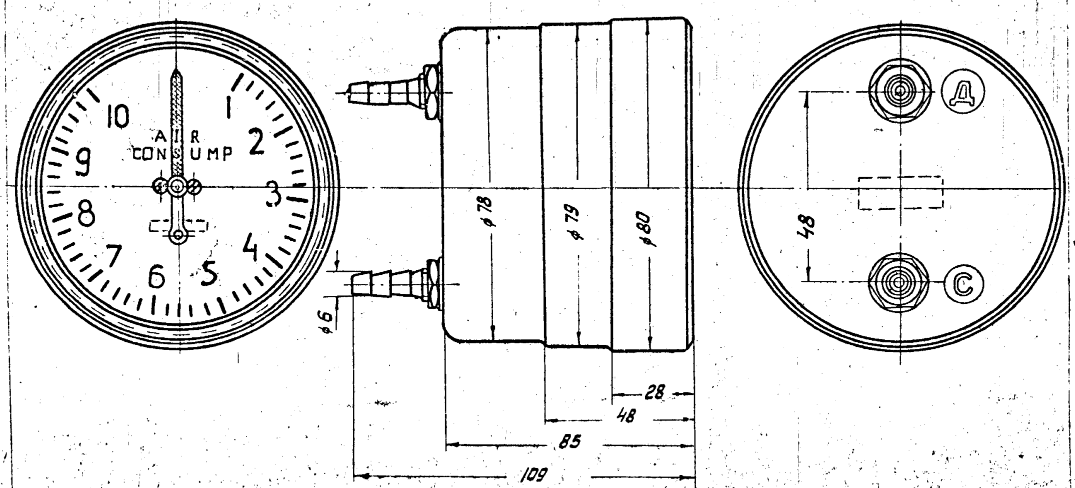

Fig. 3. Overall Dimensions of Air Flowmeter

IV. COMPLETING

The set of the air flowmeter comprises:

1. Air flowmeter - 1 ea
2. Mounting ring - 1 ea
3. Cap - 2 ea
4. Certificate - 1 ea

V. TESTING PROCEDURE AND TEST EQUIPMENT

In operation the flowmeter may be tested for:

1. Instrument reading error at +20°C.

2. Reading variations (hysteresis) at absolute pressure in the static system of 796 mm.Hg.

3. Air tightness of the static and dynamic systems.

Test the instrument for scale error at a normal temperature as follows (Fig.4):

Build up an absolute pressure of 760 mm.Hg. in the static system and in succession build up an excessive pressure corresponding to the scale points marked with figures within the limit of 1 to 10 units in the dynamic system (See Table 1).

Delay pressure at the check points for not less than 1 min., and at point 10 not less than 15 min.

Note the direct and reverse readings of the measurement values.

Determine the instrument reading error by comparison of the instrument readings with the values given in the Table I.

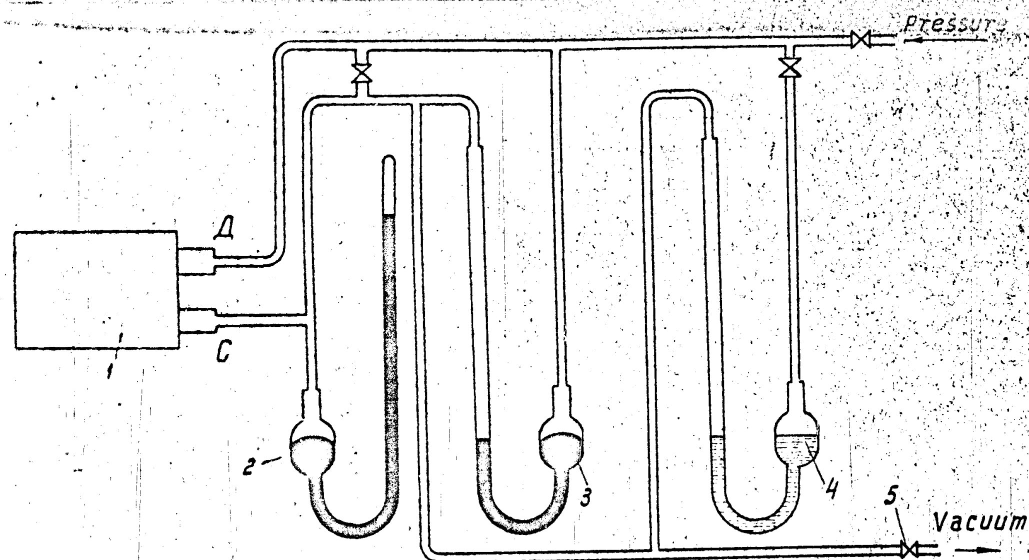

Fig.4. Air Flowmeter Testing Diagram

1- Instrument to be tested; 2- reference mercury barometer; 3- reference mercury manometer; 4- reference water manometer; 5- valve; Д- dynamic connection; С - static connection.

The readings variation (hysteresis) is calculated as a difference between the direct and reverse readings of the instrument.

Then build up in the static system the absolute pressure of 590-6, 443.9 and 295.3 mm.Hg. in succession and at each point determine the instrument reading error in accordance with the Table I.

The readings variation at this pressure is not calculated.

The aboslute pressure value in the static system is checked by the reference mercury barometer, the excessive pressure value in the dynamic system - by the reference water and mercury manometers. The reference manometers and barometers are calibrated in mm.Hg.

Check the dynamic and static systems for air tightness as follows (See Fig.4):

a) Connect a pressure source to the connection (Д) and build up an excessive pressure corresponding to the instrument maximum reading.

Then cut out the pressure source and after the hose is shut off at the instrument connection watch the instrument pointer during 1 min.

b) Connect a vacuum source to the instrument connections (C) and (Д) and build up an absolute pressure of 295.3 mm.Hg. Then cut out the vacuum source and watch changing in readings of the mercury barometer during 1 min.

To perform the above mentioned testing the following test equipment is required:

a) reference mercury barometer - 1 ea

b) reference mercury manometer - 1 ea

c) reference water manometer - 1 ea

d) two-way selector valve - 2 ea

e) set of hoses and mounting parts.

VI. MOUNTING AND OPERATING REQUIREMENTS

I. Mounting

The air flowmeter is installed on the instrument panel in accordance with the aircraft instrument equipment arrangement diagram.

The air flowmeter is mounted on the instrument panel by a standard mounting ring 80 mm. dia. with vertical or horizontal position of the instrument dial.

When mounting the instrument remove the rubber caps from the connections. Connect the connection (C) to the connection in the narrow part of the Venturi tube and the connection (Д) to the connection in its narrow part.

When mounting the pipeline make number of bendings as less as possible; bending radius should be not less than 150 mm.No dents are permitted. After mounting test the pipeline for air tightness.

Use tubes with inner diameter of 4 mm. for pipeline.

2. Operation

In operation check the following: instrument reading error at +20°C, readings variation at an absolute pressure of 760 mm.Hg. in the static system and at normal temperature, the static and dynamic systems for air tightness.

The above mentioned checks are performed once every 3 months.

The testing procedure is given in Section V of this Description.

After-flight inspections of the instrument are performed to check the glass and other instrument external parts for freedom from damage.

VII. PERIODIC MAINTENANCE OPERATIONS

Check the instrument in operation once every 3 months as well as prior to installation in the aircraft if the instrument was stored more than 3 months.

Perform checking the instrument in accordance with the requirements specified in Section V of this Description.

In case of poor air tightness of the instrument tighten the nuts (37) and threaded ring (35) (Fig.2).

If the instrument reading errors exceed the value given in the paragraph 2, Section III of this Description replace the instrument by new one.

VIII. TROUBLES AND REMEDIES

I. GLASS BROKEN

Using a special wrench unscrew the threaded ring (35) (Fig.2), remove the gasket (36) and broken glass.

Replace the glass by new one, place the gasket (36) and screw the threaded ring (35).

After repair check the instrument according to paragraphs 2, 3 and 8, Section III proceeding as specified in Section V of this Description.

2. POINTER DROPPED

Remove the glass. Check the pointer for condition: for freedom from cracks and bends, luminous painting for damage. Place the pointer on the pinion tapered end so that the pointer end aligns with the first scale division and then pushing the pointer by finger secure it in this position.

Close the instrument and check it in accordance with paragraphs 2,3 and 8, Section III proceeding as specified in Section V of this Description

3. POINTER DISPLACED

Check the instrument according to paragraph 2, Section III of this Description.

If, when checking, it is noted that the pointer displacement is constant around the whole scale, open the instrument and install the pointer as instructed in paragraph 2 above.

Close the instrument and check it in accordance with paragraphs 2,3 and 8, Section III proceeding as specified in Section V of this Description.

ELECTRIC ACTUATOR

Model M3K-3

DESCRIPTION, OPERATING AND

MOUNTING INSTRUCTIONS

ELECTRIC ACTUATOR

Model MBK-3

DESCRIPTION, OPERATING AND MOUNTING INSTRUCTIONS

CONTENTS

I. PURPOSE

The MЗK-3 electric actuator is designed for remote control of the fuelling valve.

II. COMPLETING

The electric actuator set comprises:

a) MЗK-3 electric actuator.

III. TECHNICAL DATA

Direction of rotation .... two-way

Nominal D.C. voltage .... 27 V

Operating voltage range 24.3-29.7

Loading torque:

a) nominal .... 15 kg.-cm.

b) maximum .... 25 kg.-cm.

Current drawn:

a) at nominal torque...................... 3.5 A

b) at max. torque .... 4.6 A

Outlet shaft R.P.M. limited

by limit switches .... 30±

Time required for the outlet shaft to turn from one extreme

position to another .... not more than 13 sec.

Inertial run of the outlet shaft when

[illegible] across the electric

motor terminals .... not more than 0.75 revolution.

Weight .... not more than 2 kg.

Power supply system .... two-wire

Electric actuator construction.....enclosed-type, explosion-proof.

Operating duty .... intermittent.

At a nominal torque and nominal voltage three cycles of actuation are permitted and then complete cooling. The cycle comprises: operation of the electric actuator in one direction of the outlet shaft rotation up to the extreme position, then operation of the electric actuator in reverse direction of the outlet shaft rotation up to the extreme position, after that - 3 min. interval.

The electric actuator is designed to operate in the АН-12 aircraft.

IV. D E S I G N

The МЭК-3 electric actuator consists of the following main elements:

a) Д-40Т electric motor;

b) reduction gear;

c) КВ-6 limit switches;

d) ПРОНК5НЕ7 plug connector.

Electric Motor

The Д-40Т electric motor is a two-pole D.C. series motor with a brake solenoid clutch.

Reversing of the electric motor is performed by changing the direction of the magnetic flux. For this purpose the electric motor is provided with two separate field windings which are energized depending on the direction of rotation.

The direction of current in the armature winding does not change. Switching over the field windings when changing the direction of rotation is performed by means of the one-pole selector switch.

Remember, that simultaneous switching on of both field windings is not permitted, as it may result in the electric motor failure.

The electric motor (Fig.2) consists of the following:

a) field ring with coils;

b) armature with winding and commutator;

c) drive end housing assembly.

Attached by screws in the field ring (13) made of a steel tube are two poles (14) with field windings (15).

For access to the commutator and brushes the field ring is provided with openings which are covered with a protective cap (25).

The armature (31) consists of the shaft, laminations of electrical sheets pressed on the shaft. Placed in the laminated armature slots is windings the coil ends of which are soldered into grooves in the risers of the commutator.

The commutator (29) consists of alternate copper and mica segments.

The drive end housing assembly (10) is made of duralumin and has a seat for the ball-bearing and a hole for supply wires.

The electric motor is provided with the brake solenoid clutch, designed for decreasing the inertial run of the armature shaft after de-energizing the electric motor.

The clutch winding (18) is enclosed in the steel casing (17). Pressed in the casing are three guide rods along which the brake washer (20) with the ring (21) of TdM friction material pressed on it, travels.

The casing and brake washer form a magnetic circuit of the clutch.

The cylindrical spring (23) presses the washer (20) to the disc (22) attached rigidly to the armature shaft.

The spring force creates a brake moment of the armature between the disc and brake washer.

With the solenoid clutch winding de-energized there is an air gap between the brake washer and casing.

When switching on the power supply a magnetic flux is created. In this case the electromagnetic force, created in the air gap, moves the brake washer along the guide rods to the casing, depressing the counteracing spring, thus the armature brake moment is lost.

When opening the supply circuit of the clutch winding the attraction force between the case and washer disappears, and under the action of the spring the brake washer moves along the guide rods till it contacts with the armature disc.

Due to friction between the brake washer and disc the armature is braked.

Power is supplied to the solenoid clutch winding during the period of the electric motor operation. The solenoid clutch winding is connected in series to the electric motor armature winding.

Attached to the clutch casing is the support (28) with two stamped brush holders.

The MTC-5/A-I2 brushes (16), 5x6, 5x13 mm. are installed in the brush holders.

The brushes are pressed to the commutator by spiral springs.

Brush pressure is 170-230 gr.

Reduction Gear

The reduction gear is designed to increase the torque and decrease r.p.m. transferred from the electric motor to the outlet shaft.

The reduction gear consists of two stages of cylindrical gears (outlet meshing) with total gear ratio of 30.25.

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The drive gear (9) of the reduction gear first stage is attached to the electric motor shaft by a pin.

Meshed with it is the driven gear (32) which is pressed on the second stage drive gear (33) which is pressed on the second stage drive gear (33) shank and secured on it by two cylindrical keys.

The thickened end of the second stage driven gear (35) serves as an actuator output shaft.

The shaft has inner involute splines for joint with the driven unit shaft.

The opposite end of the driven gear (35) is provided with a worm (1) which is meshed with the worm gear (4).

This gear made of brass is rigidly attached to the actuating screws (6) by means of the key (3).

The worm and worm gear form a worm-and-wheel assembly with the gear ratio 1:7.66.

The worm-and-wheel assembly with the actuating screw is designed to actuate the limit switches.

The gears of the reduction gear rotate in the ball-bearings.

The actuating screw is rotated in brass bearings.

Limit Switches

Installed in the reduction gear casing are two KB-6 limit switches which are designed to switch off the electric actuator in the extreme positions after the outlet shaft makes a certain number of revolutions, and to close (or open) supply circuits of two warning lights installed in the aircraft.

One of the light comes on when the electric motor stops in the extreme right position, the other - when the electric actuator outlet shaft is in the extreme left position.

The drive nut (32) reciprocates along the actuating screw (6). The rectangular lug of the drive nut slides in the guide plank. This plank prevents the drive nut from turning together with the actuating screw.

The drive nut presses the buttons of the limit switches (39) and (42) through the elastic plate (41).

The number of the outlet shaft revolutions is adjusted by the adjusting screw (36) screwed in the drive nut.

When screwing in the adjusting screw the drive nut travel is increased, thus the number of the outlet shaft revolutions is also increased.

The cylindrical spring (26) is designed to remove a play in the thread between the actuating screw and drive nut.

The actuating screw play is removed by washers installed between the cover (2) and casing.

Due to this, a required accuracy is provided when adjusting the limit switches.

V. PRINCIPLE OF OPERATION

The electrokinematic diagram of the electric actuator is given in Fig.3.

The electric actuator is connected to the supply circuit by means of the plug connector.

The one-pole selector switch is used for reversing the electric actuator.

When energizing the electric actuator, the solenoid clutch is energized simultaneously, unbraking the electric motor armature. The armature of the electric motor begins rotating.

3 The gear, attached to the electric motor shaft, rotates the outlet shaft of the electric actuator through the two-stage reduction gear.

The rotation from the outlet shaft is transferred simultaneously to the actuating screw through the worm-and-wheel assembly.

The electric actuator is stopped automatically by the limit switches installed in the electric actuator.

The drive shaft, when moving along the actuating screw thread, presses the button of one of the limit switches depending on the direction of rotation of the electric actuator outlet shaft.

The limit switch opens the electric motor supply circuit and closes the circuit of the corresponding light indicating the extreme position of the electric actuator outlet shaft.

VI. MOUNTING AND OPERATION

The electric actuator is bolted by the casing flange with the flange centering rim properly fitted to the mounting face.

The electric actuator can be installed in any position.

The electric actuator is connected to the electric system by means of the ШР20П5НШ7 5-pin plug connector.

Before installing the electric actuator be sure that the unit, for which the electric actuator is used, is properly mounted and reliable.

The electric actuator outlet shaft must be engaged with the driven unit without misalignment and radial tension.

The outlet shaft of the electric actuator must be in the proper extreme position.

The electric actuator must be securely attached. The attaching bolts must be locked.

Testing of the mounted electric actuator (running it from one extreme position to another) is performed first by short switchings on at a decreased voltage (about 20 V).

If the whole unit operates normally without sticking, misalignment and tension in kinematic system, test the electric actuator at a nominal voltage observing the operation duty indicated in the "TECHNICAL DATA" section.

During operation perform the following periodic maintenance operations:

a) After every 25 flying hours.

Check the plug connector for cleanliness and security of contacts, the electric actuator for security of attachment, the protective cap for close fitness.

Check the supply cable for damage and other external defects. Clean off dust, oil, water and dirt from the electric actuator external surface.

b) After every 50 flying hours.

Perform the 25-hour periodic operations.

Check the electric actuator operation and current drawn for correspondence to the nominal data.

Check the driven unit for operation.

c) After every 100 flying hours.

Perform the 50-hour periodic operations.

Remove the protective cap from the electric motor and check the commutator and brushes for condition; ensure that the commutator is not burnt, the brush springs are in good condition, the brushes are not damaged; check the brushes length (replace the brushes worn down to 9 mm.) and the brushes for smooth movement in the brush holders.

If the commutator is covered with carbon or dirt, clean it with a clean cloth moistened in Б-70 gasoline (the brushes must be raised).

If the commutator cannot be cleaned by the above method, clean it with a fine sand paper.

After cleaning the commutator scrape the intersegment slots with a pointed wooden stick and blow the interior of the electric motor with compressed air (pressure of 1-1.5 atm.).

Disassembling the electric actuator and replenishing lubricant in operation is not permitted.

The faulty electric actuator should be removed from the driven unit and replaced with a new one.

The overall dimensions of the МЭК-3 electric actuator are given in Fig.4.

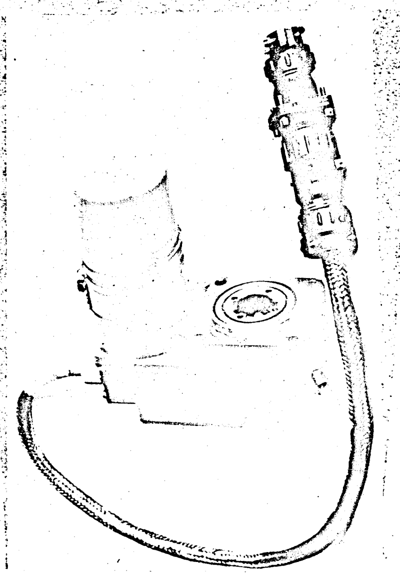

Fig.1. General View of NЭK-3 Electric Actuator

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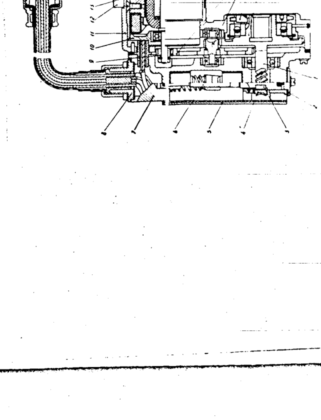

Fig.2. Section View of M3K-3 Electric Actuator

Key to Fig.2.

1 - Worm; 2 - cover; 3 - key; 4 - worm gear; 5 - cover;
6 - actuating screw; 7 - casing; 8 - connection;
9 - electric motor gear; 10 - drive end housing assembly;
11 - casing; 12 - cover bend; 13 - field ring; 14 - pole;
15 - field winding; 16 - brush; 17 - clutch casing;
18 - clutch winding; 19 - gasket; 20 - washer; 21 - cork ring;
22 - disc; 23 - spring; 24 - nut; 25 - cap; 26 - spring;
27 - key; 28 - support ring; 29 - commutator; 30 - ring;
31 - armature; 32 - and 33 - gears; 34 - round nut;
35 - gear; 36 - adjusting screw; 37 - drive nut;
38 - seal; 39 - limit switch; 40 - plank; 41 - plate;
42 - limit switch; 43 - plug connector.

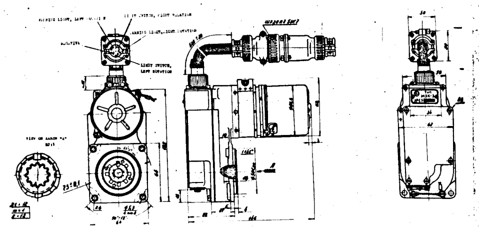

Fig.3. Electrokinematic Diagram of MЭk-3 Electric Actuator

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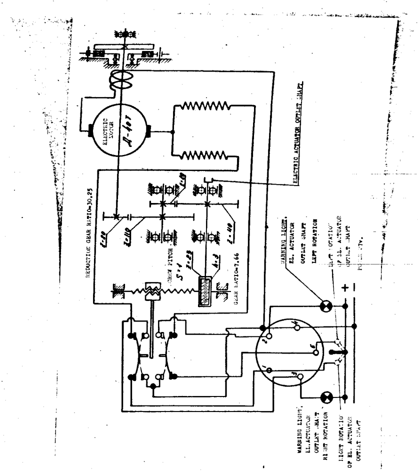

Fig.4. Overall Dimensions of MSK-3 Electric Actuator

CABIN AIR PRESSURE REGULATOR
Model APR-54

CABIN AIR PRESSURE REGULATOR

Model АРД-54

CABIN AIR PRESSURE REGULATOR

Model АРД-54

DESCRIPTION, INSTALLATION AND MAINTENANCE INSTRUCTIONS

CONTENTS

I. PURPOSE

The cabin air pressure regulator is designed for automatic control of air pressure in the pressurized cabin according to a definite law.

II. TECHNICAL DATA

Air consumption	200–2,000 kg/hr.
Differential pressure in cabin at altitudes of 0 to 2,000 m at air consumption of 1,000 kg/hr.......	not more than 25 mm.Hg.
Const. absolute pressure at air consumption of 50 to 1,000 kg/hr at altitudes of 2,000 to 7,100 m under normal conditions and of 2,000 to 4,300 m under combat conditions.........................	596 ± 15 mm.Hg.
Constant differential pressure in cabin:	
At altitudes of 4,300 to 20,000 m under combat conditions	147 ± 15 mm.Hg.
At altitudes of 7,100 m to 20,000 m under normal conditions	294 ± 15 mm.Hg.
Speed to change from normal to combat conditions.......................	10 mm.Hg/sec.
Speed to change from combat to normal conditions	from 1.5 to 5 mm.Hg./sec.
Speed of pressure increase in cabin at differential vertical speeds and with cabin pressurization system on...	from 1.5 to 5 mm.Hg./sec.

Air leakage through air pressure
regulator at differential pressure
of 235 mm.Hg............................ not more than 65 litres/min.
Hydraulic resistance of air pressure
regulator valve in return line at
air consumption of 500 kg/hr............ not more than 10 mm.Hg.
Operating voltage .... 27 V ± 10% D.C.
Current .... 0.45 ± 0.03 a
Service life ....1000 flying hours
Weight .... not more than 4 kg.

III. D E S I G N

The external view of the cabin air pressure regulator is given in Fig.1.

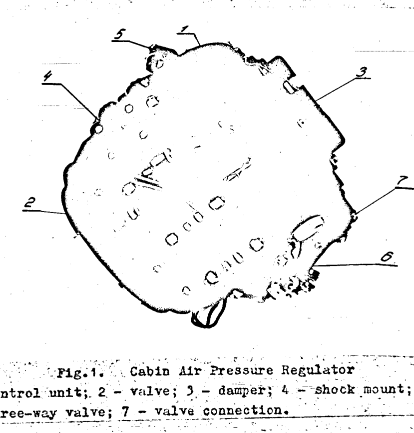

Fig.1. Cabin Air Pressure Regulator
1 - Control unit; 2 - valve; 3 - damper; 4 - shock mount; 5 - tee; 6 - three-way valve; 7 - valve connection.

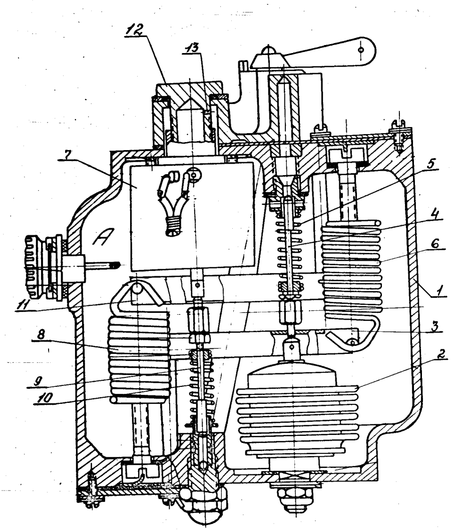

Fig.2. Design of Control Unit

1 - Casing; 2 - bellows; 3 - rod; 4 - absolute pressure valve; 5 - valve spring; 6 - spring; 7 - solenoid; 8 - spring; 9 - differential pressure valve; 10 - valve spring; 11 - rod; 12 - connection; 13 - hole; 0.5 mm.dia. for communication with atmosphere.

The differential pressure unit comprises: solenoid (7), spring (8), valve (9), valve spring (10) and rod (11).

The valves springs (5 and 10) press the valves (4 and 9) to shanks of the bellows (2) and solenoid (7) respectively.

The solenoid (7) is designed to change the adjustment of the valve opening differential pressure.

The solenoid design is given in Fig.3.

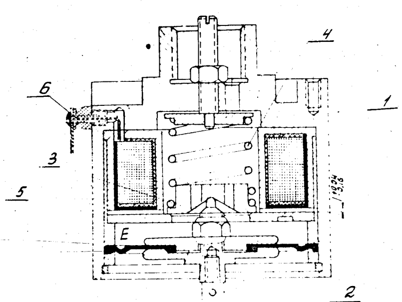

Fig.3. Design of Solenoid

1 - Solenoid coil; 2 - diaphragm; 3 - washer; 4 - spring; 5 - washer; 6 - wires running to plug connector.

... the solenoid are diaphragm (2, Fig.3), washer(3), ... (5) and wires (6) running to the plug connector.

... (2) in the solenoid separates the control unit ... the solenoid cavity E which in its turn communicates

The differential pressure unit comprises: solenoid (7), spring (8), valve (9), valve spring (10) and rod (11).

The valves springs (5 and 10) press the valves (4 and 9) to shanks of the bellows (2) and solenoid (7) respectively.

The solenoid (7) is designed to change the adjustment of the valve opening differential pressure.

The solenoid design is given in Fig.3.

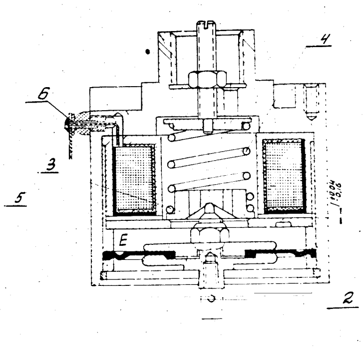

Fig.3. Design of Solenoid

1 – Solenoid coil; 2 – diaphragm; 3 – washer; 4 – spring; 5 – washer; 6 – wires running to plug connector.

The main parts of the solenoid are diaphragm (2, Fig.3), washer(3), spring (4), washer (5) and wires (6) running to the plug connector.

The diaphragm (2) in the solenoid separates the control unit cavity A from the solenoid cavity E which in its turn communicates

with atmosphere through the three-way valve by means of the hole
54 (13, Fig.2) in the connection (12).

The diaphragm position is determined by pressure differences between the cavities A and B (Fig.3).

With the solenoid de-energized, the washer (5, Fig.3) is released by the action of the spring (4) and occupies the lower position.

The spring (8, Fig.2) is adjusted so that the differential pressure valve (9) would open at an altitude of 7,100 m/pressure difference between the cavities A and B is 294 ± 15 mm.Hg./

With the solenoid energized the washer (5) by action of the electromagnetic forces is pulled up to the solenoid coil compressing the spring (4). Due to that the adjustment of the differential pressure valve (9) opening is changed and the valve opens at an altitude of 4,300 m.(pressure difference between cavities A and B is 147±15 mm.Hg.)

The design of the valve is given in Fig.4.

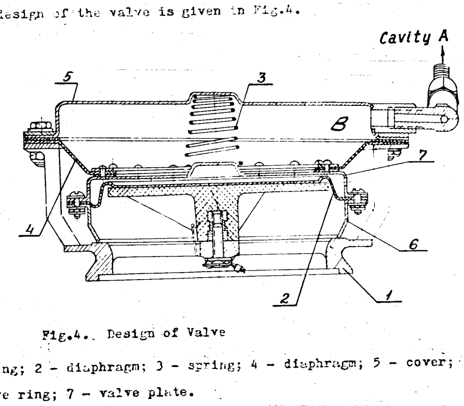

Fig.4. Design of Valve

1 - Casing; 2 - diaphragm; 3 - spring; 4 - diaphragm; 5 - cover; 6 - valve ring; 7 - valve plate.

54 The valve main parts are: casing (1, Fig.4), diaphragm (2), spring (3), diaphragm (4), valve ring (6) and valve plate (7).

Screwed in the cover (5) is the connection which connects the valve cavity B to the control unit cavity A through a hose.

The valve plate (7) is provided with a hole 4.5 mm.dia. The hole connects the cavity between the diaphragm (2) and plate (7) to the cabin.

The diaphragm (2) prevents atmospheric pressure from affecting the valve plate (7).

Given in Fig.5 is the design of the damper.

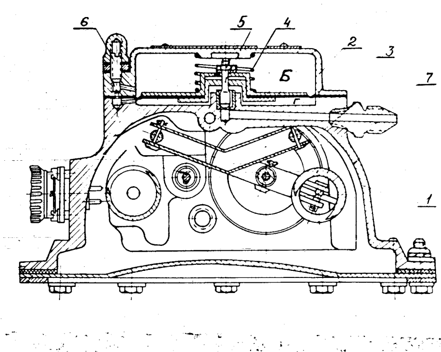

Fig.5. Design of Damper

1 - Control unit casing; 2 - casing; 3 - diaphragm; 4 - spring; 5 - valve; 6 - needle; 7 - connection.

The damper is designed to increase the speed of the valve (2, Fig.1) opening in case of a sudden increase in air supply to the cabin, thus preventing a momentary pressure increase in the cabin.

The damper is provided because pressure in the control unit changes at a low speed which is limited by the clear opening of the tee (5, Fig.1) filter metering hole and the clear openings of the valves (4, and 9, Fig.2).

Due to a low speed of the pressure change in the control unit, the speed of the valve (2, Fig.1) lifting and opening is lower than that of change in air supply to the cabin and if no damper is available, change in air supply to the cabin may cause fluctuations of the cabin pressure. If the metering hole in the tee (5, Fig.1) filter and the clear openings of the valves (4 and 9, Fig.2) are constant the speed of the pressure increase in the cabin is adjusted by the damper. The speed of the pressure increase is adjusted by moving the needle (6, Fig.5) and changing the size of the casing (2) hole.

In this case the speed of the pressure increase, adjusted by the damper, is a constant value which does not depend on the aircraft vertical speed.

The main parts of the pressure regulator damper are: casing (2), control unit casing (1), diaphragm (3), spring (4), valve (5), needle (6) and connection (7). The inner cavity of the damper is divided into the cavities Б and Г by the diaphragm (3).

The cavity Г communicates with the cavity А of the control unit (Fig.2).

With the valve (5, Fig.5) open the cavity Г communicates with atmosphere through the connection (7). The cavities Б and Г communicate with each other through the hole, 0.7 mm.dia., in the casing(2). The size of the hole is adjusted by the needle (6).

IV. OPERATION

The schematic diagram of the automatic air pressure regulator is given in Fig.6.

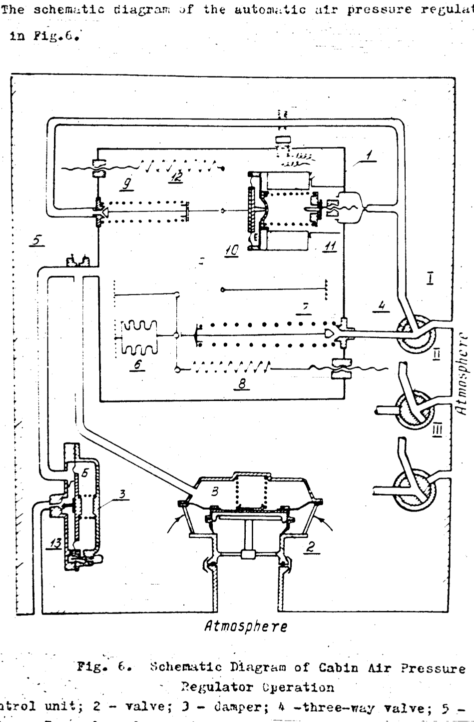

Fig. 6. Schematic Diagram of Cabin Air Pressure Regulator Operation

1 - Control unit; 2 - valve; 3 - damper; 4 -three-way valve; 5 - nozzle; 6 - bellows; 7 - valve; 8 - spring; 9 - valve; 10 -diaphragm; 11 - spring; 12 - spring; 13 - valve.

54 Air flow through the pressurized cabin is ensured by the air pressure regulator valve (2, Fig.6).

The degree of the valve opening is automatically maintained to provide the required pressure in the cabin and depends on the altitude and engine rating.

The control unit cavity A communicates with atmosphere through the three-way valve (4) up to an altitude of 2,000 m., the pressure in the cavity A is below that in the pressurized cabin by the value of the nozzle (5) hydraulic resistance(the nozzle is a connection with a calibrated hole). The cavity A communicates with the cavity B of the valve (2).

The cabin is freely ventilated through the valve (2) up to the above mentioned altitude.

When atmospheric pressure decreases (with increase in altitude) the force, acting on the bellows (6), drops and the valve (7) begins closing by the action of the spring (8); the valve is fully closed at an altitude of 2,000 m.

With increase in altitude from 2,000 m. to 7,100 m. constant pressure corresponding to atmospheric pressure at an altitude of 2,000 m. is maintained in the cavity A. Due to that, constant absolute pressure is maintained in the pressurized cabin.

At an altitude of 7,100 m. and higher the differential pressure regulator begins operating and the valve (9) opens as pressure difference acting on the diaphragm (10) comes to the value which produces the force exceeding that of the springs (11 and 12).

Thus beginning with the altitude of 7,100 m. a constant pressure difference is maintained between the cavity A and atmosphere.

With the solenoid de-energized (normal conditions) pressure difference is 294 ± 15 mm.Hg., with the solenoid energized (combat conditions) - 147 ± 15 mm.Hg.

This constant pressure difference between the cavity A and atmosphere ensures constant differential pressure in the pressurized cabin.

The three-way valve can be set in three positions:

I - for normal operation;

II - for checking differential pressure in the cabin on the ground;

III - the valve is off (checking the cabin pressurization on the ground).

When the aircraft rapidly descends the valve (2) outlet back pressure increases; this results in the pressurized cabin pressure increase which affects the cavities A, B and Γ causing the air discharge from these cavities to atmosphere through the valve (13). Due to that a large degree of the valve (2) opening is obtained and the required pressure is maintained in the cabin. The same occurs in case of a sudden increase in air flow from the engine compressor.

Pressure in the cabin versus altitude is given in Fig.7.

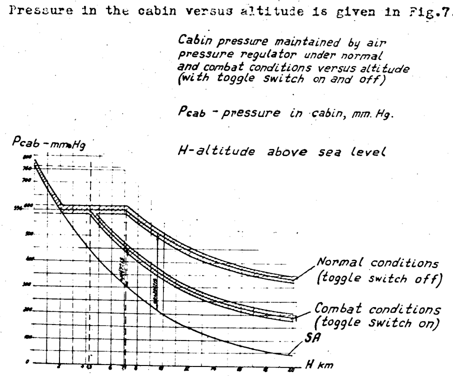

Fig.7. Pressure in Pressurized Cabin Versus Altitude.

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The cabin is freely ventilated from the ground up to an altitude of 2,000 m.: in this case differential pressure does not exceed 25 mm.Hg.

At an altitude of 2,000 m. to 7,100 m. (normal conditions) and 2,000 m. to 4,300 m. (combat conditions) constant absolute pressure is 596 ± 15 mm.Hg.

At an altitude of 4,300 m. to 20,000 m. (combat conditions, the toggle switch is on) constant differential pressure is 147±15 mm.Hg. and at an altitude of 7,100 m. to 20,000 m. (normal conditions, the toggle switch is off) – 294±15 mm.Hg.

V. INSTALLATION AND MAINTENANCE

1. Before installing the regulator in aircraft:

a) inspect it, check for presence of locking and seals;

b) check the pressure regulator attachment clamp for condition.

2. Install the cabin pressure regulator inside the pressurized cabin and attach its casing to the outlet hole flange by a clamp.

To install the regulator properly, the attachment flange for the clamp must be produced according to the drawing, Fig.8.

When installing the pressure regulator its axis should be in the vertical position.

3. The static pressure tube of the control unit should be placed in the area of the least changes in atmospheric pressure independent of the flight condition.

4. After installing the regulator in aircraft, connect the electrical wires to the plug connector.

5. Attach the regulator by a clamp using a bolt. Tighten the bolt with a torque wrench to a torque of 10 to 30 kg.

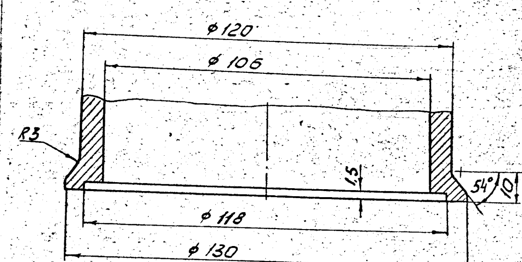

Fig. 8. Attachment Flange for Clamp

6. To check differential pressure in the cabin on the ground, set the three-way valve in the middle position.

7. To check the cabin pressurization, turn the three-way valve counterclockwise to the extreme position, do not plug the valve outlet.

8. To ensure normal operation of the regulator, turn the three--way valve clockwise to the extreme position and secure its connection with a wire.

VI. SERVICE TROUBLES AND REMEDIES

Trouble	Probable Cause	Remedy
1. Considerable differential pressure in cabin.	a) Regulator three-way valve closed.	a) Turn valve lever according to instruction.

Trouble	Probable Cause	Remedy
	b) Loose pipes connecting three-way valve and damper to atmosphere.	b) Tighten nuts.
	c) Leaking seal washers.	c) Remove regulator and check it for air tightness at pressure of 0.3 kg/cm^2. Check for air tightness by dipping regulator in bath with alcohol and by supplying air through three-way valve connection; damper connection being plugged. Eliminate leakage. Do not tighten locking nuts of valves (4 and 9, Fig.2) seats.
2. Low differential pressure.	a) Leaking damper valve.	a) Disconnect pipe, connecting damper to atmosphere and plug it. If pressure has come to normal, defect is proved. To eliminate valve leakage, disassemble damper and wash valve and seat; fit valve to seat, if necessary.

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Trouble	Probable Cause	Remedy
	b) Differential pressure valve leaking.	b) Test regulator for air tightness in bath with alcohol. If defect is proved, disassemble control unit, wash or fit it, if necessary to eliminate leakage.
3. No constant differential pressure at altitudes above 7,100 m. With increase in altitude, pressure increases with decrease in altitude - decreases.	Differential pressure valve sticking.	Disassemble control unit and eliminate differentail pressure valve sticking.
4. Considerable differential pressure at altitudes up to 2,000 m. (above 25 mm.Hg.)	Bellows untight.	Replace bellows.
5. Equal pressures under normal and combat conditions.	a) Solenoid circuit damaged.	a) Ring electrical circuit. Replace solenoid, if necessary.
	b) Solenoid armature sticking.	b) Replace solenoid.
6. Defective shock mounts.		Replace shock mounts.

COOLING TURBINE

Model 5195

COOLING TURBINE

Model 5I9B

COOLING TURBINE

Model 519B

DESCRIPTION

INSTALLATION AND MAINTENANCE INSTRUCTIONS

CONTENTS

I. PURPOSE

The cooling turbine is designed to cool the air supplied to the aircraft pressurized cabin from the turbo-jet engine compressor.

The external view of the cooling turbine is given in Fig.1.

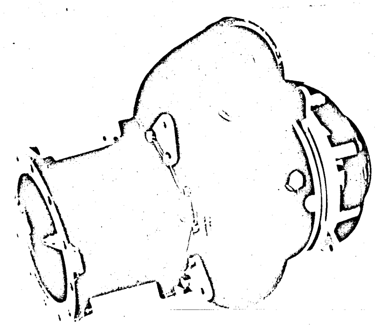

Fig.1. Cooling Turbine External View

II. TECHNICAL DATA

(for normal ground conditions)

Parameters	Range I	Range II
Cabin air consumption, kg./hr.	[illegible] ±100	1300±100
Inlet air pressure in cooling turbine, atm.	[illegible]	2.3[illegible]
Outlet air pressure in cooling turbine, atm.	[illegible].2	[illegible].2
Inlet air temperature in cooling turbine, °C	[illegible]±5	[illegible]±5

Parameters	Range I	Range II
Temperature difference	not less than 50°C	not less than 50°C
Cabin air leakage from cooling turbine	not more than 5 kg/hr.	not more than 5 kg/hr.
Weight	not more than 9 kg.	

III. DESIGN

The cooling turbine consists of the turbine and fan which are connected by a common shaft installed on two ball bearings.

The cooling turbine design is given in Fig.2.

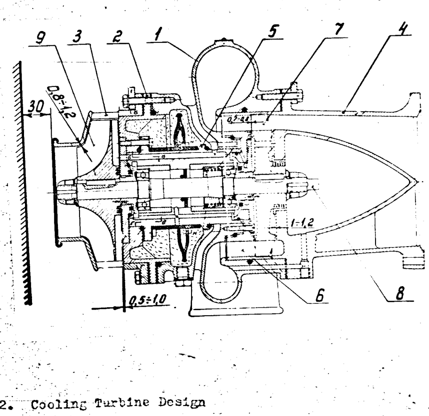

Fig.2. Cooling Turbine Design

1 – Turbine casing; 2 – turbine casing cover; 3 – fan casing; 4 – exhaust pipe; 5 – bearing casing; 6 – turbine nozzle assembly; 7 – turbine disc; 8 – shaft; 9 – fan.

The main parts of the cooling turbine are: turbine casing, turbine casing cover, fan casing, exhaust pipe, bearings casing, turbine nozzle assembly, turbine disc, shaft and fan.

The turbine casing (1) is provided with an inlet pipe for supplying hot air to the turbine nozzles.

The turbine casing cover (2) is intended for attaching the bearing casing (5) and is bolted to the turbine casing (1) end.

The fan casing (3) directs air sucked by the fan from atmosphere and is bolted to the turbine casing (1) end together with the turbine casing cover (2). The exhaust pipe (4) is used to release cold air and is also bolted to the turbine casing (1) end.

The bearing casing (5) is screwed to the turbine casing cover(2) and is used for attaching the bearings. The bearing casing is provided with holes to lubricate and cool the bearings. The turbine nozzle assembly (6) is used for converting air potential energy into kinetic one.

The turbine disc (7) is used for converting air kinetic energy into mechanical one. The shaft (8) combines all the rotating parts into one unit- rotor.

The fan (9) is designed to pick up power produced by the turbine rotor.

Structurally the turbine is of an axial-flow, single-stage type .

The rotor rotates in two radial ball bearings. The bearings are wick lubricated. Oil is filled in the turbine casing (1) through one of the four holes intended for the oil filling. The inner cavity of the turbine (1) is filled with cotton impregnated with oil which is supplied to the shaft (8) by means of the wicks.

IV. OPERATION

Compressed air from the turbo-jet engine compressor is supplied through the air-to-air heat exchanger to the turbine nozzle assembly (2, Fig.3) at a temperature up to +75°C and pressure up to 3.33 atm. In the nozzle assembly the air potential energy is converted into kinetic one. Air supplied at a hight speed from the nozzles to the turbine disc (3) blades makes the latter rotate.

Thus, the air kinetic energy is converted into mechanical one. Power produced by the turbine rotor is picked up by the fan (1). The fan sucks air directly from atmosphere. On accomplishing the operation on the turbine disc blades the air leaves the blades having lower speed, pressure and temperature. Air is supplied to the aircraft pressurized cabin through the exhaust pipe.

V. INSTALLATION AND MAINTENANCE

Before installing the cooling turbine in aircraft depreserve it and check for:

a) freedom from damages on the surface;

b) presence of locking and seals;

c) freedom from traces of corrosion;

d) presence of certificate;

e) smooth rotation of the turbine rotor by hand.

When installing, ensure that all the connections and air ducts are air-tight. The cooling turbine should be flexibly connected to the air ducts. Attach the cooling turbine by lugs in the horizontal position on shock mounts.

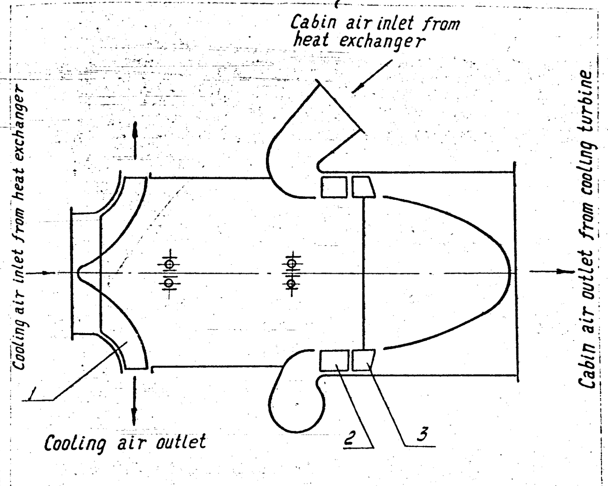

Fig.3. Schematic Diagram of Cooling Turbine

1 – Fan; 2 – turbine nozzle assembly; 3 – turbine disc.

The clearance between the fan casing end and nearest part of the aircraft should be not less than 30 mm.(See Fig.2). Lubricate the bearings with ЛНМЗ 36/1 oil.

After every 25 hours of operation fill 55 gr. of oil in the cooling turbine casing through one of the holes intended for this purpose.

The oil should have a certificate.

The temperature of air supplied to the fan should not exceed +50°C.

ABSOLUTE AIR PRESSURE REGULATOR

Model 644B

DESCRIPTION, INSTALLATION,

OPERATION INSTRUCTIONS

ABSOLUTE AIR PRESSURE REGULATOR

Model 644B

DESCRIPTION, INSTALLATION AND OPERATION INSTRUCTIONS

CONTENTS

I. PURPOSE

The 644B absolute air pressure regulator is designed to maintain absolute pressure of air supplied to the aircraft air conditioning and de-icing systems.

II. MAIN TECHNICAL DATA

Air inlet pressure .... 3.5-8 atm.
Air outlet pressure .... 3.2±0.2 atm.
Air inlet temperature .... from +180 to +280°C
Air consumption .... 1300 ± 100 kg/hr.
Hydraulic resistance at air
consumption of 900±100 kg./hr,
air inlet pressure of 3.0 atm
and air inlet temperature of 25±10°C... not more than 0.4 kg./cm.²
Air leakage through regulating valve
at inlet pressure of 3.0 atm with out-
let hole closed and air inlet tempe-
rature of +260°C .... not more than 100 l/min.
Weight .... not more than 3.5 kg.

III. DESIGN

General view of the 644B absolute air pressure regulator is illustrated in Fig.1. Construction of the regulator is shown in Fig.2.

The 644B regulator consists of the following units and parts: cast casing (1), screwed in which is the bushing (4) and cover (3) with pressed in it bushing (2). The casing (1) houses: the valve assembly (5), bottom cover (6), actuating bellows (7), top cover (8), control bellows (9).

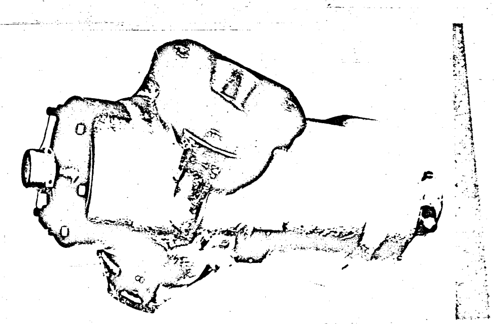

Fig.1. 644B Absolute Air Pressure Regulator.
General View.

The valve assembly (5) consists of the following parts: spindle (10), piston (11) and valve (12), tightened with nut (13).

The valve assembly (5) serves as a movable shutter ensuring the required air outlet pressure by varying the clear opening between the valve (12) and seat (B). The threaded end of the valve (5) spindle (10) is screwed to the threaded shank on the bottom (24) of the actuating bellows (7) and prevented from unscrewing by the washer(16).

The bottom cover (6) consists of the body (14), guide bushing (15) and safety washer (16).

Located in the cover (6) is the damper (17) protecting the regulator from self-oscillation.

The damper (17) consists of the split bushing (18), stop (19), spring (20) and nut (21). To ensure airtight condition the cap (22) is screwed on the cover (6).

Fig.2. 644B Absolute Air Pressure Regulator Design

1 - Casing; 2 - bushing; 3 - cover; 4 - bushing; 5 - valve assembly; 6 - bottom cover; 7 - actuating bellows; 8 - top cover; 9 - control bellows; 10 - spindle; 11 - piston; 12 - valve; 13 - nut; 14 - cover body; 15 - bushing; 16 - safety washer; 17 - damper; 18 - split bushing; 19 - stop; 20 - spring; 21 - nut; 22 - cap; 23 - flange; 24 - bellows bottom; 25 - bellows; 26 - adjusting screw; 27 - emergency valve; 28 - bellows base; 29 - bellows; 30 - cover; 31 - spring; 32 - adjusting screw; 33 - spring; 34 - locking ball; 35 - cap.

The cover (6) is secured to the casing (1) with six studs and nuts 5x0.8.

The actuating bellows (7) is designed to move the valve assembly (5) during operation of the regulator.

The actuating bellows assembly (7) consists of the following parts: flange (23), bottom (24) and bellows (25). Top cover (8) serves as a housing in which there are control bellows (9), adjusting pin (26) and emergency valve (27). The cover (8) is attached to the casing (1) with eight studs and nuts 5x0.8.

The control bellows (9) is designed to maintain constant absolute air pressure in the inner chamber of the actuating bellows (7); the pressure should be equal to the required absolute air pressure at the regulator outlet. The control bellows controls the actuating bellows (7) and valve (5).

The control bellows assembly consists of the base (28), bellows (29), cover (30) and spring (31). The air from the inner chamber of the bellows (29) is evacuated. The control bellows (9) is secured to the top cover (8) by means of threaded joint. The control bellows (9) is adjusted for the required outlet pressure by rotating the adjusting screw (26) and the base (28).

The adjusting screw (26) is designed to adjust the regulator air outlet pressure.

The emergency valve (27) consists of the following parts: adjusting screw (32), spring (33) and lock ball (34). The emergency valve is designed to function as a control bellows (9) in case of vacuum loss in the bellows (29). In this case the regulator air outlet pressure will be maintained by the emergency valve about 1 kg./cm.^{2} higher than the required value.

The cap (35) serves to protect the emergency valve (27) and adjusting screw (26) from clogging and damage.

In addition the cap serves to collect the air released by the regulator in operation and evacuate it to atmosphere or to the lowest pressure compartments in the aircraft.

IV. OPERATION

Operation of the 644B regulator is as follows:

Air from the pipeline enters the regulator inlet chamber at a pressure of 3.5-8 atm.

At the same time through a special passage in the regulator casing (1)(Fig.3) and metering hole the air enters the actuating bellows (2) and through the open valve (3) the air comes into the outlet chamber (E) and actuating bellows chamber (B).

Initially (at an intake pressure of 3 atm.) the valve (3) is fully open, adjusting screw (5) hole closed, actuating bellows (2) and control bellows (6) are static. With the air inlet pressure increasing the air pressure in other cavities increases too.

Air that has come into the inner chamber of the actuating bellows (2) compresses the vacuum bellows (6) adjusted for the required pressure at the regulator outlet. As a result of this excess air is released through the hole in the adjusting screw (5) and therefore air pressure in the inner chamber of the actuating bellows (2) is established equal to the required regulator outlet pressure of 3.2 ± 0.2 atm. This creates difference between pressure in the inner chamber of the actuating bellows and outlet pressure acting on the outer surface of the actuating bellows (2).

Affected by the pressure difference the bellows (2) will be compressed and will move the valve (3) up thus lessening the clear opening and air outlet pressure down to the required value.

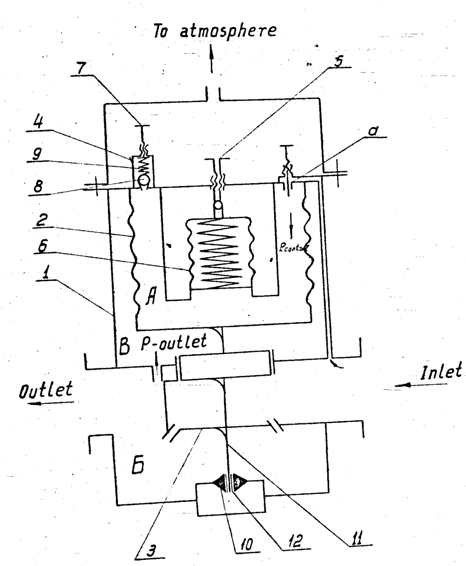

Fig.3. 644B Absolute Air Pressure Regulator Schematic Diagram

1 – Casing; 2 – actuating bellows; 3 – valve; 4 – emergency valve; 5 – adjusting screw; 6 – control bellows; 7 – adjusting screw; 8 – ball; 9 – spring; 10 – damper; 11 – spindle; 12 – bushing.

Decreasing of the regulator air inlet pressure will produce the reverse action.

At further altering of the regulator air inlet pressure the reverse action will occur.

Automatic regulation of air pressure is thus achieved.

The emergency valve (4) is put in operation in case of vacuum loss in the control bellows (6), when the hole in the adjusting screw(7) closes by the lock ball (8) actuated by the spring (9). In this case air cannot be released through the hole, and pressure in the inner chamber of the actuating bellows (2) will be increased up to 4.2 ± 0.2 atm and thus will exceed by 1 atm the pressure for which the emergency valve (4) is adjusted. As a result of this the excessive pressure is released through the screw (7) hole of the emergency valve.

In this case the emergency valve (4) functions as the control bellows (6) maintaining the regulator outlet pressure about 4 kg./cm.^{2} higher than the required pressure.

Self oscillations of the regulator moving system are damped by the damper (10) in which friction forces that appear between the spindle (11) and bushing (12) damp oscillations of the valve (3) without hindering its smooth movement.

V. INSTALLATION AND OPERATION INSTRUCTIONS

Before installing the pressure regulator depreserve it and check for:

a) dents or damage on the regulator surface;

b) locking;

c) corrosion signs;

d) having a certificate.

Install the absolute pressure regulator by means of a clamp in the line upstream of the consumer so that the air flow is directed along the arrow painted on the regulator casing. Do not readjust the pressure regulator neither lubricate it in operation.

AIR-TO-AIR HEAT EXCHANGER

Model 906

DESCRIPTION

MOUNTING AND OPERATION INSTRUCTIONS

AIR-TO-AIR HEAT EXCHANGER

Model 906

DESCRIPTION AND MOUNTING AND OPERATION INSTRUCTIONS

CONTENTS

Declassified in Part - Sanitized Copy Approved for Release 2012/01/05 : CIA-RDP80T00246A064300130001-3

I. PURPOSE

The air-to-air heat exchanger model 906 is designed for preliminary cooling the cabin air entering a cooling turbine.

The heat exchanger external view is shown in Fig.1.

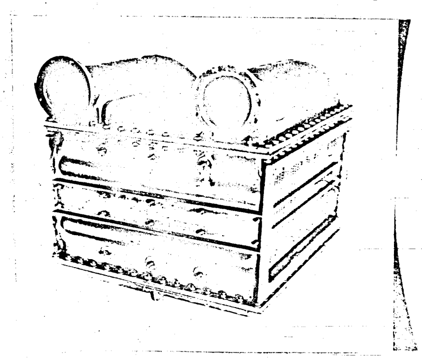

Fig.1. Air-To-Air Heat Exchanger, External View

II. PRINCIPAL TECHNICAL DATA

Hot air area .... 2.6 dm^2

Cold air area .... 5.46 dm^2

Cooling area .... 9 m^2

Cooling elements type and dimensions:

flat tube, 5.6x75 mm............... δ =0.8

corrugated plate, 2x4 mm........... δ =0.15

Number of heat exchanger tubes 144

Destruct pressure .... not less than 5 kg./cm.^{2}

Operating pressure in tubular cavity...... 2.5 kg./cm.^{2}

Air test pressure .... 3.1 kg./cm.^{2}

Water test pressure .... 3.7 kg./cm.^{2}

Dry weight .... not more than 26 kg.

III. D E S I G N

The heat exchanger consists of the following main elements: cooling elements, two covers and casing. The heat exchanger casing is shown in Fig.2.

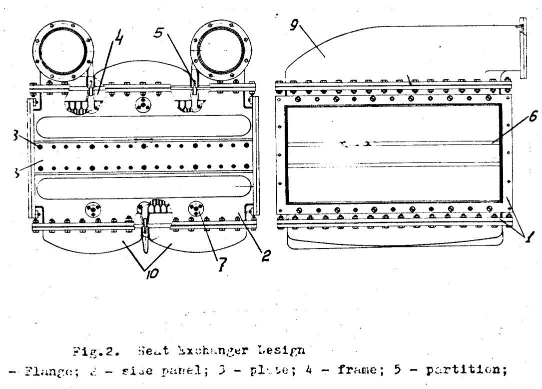

Fig.2. Heat Exchanger Design

1 - Flange; 2 - side panel; 3 - plate; 4 - frame; 5 - partition; 6 - distance tube; 7 - brace strut; 8 - nut; 9 - top cover; 10 - bottom cover

Cooling elements employ flat tubes (2, Fig.3) with sides of 5.6x75 mm. and wall of 0.8 mm. thick.

The tube ends have a rectangular shape with sides of 9.6x75 mm.

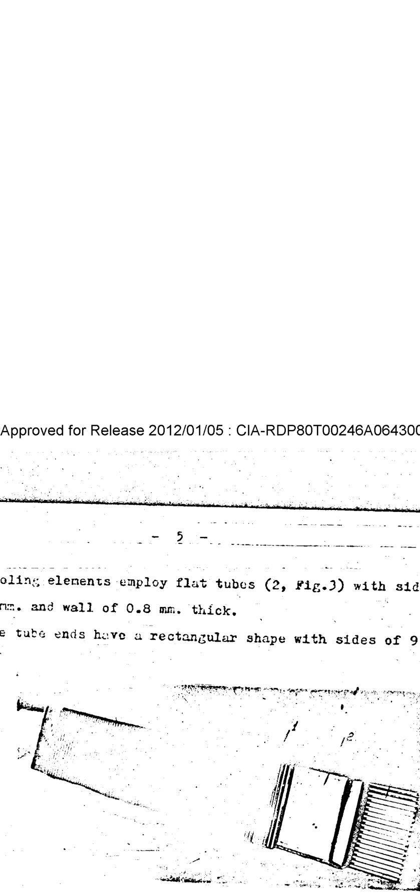

Fig.3. Heat Exchanger Cooling Elements

1 - Corrugated plate for outer finning; 2 - tube; 3 - corrugated plate for inner finning.

The heat exchanger cooling elements assembly consists of four sections.

Each section is assembled of 36 tubes closely fitted to each other; the ends are welded with athetylene welding.

To increase the cooling area, the inner and outer walls of the tubes (2) are finned with the corrugated plates (1 and 3) of 0.15 mm. thick.

Fitted to the extreme tubes section walls are stiffening corrugated plates with a wall thickness of 0.5 mm.

The corrugated plates are soldered to the tube walls. Welded to the section ends are the frames (4, Fig.2) by means of which the sections are welded to the heat exchanger casing.

Inside the heat exchanger, the sections are devided by partitions forming four hot (cabin) air passages and one cold (ram) air passage.

The cabin air passes inside the tubes cooled from outside with ram air (See Fig.4). The ram air flow is limited by the side panels (2). The side panels are corrugated to stiffen the structure and to provide temperature compensation of the heat exchanger casing and cooling elements under various temperature conditions.

Welded to the two sides of the casing (ram and cabin air areas) are flanges to connect the heat exchanger to the covers and duct.

To prevent the side panels deformation due to internal pressure, the side panels are braced by round-shaped struts (7) of 4 mm. in dia.

The struts are attached by the nuts (8) located inside the plate (3) from the side panels outer surfaces.

The plate is welded to the side panels with a spot welding.

The brace struts extreme rows, installed in the ram air area, are inserted in the distance tubes (6).

The covers (9,10) are fitted with the partitions (5) which serve for changing the direction of air flow by-passing it from one row of the sections to another.

IV. OPERATION

The hot and cold air circulation is shown in Fig.4.

The hot air bled from the engine compressor enters the heat exchanger and passes inside the tubes. On passing all the sections, the air from the last section flows to the outlet pipe. The cold (ram) air flows through the intertubes space,and cools the outer surface of the tubes.

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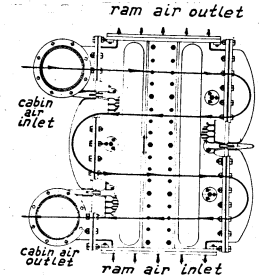

Fig.4. Cabin and Ram Air Circulation Diagram.

V. MOUNTING AND OPERATION INSTRUCTIONS

Before installing the heat exchanger in an aircraft inspect it visually. Inspect the heat exchanger surfaces for dents and other damage which might be caused during transportation or storage.

It is permitted to remedy the cover dents (if metal is not damaged) and remedy the ram air flanges deformation, if any.

Remedy the above defects without disassembling the heat exchanger.

After that, if necessary, test the heat exchanger for tightness.

To test the heat exchanger for tightness, plug the two pipes of the cover (9, Fig.2). One of the plugs must be fitted with a pipe to connect a compressed air bottle hose.

The diagram for testing the heat exchanger for tightness is shown in Fig.5.

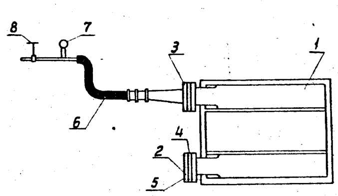

Fig.5. Diagram for Testing the Heat Exchanger for Tightness

1 - Heat exchanger; 2 - plug; 3 - plug with pipe 4 - rubber gasket; 5-6 mm. thick; 5 - bolts, nuts (screw clamps are permitted); 6 - hose; 7 - pressure gauge; 8 - air valve.

After the bottle is connected to the heat exchanger apply an air pressure of 3.0-3.3 kg./cm.^{2} to the heat exchanger inlet and keep it under this pressure for 2-3 minutes. Observing the reading of the pressure gauge (with a scale division value of 0.1 kg./cm.^{2}) set a pressure of 3 kg./cm.^{2} and close the air valve.

The heat exchanger is considered meeting the specifications if a pressure drop from 3 to 2.5 kg./cm.^{2} takes not less than 10 minutes.

When installing or removing the heat exchanger, use special supports padded with rubber, felt, etc.

The heat exchanger is attached in the aircraft by the ram air flanges.

Attach the cabin air pipes to the heat exchanger cover pipes flanges. Place rubber or paronite gaskets between the heat exchanger and airpipes flanges to provide tightness of the connections.

The heat exchanger does not require any maintenance operations during its guaranteed service life.

INVERTER Model ПТ-500Ц

DESCRIPTION AND OPERATION INSTRUCTIONS

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INVERTER Model ПТ-500Ц

DESCRIPTION AND OPERATION INSTRUCTIONS

I. GENERAL

The ПТ-500Ц inverter serves to convert direct current (27 V) into three-phase (36 V, 400 c.p.s.) A.C. and is designed for a centralized A.C. power supply to the aircraft unit.

Structurally the inverter is protected and provided with a cooling fan.

The inverter consists of:

a) D.C. electric motor;

b) three-phase synchronous generator;

c) КСУ-500Ц control box, which incorporates control units, D.C. and A.C. filters reducing the level of the inverter radio noises and units ensuring a remote-control starting of the inverter.

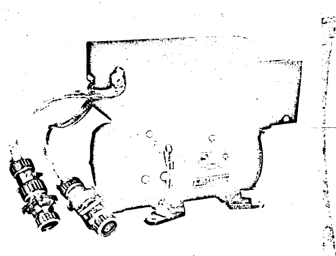

Fig.1. Inverter External View

TECHNICAL DATA

1. Supply voltage .... 27 V
2. Current consumed .... not more than 37 A

3. Speed .... 12,000 r.p.m.
4. Output voltage .... 36 V
5. Load current .... 8 A
6. Output power .... 500 vA
7. Power factor (lagging) 0.8
8. A.C. frequency .... 400 c.p.s.
9. Efficiency 40%
10. Weight (with control box) .... not more than 15 kg.
11. Service life .... 500 hours
12. Duty .... continuous

With variation in supply voltage within 27 V ± 10%, with load varying from 500 Va to 0, at ambient temperature of +50° to -60°C at altitude of 0 to 20,000 m, the arithmetical mean of three a.c. line voltages is maintained within 36 V ± 5% and the frequency - within 400 c.p.s. ± 2%.

OPERATING CONDITIONS

a) Ambient air temperature range ..... from +50°C to -60°C
b) Relative humidity .... up to 98%
c) Altitude above sea level........... from 0 to 20,000 m.

The inverter operates normally with nominal load under the following altitude conditions:

1. At an altitude of 16,000 m. and a temperature of -5°C within 2 hours when climbing to an altitude of 20,000 m at a temperature of +40°C.

Operating time at an altitude of 20,000 m....... 5 min.

2. At an altitude of 9,000 m and a temperature of +90°C within 5 minutes when climbing to an altitude of 16,000 m. at a temperature of -5°C.

Operating time at an altitude of 16,000 m – 2 hours.

d) Vibration at attachment points in accordance with diagram No.3 OTC-53.

e) Short-time shaking at 4 g appearing ~~[illegible]~~ at the aircraft landing and landing run.

f) Line acceleration in three mutually perpendicular planes .... up to 8 g.

WINDING DATA

Electric Motor Field Winding

	Series winding	Control winding
Number of coils	4	4
Diameter of bare wire	1.25x4.7 mm	0.62 mm.
Type of wire	ПЭТКСОТ	ПЭВ-2
Number of turns in coil	2	590
Average length of turn	0.202 m	0.141 m
Total resistance at 20°C	$0.005^{+18\%}_{-6\%}$	19.3±8%

Electric Motor Armature Winding

Type of winding .... wave
Number of parallel circuits .... 2 A
number of slots in armature 25
Number of active wires in slot 6
Size of bare wire .... 0.9x2.1 mm.
Type of wire .... ПЭТКСОТ
Slot pitch............................... 1-7

Commutator pitch 1-38

Total armature winding resistance
at 20°C .... 0.034 ohm

Commutator and Brushes

Number of commutator segments 75
Number of brushes 4
Type of brushes МГС-7
Length of brushes .... 6.5x12.5 mm
Spring pressure on brush .... 380 ± 40 gr

Generator Operating Winding

Diameter of bare wire .... 0.96 mm
Type of wire ПЭВ-2
Number of active wires in slot.......... 6 (in two lines)
Total number of wires in slot 12
Number of turns in phase 30
Average length of turn .... 0.32 m.
Phase resistance .... 0.12 ohm
Number of slots 30

Generator Control Winding

Diameter of bare wire .... 0.72 mm.
Type of wire ПЭВ-2
Number of active wires in slot 50
Total number of turns 1,500
Average length of turn .... 0.124 m.
Total resistance at 20°C .... 8 ohms

Generator field - a permanent magnet of special alloy.

Ball Bearings

7П180502ЗСI bearings of inclosed type with the 122-7 lubricant are used in the inverter.

III. ELECTRICAL SYSTEM AND PRINCIPLE OF OPERATION

The electrical system operation.

The inverter electrical system provides:

a) remote-control starting;

b) reducing the level of the inverter radio noises;

c) inverter output voltage stabilization;

d) inverter frequency stabilization.

Inverter Remote-Control Starting

The inverter is started or stopped by means of the switch (B); when the switch closes, the operating winding of the starting contactor (K) is connected with the negative terminal of the aircraft electrical system via the pins (4) and (5) of the ШР-I plug connector.

The contactor is actuated and connects the inverter to the aircraft electrical system.

Reducing the Level of the Inverter Radio Noises

To reduce the level of the inverter radio noises to the permissible limits, provided in the D.C. circuit is a П-shaped filter, consisting of a choke with a core (ДР) and four capacitors (C_8).

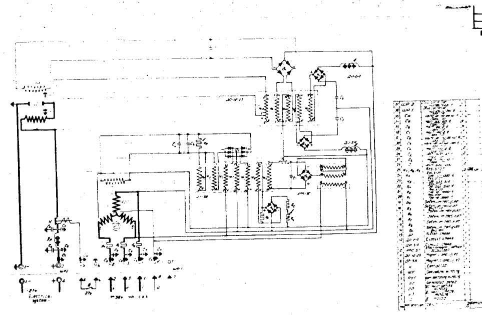

Fig.2. Inverter Wiring Schematic Diagram

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Besides, connected in the electric motor positive power supply circuit and in the contactor operating winding circuit are duct capacitors (C_5) and (C_{10}).

For the same purpose connected between the electric motor positive brushes and the casing are two capacitors (C_1).

To reduce the level of the inverter radio noises, connected in the A.C. circuit is a radio-filter consisting of four capacitors (C_9).

A.C. Frequency Stabilization

The inverter A.C. frequency stabilization is ensured by the constant speed of the electric motor.

The electric motor has two field windings: series and control. The series winding is designed to facilitate the inverter starting, to improve its operating stability and to decrease the regulated field power that permits decreasing the frequency regulator weight.

The control winding is designed to ensure the electric motor constant speed.

The control winding is supplied with A.C. circuit through the [illegible] magnetic amplifier and selenium rectifier (B_1).

The magnetic amplifier operating windings (terminals [illegible], [illegible]) are connected so that in each of them flows a pulse current, the constant component of which accomplishing the amplifier magnetization, is proportional to the operating load current and ensures the positive operating connection.

To provide the required frequency stabilization accuracy of [illegible] used in the system with [illegible] circuits, formed by [illegible] [illegible] and capacitors ([illegible]).

The resonance circuit, adjusted for a frequency of 450 c.p.s. , supplies the amplifier magnetization winding (terminals 9-10).

The flux, provided by this winding, is directed in accordance with the positive feed-back flux.

The resonance circuit, adjusted for a frequency of 350 c.p.s., supplies the amplifier neutralization winding (terminals 8-11) which produces the flux, directed opposite to the magnetization and positive feed-back fluxes.

The A.C. frequency stabilization within the above limits is performed as follows:

An increase in the supply circuit voltage or a decrease in the generator load increases the electric motor speed and A.C.frequency.

In this case the current in the magnetization winding increases and that in the neutralization winding decreases.

Due to the opposing connection of these windings, the resultant magnetic flux increases which results in increasing the core saturation and in decreasing the amplifier inductance resistance to the alternating current.

Thus, the current in the electric motor control winding increases but the motor speed and A.C. frequency decreases.

When decreasing the electric motor supply voltage or increasing the load, the regulation process goes on in reverse order.

At a frequency of 400 c.p.s., the currents in the magnetization and neutralization windings become equal and the magnetic fluxes of these windings are neutralized.

With the electric motor supply nominal voltage, generated in the field control winding is such a current which ensures a frequency of 400 c.p.s.

To smooth the ripples of the rectified voltage connected to the selenium rectifier output (P_1) is the capacitor (C_2).

The Inverter Output Voltage Stabilization

The inverter output voltage is stabilized by changing the reluctance value of the generator stator field ring.

For this purpose, provided in this section of the magnetic circuit is a toroidal winding (УОГ), which is supplied via the voltage regulator by the generator rectified current.

This winding is laid together with the generator operating winding in the same stator slots.

Thus, two fluxes act in the stator field ring: the permanent flux determined by ampere-turns of the generator control winding, and the alternating flux determined by the magnetizing force of the magnets.

The current change in the generator control winding changes the magnetic permeability and, consequently, the reluctance value of the stator field ring.

The operating flux value changes depending on the reluctance change.

The generator control winding is connected to the output of the ЕТ-5 Б three-phase magnetic amplifier; the control [illegible] depends on the resultant magnetizing flux generated by the currents in the magnetization windings (terminals 2-5) of the series feed-back (terminals 4-3), parallel feed-back (terminals 6-13) and in the neutralization winding (terminals 10-11), connected opposite to them.

The amplifier magnetization winding is supplied by the generator regulated voltage via the selenium rectifier (B_2) and the temperature compensation resistors (R_2, R_6 and R_4); the latter is also used for regulating the circuit.

The feed-back windings increase the amplifier sensitivity; they act in accordance with the magnetization winding.

The resistor (R_5), connected in series with the parallel feed-back winding, is used for regulating the sensitivity.

The neutralization winding is supplied by the regulated voltage provided by the ЭМС-5 Г electromagnetic voltage regulator via the selenium rectifier (B_4) and the temperature compensation resistor(R_4).

Connected to the selenium rectifier (B_4) output is the capacitor (C_7) to smooth the pulsing of the rectified voltage.

For this purpose connected in parallel with the generator control winding are capacitors (C_4).

The neutralization winding produces the permanent magnetic flux, practically preserving its value and direction at all ratings of the inverter operation.

This winding expands the amplifier operating characteristics and permits increasing the magnetization ampere-turns for increasing its sensitivity.

The voltage is regulated as follows:

An increase in the regulated voltage, increases the current in the ЖТ-5Б amplifier magnetization winding.

An increase in the magnetization winding current causes increase in the amplifier core saturation and, consequently, decrease in its reactance; that, in its turn, increases the current in the generator control winding.

An increase in the generator control winding current decreases the magnetic permeability of the stator field ring and decreases the generator operating flux and, consequently, the voltage across its terminals.

When decreasing the regulated voltage, the regulation process goes on in reverse sequence.

The nichrome resistors (R_5, R_6 and R_7), connected in each phase of the generator serve to decrease the impact short-circuit currents.

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The neutralization winding is supplied by the regulated voltage provided by the ЭМС-5Г electromagnetic voltage regulator via the selenium rectifier (B_4) and the temperature compensation resistor(R_1).

Connected to the selenium rectifier (B_4) output is the capacitor (C_7) to smooth the pulsing of the rectified voltage.

For this purpose connected in parallel with the generator control winding are capacitors (C_4).

The neutralization winding produces the permanent magnetic flux, practically preserving its value and direction at all ratings of the inverter operation.

This winding expands the amplifier operating characteristics and permits increasing the magnetization ampere-turns for increasing its sensitivity.

The voltage is regulated as follows:

An increase in the regulated voltage, increases the current in the ДТ-5Б amplifier magnetization winding.

An increase in the magnetization winding current causes increase in the amplifier core saturation and, consequently, decrease in its reactance; that, in its turn, increases the current in the generator control winding.

An increase in the generator control winding current decreases the magnetic permeability of the stator field ring and decreases the generator operating flux and, consequently, the voltage across its terminals.

When decreasing the regulated voltage, the regulation process goes on in reverse sequence.

The nichrome resistors (R_7, R_8 and R_9), connected in each phase of the generator serve to decrease the impact short-circuit current.

IV. INVERTER DESIGN

The ПТ-500Ц inverter consists of the following main assemblies and parts:

1. Casing cast integral with two supports;
2. Electric motor field ring with field coils and pole-pieces;
3. Generator stator;
4. Electric motor end housing assembly;
5. Generator end housing assembly;
6. Fan;
7. Armature assembly, consisting of the electric motor armature and generator rotor, mounted on a common shaft.
8. КСУ-500Ц control box.

The casing (1) is cast of aluminium alloy, made in the form of a cylinder with two supports.

The lower support with four holes serves for attaching the inverter to the aircraft structure, the upper one with six holes - for attaching the КСУ-500Ц control and filters box to the inverter.

The casing cylindrical portion has holes, through which the air is drawn into the inverter to cool the electric motor.

Two openings in the casing end serve to supply cooling air directly to the commutator operating surface.

On both ends of the casing there are threaded holes, through which the end housing assemblies (4 and 5) are screwed to the casing.

Made in the upper support is an oval hole for the wires leading from the inverter to the control box.

The generator stator (3) and the electric motor field ring (2) are attached inside the casing (1) by lock screws.

The electric motor field ring (2) is made of "АРМКО" steel in the form of a tube and serves as a magnetic circuit.

Eight countersunk holes serve to attach four pole pieces (9) and field coils (10), set on the pieces, by screws with the countersunk heads.

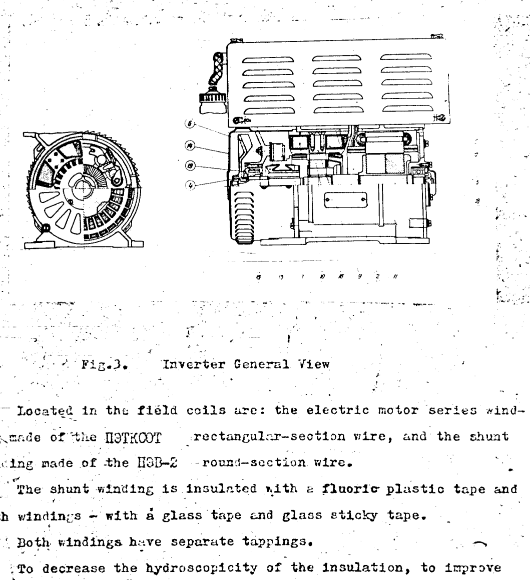

Fig.3. Inverter General View

Located in the field coils are: the electric motor series winding made of the ПЭТКСОТ rectangular-section wire, and the shunt winding made of the ПЭВ-2 round-section wire.

The shunt winding is insulated with a fluoric plastic tape and both windings - with a glass tape and glass sticky tape.

Both windings have separate tappings.

To decrease the hydroscopicity of the insulation, to improve the thermal transfer and insulation quality, the coils are dried under vacuum conditions, impregnated with insulating varnish under pressure and dried again.

The electric motor pole pieces (9) are assembled of electric-steel laminations, 1 mm. thick, attached by holddown studs.

The generator stator laminations assembly (3) is made of electric-steel laminations, 0.35 mm. thick, glued with the БФ-2 glue.

Located in the stator slots are two windings: the star-connected operating winding (11) and the control winding (12), made of the ПЭВ-2 wire. The two windings have separate tappings. The generator stator windings, as well as the electric motor field coils are impregnated and dried.

The end housing assembly (4) is cast of АЛ-5 aluminium alloy and heat treated for improving its mechanical strength.

Provided in the end housing assembly is a recess with a steel bushing for a ball bearing.

The ball bearing, placed in the recess, is secured via its outer race by the flange, which has a felt sealing. This sealing, together with the ball bearing, sealing serves to prevent the lubricant from leaking out of the ball bearing due to the air suction created by the fan.

Attached to the four bosses of the end housing assembly are four brush-holders of a reactive type. Two of them - negative - are attached directly to the end housing assembly, the positive brush-holders are insulated from the end housing assembly by insulating gaskets and bushings.

Installed on the positive brush-holders are КТ capacitors which serve for reducing the level of radio noises.

One lead of the capacitor is grounded, the other lead is connected to the brush-holder.

The brush-holders are attached to the end housing assembly by means of bolts, locking washers and nuts.

The spring pressure on the brush (13) is adjusted within the required limits by turning the bushing to which a spiral spring is attached.

The bushing is secured on the brush-holder pin by a cotter-pin.

The brushes (13) are of a rectangular shape and made of copper-graphite powder pressed under a high pressure.

The current is conducted from the brush to the brush-holder via brush leads, sealed in the brush and covered with insulating sleeves.

The end housing assembly is made so that with the end cap (14) removed, the brushes are readily accessible.

The end housing assembly is attached to the field ring by screws through the oval-holes, due to which the end housing assembly may be turned when adjusting the electric motor neutral position.

The end cap (14) is made of aluminium and attached to the end housing assembly by four screws.

The louvers, made in the end cap, are located opposite the fan blades and serve to vent the hot air from the inverter.

The generator end housing assembly (5), as well as the electric motor end housing assembly (4) is cast of AЛ-5 aluminium alloy and heat treated.

The ball bearing recess in the end housing assembly (5) is made so that the outer race remains free, not fixed in the axial direction which is necessary for compensating the shaft thermal expansion and for tolerances for the adjacent parts.

On one side the ball bearing recess is covered with the end housing assembly bead, on the other - by a flange made of sheet steel.

The end housing assembly wall has vent opening. The end housing assembly is attached to the field ring by four screws.

The fan (6) is cast of aluminium alloy and has 7 blades.

The fan blades are slightly inclined to remove the heated air from the inverter.

The fan is secured on the shaft by means of a key and is attached by a nut and lock washer.

The fan hub has a steel bushing fitted with a felt sealing which prevents lubricant leakage from the ball bearing.

The inverter armature (7) consists of the commutator (15), the electric motor iron laminations assembly (16), with the winding and the generator rotor (17) assembled on a common shaft.

The iron laminations assembly (16) is made of electric-steel laminations, 0.35 mm.thick, subjected to the annealing and varnished for decreasing the electromagnetic losses.

The extreme laminations-insulating - are made of glass-textolite and serve to protect the armature coils insulation from being damaged when leaving the lamination slots.

The armature winding is made of ПЭТКСОТ rectangular-section wire and laid in laminations slots.

The armature winding is insulated from the iron laminations assembly by three layers of flexible glass-mica 0.1 mm. thick.

The end parts of the armature winding are tightened with bindings of steel wire.

The bindings are joined by brass silver-plated clamps soldered with ПСР-3 solder. The armature winding, as well as the field winding is impregnated with an insulating varnish.

The external surfaces of the iron laminations assembly and pole pieces are coated with a colourless varnish to protect them from corrosion.

The commutator (15) consists of 75 segments, made of cadmium copper, insulated from each other by mica spacers.

The commutator segments are pressed with a bushing and washer and tightened with a nut.

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The commutator segments are insulated from the bushing and washer by means of mica cones and mica bushing.

The commutator operating surface is machined precisely and its radial play with the inverter assembled, is not more than 0.02 mm. The two ends of each armature coil are argon welded to the commutator risers.

The generator rotor (17) is a permanent magnet cast in a housing of АЛ-5 aluminium alloy. To avoid blebs when casting the permanent magnet and to obtain better magnetic properties, the rotor permanent magnet is made in two separate magnets of special alloy. The armature is dynamically balanced by drilling the commutator bushing and aluminium rotor end and by soldering the ПСР-3 solder on the bindings.

The armature rotates on two ball bearings slide fitted to the shaft.

The shaft is rolled for mounting the iron laminations and generator rotor and has a thread for nuts attaching the ball bearings and fan.

The КСУ-500Н control box (8) is attached to the upper support of the inverter casing (1) by means of six screws.

The control box is made of duraluminium sheet.

Located in the box are: a starting device for remote-control starting, radio-noise filters and control units regulating A.C. frequency and voltage within the required limits.

The starting device consists of the КМ-50Д starting contactor and its operating winding is connected to pins (4) and (5) of the ШР28ПК7ЭШ9 plug connector. Connected to the contactor operating winding circuit is the КБПС-4-110-20-0.1-III duct capacitor.

Provided in the D.C. circuit is a filter, consisting of a choke, a КБПС-4-110-40-0.25-III duct capacitor and four МБГТ 2 mf capacitors (160 V).

The D.C. filter elements are mounted in the box shielded cell.

The wires of the ШР28ЛК29Г7 plug connector (which is used to supply power to the inverter from the aircraft electrical system) are connected to the shielded cell of the D.C. filter by means of the connection located on the wall of the control box.

Provided in the A.C. circuit is a filter consisting of the МБГТ-300-0.5-II capacitors and four КБПС-А-II0-20-0.I-III duct capacitors, connected in the A.C. zero and phase circuits.

The filter output wires, as well as the filter in the D.C. circuit, are laid in the removable shield.

The A.C. output passes via the pins (1,2,3 and 6) of the ШР28ПК73Ш9 plug connector, which, as well as the ШР28ЛК29Г7 plug connector, is connected to the control box by means of a shielded harness through the connection.

The control units are fastened on the walls and bottom of the control box.

The lower and upper units of the box are reinforced with angles.

To increase the box properties to withstand vibration all the units are interconnected with clamps.

To facilitate the box mounting on the inverter, the box is provided with a terminal block.

The box cover (18) is made of aluminium sheet and has beadings for stiffening and the grills for cooling the box units during the inverter operation.

The box cover is attached to the box by means of four screws which are safety wired. The inverter and the box external surface, except for the joint faces, painted with " МЧАР-25" black enamel.

V. INSTALLING THE INVERTER

The inverter is installed in the aircraft in horizontal position and attached through the lower base holes by means of four M6 screws.

Prior to installing the inverter in the aircraft proceed as follows:

1. Inspect the inverter and check it for damage which could occur during shipment and storage. Particular attention should be given to the condition of the locking parts (safety wires, spring washers, etc.) and to the tightness of the threaded connections.

2. Connect the inverter to the aircraft electrical system. The overall and installation dimensions are given in Fig.4.

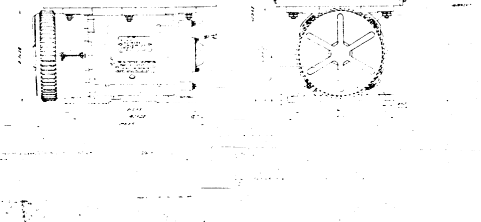

Fig.4. Overall and Installation Dimensions

VI. MAINTENANCE AND OPERATION

The Manufacturer guarantees reliable operation of the inverter within the guaranteed service life. During that period the inverter does not require any maintenance, does not need any replacement of brushes and ball bearings.

After the expiration of the guaranteed service life, make sure that the inverter is fit for further operation, inspect and disassemble the inverter and replace brushes and ball bearings if necessary.

VII. SERVICE TROUBLES AND REMEDIES

Trouble	Cause	Remedy
1	2	3
1. Inverter fails to rotate when switched ON.	a) Brushes do not contact the commutator as a resutl of their sticking in holders.	a) Remove the brush from the brush--holder and clean its sides with fine sandpaper No.120.
	b) Broken wires or poor contact at pins (4) and (5) of ШР28ПК7ЭШ9 plug connector.	b) Check wires and contacts at pins (4) and (5) and remedy break or poor contact in plug connector.
	c) Armature winding is broken.	c) Forward the inverter to a repair shop or replace the armature.

1	2	3
2. Inverter is excessively heated.	a) Load or rating exceed those given in the specifications.	a) Check the electric motor current by an ammeter and reduce the load and rating to normal.
	b) Armature winding is short-circuited.	b) Replace the armature or forward it to a repair shop.
	c) Armature is stiff to rotate.	c) Check spring pressure on brush (it should be 380±40 gr) Remove brushes from brush-holders, rotate the armature by hand. When the armature is stiff to rotate, find the cause of the defect and remedy it by reassembling the inverter and replacing the ball bearings (in a repair shop).
3. Inverter fails to gain full speed, commutator segments are burned in some places.	Commutator segments are short-circuited with burrs, brush dust or with metal excess on risers due to argon welding.	Using a wooden stick remove burrs from the commutator segments and risers. Carefully machine the commutator to avoid damage to segments,

1	2	3
		blow out the inverter with dry compressed air to remove brush and copper dust.
4. Brushes excessively spark and commutator is burnt.	a) Brushes are poorly fitted to the commutator.	a) The brush operating surface is poorly fitted to the commutator (mat coloured areas) covering more than 25% of the operating surface. Fit brushes to the commutator.
	b) Commutator is dirty.	b) Wipe the commutator with a clean cloth slightly dampened in clean gasoline. If the dirt can-not be removed, clean the commutator with sand paper No.120.
	c) Inverter is overloaded.	c) Do as in step 2(a)
	d) Armature winding is short-circuited.	d) Do as in step 2(b)
	e) Excessive radial play of commutator.	e) True up the commutator; the radial play should not exceed 0.02 mm.(with the inverter assembled).

VIII. DISASSEMBLY AND REASSEMBLY OF THE INVERTER

Never disassemble the inverter during operation. Only in case of extreme necessity or if there is a properly equipped repair shop, the inverter is permitted to be disassembled into its main parts.

Disassemble the inverter on a clean bench to prevent metal chips from getting into the inverter parts and assemblies.

INVERTER DISASSEMBLY PROCEDURE

Description	Disassembly procedure and tools	Remarks
1	2	3
1. Remove the end cap (14).	1. Remove the safety wire, remove the end cap attachment screws and remove the end cap (14) from the end housing assembly (4).	
2. Remove the flange (18).	2. Using a screwdriver remove the flange attachment screws and remove the spring washers and the flange with a gasket.	
3. Remove the shaft nut at the end housing assembly (6).	Unbend the washer tongues locking the nut; hold the fan by hand (to prevent the armature turning) and remove the nut. Remove the locking washer.	
4. Remove the end housing assembly (5).	4. Using a screwdriver remove the end housing assembly attachment screws and remove the end housing assembly (5) with the ball bearing using a puller (pushing the shaft).	

1	2	3
5. Remove the fan (6).	5. Remove the fan-to-shaft attachment nut as specified in step 3 and removd the fan (5) and the key.	
6. Remove the armature (7).	6. Using a puller (pushing the shaft) press the armature out of the ball bearing and remove the armature, placing a steel housing on the generator rotor magnet with the magnet exposing from the stator assembly. Before pressing the armature out of the ball bearing, remove the brushes from the brush holders.	
7. Remove the end housing assembly (4).	7. Using a screwdriver remove the wire end lugs attachment screws of the wires passing from the coils to the brush-holders. Remove the end housing assembly(4)-to- the field ring attachment screws, having removed the safety wire. Remove the end housing assembly (4) by hand or slightly striking it with a wooden hammer. Remove the flange(19) attachment screws and the ball bearing from the end housing assembly.	
8. Remove the end cap (8).	8. Having removed the safety wire, remove end cap attachment screws and the end cap (20).	

Further disassembly is not recommended.

Reassemble the inverter reversing the disassembly.

If, when disassembling the rotor magnet was not enclosed in a steel housing, magnetize it and stabilize in a special unit.

When reassembling prevent foreign objects and dirt from getting inside the inverter.

Replace spring washers which lost elasticity and screw with a damaged thread.

Lock all attachment parts the same way as they were locked before disassembly. Place the ball bearings on the shaft so that they rest against the inner race. When installing a ball-bearing prevent its from misalignment.

Insert brushes in brush-holders only after the inverter reassembly is completed to prevent them from being damaged by the commutator end.

IX. S T O R A G E

a). The inverter must be stored in a dry, heated and ventilated room.

The room floor should be wooden, xylolite or tiled.

b) A temperature not below 10°C should be maintained in the room with an annual temperature variation from +10°C to +35°C.

Sharp changes in temperature and air humidity are not permitted in the room.

The air relative humidity should not exceed 70%.

Temporary relative humidity increase up to 80% is permitted.

c) The inverters storage rooms must be free from gases which may cause corrosion (smoke, fumes, sulphur oxide, ammonia, chlorine etc.).

d) Never store the inverter together with chemical agents and readily evaporating substances which may cause corrosion (acids, alkalis charged batteries, etc.).

e) Store the inverter on shelves.

The shelves should be made of wood with a relative humidity not exceeding 18%, well coated with drying oil and painted with oil paint.

f) The lower shelf should be located not less than 0.5 m. from the floor.

All the shelves should be installed not less than 0.5 m. from a wall.

g) Never place the inverter directly on wooden shelves, but place paraffined and oil paper under them.

h) At the Consumer's depots store the inverter without packing.

<u>NOTE</u>: Never store boxes containing the inverters in the open.

Open the boxes only in a room.

Wipe misted parts of the inverter with a clean dry cloth.

PAG-1FP

INVERTER Model ПАГ-1ФП

DESCRIPTION AND OPERATING INSTRUCTIONS

INVERTER Model ПАГ-1ФП

DESCRIPTION AND OPERATING INSTRUCTIONS

I. PURPOSE AND GENERAL INFORMATION

The ПАГ-1ФП inverter is used for converting 27-volt direct current into three-phase 36-volt, 400 c.p.s. A.C.

The inverter is used for feeding aircraft gyro units and other special devices.

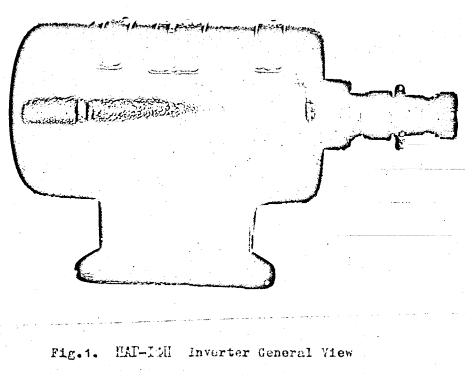

Fig.1. ПАГ-1ФП Inverter General View

The ПАГ-1ФП inverter is structurally manufactured as a motor-generator consisting of a two-pole D.C. motor with compound excitation and a three-phase synchronous generator excited by a permanent magnet.

The motor and the generator are assembled in one case, the motor armature and the generator rotor are mounted on a common shaft. The inverter is provided with a filter used for localization of the inverter radio-noise.

The inverter is provided with a fan-assisted cooling and installed in the aircraft without shock absorbing mounts.

The negative wire of the power supply circuit is connected to the inverter field ring assembly.

2. OPERATION REQUIREMENTS AND TECHNICAL DATA

The ПАГ-1СП inverter is designed for normal operation under the following conditions:

a) altitude above sea level	- corresponding to aircraft flight altitude
b) ambient air temperature range	- from +50 to -60°C
c) relative humidity	- up to 98% at 20±5°C

PRINCIPAL TECHNICAL DATA OF THE INVERTER

Supply voltage	27 V ± 10%
Current drawn (at 27 v)	4.5 A
Output voltage	36 ± 3.6 V
Load current	0.85 A
Power	53 VA
Power factor	0.65
Frequency	400^{+60}_{-40} c.p.s.
Speed of rotation	$8{,}000^{+1{,}200}_{-800}$ r.p.m.
Number of phases	3
Phase connection	Star connection
Duty	continuous
Direction of rotation (as viewed from the commutator end)...	R.H.

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Phase connection	Star connection
Duty	continuous
Direction of rotation (as viewed from the commutator end)...	R.H.

Weight .... 3.5 kg
Overhaul service life .... 1,000 flying hours.

3. COMPLETING

The inverter assembly consists of:

1. Inverter, proper.
2. Spare brushes - 2

4. INVERTER ELECTRICAL SYSTEM AND PRINCIPLE OF OPERATI...

The inverter schematic diagram is shown in Fig.2. The inver... is connected with the external circuits by means of a five-pin pl... connector. The positive wire of the power supply circuit is conn... to terminal 1, the negative wire is connected to terminal 2 gr... to the inverter case. Terminals 3,4 and 5 are used for tapping ... the A.C. voltage and connected to the generator stator winding.

There is no protection in the inverter circuit and it ... provided in the external circuit. Since the inverter has lo... is started directly by a switch without any remote control ...

From the input terminal 1 the "Plus" is conducted to t... Π-type filter consisting of a choke coil with iron-core, ... capacitor (C_1) and two interlocking capacitors (C_2) and (C_3) further, to the series field winding and electric motor arm... For suppressing high-frequency noise resulting from the ... operation, the positive brush is grounded to the inverter ca... through the capacitor (C_4).

Connected in the circuit of the shunt field winding is ... adjustable glass-sealed resistor (R) for setting the inver... when adjusting the inverter.

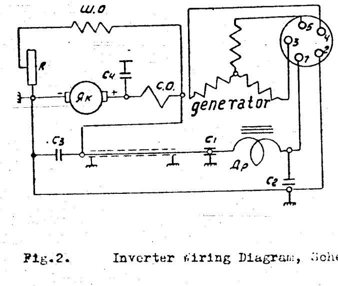

Fig.2. Inverter Wiring Diagram, Schematic

The generator is excited by a six-pole permanent magnet. The generator windings ends are connected to the pins of the plug connector so that when the terminals of the phase monitor A, B and C are connected to the plug connector pins 3,4 and 5, the inverter will rotate clockwise.

When energizing the inverter motor with D.C. it begins rotating together with the rotor creating an electromotive force (EMF) in the generator stator winding.

Frequency of the generator alternating current is proportional to the rotor rotating speed and is

$$f = \frac{PN}{60}$$

where P - number of pairs of magnet poles,

N - speed of the rotor rotation.

According to this relation the inverter nominal frequency is 400 c.p.s.

The output voltage of the generator is also directly proportional to speed of rotation and inversely proportional to the load current.

The inverter is delivered from the Manufacturing plant with the rotation speed adjusted for the nominal load. In this case for the nominal supply voltage of 27 volts, the frequency and output voltage of the inverter are respectively 400 c.p.s. and 36 volts with small deflections. At an ambient air temperature change from +50 to -60°C and power supply voltage fluctuation within ± 10%, the frequency and output voltage of the inverter may change within the full range of limits outlined in paragraph 3.

5. DESIGN

The inverter consists of the following main elements: a case (field ring) with a support, cast of aluminium alloy; screwed inside which are the generator and motor stators. Located in the field ring support are the filter capacitor (C_3) of 1 mf and 35-ohm adjusting resistor used for adjusting the speed of the inverter armature rotation.

The electric motor stator assembled of steel laminations 1 mm. thick with two pole pieces fitted with the field coils having a shunt and series - connected windings. The coils of the pole pieces are connected in series. The resistance of the shunt winding is 41±6% ohms and that of the series winding is 0.065±6% ohm.

The generator stator assembled of steel laminations 0.35 mm. thick, pressed in a thin-walled steel cylinder. In 18 slots of the stator skewed longwise by one slot pitch is laid a three-phase winding. The generator and motor stator windings are impregnated with asphalt varnish and then enameled. The resistance of the stator winding across output terminals is 2.80 ohms ± 6%.

The armature assembly consisting of the electric motor armature and the generator rotor mounted on a common shaft.

The electric motor armature is laminations assembly [illegible] made of steel laminations 0.5 mm. thick and it has 11 slots laid in which is the winding connected to the commutator consisting of 33 cadmium-copper segments isolated by mica; the segments are based on a plastic core.

The armature winding is impregnated with bakelite varnish. The resistance of the armature winding is 0.78 ohms ±6%. The generator rotor is a six-pole magnet cast in aluminium alloy. On the armature end of the rotor is the cast aluminium 6-blade centrifugal fan used for cooling the inverter.

The commutator end housing assembly made of aluminium alloy with a pressed steel bushing for a ball-bearing.

On the cylindrical lug of the end housing assembly is a plastic brush bracket with two brush holders for the brushes measuring [illegible].5x7x16 mm. is set. Springs of the brush holders are made of steel strip and directly press the brushes.

The spring pressure is 225±25 gr and can be adjusted by turning the ring of the brush holder. Attached to the commutator end housing assembly is a 680-[illegible] capacitor [illegible] of the filter.

The commutator end housing assembly is enclosed with an aluminium cover fixed by 4 screws.

The plug-connector end housing assembly [illegible] cast of aluminium alloy and having from inside a recess for a ballbearing and from outside a lug for attaching the plug connector.

Mounted in the end assembly is the filter elements: [illegible] mf, capacitor (C_2), 0.1 mf dust capacitor (C_1) and [illegible] choke coil. Both the end housing assemblies are attached to the field ring by means of two tightening studs.

Two radial magneto-type ball-bearings, the inner races of which are fixed on the shaft. To facilitate the removing of the rotor assembly from the shaft the ball-bearing race, from this side, is fitted without negative tolerance and fastened with a nut. The outer race of the bearing located in the plug-connector end housing assembly is fixed stationary and in the commutator end housing assembly the race is installed with a clearance and pressed to the balls by 4 springs placed in the jackets of the flange screwed to the end housing assembly. When assembling, the pressure of the springs is adjusted by [illegible] washers so that an end play of the armature would be not less than [illegible].3 mm. The bearings are filled with the [illegible] lubricant.

All the inverter solderings are made with pure tin.

II. OPERATING INSTRUCTIONS

If properly operated the [illegible] inverter functions trouble-free during the guaranteed service life and after the expiration of the service life may be used for further operation.

1. Mounting the Inverter in Aircraft

Before mounting the inverter in the aircraft check it for [illegible] damage which might have appeared when transporting or unpacking. Test the inverter operation by running it at no - load.

The current drawn by the inverter at idle run should not exceed 2.4 A at a supply voltage of 27 volts.

The inverter is fastened to the aircraft structure by 4 bolts through the holes in the support. When connecting a wire to the plug connector observe the correct polarity on pins 1 and [illegible] since connecting the inverter with a reversed polarity results in the inverter failure.

Numbering of wires led to a load unit must also be observed to prevent incorrect phase sequence.

The inverter power supply circuit must be equipped with 5-ampere fuses. The alternating-current circuits are not equipped with fuses as a momentarily short-circuit of the generator is permitted.

2. Maintenance

During operation the inverter does not require any maintenance, except for the inspection of the brush commutator assembly which must be made after every 200 flying hours.

INSPECTION OF BRUSH-COMMUTATOR ASSEMBLY

If the commutator has s smooth bronze (or brown) colour it indicates a good commutator ensuring proper operation of the brushes.

If the commutator is smudged (greasy, black colour) clean it with a clean rag dampened in gasoline. If the smudged commutator can not be cleaned by the above method, clean it by using a fine sand paper pressing it to the commutator by a flat wooden stick with the inverter spinning.

The brushes should be perfectly fitted to the commutator and freely slide in the brushholders .

Cracks and splits are not permitted.

The minimum permissible operating length of the brushes is 10 mm. Therefore, for providing some margin for the period of time between inspections (200 hours), the brushes are subject to replacement, if their length is less than 11 mm.

Bear in mind that the brushes are worn about 1 mm. during 200 hours of operation and that the premature wearing of the brushes and frequent necessity of their replacement indicate some troubles in the inverter operation or abnormal operating conditions.

When replacing the brushes fit them to the commutator. For fitting the brushes to the commutator wrap the latter with a strip of fine sand paper with a smooth side to the commutator; insert new brushes into the brushholders, load the brushes by the springs and, after that turn manually the inverter armature until all the contacting surface of the brushes is properly fitted to the commutator. After fitting the brushes or cleaning the commutator blow the inverter with a clean compressed air for removing the carbon dust.

Then finaly fit the brushes to the commutator during 2 or 3 hours with the inverter spinning at idle (no-load) run.

INVERTER Model HO-750 seriesII

DESCRIPTION AND OPERATION INSTRUCTIONS

750

INVERTER Model ИО-750-2 series

DESCRIPTION AND OPERATION INSTRUCTIONS

I. DESCRIPTION

1. Purpose and General Information

The inverter converts 27 V D.C. (from the aircraft electrical system) into one-phase, 115V,400 c.p.s. A.C.

The inverter consists of the following main elements:

a) a single-case unit incorporating a compound D.C. electric motor and a one-phase synchronous A.C. generator;

b) a control box containing the equipment which provides: inverter remote-control (starting and stopping), voltage and frequency stabilization, supression of radio noises, created by the inverter, conducting of 10-A D.C. from the aircraft electrical system to the inverter input terminals, manual control of output voltage to reduce it to the nominal value;

c) centrifugal switch to cut-out the inverter when its speed exceeds the permissible value.

The control unit does not incorporate elements protecting the electric motor and generator from overloading and short-circuiting. The inverter protection is provided in the aircraft electrical system.

The inverter is of an inclosed-type construction with fan-assisted cooling.

The negative power supply wire is grounded to the inverter case. The A.C. circuits are insulated.

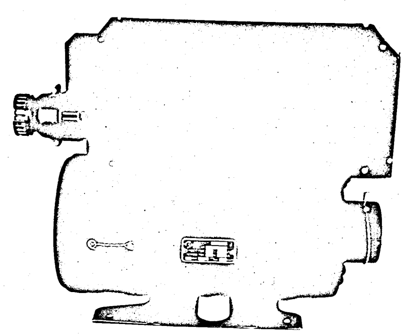

Fig.1. ПО-750-2 series Inverter External View

2. Operating Requirements and Technical Data

The ПО-750-2 series inverter is intended for operation under the following conditions:

a) Altitude above S.L. - aircraft flight altitude

b) Ambient temperature range - from +50 to $-60^{\circ}C$

c) Relative humidity - up to 98% at $20\pm5^{\circ}C$.

750

PRINCIPAL TECHNICAL DATA

Supply voltage	27 V ± 10%
Current drawn (at 27 V)	56 A
Output voltage	115 V ± 4%
Load current	6.5 A
Power	750 VA
Power factor	0.9 (lagging)
Permissible overload	10% during 5 min.
Frequency	400 c.p.s. ± 5%
Speed	12,000±600 r.p.m.
Number of phases	1
Duty	continuous
Weight (with control box)...	14.8 kg.
Overhaul service life	1,000 flying hours

NOTES: 1. The voltage can be reduced to the nominal value by a voltage regulating rheostat when voltage varies from 111 to 119 V.

2. Output voltage curve deviation from sine curve does not exceed 10% throughout the load range.

3. Direction of the inverter armature rotation – – counterclockwise as viewed from the commutator end.

3. Inverter Wiring and Principle of Operation

The power supply wires are connected to the two terminal bolts on the control box. The positive wire is insulated and the negative wire is grounded to the box case. Adjacent to the terminal bolts is a 10-pin plug connector conducting output A.C. and input D.C., operating the starting buttons or switch, transmitting a signal to energize a stand-by (auxiliary) inverter when the centrifugal switch is actuated.

Current from the (+) terminal bolt flows to a starting contactor via two capacitors connected in parallel; these capacitors together with two capacitors (C_1) form a Π -shaped filter whose choke is the generator field series winding connected in series with the electric motor series winding and armature. The filter is equipped with two capacitors (C_2) directly connected to the electric motor positive brushes.

The capacitors (C_6 and C_7) are provided for filtering the output A.C. and input D.C.

The inverter is started by a switch installed between pins No.1 and 4 of the plug connector; the switch energizes the starting contactor coil through the normally-closed contacts of the centrifugal switch. Button control can be used for this purpose when the inverter operates alone.

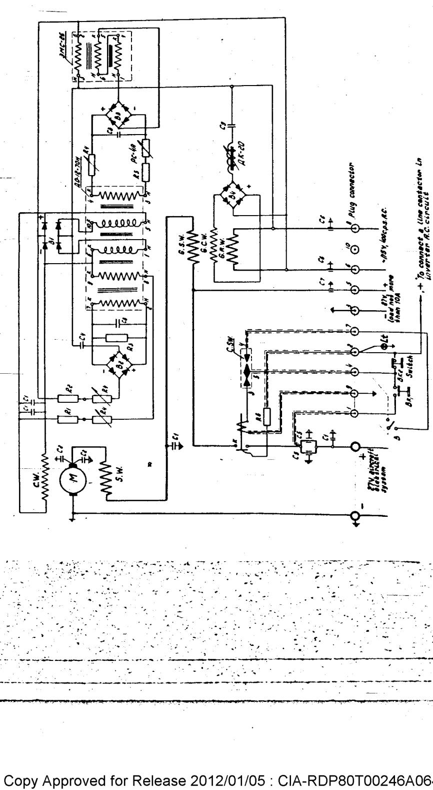

Fig.2. Inverter Schematic Diagram

FREQUENCY AND VOLTAGE STABILIZATION

The inverter frequency and voltage is stabilized by: compounding the generator field, changing the field current in the generator control winding (G.C.W.) by means of an electric resonance circuit and changing the field current in the electric motor control winding with the help of an electromagnetic regulator.

The inverter electric motor is fitted with two field windings- a series one which facilitates starting and a control one whose current is automatically changed with a change in the generator voltage. The electric motor control winding current is changed by the electromagnetic voltage regulator which increases or decreases the electric motor control winding current, depending on a regulated voltage value and sign (of deviation from the nominal).

The voltage regulator magnetic amplifier compares the reference, stabilized (by the electromagnetic stabilizing regulator) voltage with the generator output voltage.

The generator voltage at all operation ratings is maintained within 110.4-119.6 V.

The generator is fitted with two field windings - series one (energized with the electric motor current)and a control winding. The generator control winding current is in a linear relation with the generator output voltage frequency.

The regulator maintains an A.C. frequency within 380-420 c.p.s. at all the inverter operation ratings.

To prevent the inverter from overspeeding due to some trouble, the electric motor shaft is fitted with the centrifugal switch (C.SW.) which at the inverter speed exceeding 14,000-15,000 r.p.m. opens its normally-closed contacts, cuts-out the inverter and

1750

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150 switches-on a warning light (Lt.).

The repeated starting of the inverter de-energized by the centrifugal switch is possible only by pressing the button setting the switch elements to the initial position.

INVERTER DESIGN

The ПО-750-2 series inverter consists of the following main elements:

1. Casing (field ring)
2. Armature
3. Commutator end housing assembly
4. Slip rings end housing assembly
5. Fan
6. Centrifugal switch
7. Control box

1. CASING (field ring)

The field ring is a welded steel tube. Screwed inside the field ring are four pole pieces for the electric motor and four pole pieces for the generator.

Fitted to the pole pieces are shunt and series windings of the electric motor and generator. To increase insulation against moisture the coils are impregnated with insulating lacquer.

Screwed to the field ring is a support for the control box.

2. ARMATURE

Pressed to the steel shaft are: commutator, electric motor armature laminations, ~~[illegible]~~.

slip rings and the generator iron laminations with a aluminium cross-piece. The openings of the cross-piece and armature laminations and the commutator bushing are aligned and form vent passages for cooling air.

The electric motor and generator armature windings are impregnated to prevent the insulator against moisture and brush dust.

3. COMMUTATOR END HOUSING ASSEMBLY

The commutator end housing assembly is made of aluminium alloy with four fins. The commutator end housing assembly is fitted with four brush holders carrying brushes of 8x16x25 mm. size. The brush pressure is within 460-550 grm. Pressed in the housing is a steel bushing for a ball bearing.

Clamped to the housing fins are four capacitors of 680 mF each.

The end housing together with the capacitors is enclosed with a aluminium hood.

The hood is provided with grills to supply cooling air to the brushes.

The commutator end housing assembly is attached to the field ring by four screws through oval holes, permitting to adjust the neutral position.

4. SLIP RINGS END HOUSING ASSEMBLY

The assembly is an aluminium casting with two fins.

Mounted in the housing assembly are two brush-holders for 6.5x8x15 mm. brushes.

Pressed in the housing assembly is a bushing for ball-bearings.

The slip rings end housing assembly is attached to the field

750 ring by four screws and closed with the hood provided with grills to intake cooling air.

5. F A N

Mounted on the commutator end shaft is a fan with seven blades made of aluminium alloy. When the inverter is operating, the cooling air flows through the slip ring end grills in the hood and is devided into two parallel streams flowing:

1. Over the armature surface, commutator and between the pole pieces.

2. Through the armature vent passages. Besides, some quantity of air for cooling the brushes is supplied through the commutator end housing assembly hood grills.

6. CENTRIFUGAL SWITCH

The principle of the centrifugal switch operation is based on centrifugal forces created by the switch head rotation.

Under the action of these forces, the selector switch is switched over.

The selector switch consists of two main assemblies: selector mechanism and contact-panel with a button.

The contact panel is attached to the slip rings end housing assembly through the intermittent cone.

7. CONTROL BOX

The control box is made of sheet steel and mounted on the inverter casing.

The box cover is provided with grilles to cool its elements.

Stamped in the box bottom is a hole to receive the inverter outlet wires.

Mounted on the box is a terminal block with bolts to connect to a supply circuit and a plug connector to connect control circuits for the output voltage.

Above the plug connector is a rheostat slot (for a screwdriver) to adjust the output voltage.

The control box incorporates the following elements:

1. D.C. radio filter
2. A.C. radio filter
3. Starting contactor
4. Choke
5. Magnetic amplifier
6. Electromagnetic voltage regulator
7. Amplifiers, capacitors and resistors.

II. OPERATION INSTRUCTIONS

1. MOUNTING THE INVERTERS

The inverter is mounted in an aircraft in the horizontal position by four shock mounts.

Before installing the inverter in the aircraft, inspect it for damage (which may occur during transportation and storage) and for contact security in the plug connector.

2. OPERATION

During operation, the inverter does not require any maintenance besides inspection of the commutator-brush assembly. This inspection must be performed after every 200 flying hours.

THE COMMUTATOR-BRUSH ASSEMBLY INSPECTION

Under the normal conditions, the commutator is covered with dark colour providing the good operation of the brushes.

If the commutator is dirty or has a grease, black covering, remove it with a cloth dampened with gasoline.

If the dirtiness can not be removed, clean the commutator with a fine sand paper pressed to commutator with a flat stick.

The brushes must be properly fitted to the commutator and easily move in the brush holders. No cracks and damages to the brushes are not permissible.

Minimum permissible length of the brushes is:

D.C. ~~brushes~~-17 mm.

A.C. brushes - 9 mm.

When replacing the brushes fit them to the commutator and to slip rings using a sand paper and grind them when the inverter is idling for 5-6 hours.

3. STORAGE

The storage place must be dry, ventilated and heated.

4. POSSIBLE TROUBLES AND THEIR REMEDIES

Trouble	Cause	Remedy
1. Inverter fails to start	a) External wiring broken	a) Remedy broken wire
	b) Power supply circuit inside the box broken or poor contact of the connections.	b) Examine power circuit and remedy defect. Check and ensure proper contact connections.
2. Brush sparking and commutator burning.	a) Brush poorly fit to cummutator	a) Check brushes attachment, easy movement of brushes in brush holders and brush springs for condition
	b) Dirty commutator	b) Clean commutator
3. Inverter is excessively overheated.	a) Armature is stiff to rotate.	a) Check brush spring pressure easy rotation of armature with brushes lifted and reassemble inverter if its armature is stiff or ununiformly rotates.

RELAY BOX

Model KTIP-9

DESCRIPTION

RELAY BOX MODEL КПП-9

DESCRIPTION

I. PURPOSE

The КПР-9 relay box is designed for automatic switching-over of 3-phase A.C. consumers' power supply from a main to a stand-by (auxiliary) inverter under emergency conditions.

The КПР-9 box operates in conjunction with inverters supplying power to A.C. circuits.

When using one of the two inverters as a main one and the other only as a stand-by inverter, one КПР-9 box is installed.

When the two inverters are used as main or stand-by units, two КПР-9 boxes are installed.

The КПР-9 box is operated in A.C. circuits without a zero phase.

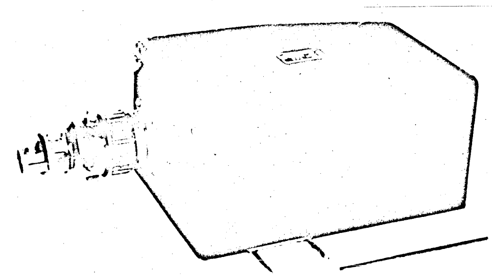

Fig.1. [illegible]-9 Box [illegible] view

II. TECHNICAL DATA

A. OPERATION REQUIREMENTS

1. Ambient air temperature range - from -60°C to +50°C.
2. Ambient air relative humidity at +20°±5°C - up to 98%.
3. Attachment points vibration at a frequency of 10 to 30 c.p.s. with 0.5 mm. amplitude and at a frequency of 30 to 200 c.p.s. with amplitudes increasing in accordance with an acceleration of 1.8 to 3.5 g.
4. Four-fold shock overload.
5. Linear acceleration - up to 8 g.

B. MAIN TECHNICAL DATA

1. Nominal supply voltage:
   A.C. circuit - 36 V (linear)
   D.C. circuit - 27 V
2. Nominal frequency of input A.C. - 400 c.p.s.
3. Power consumed:
   A.C. circuit - not more than 8 V.
   D.C. circuit - not more than 1[illegible] W
4. The box electrical system provides switching-over the inverters under the following conditions:
   a) interphase short-circuiting;
   b) three-phase short-circuiting;
   c) one, two or three phases broken;
   d) inverter D.C. supply circuit short-circuited or broken (blown-out fuse).

III. OPERATING THE BOX

During operation, the [illegible]-9 box does not require any adjustment and special maintenance.

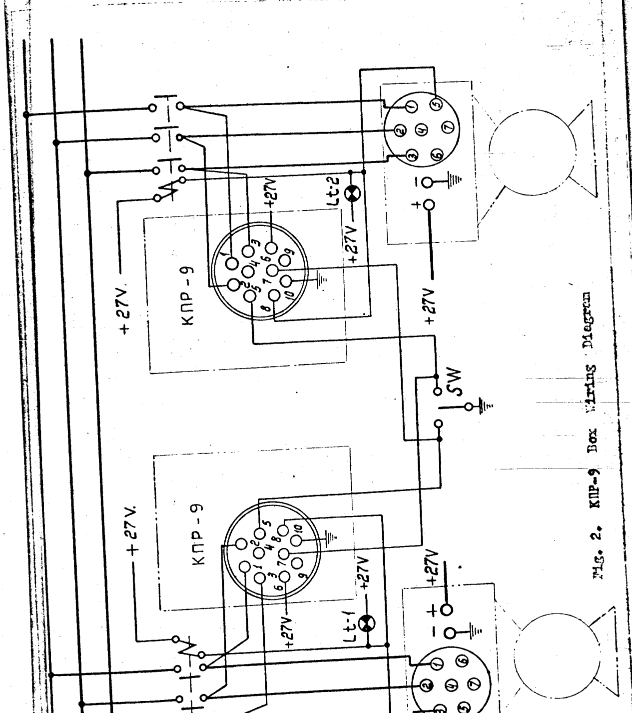

Fig. 2. KПР-9 Box Wiring Diagram

D.C.CIRCUIT OVERVOLTAGE PROTECTION UNIT

Model ASH-8M SeriesII

DESCRIPTION, INSTALLATION AND OPERATION INSTRUCTIONS

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-8M

D.C. CIRCUIT OVERVOLTAGE PROTECTION UNIT

Model АЗП-8М, Series II

DESCRIPTION, INSTALLATION AND OPERATION INSTRUCTIONS

0-8M

CONTENTS

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П-8М

I. PURPOSE

The АЗП-8М, series II overvoltage protection unit is designed to protect the D.C. electrical system of the АН-12 aircraft against overvoltage caused by overexcitation of any of the D.C. generators operating in parallel in conjunction with batteries. Each generator is provided with an overvoltage protection unit.

The overvoltage protection unit operates in conjunction with the voltage regulator and differential cut out relay.

II. TECHNICAL DATA

1. Normal supply voltage .... 28.5 V, D.C.
2. Current in power contacts circuit .... not more than 15 A
3. The overvoltage protection unit operating in the generator circuit should function at all emergency ratings caused by voltage regulator failure, if the generator output voltage in this case is not less than 34 V.

   NOTE: The overvoltage protection unit is not actuated with short-time commutating overvoltage of the generators.
4. Overvoltage protection unit actuation time in all conditions - - not less than 0.06 sec. and not more than 1.5 sec.
5. Duty - continuous
6. Weight - not more than 1.8 kg.
7. The overvoltage protection unit operates in any conditions that may exist in the АН-12 aircraft.

III. DESIGN

The overvoltage protection unit comprises the following elements:

a) РЭД-М time-delay relay;

b) ТКЕ1Р2Д relay;

c) ТКЕ21ПД relay;

d) КНК-М button-type contactor;

e) ПОВ-10-20 ohm - 1 resistor;

f) ПОВ-10-22 ohm - 1 resistor;

g) PC-25 No.10 variable resistor;

h) two МЛТ-0.5-100 ohm - II-5 resistors;

i) ШР20П5 ПЮ and ШР20П5 ПЮ plug connectors.

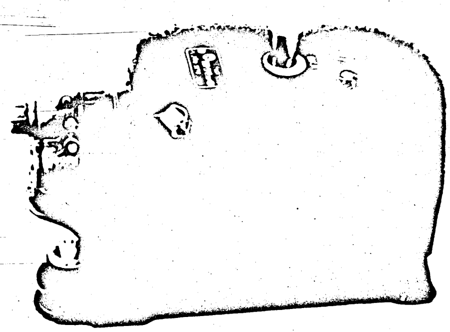

Fig. 1. General View

All the elements of the overvoltage protection unit are electrically connected according to the cording diagram; they are located on the base and covered with a cover.

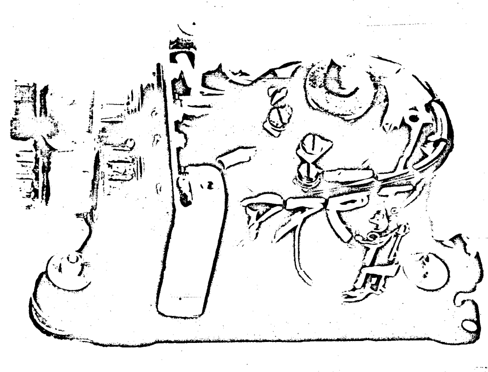

Fig.2. View of the Unit with Cover Removed

NOTE: Initial position of the overvoltage protection unit - with the switch button pressed.

П-8М

РСД-М is a time-delay relay whose time delay depends on voltage. The relay winding is connected in parallel with the generator shunt winding and is sensitive to increase in voltage of this winding. The time delay provided by the relay is necessary to ensure selective actuation of the relay and to prevent inadvertent operation of the relay at a short-time voltage increase caused by a load drop, for instance.

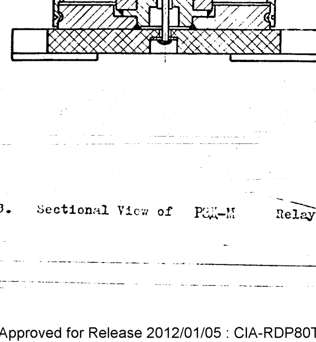

Fig.3. Sectional View of РСД-М Relay.

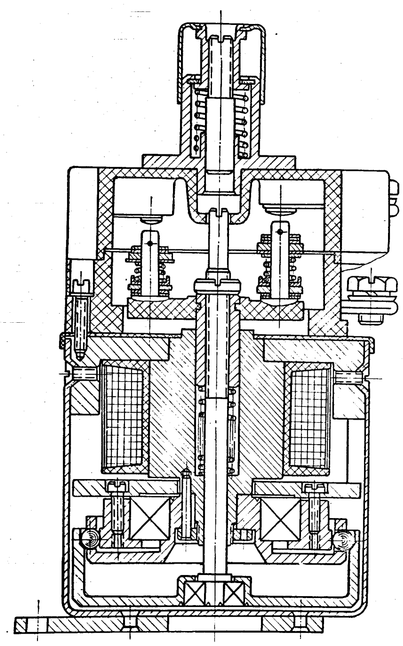

Fig.4. Sectional View of KMK-M Contactor.

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8M

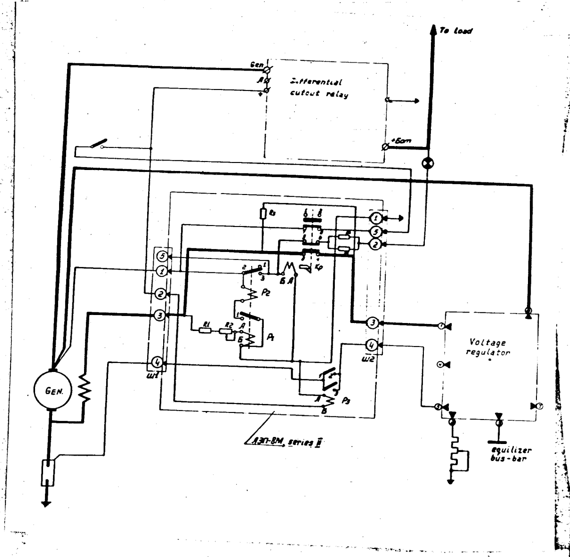

Fig.5. Diagram of Connection of the Unit to Aircraft Electrical System

П-8М

The КНК-М is an impulse button-type contactor with ball rotary catch which has two couples of power contacts (one couple-normally open, the other one-normally closed), and two couples of auxiliary contacts (one couple-normally open, the other one - normally closed with the switch button pressed).

The ТКЕ21ПД and ТКЕ1Р2Д are switching relays of flap type.

IV. PRINCIPLE OF OPERATION

When generator voltage becomes more than 30 V in a certain period of time depending on voltage value, the РЗД-М relay is actuated.

The voltage is supplied via the normally-open contact of the РЗД-М relay to the winding of the ТКЕ21ПД(Р2) relay which after it is actuated supplies voltage via its normally open contact to the КНК-М (Кр) contactor winding (see Fig.5). The КНК-М contactor is actuated and:

a) breaks the generator field winding circuit;

b) de-energizes the "ДМР " differential cut out relay, and the latter, when actuated, cuts off the faulty generator from the electrical system;

c) cuts off power supply from the ТКЕ1Р2Д(Р3) relay winding;

d) switches on the circuit of the light indicating the over-voltage protection unit actuation.

In case of the generator field loss, the РЗД-М(РI) and ТКЕ2IПД(Р2) relays are cut off.

The ТКЕ1Р2Д(Р3) relay contacts break the circuit of the voltage regulator equalizer winding. To ensure proper operation of the remaining generators the equalizer winding of the faulty generator must be cut off automatically.

When the KHK-M contactor is actuated, its rod moves up; the contacts may be set to the initial position by pressing the switch button.

V. INSTALLATION AND OPERATION

Before installing the unit on the aircraft check:

a) by visual inspection - for mechanical damage that may appear as a result of careless transportation and unpacking;

b) in cold state - for insulation resistance which should not be less than 10 megs;

c) in cold state - for proper switching by applying "Plus" of 28.5 V to the 1, 2, 3 (Ш1) terminals, and "Minus" - to the 4(Ш1) and 1 (Ш2) terminals; after functioning press the switch button.

d) the unit base attachment lugs for freedom from oxide film.

The overvoltage protection unit is installed on the AH-12 aircraft in the horizontal position and secured to the base with four bolts. The bolts should be securely locked.

The unit is connected to the circuit through plug connectors. The cables running from the plug connectors must permit free operation of the unit shock mounts.

The overvoltage protection unit is adjusted by the Manufacturer, and therefore it is not allowed to disassemble it in operation. In case of malfunction of any element of the unit, replace the unit by a new one.

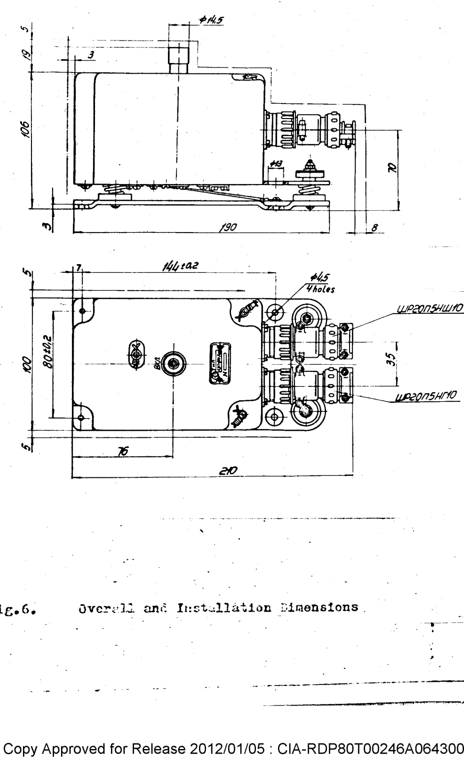

Fig.6. Overall and Installation Dimensions

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ELECTRIC ACTUATOR

Model M3K-2 (Series 2)

DESCRIPTION AND INSTALLATION

AND OPERATING INSTRUCTIONS

ELECTRIC ACTUATOR MODEL [illegible]-2 (Series 2)

DESCRIPTION AND INSTALLATION AND OPERATING INSTRUCTIONS

CONTENTS

I. PURPOSE

The M3K-2 electric actuator is used for actuating a fuel valve.

II. COMPLETING

The electric actuator set includes:

a) M3K-2 electric actuator, proper;

b) Two brushes (A12) marked "4".

III. TECHNICAL DATA

1. Nominal voltage .... 27 V
2. Operating voltage range .... 24.3-29.7 V
3. Nominal torque on outlet shaft ....2.5 kg.-m.
4. Current drawn at nominal load, voltage and normal ambient temperature .... not more than 3.6 A
5. Time required for outlet shaft to turn from one extreme position to the other through 95° at nominal torque, normal ambient temperature and nominal voltage across electric motor terminals:..not less than 3.6 sec. ....not more than 5.6 sec.
6. Max. turn angle of outlet shaft limited by limit switches .... not less than 95°

With the outlet shaft in the extreme positions the contacts of the limit switches actuating the warning light are closed. The limit switches contacts start closing with the outlet shaft 5-10° short of the extreme position (limited by 95°).

NOTE: The turn angle of the actuator outlet shaft can be decreased by rigid stops within 50 to 95°. In this case the limit switches are actuated after some slipping of the actuator friction clutch.

Adjustment of the limit switches (operating the warning lights) for closing is accomplished when installing the electric actuator in the aircraft; in this case the limit switches contacts start closing when the outlet shaft is 5-10° short of the extreme position.

7. The friction clutch slips at a torque not less than 3 kg.-m. and not more than 6 kg.-m.

8. The electric actuator duty - intermittent.

It is permitted to accomplish two cycles of actuation at nominal torque and nominal voltage - then the actuator should be cooled completely.

A cycle implies one turn of the outlet shaft through 50-95° (limited by rigid stops) from one extreme position to the other and return to initial position, then again a turn of the outlet shaft from one extreme position to the other and return to initial position.

Interval between cycles - 30 sec.

9. Electric actuator weight - not more than 2.15 kg.

10. Inertia run of the outlet shaft when idling at 20 volts across the electric motor terminals .... not more than 2°.

11. Max. permissible temperature of separate units of the electric motor after running under nominal conditions:

a) armature winding ....70°

b) field winding ....75°

c) solenoid clutch winding ....75°

d) commutator ....70°

12. The electric actuator is designed for use in AH-12 aircraft.
13. Power supply circuit .... two-wire.
14. Electric actuator construction - enclosed, explosion-proof.

IV. D E S I G N

The M3K-2 consists of the following main components:

a) electric motor model Д-12ТФ series 2;

b) reduction gear;

c) friction clutch;

d) limit switches panel;

e) warning lights switches;

f) plug connector, ШР28П7НШ7.

Electric Motor

The Д-12ТФ, series 2, motor is a two-pole, reversing D.C. electric motor with a series field winding and a solenoid brake clutch.

The electric motor direction of rotation is reversed by changing the magnetic flux.

For this purpose the electric motor is equipped with two independent field windings separately energized depending on the required direction of rotation.

The direction of current flow in the armature winding remains constant. The separate energizing of one of the field windings is made by means of a single-pole selector switch.

Bear in mind that a simultaneous energizing of both field windings is not permitted because it may result in the windings burning-out.

The electric motor (Fig.2) consists of a field ring with field coils, an armature with winding and commutator, a solenoid brake clutch and a drive end housing assembly.

The field ring (25) is a steel cylinder, screwed inside which are two pole pieces (24) carrying the two separate field windings.

The commutator end of the electric motor is enclosed by the end cap (36).

The drive end housing assembly made integral with the field ring has:

a) a recess for a ball-bearing supporting the front end of the armature shaft;

b) a hole for receiving the armature shaft end and wires to energize the electric motor.

The armature (23) runs on two ball bearings No.60024 mounted in the electric motor casing.

The armature consists of a shaft and laminations assembly made of electrotechnical steel.

The winding is laid in the slots of the laminations and the two ends of each armature winding coils are soldered into the grooves in the risers of the commutator (28). The commutator consists of alternate copper and mica segments.

The dovetailed segments of the commutator are assembled by K-6 plastic material. The armature shaft drive end is of cylindrical shape to engage with the electric actuator reduction gear.

Mounted on the armature shaft commutator end is the solenoid clutch brake disc (31) made of stainless steel. The disc is attached by the nut (32).

Inside the electric motor casing at the commutator end is the solenoid brake clutch decreasing the intertia run of the armature after the electric motor is de-energized.

The solenoid clutch winding is enclosed in the steel casing(...).

Pressed in the casing are three pins guiding the steel brake washer (30)carrying the brake ring(34)made of friction material

The casing (29) and brake washer (30) form the clutch magnetic circuit. The spring (33) constantly presses the washer to the brake disc (31) fixed on the armature shaft. The spring creates the armature braking moment between the disc and brake washer.

The clutch winding is connected in series with the electric motor armature winding.

With the electric motor inoperative, a clearance between the brake washer (30) and clutch casing (29) should be not less than 0.2 mm. With the clutch winding energized, the main portion of the magnetic flux (created by the clutch winding magnetic force) closes through this clearance.

The electromagnetic force developed in this clearance overcomes the spring (33) force, moves the brake washer (30) to the casing (29) along the pins, compresses the return spring and releases the armature.

With the electric motor stopped, the electromagnetic force disappears, the spring moves the brake washer till it contacts the disc (31) and brakes the armature.

Attached to the clutch casing (29) is the support ring (37) with the two stamped brush-holders (38).

The electric motor is fitted with the brushes (27) type A-12, 4x5x7 mm.

The brushes are pressed to the commutator by spiral springs. Brush pressure is 110-150 gr.

To afford access to the commutator and brushes; the electric motor casing has special openings closed by the end cap (36).

The solenoid clutch casing (29) is secured to the electric motor field ring (25) by the pins (21).

Reduction Gear

The reduction gear serves for increasing a torque and decreasing r.p.m. transmitted to the actuator outlet shaft from the electric motor.

The reduction gear is a planetary-type 5-stage reduction gear with a total gear ratio of 3388.38.

The first three stages of the reduction gear are located directly behind the electric motor, the 4-th stage - between the limit switches panel (13, Fig.3) and friction clutch, the 5-th stage - after the friction clutch.

The planetary gears (15, 17 and 19) of the first three stages of the reduction gear are constantly meshed with the stationary gear (18) attached to the reduction gear casing (2) by the pins (16).

The first stage planetary gears (19) axles run in metal-ceramic bearings, and the planetary gears (15 and 17) of the 2-nd and 3-rd stages - directly on their axles.

The 1-st stage driving gear (40), keyed to the electric motor armature shaft, transmits the rotation to the 2-nd stage driving gear (41) via the planetary gears (19).

The gear (41) is made integral with the drive shaft fitted with three levers spaced 120° apart. Each lever carries an axle for a planetary gear.

The rotation of the 2-nd stage driving gear (41) is transmitted to the 3-rd and 4-th stage driving gears (44 and 12) through the planetary gears (15 and 17).

Engaged with the 4-th stage driving gear (12) are the planetary gears (9) which running around the stationary gear (10), riveted to the actuator casing, rotate the friction clutch case (49).

Through the friction clutch, the case rotates the 5-th stage driving gear (61) which through the planetary gears (64) rotates the drive plate (63) together with the actuator outlet shaft.

The electric motor shaft-to-actuator outlet shaft total gear ratio is 3388.38.

This gear ratio indicates that the outlet shaft speed is 3388.38 times less than that of the electric motor armature.

Friction Clutch

The friction clutch is designed for protecting the electric motor against a short-circuiting at an excessive but momentary overload of the outlet shaft.

The friction clutch is installed in the casing (2, Fig.2) and is centered in a sliding bronze bearing and a pin of the reduction gear 5-th stage drive shaft.

The clutch consists of six steel and six metal-ceramic discs. The metal-ceramic discs (5) outer splines mesh with the clutch casing (52) and the remaining discs (4) are engaged with the bushing (6).

The discs are compressed by the four spiral springs (46) located in the case (49) pockets.

One end of the spring rests against the plug (47) serving for adjustment of the spring tightness and, therefore, for adjustment of the friction clutch moment.

The other end of the spring rests against the ring (8) transmitting a force to the discs (4 and 5) through the balls (7) and [illegible] (51).

Through these discs, the [illegible] of the [illegible] (4[illegible]), rigidly connected with the [illegible] ([illegible]), is transmitted to the bushing ([illegible]) and then through the six balls ([illegible]) to the [illegible]-th stage driving gear ([illegible]) which rotates the actuator outlet shaft ([illegible]).

The gear (61) and bushing (6) are placed on the shaft (59) fixed to the case (49).

If the electric actuator outlet shaft torque exceeds that of the friction clutch sliding, the gear (61) and bushing (6) with the discs (4) will continue rotating and the discs (5), casing (58) with the case (49) and shaft (59) will be motionless; due to this the balls (3) start moving along the grooves of the bushing (6), moving the latter axially and compress the springs.

The interdiscs pressure becomes less and the clutch will slide.

The clutch will slide until the outlet shaft torque drops or the electric motor is off.

Limit Switches Panel of Electric Motor Power Supply Circuit

The limit switches panel (13, Fig.2) of the electric motor power supply circuit is attached inside the reduction gear casing (2) and consists of a plastic panel with four pressed-in bushings, ... (45), two contact plates with fixed contacts and two contact ... with moving contacts.

The panel contacts are opened when the cam (46) rotat... with the friction clutch case (49) presses the tappet (15). ... case the tappet moves and presses out the contact ... with the moving contact. As a result of this the elect... supply circuit is opened for the given direction of rotation.

Warning Lights Limit Switches Panel

The warning lights limit switches panel is ... actuator casing box. The gear rim of the outlet sh... the gear (58) made integral with the actuating scre...

With the gear rotating, the actuating screw moves the nut (53) carrying two stop screws - one for the left panel and the other for the right panel.

The nut moved by the adjusting screw has lugs sliding along the plate, which prevents the nut turning radially.

With the outlet shaft in an extreme position, the stop screws press the contact springs (50) and close the panels contacts.

V. PRINCIPLE OF ELECTRIC ACTUATOR OPERATION

The electrokinematic diagram of the electric actuator is shown in Fig.3.

The electric actuator is designed to operate from a two-wire circuit.

Being supplied from the aircraft electrical system the current will flow through the plug connector pins, closed contacts of the electric motor power supply to one of the field windings, armature winding, solenoid clutch winding and negative terminal (1).

The clutch is actuated and the rotation of the electric motor shaft is transmitted to the actuator outlet shaft through the four stages of the planetary-type reduction gear, friction clutch and 5-th stage of the reduction gear.

With the outlet shaft turned through a required angle the warning light contact closes and with the outlet shaft stopped by the fuel valve stop the friction clutch slides.

In this case the actuator shaft remains motionless and the electric motor armature continues rotating, which protects the electric motor against short-circuiting.

The friction clutch will slide until the cam attached to the friction clutch case, presses one of the tappets which opens the panel contacts. As a result of this the electric motor is de-energized and the armature is braked by the brake disc of the solenoid clutch.

With the other field winding of the electric motor energized the actuator outlet shaft will rotate in the opposite direction.

VI. INSTALLATION AND OPERATING INSTRUCTIONS

The electric actuator flange is attached to the fuel valve body by four bolts.

The electric actuator may be mounted in any position. The actuator is connected to the aircraft electrical system through a ШРАГ7НЕ7 plug connector. The actuator outlet shaft has inner splines for engagement with a driven unit. When installing the electric actuator see that the driven unit is mounted properly.

The driven unit must be free from sticking, misalignment, etc. The mounting face must permit the actuator to be installed without any misalignment and tension.

The electric actuator must be securely attached and the attachment bolts securely locked.

Perform the first operating test of the electric actuator in conjunction with the driven unit by momentarily switching on the electric actuator several times.

If the unit operates properly without sticking, misalignment and tension in the kinematic system, test the electric actuator in conjunction with the driven unit at the nominal voltage, observing the duty specified in the "TECHNICAL DATA" section.

The electric actuator is delivered from the manufacturing plant with the warning light contacts being adjusted for the outlet shaft turn angle of not less than 95°.

To re-adjust the warning light actuation, do as follows:

1. Set the fuel valve shaft in the middle position.

2. Set the actuator outlet shaft in the middle position till the mark on the outlet shaft end coincides with the middle mark on the casing flange.

<u>NOTE</u>: Never permit the outlet shaft to turn to exceed the extreme positions, which is checked by matching the outlet shaft end mark with the flange extreme marks.

3. Connect the electric actuator to the valve and close the valve by pulse energizing the actuator electric motor; in this case the outlet shaft extreme position limit switch must de-energize the electric motor.

4. In this position, move the adjusting screw to the warning light contact plate till the circuit is closed, which is indicated by the warning light coming on.

After that tighten the adjustment screw 1/3 revolution maximum.

5. Adjustment of the fuel valve open position warning light is performed after actuating the electric motor for opening the valve according to paragraph 4.

6. After the adjustment safety the adjusting screws by locking nuts and washers. Install the cover in place, secure it by four screws and lock them.

Make entries, concerning the adjustment performed, in the electric actuator certificate.

PERIODIC MAINTENANCE

During operation, perform the following periodic maintenance operations:

After every 25 flying hours:

Check the electric actuator plug connector contacts for cleanliness and security.

After every 50 flying hours:

1. Perform the operations indicated in the 25-hour maintenance.

2. Check that the actuator program operation and current drawn correspond to the nominal data; test the driven unit for proper functioning.

After every 100 flying hours:

1. Perform the operations indicated in the 50-hour maintenance.

2. Remove the electric motor end cap, check the commutator and brushes for condition; make sure that the commutator is not burnt, the brush springs are in proper condition, the brushes are not damaged and have sufficient length (replace the brushes worn to 6 mm.long).

Check the brushes for free movement in the brush-holders.

If the commutator is burnt or dirty, clean it with a cloth slightly dampened with Б -70 gasoline (when cleaning, lift the brushes). If this method is not sufficient to clean the commutator, clean it with a fine sand paper.

After cleaning the commutator with the sand paper, clean the intersegments grooves with a pointed wooden stick and blow the electric motor interior with compressed air.

NOTE: If the actuator is hard accessible to perform the above operations, remove the actuator from the aircraft for inspection and maintenance purpose. After the operations are performed, install the electric actuator in place and test the driven unit for proper functioning.

During operation never disassemble the electric actuator and replenish its lubricant.

If the electric actuator fails to operate properly replace it

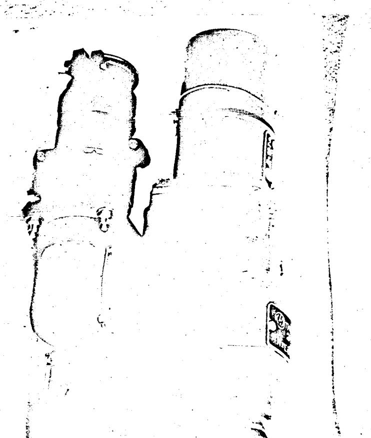
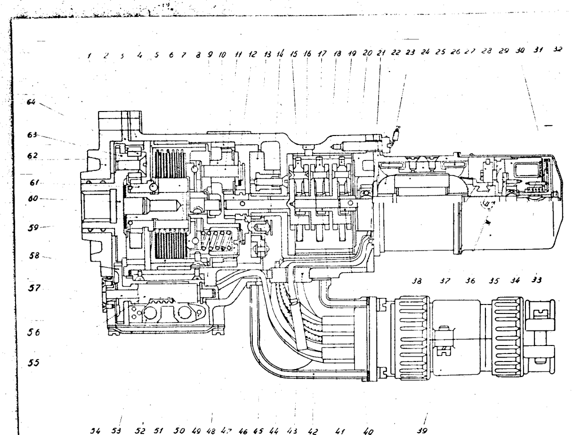


Fig.1. MЗK-2 Electric Actuator General View



Longitudinal-Section View of the MJK-2 (series 2)
Electric Actuator

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Key to Fig.2.

1 - Stationary gear; 2 - casing; 3 and 7 - balls; 4 and 5 - friction discs; 6 - bushing; 8 - ring; 9 - 4-th stage planetary gear; 10 - stationary gear; 11 - axle; 12 - 4-th stage driving gear; 13 - limit switches panel; 14 - drive shaft; 15 - 3-rd planetary gear; 16 - pin; 17 - 3-rd stage planetary gear; 18 - stationary gear; 19 - 1-st stage planetary gear; 20 and 22 - end housing assemblies; 21 - pin; 23 - armature; 24 - pole piece; 25 - electric motor field ring; 26 - coil; 27 - brush; 28 - commutator; 29 - solenoid clutch casing; 30 - brake washer; 31 - brake disc; 32 - nut; 33 - spring; 34 - ring; 35 - washer; 36 - end cap; 37 - support ring; 38 - brush-holder; 39 - plug connector; 40 - 1-st stage driving gear; 41 - 2-nd stage driving gear; 42 - elbow; 43 - rubber bushing; 44 - 3-rd stage driving gear; 45 - tappet; 46 - cam; 47 - plug; 48 - spring; 49 - case; 50 - contact spring; 51 - disc; 52 - friction clutch casing; 53 - special nut; 54 and 57 - covers; 55 - actuating screw; 56 - axle; 58 - gear; 59 - shaft; 60 - outlet shaft; 61 - 5-th stage driving gear; 62 - cover; 63 - drive plate; 64 - 5-th stage planetary gear.

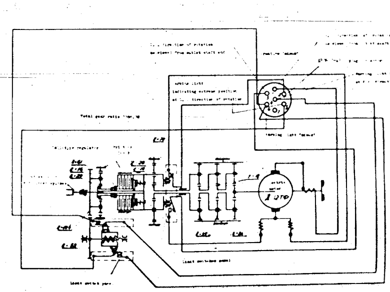

Fig.3. Actuator Electrokinematic Diagram

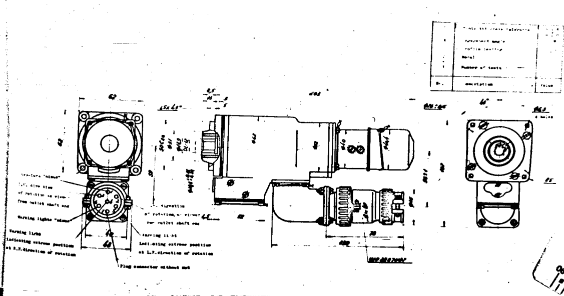

Fig.4. Electric Actuator Overall and Installation Dimensions

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T I M E R

Model ГIMK-4 (Second Series)

DESCRIPTION, INSTALLATION AND OPERATION INSTRUCTIONS

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T I M E R

Model EMG-4 (Second Series)

DESCRIPTION, INSTALLATION AND OPERATION INSTRUCTIONS

CONTENTS

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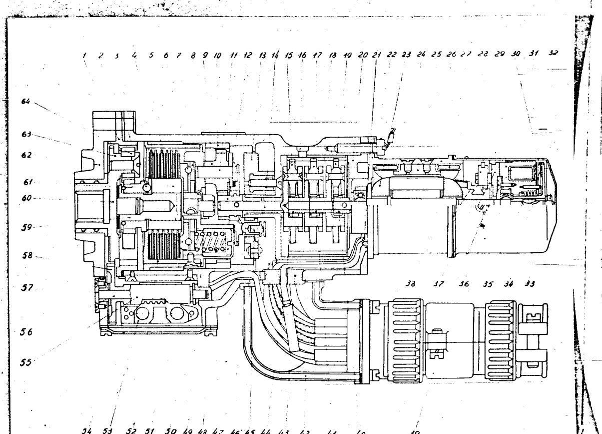
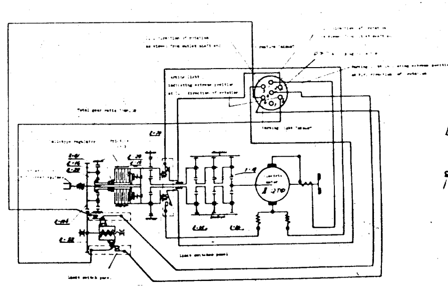


Longitudinal-Section View of the MDK-2 (series 2)

Key to Fig.2.

1 – Stationary gear; 2 – casing; 3 and 7 – balls; 4 and 5 – friction discs; 6 – bushing; 8 – ring; 9 – 4-th stage planetary gear; 10 – stationary gear; 11 – axle; 12 – 4-th stage driving gear; 13 – limit switches panel; 14 – drive shaft; 15 – 3-rd planetary gear; 16 – pin; 17 – 3-rd stage planetary gear; 18 – stationary gear; 19 – 1-st stage planetary gear; 20 and 22 – end housing assemblies; 21 – pin; 23 – armature; 24 – pole piece; 25 – electric motor field ring; 26 – coil; 27 – brush; 28 – commutator; 29 – solenoid clutch casing; 30 – brake washer; 31 – brake disc; 32 – nut; 33 – spring; 34 – ring; 35 – washer; 36 – end cap; 37 – support ring; 38 – brush-holder; 39 – plug connector; 40 – 1-st stage driving gear; 41 – 2-nd stage driving gear; 42 – elbow; 43 – rubber bushing; 44 – 3-rd stage driving gear; 45 – tappet; 46 – cam; 47 – plug; 48 – spring; 49 – case; 50 – contact spring; 51 – disc; 52 – friction clutch casing; 53 – special nut; 54 and 57 – covers; 55 – actuating screw; 56 – axle; 58 – gear; 59 – shaft; 60 – outlet shaft; 61 – 5-th stage driving gear; 62 – cover; 63 – drive plate; 64 – 5-th stage planetary gear.



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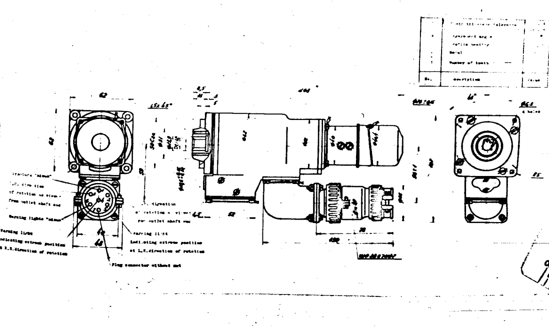

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T I M E R

Model ГIMK-4 (Second Series)

DESCRIPTION, INSTALLATION AND OPERATION INSTRUCTIONS

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T I M E R

Model HM[illegible]-4 (Second Series)

DESCRIPTION, INSTALLATION AND OPERATION INSTRUCTIONS

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C O N T E N T S

4

I. PURPOSE

The timer model ПМК-4 (second series) is designed for successive switching on four heating elements of the propeller blades and spinners through the intermediate contactors.

II. TECHNICAL DATA

1. Nominal supply voltage .... 27 V
2. Current drawn .... not more than 0.75 A
3. Commutation current at contacts of the timer micro switches is not more than 4 A of the inductive load with the circuit time constant of $\frac{L}{R}$ = 0.015 sec.
4. Number of signals sent 4
5. Sequence of signals .... in succession
6. Signal duration within voltage range of 24–30 V .... 12.75 ± 1 sec.
7. Operating duty .... continuous
8. Weight .... not more than 1 kg.
9. Timer reliable operates:
   a) within operation voltage range of 24 to 30 V.
   b) at relative humidity of ambient air up to 98% and temperature of +20 ± 5°C.
   c) at ambient air temperature change of +60°C to −60°C.
   d) at altitude and under conditions specified for АН-12 aircraft.

III. D E S I G N

The НМ-1 timer (second series) is a rectangular box consisting of a cast base and removable cover. Secured to the base by the screws using insulation bushings is the НМ-50У timing mechanism and МБГЧ-С-200-А-2х0.5-II capacitor.

The insulation bushings are provided because the Д-2Р electric motor of the timer has the single-wire circuit and the box - two-wire circuit. All the elements of the timer are closed with the cover which is screwed to the base.

Attached to the vertical wall of the base is the ШР28П7НШ9 plug connector and terminal bolt.

The НМ-50У timing mechanism is the motor-type time relay designed to actuate the time program according to the specifications and consists of the Д-2Р motor, reduction gear, program cams (discs) block and КВ1-20 micro switch block.

The Д-2Р motor is the d.c. motor with a centrifugal speed governor and is attached to the timer front wall by 4 screws.

The motor is connected to shaped cams block shaft through the reduction gear of 1:6358.3 ratio.

The reduction gear is connected to the cam shaft through the safety dog clutch which ensures disengagement of the reduction gear and shaft in case of supply voltage wrong polarity.

The program cams block consists of the shaft, steel intermediate washers, program cams set and hexagonal distance bushings.

The shaft of the program cams block is provided with two flats for fixing the position of the intermediate washers. The ends of the shaft are made in the form of journals. One end of the shaft is threaded to attach the program cams set.

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The plastic program cams are frictionally secured to the shaft using the spring washers. The cams are provided with a dwell of 180 deg. and can turn through any angle by a special wrench.

The dwell of the twin cams can be set from 0 to 180 deg. by changing the cams position.

The intermediate washers are intended to separate the twin cams and adjust each cam separately. The space between the cams is ensured by the distance bushings which are placed on the shaft flat; the bushings permit to hold the shaft during the cams adjustment.

The micro switches block is installed above the program cams and consists of three switches model KB1-20 and three levers with springs secured between the brackets by the pins. The levers permit to switch off the micro switches depending on the cam shape. The spark-quench capacitor model МБГП-3-200-А-2х0.5-П is designed to protect the circuit from radio interference due to operation of the Д-2Р electric motor commutator-brush assembly.

All the elements of the timer are attached between two plates secured by studs; two lower studs are provided with threads for attaching the timing mechanism.

IV. O P E R A T I O N

The ПМЗ-4 timer (second series) should provide 4 consequent signals of 12,75 ± 1 sec. duration.

When connecting the timer to the aircraft system, "minus" is supplied constantly to the terminal (1) of the ШР plug connector.

When supplying "plus" to the terminal (2) of the ШР plug connector, the Д-2Р motor is energized and starts rotating the program cams block; the latter act upon the KB1-20 micro switches and send to the outer circuit signals which follow one another consequently.

The signal sequence according to the [illegible] plug connector terminals is the following: 3,4,6, 5 and then again from the terminal (3) etc.

When de-energizing the terminal (2) of the [illegible] plug connector, the timer stops and signals are not sent to the outer circuit any longer.

In case of a repeated start of the timer, signals may be sent beginning from any terminal of the plug connector.

V. INSTALLATION AND OPERATION INSTRUCTIONS

Installation

The timer is installed in the aircraft so that the electric motor shaft is in the horizontal position (the shaft position is marked on the timer cover) and is attached with 4 bolts by the base lugs. The mounting faces for the timer installation should be in one plane and cleaned till a metallic lustre appears.

The timers can be used in aircraft both with the single and two-wire circuits.

When the timer is used in the single-wire circuit the terminal located on the base vertical wall should be grounded to the aircraft structure.

Operation

The ВМК-2 timers (second series) are sealed and require no adjustment during operation.

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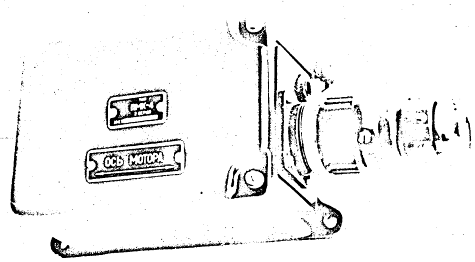

Fi. . . ПМК-4 Timer General View

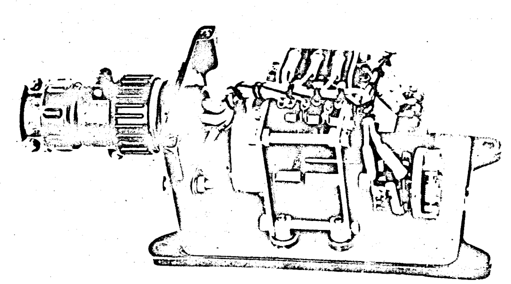

Fig.2. ПМК-4 Timer with Cover Removed

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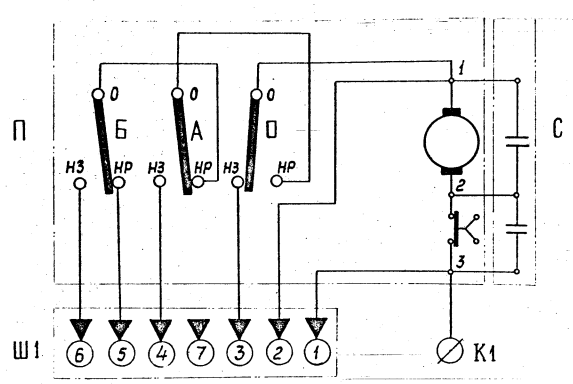

Designation	Name	Qty	Remarks
KI	Contact terminal	1	
Ш1	ШР[illegible]НШ9 plug connector	1	
C	МБГП-3-200-А-[illegible]х0,5-П contactor	1	ГОСТ [illegible]
П	ПМБ-50[illegible] timing mechanism	1	

Fig. 3. Schematic Diagram of [illegible] Timer, second series.

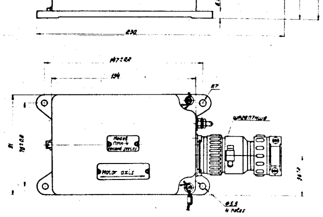

Fig.4. Overall and Mounting Dimensions of ПМК-4 Timer, secon
series

GYRO FLUX-GATE COMPASS

Model ГИК-1

DESCRIPTION AND OPERATION INSTRUCTIONS

GYRO FLUX-GATE COMPASS

Model ГИК-I

DESCRIPTION AND OPERATION INSTRUCTIONS

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CONTENTS

I. PURPOSE

The ГИК-I gyro flux-gate compass is designed to indicate the magnetic and true course, the aircraft turn angle and to transmit the course signals to other consumers.

II. COMPLETING

The ГИК-I remote gyro flux-gate compass set includes:

1. ИК flux-gate detector unit 1
2. Г-3М gyro unit.................... 1
3. КМ correcting mechanism 1
4. У-6М amplifier, series 2......... 1
5. УГ-2 navigator's indicator 1
6. УК-4 pilot's indicator 2
7. СК-19 junction box 1
8. 5-КС synchronizing button 3

NOTE: The ГИК-I gyro flux-gate compass operates:

a) in conjunction with the ВК-53РБ erecting cut-out switch;

b) from an A.C. power supply source - the ПТ-125Ц inverter or another power supply source, which provides the ГИК-I gyro flux-gate compass and ВК-53РБ erection cut-out switch with a power supply of 85 VA, 33.9-39.6 V, 400 ± 8 c.p.s. A.C. and 27 ± 2.7 V.D.C.

The ГИК-I gyro flux-gate compass general view is given in Fig.1.

III. TECHNICAL DATA

1. The compass is ready for operation after power supply is connected to it:

a) at an ambient air temperatures of $+20^\circ$ and $+50^\circ C$ .... in not more than 1 min.

b) at an ambient air temperature of $-60^\circ C$ .... in not more than 3 min.

2. Compass error in determining the true heading by the main [illegible]-2 navigator's indicator:

a) at an ambient air temperature of $+20^\circ C$... not more than $\pm 1.5^\circ$.

b) at an ambient air temperatures of $+50^\circ C$ and $-60^\circ C$ .... not more than $\pm 2^\circ$.

3. Repeaters reading error compared to the main navigator's indicator under normal conditions should not exceed $\pm 2^\circ$. Error permitted on three scale points is $\pm 2.5^\circ$.

4. Additional after-turn error in the compass readings per min. of turn .... not more than 0.5°.

5. Compass reliably operates at an ambient air temperature of $+50^\circ$ to $-60^\circ C$.

6. Compass operates at altitudes up to 25,000 m.

7. Compass is supplied from:

a) 27 ± 2.7 V D.C. power supply source;

b) three-phase 33.9-39.6 V, 400 ± 8 c.p.s. A.C. power supply source.

8. Three-phase A.C. power consumed by compass:

a) without BK-53PB erection cut-out switch... not more than 60 VA.

b) with BK-53PB erection cut-out switch ..... not more than 85 VA.

9. Number of magnetic course consumers connected to the compass, with each consumer interphase resistance not less than 1,000 ohms........ not more than 4 (not including [illegible]-4 indicator of ГИК-I gyro flux-gate compass)

10. Weight .... not more than 12.6 kg.

IV. PRINCIPLE OF OPERATION AND BRIEF DESCRIPTION OF COMPASS

The ГИК-I gyro flux-gate compass employs the principle of the directional gyro operation in conjunction with the flux-gate detector unit - the course corrector.

Fig. 3 presents the compass block diagram.

The gyro unit, which is the course gyro transmitter, is connected through a remote potentiometer transmission to the indicator, therefore the aircraft position in azimuth and its deviation from the preset course through a certain angle at every moment is read on the indicator dial.

Due to friction in the pivots and unbalancing, the free gyro precesses, i.e. constantly drifts in azimuth at a low angular velocity (not more than 0.5 deg./min.).

To correct the course error caused by the gyro precession, introduction of the magnetic course correction is provided in the gyro flux-gate compass.

This correction (for azimuth) is automatically transmitted from the flux-gate detector connected through the correcting mechanism to the gyro unit by remote transmission systems.

When the aircraft turns, the azimuth correction is out-out, thus preventing introduction of compensation for the indicator error caused by the non-horizontal position of the flux-gate of the detector unit during turns.

The gyro rotor axis is stabilized in the horizontal plane by the correcting device which as well as the azimuth correction is cut-out by the erecting cut-out switch to decrease errors at turns.

The ГИК-1 gyro flux-gate compass is provided with three follow-up systems: the first system connects the flux-gate detector unit and the correcting mechanism, the second - the correcting mechanism and the gyro unit, the third - the gyro unit and the indicator. Each follow-up system has its amplifying channel and follow-up drive which consists of the ДИД-0.5 electric motor and reduction gear. All the three channels are combined in one amplifier.

The principle of the flux-gate detector operation consists in the following:

The Earth's magnetic field produces a magnetic flux in the flux-gate permalloy cores. The magnetic flux value depends on the cores position relative to the Earth's magnetic field vector.

Due to changing of the permalloy magnetic permeability, the direct magnetic flux turns into the alternating pulsating flux, as a result of this an electromotive force is generated in the windings, wound around the cores, by the electromagnetic flux density law. The electromotive force value is determined by the cores position relative to the Earth's magnetic field i.e. by the flux-gate detector position in azimuth.

The sensing element of the detector is a so-called flux-gate which consists of three legs positioned 60° apart and secured on the same platform. Use of such a sensing element to determine the magnetic course permits obtaining high accuracy and stability of readings, with the Earth's magnetic field horizontal component $H=0.06$ oersted.

The flux-gate leg consists of 2 identical cores located parallel to each other. Wound around the cores are two windings: excitation winding and signal winding.

The excitation winding is wound on each core separately, connected in series and supplied from a 7.7 V.A.C. power source; the signal winding is wound on the two cores.

The principle of the flux-gate sensing element operation consists in the following: in the windings of the flux-gate three legs occurs the electromotive force (e) which depends on the angle (φ) formed by the direction of the core longitudinal axis and the Earth's magnetic field horizontal component (H_{earth}) direction by the formula $e = E \cos\varphi$.

The signal windings of the flux-gate three legs are delta connected and by three electrical wires they are connected to the transformer stator winding of the КМ correcting mechanism selsyn. The currents generated in the selsyn-stator windings, excite in the selsyn-stator a magnetic flux (Φ) which in its turn induces an electromotive force in the selsyn rotor winding.

The more unsynchronized the "flux-gate-selsyn transformer" system the higher is the voltage generated in the rotor winding.

The voltage picked up from the rotor winding is sent to the amplifier first channel input and next to the control winding of the ДИД-0.5 electric motor which by means of the reduction gear turns the selsyn rotor to the position corresponding to the zero electromotive force.

Thus, a turn of the ИД flux-gate detector sensing element through any angle with respect to the Earth's magnetic meridian (the aircraft turn) results in the correcting mechanism selsyn rotor turning through the same angle.

The correcting mechanism is designed:

1. To connect the ИД flux-gate detector to the Г-3М gyro unit to which, as mentioned above, the course signal is transmitted.

2. To compensate for the quadrantal deviation, instrument and methodical errors by a special cam strip device.

The correcting mechanism incorporates the following units: selsyn, electric motor with reduction gear, potentiometer and cam strip device.

The selsyn rotor is placed on the shaft, rotated by the electric motor through the reduction gear. Through the cam strip device the shaft transmits rotation to the wiperholder with wipers, the wipers can also get an additional angular motion about the shaft.

The selsyn stator and the potentiometer are secured in the correcting mechanism casing.

The potentiometer is used to transmit the course signal corrected by the cam strip device, to the Г-3М gyro unit. With the "correcting mechanism potentiometer - Г-3М gyro unit potentiometer" system asynchronized, picked up from the correcting mechanism potentiometer is the asynchronizing signal, which after being amplified in the amplifier second channel is sent to the gyro unit ДИД-0.5 electric motor control winding. The electric motor reduction gear turns the gyro unit potentiometer wipers till the potentiometer of the gyro unit and that of the correcting mechanism are synchronized.

Thus, each turn of the aircraft and consequently of the flux-gate detector sensing element through the same angle in the horizontal plane results in turning the gyro unit potentiometer wipers through the same angle. The Г-3М gyro unit is one of the ГИК-1 flux-gate compass main elements and is used for memorizing, averaging the aircraft course, determined by the flux-gate detector, and for transmitting it to visual display indicators and other consumers of the magnetic course.

The gyro unit sensing element is the directional gyro i.e. an astatic gyro having three degrees of freedom, whose main gyro axis (the axis of the rotor rotation) is located horizontally. Rigidly secured on the gyro unit outer gimbal ring vertical axis is a ring potentiometer. 27 V D.C. power is supplied to the two diametrically opposite points of the potentiometer.

The voltages are picked up from the potentiometer by three wipers secured on the gear and located 120° apart.

The gyro unit potentiometer wipers are electrically connected to the correcting mechanism potentiometer wipers and also to the three tappings on the УШ-2 navigator's indicator film potentiometer forming with the latter a potentiometer remote transmission system with an electric motor which provides transmitting of the corrected course data to the navigator's indicator.

The УШ-2 navigator's indicator is designed to indicate the magnetic or true course of the aircraft and to transmit D.C. course signals to the consumers.

The УШ-2 navigator's indicator consists of the following main units: film (glass) potentiometer, wire potentiometer, reduction gear with an electric motor, cam strip, variation introducing device, scales and pointers.

Change in the aircraft course results in asynchronizing the "Gyro unit potentiometer - navigator's indicator potentiometer" follow-up system.

From the film potentiometer the asynchronizing signal is sent to the amplifier through two wipers located 180° apart. After being amplified in the corresponding amplifier channel this signal is transmitted to the control winding of the ДИД-0.5 electric motor incorporated in the УШ-2 navigator's indicator.

The electric motor through the reduction gear turns the УШ-2 navigator's indicator film potentiometer till it is synchronized with the gyro unit potentiometer.

Secured on the same shaft with the film potentiometer is the wire potentiometer which is electrically connected through three wipers to the УК-4 indicators and the true course consumers.

To obtain the true course data on the navigator's indicator, it is necessary to introduce magnetic variation correction for the given area. The correction is introduced by turning the knob on the indicator face. The correction value is set by the magnetic variation scale.

Used as pilots' indicators are УК-4 indicators.

The УК-4 indicator is a ratiometer-type instrument which indicates the aircraft course. The УК-4 indicator is connected to the navigator's indicator by a remote potentiometer transmission operating in the indicator mode.

V. COMPASS ELECTRICAL SYSTEM

I. Block Diagram

The ГИК-I gyro flux-gate compass(set No.6), whose block diagram is shown in Fig.3, consists of the following main units: gyro unit, magnetic corrector, amplifier and visual indicators.

Used as a magnetic corrector in the ГИК-I gyro flux-gate compass is the ИД flux-gate detector with КМ correcting mechanism and corresponding amplifying channels which are incorporated in the У-6М series 2 amplifier.

The ГИК-I compass indicators are the УГ-2 navigator's indicator and УК-4 pilot's indicator.

When the aircraft turns at an angular velocity exceeding 0.1÷0.3 deg/sec. the corresponding circuits of correction(magnetic correction and correction of gyro rotor axis horizontal position) are automatically cut out by the ВК-53РВ erection cut-out switch.

2. Wiring Diagram

The ГМК-I gyro flux-gate compass wiring diagram is shown in Fig.4.

After the compass is energized and the amplifier valves are warmed-up, the follow-up system connecting the flux-gate detector to the correcting mechanism becomes synchronized.

The electrical asynchronizing signals from the flux-gate windings are transmitted through three wires to the windings of the correcting mechanism receiving selsyn stator. The electrical signal picked up from the selsyn rotor is sent, after being amplified in channel I, to the control winding of the correcting mechanism ДИД-0.5 electric motor which through the reduction gear turns the selsyn rotor till the synchronized position is obtained, i.e. the voltage across the rotor winding ends is zero.

Three potentiometer wipers placed on the same axle with the selsyn rotor are electrically connected to the three wipers of the potentiometer installed on the gyro unit outer gimbal ring vertical axis.

The electrical asynchronizing signal from the correcting mechanism potentiometer is sent to the amplifier II channel input. The amplifier output voltage is supplied to the control winding of the gyro unit ДИД-0.5 electric motor which through the reduction gear rotates the potentiometers wipers until the synchronized position is obtained.

In its turn, the gyro unit potentiometer is connected by three wires with the navigator's indicator film potentiometer. Change in the relative position of the wipers and the gyro unit potentiometer caused by change in the aircraft course and also by the main gyro axis drift in azimuth, is transmitted in the form of electrical asynchronizing signals to the amplifier III channel input. The voltage from the amplifier III channel output is transmitted to the ДИД-0.5 electric motor control winding of the indicator.

The ДМ-0.5 electric motor turns the navigator's indicator course axle and the film potentiometer until the latter is synchronized with the gyro unit potentiometer.

To transmit the course signal to the consumers (pilot's indicator, etc.), secured to the УШ-2 navigator's indicator course axle is a ring wire potentiometer which is supplied with 27 V.D.C.

Connected to the three taps of the УШ-2 navigator's indicator wire potentiometer through three wires are two УК-4 pilot's indicators. The potentiometer transmission incorporates the УШ-2 navigator's indicator ring potentiometer and three-phase magnetoelectric ratiometer of the УК-4 pilot's indicators.

Connected in the power supply circuit is a ПК-30-0.25 A fuse to protect the remote potentiometer transmission (the gyro unit potentiometer and УШ-2 navigator's indicator potentiometer) from burning out if any of its circuits are grounded to the aircraft structure.

VI. TESTING THE ГИК-1 GYRO FLUX-GATE COMPASS IN LABORATORY

Before mounting the compass in the aircraft it can be checked using a special УПК-3 portable test unit in accordance with the description and instructions furnished with it.

When the test unit is not available check the compass by means of a special system formed of plug connectors, wire harnesses and CK-19 junction box. Connect the wire harnesses and the junction box in accordance with the cording diagram (Fig.5).

Check the compass under the following conditions:

1. Intensity of the Earth's magnetic field horizontal component in the place of the flux-gate detector installation should be within 0.14-0.19 oersted.

2. Intensity of the magnetic field should be constant. Permissible value of change in the magnetic field horizontal component direction is not more than ± 0.25°.

3. Ferromagnetic masses should be located at a distance not less than 2m. from the flux-gate detector. When checking the compass, the displacement of ferromagnetic masses is not permitted.

4. Voltage and frequency of power supply sources should be within the limits given in Section III.

To check the compass errors, install the flux-gate detector on an anti-magnetic table provided with a limb graduated for 360°. Before checking, remedy the flux-gate detector installation error as specified in Section VIII. Next, setting the flux-gate detector on the points to be checked in increments of 30 deg. determine the readings of the УШ-2 navigator's indicator pointer.

By substracting the readings of the limb from the indicator readings, obtained is the compass error value, which should not exceed ± 4.5°. The check is performed under normal conditions with the quick synchronizing button on, without introducing the magnetic variation.

<u>NOTE</u>: Using the correcting mechanism cam strip, the compass error can be decreased to a value not exceeding 1-1.5° (under normal conditions). On delivery of the compass from the Mfr's plant the cam strip is set in the middle position when the instrument error does not exceed ± 4.5°. This error is corrected simultaneously with compensation for the compass deviation.

When checking the error also check the indicators pointer oscillations. The amplitude of the dial sustained oscillations should not exceed ± 0.5° (under normal conditions).

Determine the high synchronizing speed as follows: Set the flux-gate detector at 0 by the limb. After synchronizing is accomplished, switch off the high speed and turn the flux-gate detector through an angle of 170°. After the lapse of 10 sec. switch on the high speed, start the stop-watch and determine the time required for the indicator-pointer to turn through an angle of 170°. The quotient obtained from dividing 170° by the time, measured by the stop-watch, is the synchronizing speed which should be not less than 8.5 deg./sec.

To check the normal speed, synchronize the ДК-2 navigator's indicator readings with the position of the flux-gate detector at any point. Next, switch off the high speed and turn the gyro unit asynchronizing it relative to the flux-gate detector by 120°(determining the turn angle value by observing the indicator pointer reading).

After that start the stop-watch and determine the time required for the pointer to turn through an angle of 9°. The quotient obtained from dividing 9° by the time, in min., is the normal synchronizing speed value, which should be within 1-5 deg/min.

Check the synchronizing speed by turning the gyro unit clockwise and counterclockwise. Difference in the speeds of the pointer movement in both directions should not exceed 1.5 deg./min.

VII. W I R I N G

The compass units electrical wires are connected in the СК-19 junction box in accordance with the cording diagram (See Fig.4).

When wiring the compass units proceed as follows:

I. lay the wires in shielding conduit:

a) from the pins M and N of the correction mechanism 14-pin plug connector and the pins A and 3 of the У-6М series 2, amplifier, plug connector to the terminals A-7 and A-9 of the junction box:

b) from the pins В, Г and Д of the flux-gate detector plug connector to the pins В, Г and Д of the correcting mechanism plug connector.

2. Ground the shielding conduit to the aircraft structure in several points.

3. Thoroughly attach the ends of the wire conduits. The conduits braiding wires should not contact the plug connector pins.

4. Prevent the mounting wires from being damaged.

5. For wiring use the wires used for the aircraft electrical system.

6. Voltage drop should not exceed 0.5 V in the wires laid:

a) from the aircraft electrical system through the junction box to the gyro unit and amplifier;

b) from the inverter through the junction box to the gyro unit;

c) from the inverter through the junction box to the amplifier.

7. The wire section area should be not less than 0.5 mm^2.

The wires connecting the ГИК-I compass units should be grouped and tied in harnesses.

The wire harnesses should be attached to the aircraft skin. In all places where the wire harnesses pass through metal structures they must be protected with special protective collars and rings.

Each wire of the harness is connected to the terminal block of the junction box through a special eye-lug soldered to the wire. If the wire ends have no eye-lugs, do not connect them to the junction box.

The wire harnesses are connected to the ГИК-I compass units through plug connectors. Separate wires are soldered to the proper sockets; the wires must be soldered to the sockets in strict accordance with their labels.

If the wires are broken never lengthen them. The receptacle half of the plug connector is mounted on a corresponding instrument.

The instrument internal wiring leads are soldered to the receptacle pins in accordance with the wiring diagram of the given instrument.

To connect properly the plug connector two halves, the plug has a key slot and the plug - a key.

After the wiring is completed, check to see that all the compass units, power supply wires and consumers are properly connected to the CK-[illegible] junction box terminals.

[illegible]: To prevent burnout of the gyro unit and YM-2 navigator's indicator potentiometer windings, thoroughly insulate the wires connecting the gyro unit, correcting mechanism and indicator (wires connected to the junction box terminals [illegible], 57, [illegible], [illegible], [illegible], [illegible]2 and [illegible]) from one another and from the aircraft structure. Neglecting this requirement will result in damage and failure of the [illegible] compass.

Prior to [illegible] the plug connector to the gyro unit proceed as follows:

1. [illegible] all the [illegible] units but do not energize them.
2. [illegible] the resistance between the [illegible] [illegible] [illegible] to the wiring [illegible].

The resistances [illegible] should be equal [illegible] tolerance of [illegible].

3. [illegible] check the resistance of insulation between the [illegible] and the [illegible] which [illegible] on the wire [illegible] end, and also between the socket [illegible] and aircraft structure; if the insulation resistance between the above [illegible] is not less than [illegible], the gyro unit is permitted to be [illegible] to the circuit.

If the resistance is less than 2 megohms, detect and remedy the defect and then repeat the checking.

Neglect of the above requirements may cause damage to the gyro unit and failure of the ГМК-1 compass.

To protect the gyro unit potentiometer from burnout, provided in the junction box is a ПК-30-0.25 A fuse (a fuse with conical tips, 30 mm.long for nominal current of 0.25 A).

Never use in the junction box another type of fuse for different nominal current.

VIII. SWINGING AND COMPENSATING THE GYRO FLUX-GATE COMPASS

Steel masses and electromagnetic fields of the aircraft affect the flux-gate detector and cause errors in determination of the magnetic course by the compass. The value and character of these errors are similar to the magnetic pointer deviation.

Locate the flux-gate detector where it will be least affected by ferromagnetic masses and electromagnetic fields. It is impossible to completely isolate the flux-gate detector from the influence of ferromagnetic masses, ~~therefore~~, there will always be an error in determining the course.

The ΔC deviation value is determined as the difference between the aircraft magnetic course (MC) and the compass course (CC).

$$\Delta C = MC - CC$$

The semicircular deviation in the ГМК-1 gyro flux-gate compass is compensated by a compass compensator; the quadrantal deviation is compensated by a cam strip incorporated in the correcting mechanism.

When installing the ГИК-I compass in the aircraft the installation error is compensated the first.

To compensate the installation error, determine the error on all the four magnetic courses (0, 90, 180 and 270°) and calculate the installation error by the following formula:

$$C = \frac{C_{0^\circ} + C_{90^\circ} + C_{180^\circ} + C_{270^\circ}}{4}$$

Compensate the installation error exceeding 1° by turning the flux-gate detector about the aircraft C.L. To do this, loosen three screws attaching the flux-gate detector and turn it for the value of the error determined.

After compensation for the installation error start compensating for the semicircular deviation; to do this, swing the aircraft to the magnetic course of 0°, determine the deviation value (ΔC = MC − CC), next swing the aircraft to the 180° course and obtain the magnetic deviation value of $\frac{\Delta C_{0^\circ} + \Delta C_{180^\circ}}{2}$ by rotating the N-S magnet. Do the same on the courses of 90-270° by rotating the E-W magnet obtain the deviation value of $\frac{\Delta C_{90^\circ} + \Delta C_{270^\circ}}{2}$

After compensation for the semi-circular deviation is accomplished, tighten the screw of the clamp on the compass compensator magnet and lock it with a brass wire, next start compensating for the quadrantal deviation. Compensate for the quadrantal deviation, instrument and methodical errors of the compass by means of the correcting mechanism on strip on 24 magnetic courses. To compensate for the quadrantal deviation, swing the aircraft on 0° magnetic course.

Using a screwdriver, unscrew three screws (1) and remove the cover (3) pulling it by the head (Fig.2) located around the circumference under the correcting mechanism cover are twenty four heads of the adjusting screws (4), dial (5) and pointer (6).

Using the screwdriver (7) rotate the adjusting screw, located against the end of the pointer (6) observing the readings on the УШ-2 indicator dial (magnetic variation value should be equal to zero).

The high speed synchronizing button should be pressed.

If ΔC deviation is positive, i.e. the course read on the indicator (CC) is less than the preset magnetic course (MC) of the aircraft, rotate the adjusting screw counterclockwise (unscrew); if ΔC deviation is negative, i.e. the course read on the indicator (CC) is more than the aircraft magnetic course (MC), rotate the adjusting screw clockwise (screw in).

Adjust (rotate the adjusting screw) so that the indicator shows the preset magnetic course; in this case 0°. Compensate for deviation on all the 24 courses in a similar way (0, 15, 30, 45, 60 etc. in increments of 15 deg.).

When the compass is delivered from the Mfr's plant, the adjusting screws of the correcting mechanism cam strip are set in middle position, in which the cam strip efficiency is not less than ± 6°.

During the cam strip adjustment, when compensating for deviation, the adjusting screws shift from middle position. Therefore, before repeatedly compensating for deviation by means of the correcting mechanism, which was adjusted before (e.g. after replacing the compass set in the aircraft, replacing its individual units, after repair etc.) set the adjusting screws of the correcting mechanisms in middle position.

To do it, proceed as follows: energize the ГИК-I gyro flux-gate compass. Rotating a magnet about the flux-gate detector, set the correcting mechanism pointer at zero point of the dial. Rotating the adjusting screw located against the pointer end (with the quick synchronizing button pressed), set the УШ-2 navigator's indicator pointer at zero.

3. Setting the correcting mechanism pointer on the divisions after every 15° in the same way, obtain equal readings on the correcting mechanism and УШ-2 navigator's indicator dials.

When replacing the flux-gate detector and the correcting mechanism repeatedly compensate for deviation as specified in this Section.

IX. CHECKING THE GYRO FLUX-GATE COMPASS BEFORE FLIGHT

Before flight check:

1. the units for external condition;
2. the units for security of attachment;
3. the plug connectors for proper connection;
4. position of the amplifier sensitivity regulator;
5. the compass set for reliable operation (checked before each flight).

The sensitivity regulator of the У-СМ amplifier, Series 2, is usually set in the position marked 3 or 4 for middle latitudes, 4 or 5 for high latitudes and 2 or 1 for latitudes close to the equator.

To check the compass set for reliable operation, energize the set and in 1-3 min. synchronize the compass system by pressing the quick synchronizing button. Next, with the button pressed, bring a permanent magnet (or another steel object:wrench, screwdriver) to the flux-gate detector so that the dial would turn through some angle, after that release the button and remove the magnet from the flux-gate detector at a distance not less than 2 m. In 15-20 sec. press the button and observe the movement of the indicator dial which should, smoothly rotating, settle in the initial synchronized position. If after synchronizing, the indicator pointer continues oscillating with an amplitude exceeding 1°, decrease the amplifier sensitivity by rotating the sensitivity regulator with the screwdriver to the left till the pointer stops oscillating.

X. PERIODIC MAINTENANCE OPERATIONS

Perform the periodic maintenance after every 50 hours of the compass operation in the aircraft.

Flux-Gate Detector

Disconnect the flux-gate detector plug connector.

Check the flux-gate detector for security of attachment for external damage and for fluid traces on the detector surface and on the plug pins.

Using a 500 v. megger check the insulation resistance between the plug connector pins B, Γ, Д and the detector casing. The insulation resistance must be not less than 20 megs.

Tighten the plug connector coupling nut.

KM Correcting Mechanism

Examine the correcting mechanism for external damage and security of attachment.

Check the plug connector coupling nut for proper tightening.

Г-3M Gyro Unit

Examine the gyro unit for external damage, condition of the shock-absorbing springs (if the springs are broken, remove the gyro unit replace the springs).

Disconnect the plug connector from the gyro unit and check the resistance between the plug connector pins.

a) Resistance between the pins З and К should be from 80 to 110 ohms.

b) Resistance between the pins Ж and И should be from 40 to 600 ohms.

c) Resistance between the pins А and Б, Б and В, А and В should be from 370 to 578 ohms. Connect the gyro unit to the ГИК-I compass set circuit and check the normal and high synchronizing speeds as specified in Section VI.

УК-2 Navigator's Indicator

Examine the indicator for external damage. Check the plug connector coupling nut for proper tightening.

Check the direction indicator pointer oscillation and drift with the power supply on and the aircraft engines running. The pointer drift and oscillation should not exceed ±1°. In this case the magnetic variation setting knob must not rotate inadvertently. To determine the pointer drift, note the course indicator readings, with the engines inoperative, and compare them with the readings when the aircraft is vibrating.

УК-4 Indicator

Inspect the indicator for external damage. Check the plug connector coupling nut for proper tightening.

Check the pointer oscillation and drift with the power supply on and the aircraft engines running. The pointer drift and oscillations should not exceed ± 1 mm. In this case the indicator dial should not rotate inadvertently. To determine the pointer drift, note the indicator readings, with the engines inoperative, and compare them with the readings when the aircraft is vibrating.

У-6М Amplifier, Series 2.

Inspect the amplifier for external damage, security of attachment and proper tightening of the amplifier plug connector coupling nut.

Check the amplifier for reliable operation, when checking the compass set.

СК-19 Junction Box

Inspect the box for external damage. Turn four attachment screws and remove the cover from the box. Using a special socket wrench, check tightening of all the nuts on the terminal blocks. Check the fuse, and security of the terminal blocks attachment in the box. Place the cover on the box and secure it by turning the attachment screws.

ГИК-I Compass Set

1. Connect all the ГИК-I compass set units, except the gyro unit to the proper plug connectors of the aircraft electrical system, but do not energize the set from the aircraft electrical system and ПТ inverter.

2. Check the resistance between the sockets A and Б, A and B, Б and B of the gyro unit plug located on the wire harness end.

The resistances should be equal (with a tolerance of ±20 ohms), each should be not less than 100 ohms. Check the insulation resistance between the sockets A and Б, A and B, A and Г and between the aircraft structure and the sockets A and Г using a 500 v. megger.

If the insulation resistance is less than 1 meg, detect and repair the defect and repeat testing the insulation resistance.

3. Connect the gyro unit to the compass set circuit energize the set and check the compass operation as specified in Section VI.

XI. PACKING, SHIPMENT AND STORAGE

Place each of the ГИК-I compass units in a special carton box. The carton box should also contain the unit attachment parts and certificate.

Pack the carton boxes with the ГИК-I compass units in a special wooden case. The case gross weight should not exceed 50 kg. During shipment handle the case with care.

Store the ГИК-I units in a dry room at a temperature of +10 to +30°C.

Place the boxes with units on shelves. The room must be free from vapours, acids and alkalis.

IMPORTANT: When shipping the aircraft by rail, remove the gyro unit from the aircraft and place it in the Mfr's plant package.

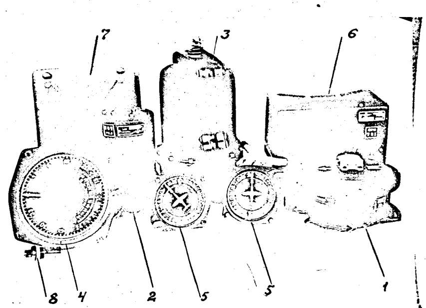

Fig.1. ГИК-I Compass Set

1 - ИД- flux-gate detector; 2 - КМ correcting mechanism; 3 - Г-3М gyro unit; 4 - УШ-2 navigator's indicator; 5 - УК-4 indicator; 6 - У-6М amplifier; 7 - СК-19 junction box; 8 - synchronizing button.

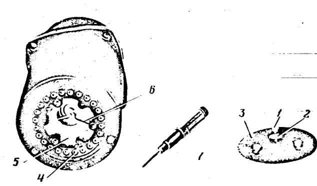

Fig.2. Correcting Mechanism

1 - Screw; 2 - head; 3 - cover; 4 - adjusting screw; 5 - dial; 6- pointer; 7 - screwdriver.

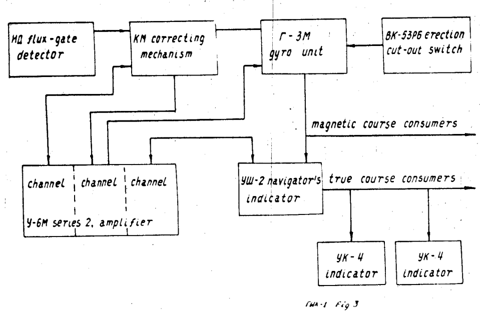

Fig.3. ГИК-I Compass Set Block Diagram.

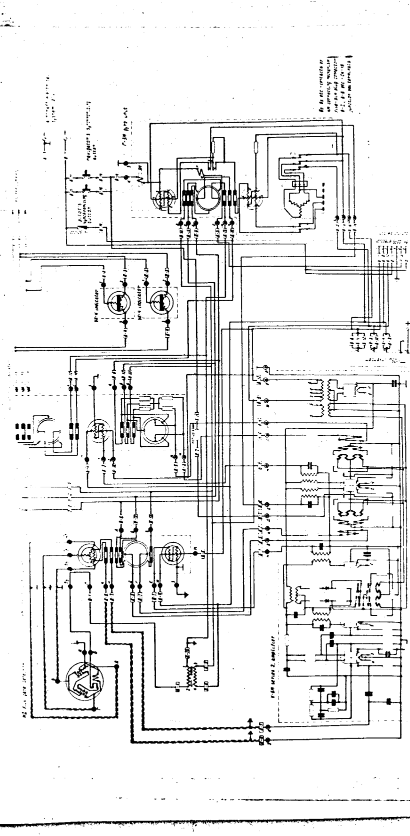

Fig.4. ГИК-I Compass Set Wiring Diagram

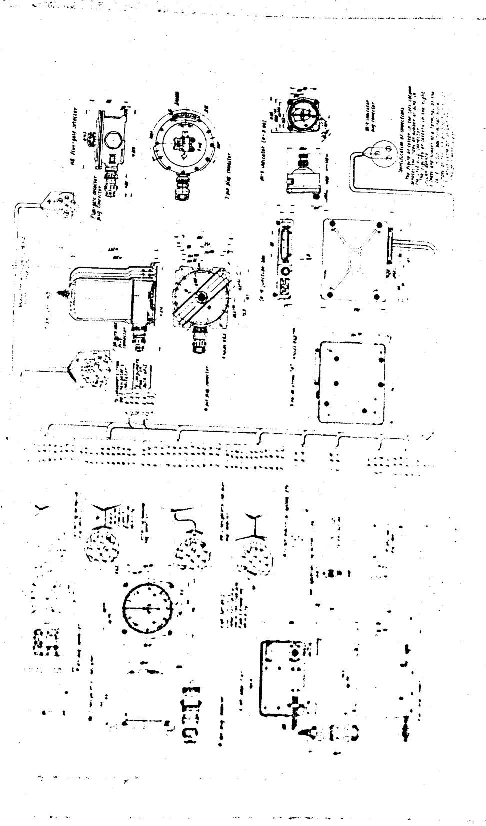

Fig. [illegible] [illegible] Compass Set Cording Diagram (with CK-19 Junction Box)

BRIEF MAINTENANCE INSTRUCTIONS

for

AIRCRAFT LEAD-ACID DRY-CHARGED STORAGE BATTERY

Model 12- CAM - 28

Declassified in Part - Sanitized Copy Approved for Release 2012/01/05 : CIA-RDP80T00246A064300130001-3

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BRIEF MAINTENANCE INSTRUCTIONS

for

AIRCRAFT LEAD-ACID DRY-CHARGED STORAGE BATTERY

Model 12-CAM-28

NOTICE

1. Give a charge to the storage batteries (excluding the first charge) at two values of charging current and continue charging till completed.

2. Store the batteries filled with electrolyte only in charged condition.

3. Never keep the batteries discharged for a period exceeding 8 hours.

4. Once a month overcharge the batteries being in operation and give them a test cycle of charge/discharge every three months.

5. Check the electrolyte level and specific gravity. Add periodically distilled water to the battery cells.

Never add acid to obtain the required electrolyte level in the battery cells.

6. Install in aircraft only the fully charged batteries.

7. Check the generator control box for proper function.

8. When carrying the batteries or installing them in the aircraft handle the ebonite battery case and parts with care.

9. Do not store the batteries for a period exceeding the time indicated.

10. The batteries should not be exposed to the direct sun rays; do not place the storage batteries in pile.

11. If cracks appear on the battery sealing compound, remedy them immediately by melting the sealing compound.

Melt the sealing compound using a hydrogen flame, torch or other means, provided the battery is discharged and plugs removed.

12. Check the vent plugs for proper function. Do not install the plugs whose valves fail to open when the battery is returned to the normal position after being turned over through 180° and 90°.

BRIEF MAINTENANCE INSTRUCTION FOR THE 12-CAM-28 AIRCRAFT DRY-CHARGED STORAGE BATTERIES

I. CONDITION OF A STORAGE BATTERY DELIVERED FROM THE MANUFACTURING PLANT

1. The storage battery is delivered without electrolyte in it but with the plates dry-charged. Each battery is accompanied with a special certificate.

2. All the battery cells are closed with solid ebonite plugs (used during shipment only) tightly screwed in.

A set of vent plugs (12 ea), spare vent plugs (6 ea) and rubber washers (18 ea) are furnished together with the battery certificate and these Maintenance Instructions.

The battery date of manufacturing and number are given in the certificate. The battery number is marked on the battery positive terminal.

II. TECHNICAL DATA

3. a) Nominal voltage .... 24 V.

b) Max. weight with electrolyte.......... 28.5 kg.

c) A fully charged battery at the electrolyte temperature of +20°C ± 2° provides four startings of an engine during the first year of service conforming to the rating indicated in Table 1, and three startings – during the second service year.

28 The battery at the electrolyte temperature of $-5^{\circ}C$ in the middle cells provides two startings of an engine during the whole service life conforming to the same rating.

The voltage across the battery terminals at the end of the final starting is not less than 16 volts.

Table 1.

Time ON, sec.	Current, amperes (approx.)	Remarks
0	650	
5	510	
10	400	
15	315	
20	250	
25	200	
30	150	
35	125	
40	100	
45	75	

б) capacity of the battery for five-hour discharge rate at a current of 5.6 A and at the electrolyte average temperature of $+25^{\circ}C$ should be:

during the first half year period (beginning with the third discharge) .... 28 A.H.,

during the second half year period .... 23 A.H.,

during the second year .... 21 A.H.

The storage battery may be discharged till 1.7 V across one of the cells.

-28

c) The battery is designed to operate under the following conditions:

1. At altitude .... up to 17 km.

2. In ambient temperature range... from +50°C to -50°C;

3. At a vibration of the attachment fittings of 50 c.p.s. with overloading up to 2.5 g.

III. STORING THE BATTERIES WHICH HAVE NOT BEEN IN SERVICE

4. Store the batteries in a clean, dry, closed location at a temperature of +5°C to +30°C.

5. The storage batteries with solid plugs tightly screwed in should be kept on shelf-stands; bolts and nuts of the battery terminals, as well as the wing nuts and handles should be well coated with vaseline or grease.

While storing the batteries clean them thoroughly and coat the above mentioned parts with vaseline or grease, but not too thick, to prevent the grease from getting on the sealing compound, as the latter may be damaged as a result of this.

A shelf life of the batteries that have not been in service is three years.

IV. PREPARATION OF ELECTROLYTE

6. When preparing the storage battery electrolyte, take sulphuric acid (ГОСТ 667-53, grade А and Б) and distilled water.

If distilled water is not available, rain water (provided it was collected from a wooden roof) or snow water may be used.

Prepare and store the electrolyte and water either in a lead-lined wooden container or in an ebonite or glass vessel.

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ELECTROLYTE PREPARATION PROCEDURE

7. Fill the container with a required quantity of distilled water, then slowly pour concentrated sulphuric acid into it.

Personnel engaged in preparing the electrolyte should do it very carefully and wear goggles.

Never pour water into the acid since heat may be generated so rapidly that the acid will be thrown upon the operator and may cause painful burns or spoil the clothes.

Stir the mixture continuously while pouring concentrated sulphuric acid into distilled water, especially on adding a new portion of concentrated sulphuric acid.

When sulphuric acid is gradually poured into distilled water to produce electrolyte, the resulting mixture should be thoroughly stirred to mix and cooled to +25°C; then check the specific gravity of the electrolyte prepared.

Should the electrolyte specific gravity exceed the required one, adjust it by diluting with distilled water.

If the electrolyte specific gravity is lower, adjust it to the value required by adding the acid.

T A B L E

of specific gravity corrections for various electrolyte temperatures

Electrolyte temperature, °C	Specific gravity correction	Electrolyte temperature, °C	Specific gravity correction
+50	+0.0175	- 0	-0.0175
+45	+0.0140	-5	-0.0210
+40	+0.0105	-10	-0.0245

Electrolyte temperature, °C	Specific gravity correction	Electrolyte temperature, °C	Specific gravity correction
+35	+0.0070	−15	−0.0280
+30	+0.0035	−20	−0.0315
+25	0.000	−25	−0.0350
+20	−0.0035	−30	−0.0385
+15	−0.0070	−35	−0.0420
+10	−0.0105	−40	−0.0455
+5	−0.0140	−45	−0.0490

Example: What is the electrolyte specific gravity at a temperature of +25°C, if at a temperature of −15°C the hydrometer reads 1.235?

Consulting the Table find the correction 0.0280. Therefore, the actual electrolyte specific gravity at +25°C will be:

1.235 − 0.028 = 1.207 or 1.21 approximately.

If the hydrometer reads 1.235 at a temperature of +50°C, then the actual electrolyte specific gravity at +25°C will be:

1.235 + 0.0175 = 1.2525 i.e. slightly above 1.25.

T A B L E

for preparing sulphuric acid solution from sulphuric acid having specific gravity of 1.83

To prepare a solution of sulphuric acid (H_2SO_4) having specific gravity of	Take the following amount of 1.83 specific gravity sulphuric acid per 1,000 grs. (1,000 cm³) of distilled water heated up to 15÷20°C.	
	Grs	cm³
1.120	220	120
1.260	540	295

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V. PREPARING STORAGE BATTERIES FOR SERVICE

A. Procedure for Dry-Charged Storage Batteries

8. To prepare a storage battery for service (the first charge) proceed as follows:

a) remove the battery cover;

b) unscrew the solid plugs;

c) fill the battery cells with electrolyte having specific gravity of 1.260 ± 0.005 corrected for a temperature of +25°C.

The temperature of the electrolyte used for filling the batteries should never exceed 25°C. When filling the batteries use a glass or ebonite funnel and a calibrated glass vessel.

It is required about 3.6 litres of electrolyte for initial filling of the battery.

For preparation of such a quantity of electrolyte having specific gravity of 1,260 it is required 0.87 litres or 1.59 kg. of sulphuric acid of 1.83 specific gravity.

The electrolyte level should be from 6 to 8 mm. above the protector plate.

If any electrolyte was spilled on the battery, it should be removed with a clean wet cloth.

After filling all the cells with the electrolyte, allow the battery to stand for 1 or 2 hours for plate impregnation, and then the battery can be placed for charging.

The battery should be placed for charging when the electrolyte temperature decreases to 35°C.

NOTE: . If the electrolyte temperature after one or two hours of cooling is above 35°C, wait till the temperature decreases to the above mentioned temperature.

If the electrolyte level has fallen, add more electrolyte to restore it. Check the electrolyte level in all the battery cells.

9. The ammeter and rheostat to control the current are connected to the charging circuit in series. Connect the battery positive terminal to the positive terminal of the charging circuit, and the negative terminal of the battery - to the negative terminal of the charging circuit; check the battery for proper connection to the charging circuit and begin the first charge at a rate of 4.0 amperes.

Charge the battery at the above rate until the charge is completed which is determined by the following conditions observed during 2 hours:

a) constant terminal voltage and specific gravity of electrolyte;

b) uniform and intensive gassing from all the cells.

The voltmeters and ammeters must be of high accuracy and carefully tested.

The first charge duration of the battery must be from 3 to 5 hours (excluding an interval).

10. If when charging the battery, the electrolyte temperature rises up to 45°C or the electrolyte excessively frothes, stop charging till the electrolyte is cooled to 35°C. In this case the battery charging duration is extended respectively.

11. If on expiration of five hours the signs of completion of the charge (constant specific gravity of electrolyte and constant terminal voltage) are not obtained, continue charging at the second charge rate in accordance with para.13 of these Instructions.

If at the end of charging the electrolyte specific gravity does not reach a normal value of 1.260 ± 0.005 corrected to a temperature of 25°C, give the battery one or two charge/discharge test cycles at the rate indicated in para.12 and 13.

At the end of the second charging and the third charging adjust the electrolyte specific gravity to 1.260±0.005 corrected to a temperature of 25°C.

If a terminal voltage of one of the cells is considerably lower than that of the other cells, continue charging the battery at the charge rate of 2A till an approximately equal terminal voltage across all the battery cells is obtained.

If the charging is continued but the voltage across the cell does not increase, remedy a short circuit in the cell or some other defect. (See para.11)

12. If no signs of the charge completion appear discharge the battery at 5.6 A. till a voltage of 1.70 V. across one of the cells is obtained, and then charge the battery conforming to para.13.

13. Perform the second charge and all subsequent charges at two rates of the charging current as follows:

Rate No.	Charging current, A	Duration
1	4.0	Till 2.4 0V. - 2.42 V across the cell.
2	2.0	Till charge is completed which is determined by the following conditions observed during 2 hours: a) constant terminal voltage and specific gravity of electrolyte in all cells. b) uniform and intensive gassing from all cells.

After completion of the charge allow the battery to stand for one hour and then check the electrolyte level in the cells which should be from 6 to 8 mm. above the protector, provided the electrolyte specific gravity is 1.260 ± 0.005 (corrected to 25°C).

Adjust the electrolyte specific gravity and level to the above-given values by adding distilled water into the cells and connect the battery to a 2.0 A. charging circuit for 1 or 2 hours in order to mix the electrolyte.

Measure the electrolyte level with a glass tube.

Insert one end of the tube into the cell, so that it contacts the protector plate, and close the upper end of the tube with a finger, then take the tube out. The height of the electrolyte contained in the tube is equal to the electrolyte level above the protector.

14. In special cases when the batteries are urgently required for service, they may be installed in aircraft immediately after impregnating the battery plates with electrolyte without a subsequent charging. In such cases check preliminarily the battery cells voltage using a discharge tester with a 6A. load; the voltage should be not less than 2 volts per cell.

If the check results are unsatisfactory, do not place the battery for service, but charge it according to para.9 of these Maintenance Instructions.

B. Procedure for Batteries Stored without Electrolyte in them and in Discharged Condition

15. Unscrew the plugs and fill the cells with the electrolyte of 1.120 specific gravity. The temperature of the filling electrolyte should not exceed 25°C.

Duration of the plates impregnation is 3 hours. During the plates impregnation, check the electrolyte temperature. Place the battery on charge at the electrolyte temperature of not higher than 35°. If the electrolyte temperature after three hours of plate impregnation is above 35°C. allow the battery to cool or cool it especially by some means.

16. Charge the battery conforming to para.13 of these Maintenance Instructions with the second rate of charging current till the charge is completed which is determined by the constant terminal voltage and electrolyte specific gravity observed during 3-4 hours.

After completion of the charge, discharge the battery at the current corresponding to the 5-hour discharge rate till the voltage of 1.7 V. across one of the cells is obtained and then recharge the battery fully.

At completion of the second charging (on obtaining constant specific gravity of the electrolyte), adjust the electrolyte level and specific gravity.

C. Procedure for Batteries Stored with Electrolyte in them and in Charged Condition

Prior to putting into service the battery stored with the electrolyte in it should be given a test cycle of charge/discharge conforming to Section VI of these Maintenance Instructions.

VI. BATTERY IN SERVICE

17. Tested and fully charged batteries may be operated in aircraft. Prior to installation in aircraft, check the batteries for condition of sealing compound, terminals, monoblock case and vent plugs. The battery sealing compound must be free from cracks.

The terminal bolts thread must be in good condition; the bus-bar ends and terminal surfaces contacting with the bus-bars must be free from oxides.

The monoblock case must not have cracks.

After visual inspection of the batteries screw in the vent plugs, which should be cleaned from dirt.

18. The batteries are to be discharged in sefvice as specified in Table 1, para.3 of these Maintenance Instructions.

19. The state of battery discharge may be approximately determined by their voltage or electrolyte specific gravity, the latter method being a more reliable.

a) Determining the State of a Battery Discharge by Voltage

To determine the state of the battery discharge, connect it(with the generator inoperative) to any of the aircraft electrical instruments that consumes current of about 12 A.

The relations between the battery voltage and the state of discharge are given in the Table below.

State of battery charge	Voltage at load of 12 A., volts
Fully charged	24-25
25% discharged	24-25
50% discharged	23-24
75% discharged	22-23
Completely discharged	21-22

b) Determining the State of a Battery Discharge by the Electrolyte Specific Gravity

Check the electrolyte specific gravity in each cell using an acidometer or hydrometer.

The relations between the electrolyte specific gravity and the state of battery discharge are given in the Table below.

28

State of battery cells discharge	Electrolyte specific gravity (corrected to 25°C	
	At 5-hour discharge rate at 5.6 A.	At discharge for engine starting
Fully charged	1.255-1.265	1.255-1.265
25% discharged	1.210-1.220	1.240-1.250
50% discharged	1.170-1.180	1.225-1.235
75% discharged	1.120-1.130	1.210-1.220
Completely discharged	1.070-1.080	1.180-1.210

20. Check the state of the battery discharge after every flight. If the battery is discharged completely or partially (more than by 25%), send it not later than in 8 hours to a charging station. Charge the battery conforming to para.13 of these Maintenance Instructions. Record the battery charging in the battery certificate.

At the end of a flying day (night) determine the state of the battery discharge both by its voltage and electrolyte specific gravity.

21. Recharge idle batteries once a month at a charging current of 2A. Give a recharge to the battery till all the battery cells show signs of completion of the charge which are indicated in para.13 of these Maintenance Instructions.

22. The batteries in service should be overcharged once a month, and once in three months they should be given a test cycle of charge/ /discharge to prevent the acid sulphation. Make entries about the work performed in the certificate.

28 PROCEDURE OF THE TEST CYCLE OF CHARGE/DISCHARGE

Perform the test cycle of charge/discharge in the following order:

a) charging at normal rate;

b) overcharging (additional charging with intervals);

c) discharging;

d) charging.

Charge the battery conforming to para.13 of these Maintenance Instructions.

Overcharge the battery as follows:

connect the fully charged storage battery in an hour after completion of its charging (or an additional charge) to the charging circuit of 2 A. and continue charging till heavy gassing.

Then make an interval for an hour and again charge the battery till heavy gassing. Perform this procedure from 3 to 5 times.

Continue charging at a charging current of 2 A, followed by intervals till "boiling" of the electrolyte occurs immediately after switching on the battery for charging.

Discharge and recharge the battery as follows:

on finishing overcharging, discharge the storage battery at 5.6 A. till a voltage of 1.7 V across one of the battery cells is obtained. Then charge the battery conforming to para.13. After completion of the charge check and adjust the electrolyte level and specific gravity to the specified values in each cell.

23. Do not add electrolyte or acid to the battery in service, except for cases when it is known for certain that the electrolyte level lowered due to the electrolyte spillage.

In such cases refill the cells with a solution of sulphuric acid with specific gravity equal to that of the electrolyte in the cells.

VII. STORING THE BATTERIES THAT HAVE BEEN IN SERVICE

24. The storage batteries that have been in service and operated not more than 50 per cent of their service life, may be stored with electrolyte in them and in charged condition, or without electrolyte in them and in discharged condition.

The best way of storing the batteries is the first method. Storing the batteries without electrolyte in them and in discharged condition may be recommended only in cases when there is no possibility to store them filled with electrolyte.

A. Storing the Charged Batteries with Electrolyte in them

25. When storing the batteries observe the following requirements:

1) Place the battery for charging, fully charge it, then overcharge the battery according to para.22.

2) Check the electrolyte level and specific gravity and adjust them to the normal values.

3) Install the vent plugs in all the battery cells and wipe the battery surface with a cloth dampened with bicarbonate soda or ammonia spirit solution, wash the storage battery surfaces with water and wipe it with a clean cloth dry.

4) Clean the battery terminal bolts and nuts and lubricate them with a thin coating of technical vaseline or grease, then place the battery for storage.

5) Every month recharge the battery at a charging current of 2A. till the charge is completed which is determined by constant terminal voltage and electrolyte specific gravity. The batteries may be stored for not more than 6 months.

26. Before being put into service, the above mentioned batteries should be recharged at a charging current of 2 A. till no further rise in the terminal voltage and electrolyte specific gravity is noted.

B. Storing the Batteries without Electrolyte in them which have been in Service

27. The batteries that have been occasionally used and will be idle for a long period of time may be stored without electrolyte in them and in discharged condition.

28. Before placing the batteries for storage give them a test cycle of charge/discharge conforming to para.22 and then discharge the batteries at a 5.6 A. current till a voltage of 1.7 V across one of the battery cells.

Turn the discharged storage batteries so that the vent plug holes are down, and keep them in this position for three hours. To remove the electrolyte completely tilt the storage batteries slightly and shake them. Do not wash the batteries with water before placing them for storage.

29. The batteries placed for extended storage should be thoroughly wiped dry with a clean cloth and with the solid plugs screwed-in tight.

To prevent buckling of the sealing compound when storing the batteries, close the cells with the solid plugs at the air temperature of 30° to 45°C inside the cells; for this purpose the storage batteries should either be kept at a corresponding ambient air temperature or be externally warmed by hot water.

30. The batteries that have been in use are recommended to be stored without electrolyte in them for about a period of three months maximum.

4-28

VIII. REPAIR INSTRUCTIONS

Not more than 24 hours are permitted to elapse from the moment of discharging the storage batteries under repair till the moment of preparing them for operation.

Battery Troubles

31. The storage batteries may have three categories of defects, namely:

1) electrochemical defects, which can be remedied by an electrical method (special rates of charge and discharge);

2) mechanical defects, which can be remedied by the using organization;

3) defects of plates and monoblock cases which can be remedied in special repair shops.

Troubles may be detected when making visual inspection of the battery or by measurements when performing electrical test.

The following defects may be found during visual inspection: cracks in the cell containers and monoblock case, leakage of electrolyte, cracking or softening of sealing compound, external surfaces contamination, breakage of terminal posts and cell connectors, poor contacts between terminal posts and cell connectors, poor tightness of cell covers, breakage and clogging of vent plugs.

Most such defects can be repaired by the using organization.

Defects indicated above in the first and the third steps may be detected without disassembling batteries and by watching some cells and the whole battery when charging and discharging. The nature of a trouble may be determined by the voltage of the battery or its separate cells, by the temperature and specific gravity of the electrolyte, as well as by gassing in the process of charging.

W-28

The Serviceable Battery after Completion of Charge must have:

1. voltage across each cell .... 2.45 to 2.6 V, (when energized);
2. electrolyte specific gravity .... 1.26 ± 0.005
3. electrolyte temperature .... not more than 45°C.
4. almost simultaneous "boiling" and gassing in all cells;
5. colourless and transparent electrolyte without sediment.

The battery in good condition should have not less than 75 per cent of the nominal capacity.

Symptoms of the battery troubles are given below.

Cell with Sulphated Plates

When charging the battery the following signs indicating the sulphated plates are observed:

1. Increased voltage.
2. Reduced electrolyte specific gravity (1.23 - 1.24 at the end of the charge).
3. Increased electrolyte temperature.
4. Premature gassing ("boiling") at the beginning of the charge.

When discharging the battery the following signs indicating the sulphated plates are observed:

1. Decreased voltage (by some tenths of a volt)
2. Reduced capacity;
3. Increased electrolyte temperature.

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V-23

Cell with Short-Circuited Plates

When charging the battery the following signs are observed:

1. Decreased voltage (2÷2.2 V at the end of the charge);
2. Reduced electrolyte specific gravity (1.23 – 1.24 at the end of the charge).
3. Increased electrolyte temperature.
4. Delayed gassing or complete absence of gassing.

When discharging the battery the following signs are observed:

1. Decreased voltage;
2. Reduced capacity;
3. Increased electrolyte temperature.

When the battery is inoperative:

1. Decreased and continuously decreasing voltage.
2. Reduced electrolyte specific gravity.
3. Increased electrolyte temperature.

Cell with Reversed Polarity

1. A cell has a polarity differing from that of the other cells of the battery.
2. Reduced terminal voltage of the battery (each cell with a reversed polarity decreases the battery voltage by 4 V approximately).

Bear in mind that the reversed polarity of some cells may occur because of discharging the cells till zero voltage, and if the discharge is continued the cells polarity is reversed.

Cell with a Torn Plate

The battery cell with a torn plate during charge has:

1. Reduced specific gravity of electrolyte at the end of the charge.

2. Premature gassing.

When discharging:

1. Decreased voltage

2. Reduced capacity.

Cell with Worn out Plates

When discharging the battery the cell has a reduced capacity.

Cell with Dirty Electrolyte

The cell with dirty electrolyte has:

1. More intensive self-discharging.

2. Abnormal electrolyte colour, odour and sediment.

As it has been said above, the battery troubles may be determined not by one or two symptoms, but by the total sum of them. Thus, for instance, both the cell with sulphated plates and the cell with short-circuited plates have an increased electrolyte temperature and a reduced specific gravity of the electrolyte during charging.

To make certain, take into consideration other signs of battery troubles; for this purpose perform a test cycle of charge/discharge.

Remedying the Defects. To eliminate sulphation, give the battery or its separate cell a desulphating charge conforming to para.38.

To eliminate short circuiting of the plates, open the faulty cell. In some cases, however, the short circuit may be removed by shaking the battery, by sucking up and pouring the electrolyte back using a rubber bulb, or by washing the battery with distilled water several times.

The battery cell, which is lagging during the battery charge or has a reversed polarity, should be recharged at a rate of 2 A. separately.

Preparing Batteries for Repair

32. Repair batteries, if visual inspection and electrical test proved the necessity of it.

To avoid damage to the negative plates, before beginning repair, give the battery a preliminary discharge at a rate of 5.6 A. till a voltage of 1.7 V across one of the cells is obtained.

33. On discharging remove the electrolyte and wash the cells with water.

DISASSEMBLING THE BATTERY

34. Place the battery prepared for repair on a bench.

Disconnect the defective cell as follows:

1-st Method. Using a hack saw, cut the cell connectors. This method may be used when the cell connectors previously cut will be utilized during subsequent assembly and soldered in places of their separation with the help of a special device.

2-nd Method. The battery is tilted 45°-90° to one side so that the melted lead drop from the battery. Melt the heads of the cell connectors using a torch, and then remove them with a screw-driver.

Apply this method, if the new connectors will be used during subsequent assembly of the battery.

35. On removing the cell connectors, cut the sealing compound all the way round the cell container walls of the monoblock case with a putty knife heated up to $100^{\circ}+150^{\circ}C$, and remove the sealing compound from the grooves; then using a puller or catching the head of the cell connectors lift out the cell cover together with the groups of plates.

36. Thoroughly inspect the groups of plates removed out of the containers, during inspection the following troubles may be found:

No.	Troubles	Symptoms of troubles
	REPAIRABLE	
1.	Short-circuited plates.	Positive plates are short-circuited with negative ones via a foreign metal object via lead sediment or due to distortion of separators.
2.	Damage (broken edge, cracks and holes) and displacement of separators.	Plates possess places not overlapped with separators.
3.	Excessive displacement of plates relative to each other in cells.	Some points of plates are not overlapped with separators.
4.	Sulphated plates.	White lead sulphate on negative and positive plates easily removed by scraping.
	IRREPAIRABLE	
1.	Softening and shedding of positive plates active material.	Plate grid is bare and space between ribs on cell bottom is filled with active material.
2.	Agglomeration of negative plates active material.	Active material is hard and shrunk cracks in active material and its

No.	Troubles	Symptoms of troubles
		separation from grid bars).
3.	Hard uniform sulphation.	White lead sulphate on positive and negative plates which cannot be removed by scraping.
4.	Broken plate edges.	Cracked edges of plates.
5.	Plates are not attached to plate strap.	Torn plates.

R E P A I R

37. The groups of plates having repairable defects are to be repaired.

The short circuits shall be removed by cleaning the places of short circuiting separators with broken edges or cracks or holes shall be removed and replaced with new ones; all the plates and separators shall be arranged so as to provide a uniform overlapping of the plates with the separators.

38. Eliminate sulphation as follows:

Charge the battery or a separate cell at a rate of 1 A. with a weak electrolyte having the specific gravity of 10.6. Continue charging till all the signs of completion of the charge appear, and continue charging after two hours' interval.

An increase in the electrolyte specific gravity is a sign of a sulphate elimination beginning: as soon as the electrolyte specific gravity increases up to 1.15 dilute the electrolyte to obtain the specific gravity of 1.06. Continue charging in this way till the electrolyte specific gravity in the process of charging ceases to increase.

If the test discharge shows an insufficient capacity of the battery, repeat the desulphation charge to eliminate sulphation, having filled the battery with distilled water, However, the number of such alternative chargings and dischargings should be not more then three, to avoid softening of the positive plates active material.

39. Remove the groups of plates having the plates with irrepair- able defects and use new plate groups or serviceable plate groups from other batteries to install them in the battery.

When installing the groups of plates see that the correct posi- tion of separators and plates is maintained and ensure the proper polarity order of the cells.

40. Prior to installing the new plate groups, clean thoroughly the cell containers whose groups of plates are to be replaced from residue of sealing compound, sediment and moisture.

41. If new groups of plates or spare parts are not available, it is recommended to disassemble completely one or two of 7 to 8 defec- tive batteries available to obtain necessary parts for repairing the remaining defective batteries, i.e. to obtain from available quantity of the defective batteries a smaller number of the serviceable batteries (by repairing).

42. All the groups of plates, installed in the cell containers, shall be packed with a rubber or asbestos cord. Perform packing, slightly pressing the cord in slots between the monoblock case wall and the cover of the cell so as to prevent the sealing compound from getting into cell.

43. On packing, seal the battery with a sealing compound. For this purpose (if a fresh sealing compound is not available) use the sealing compound removed when repairing the batteries.

Melt the sealing compound in a pot preliminarily to obtain the state convenient for sealing.

When melting and prior to sealing thoroughly mix the sealing compound, as the asbestos contained in the sealing compound precipitates on a vessel bottom, if not stirred.

44. On sealing the batteries with the sealing compound solder the cell connectors. Soldering can be performed in two ways: if the cell connectors were cut in two halves when disassembling, solder it in place of the cut using a special device.

In the using organization perform soldering by means of electric welding. A carbon rod taken from a dry battery may be used as an electrode.

Secure a lead rod and a carbon rod in holders each of which consisting of an iron bar with a clamp fitted with a wooden handle. Perform welding at a current of 50 to 100 amperes.

The following power sources can be used: charging units, a battery, or in case of alternate current, a step-down transformer with secondary voltage of 12 volts.

Preliminarily remove oxides from the surfaces to be soldered. Solder a cell connector Clean the surfaces till metal glitter appears. contacting the carbon rod end with the other electrode, i.e. with the part to be soldered or with the lead rod.

In this case the current, overcoming the resistance of the contact melts the lead. The best soldering rating may be selected by adjusting the power source voltage and welding current with the aid of a rheostat connected in the electrode circuit.

Soldering the battery under repair which was not properly treated beforehand is strictly prohibited, as it may cause an explosion. To prepare the battery for soldering, treat it in the same way as when eliminating cracks in the sealing compound.

If during disassembling the battery, the cell connectors were removed by melting, re-assemble the battery as follows:

place new cell connectors on the cover bushings (soldered to terminal posts) so as to connect the battery cells in series and then perform soldering.

If necessary, a lead part (cell connector, terminal, ect.) may be cast afresh in a metal device which should be made to match the old terminal or cell connector shape.

Battery Repair Quality Check

45. On repairing, check the battery:

a) for secure soldering of the cell connectors. Check by means of a metal lever applying a small force to the latter;

b) for cavities in soldering places and for lead over-flows. Eliminate cavities by a repeated soldering and lead overflows by scraping;

c) for proper sequence of cells polarity;

d) for tightness.

To check the battery for tightness, immediately after charging, close the vent holes with solid plugs tight and turn the battery over through 180°(with plugs down) and leave the battery in this position for five minutes.

In five minutes set the battery in the normal position and inspect it for electrolyte leakage, then unscrew the plugs.

If the electrolyte leaks through the sealing compound, eliminate spillage by melting the compound; if the leakage is detected in soldered places, solder these places again.

Remedy the above defects only on discharged batteries with plugs removed and battery surfaces wiped dry.

Test the repaired batteries for tightness after they are treated according to paragraphs 43 and 44.

46. After visual inspection fill the repaired battery with electrolyte having specific gravity of 1.120, allow the plates to impregnate for an hour and then charge the battery conforming to para.13.

47. After charging the batteries give them a test cycle of charge/discharge conforming to para.22.

On completion of the charge, which follows directly the test cycle of charge/discharge, adjust the electrolyte specific gravity and level to obtain their normal values in each cell.

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PRESSURE HEAD

TП-156

The modified design

PRESSURE HEAD

TH-156

The modified design

I. GENERAL

The pressure head /Fig.1/ is used in aircraft for receiving the full impact pressure /the total pressure/ of the airstream, produced by the forward motion of the aircraft, and for transmitting this pressure to the air speed indicator.

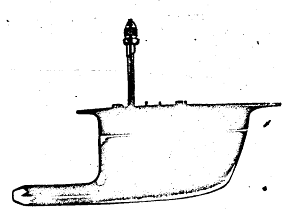

Fig.1. Pressure head unit

II. PRINCIPLES OF THE PRESSURE HEAD

The open end of the pressure head receives the full impact pressure, i.e., the air pressure due to the speed of the aircraft through the air. This pressure is transmitted through a tube into a metal elastic diaphragm /capsule/ of the airspeed indicator.

The full impact pressure of the air is the total of the dynamic and static /atmospheric/ pressures:

$$P = Pd + Po,$$

where P - impact air-pressure

P_d - dynamic air-pressure

P_o - static air-pressure

The diagram of connection of the pressure head with the air-speed indicator is shown in Fig.2.

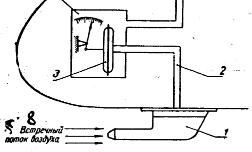

Fig.2. Connection of the pressure head with the air-speed indicator.

1.Pressure head. 2. Full pressure pipe-line. 3. Air-speed indicator capsule. 4. Air-speed indicator. 5. Static vent. 6. Fuselage. 7. Static pressure pipe-line.

X Head air flow

The pressure head 1 is fitted on some outside forward part of the aircraft with its open end facing the flying direction so that the incoming air-stream inside it a dynamic pressure in addition to the static pressure of the atmosphere. From the pressure head the pressure is conveyed by the tube 2 to the sealed capsule 3 of the air-speed indicator 4.

The pressure of the ambient atmosphere /the static pressure/ is simultaneously transmitted to the interior of the indicator case through the static vent 5, located on the surface of the fuselage 6, and the static pressure tube 7, so that the pressure within the case is always equal to that of the surrounding atmosphere.

The difference between the pressures inside and outside the capsule caused it to expand or collapse.

This differential /dynamic/ pressure can be calculated on the following formula:

$$Pd = P - P_0$$

Since the dynamic air-pressure is a function of the air-speed, it is possible to calibrate the scale of the indicator in speed units.

III. DESIGN

The modified design of the pressure head, differs from the early types by a sealed connection between the head and the flange 22 /Fig.3/. The flanges of pressure heads are not interchangeable.

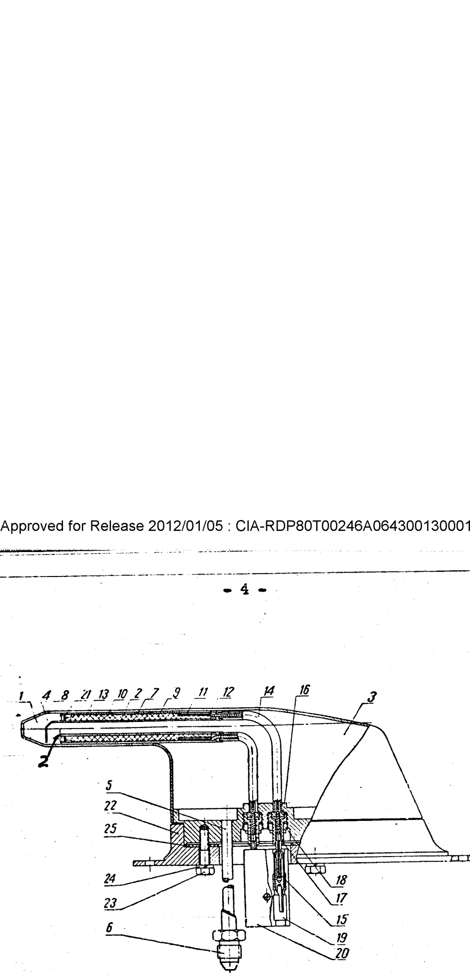

Fig.3. Section through the pressure head.

1. Pressure chamber. 2. Tube. 3. Chamber. 4. Baffle plate. 5. Tube. 6. Nipple. 7. Case. 8. Drain hole. 9. Cartridge. 10. Nickel wire. 11. Leads. 12. Tube. 13. Insulation. 14. Tube. 15. Pintles. 16. Washer. 17. Sleeve. 18. Nut. 19. Sleeve. 20. Insulation plates. 21. Washer. 22. Mounting flange. 23. Screw bolt. 24. Lock washer. 25. Shim.

The main part of the pressure head is its pressure chamber 1 which receives the full impact pressure of the airstream. From the chamber 1 the pressure is conveyed through the tube 2 to the chamber 3. The tube 2 is fitted with a baffle plate protecting it from moisture and dust. From chamber 3 the full pressure is transmitted into tube 5 ending with nipple 6, which is connected by a pipe line with the capsule of the air-speed indicator.

The case 7 has a hole 8 to drain away any moisture that might penetrate into the tube with the outside air.

The pressure head is provided with an electric heater to prevent ice formation when flighing at low temperatures. It consists of a ceramic frame 9 fitted with a nickel wiring 10.

The resistance of the nickel wire changes in a wide range with the temperature. The cooling of the pressure head is accompanied by a drop in the resistance of the nickel wire which in its turn leads to an automatic increase in heating.

The tips of the wire 10 are soldered to the leads 11 made heatproof by thermical asbestos and glassfiber insulation.

The heater is inserted in a metal tube 12 which is closed on the pressure chamber side with the washer 21.

A mica insulation 13 is placed between the tube 12 and the heater.

Leads 11 are encased in metal tubes 14 which serve to protect them from damage and moisture. The tips of these leads are soldered to the pintles 15, which are insulated from the body of the pressure head with an insulation washer 16 and a sleeve 17, both secured with a special nut 18.

The heater and the leads are thus placed in a casing

7. The pressure head unit /including the flange/ weighs no more than 550 gm.

8. The over-all dimensions of the pressure head are given on Fig.4.

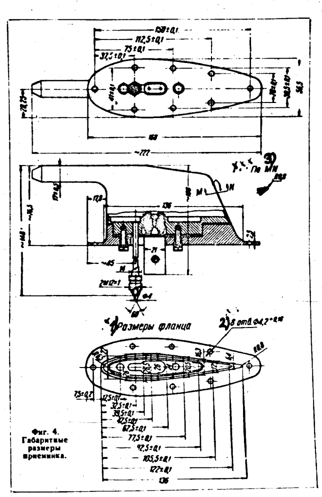

Fig.4. Over-all dimensions.

1/ Dimensions of the flange; 2/ 8 holes dia.4.2$^{+0.16}$ mm

V. INSTALLATION AND MAINTENANCE

The pressure head should be installed in accordance with the general installation layout of the aircraft; it should be in line with the fore and aft axis of the aircraft and placed in such a way as not to be affected by the disturbed air flow from any part of the structure. The drain hole must be at the bottom of the tube.

The correct position of the pressure head is additionally indicated by the marking "Top".

The pressure head is fixed to the skin of the aircraft with eight 4 mm head screws.

The nipple of the pressure head 6 /see Fig.3/ is connected with the corresponding pipe-line of the aircraft air-system. When tightening the nut of the connecting tube care must be taken to support the nipple by an open end wrench, in order to prevent the tube 5 from distortion. The heater current supply leads are soldered into the sleeves of the plug. To solder these leads the screw fixing the plug shields should be loosened and the sleeves taken out.

After installing the pressure head it is necessary to check:

a/ its airtightness;

b/ the insulation resistance of the heater, and

c/ the current consumption of the heater.

The test should be carried out as described in Section VI.

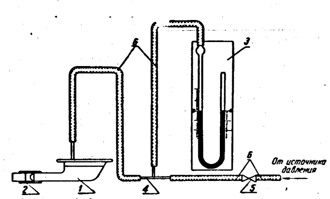

Fig.5. The diagram of the pressure head airtighting test.
1. Pressure head. 2. Stopper. 3. Mercury gauge.
4. T-joint. 5. Valve. 6. Hoses.

First the inlet hole and the drain hole should be stopped and then the pressure of 420 mm Hg is applied through the outlet nipple.

The drop in the pressure after turning off the pressure source should not exceed 0.5 mm Hg per minute.

2. The insulation resistance of the current elements is checked at normal temperature and a relative humidity from 30 to 80 p.c. by connecting the first lead to the short-circulited pintles, and the second lead - to the body of the pressure head. The insulation resistance should in this case be not less than 20 megohms.

3. The current of the heater may be checked by means of connecting it into the diagram as it is shown on fig.6.

An ammeter will show the current flown through the heating element, which must be 2.4 ÷ 4.2 a in 2 minutes after switching on.

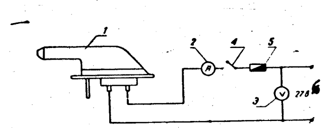

Fig.6. Diagram of the current consumption test of the heating element.
1. Pressure head. 2. 15a-Ammeter. 3. 30 v-Voltmeter. 4. Switch. 5. 5a-Fuse. 6. 27 v.

VII. PACKING, STORAGE AND TRANSPORTATION

Like every other instrument the pressure head should be handled with care trying to avoid severe shocks and shakings during its transportation and operation.

Pressure heads must be stored in dry and ventilated storehouses at temperature from +10°C to +30°C and a relative humidity of not more than 80 p.c., keeping out any agent of corrosion. Each of them is wrapped up in paper and put into a special container made of corrugated cardboard.

The pressure heads must be kept packed until they are installed on the aircraft.

A complete pressure head delivery set consists of:

1/ The pressure head with its flange and plug.

2/ Certificate.

3/ Description booklet.

Containers with the pressure heads are transported in wooden cases with a moisture proof layer, tightly fitted so as not to move on the way.

The space between the containers is filled up with soft paper or wood shavings.

The weight of each packing case should not exceed 50 kg. when filled.

Each case should have markings "Handle with Care" and "Do not drop".

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PARACHUTE, TYPE C-3

SERIES 2

DESCRIPTION AND INSTRUCTIONS
FOR PACKING AND USE

C O N T E N T S

DESCRIPTION OF PARACHUTE, TYPE C-3, SERIES 2

I. Purpose

The parachute together with the oxygen breathing apparatus, automatic time release mechanism, type КАП-3, and the life boat is an individual life saving appliance designed for use by the crew of fast and high-altitude aircraft for forced bailing out over land and water (Figs 1 and 2).

II. Specifications

1. With the total weight of the wearer and the parachute, oxygen breathing apparatus, automatic time release mechanism, type КАП-3, and the life boat not exceeding 100 kg, the parachute ensures normal landing under the following conditions:

(a) if the parachute is released immediately after bailing out of an aircraft flying in level flight at a true airspeed of up to 600 km. per hour at altitudes from 100 to 12,000 m.;

(b) at delayed opening of the parachute after bailing out of an aircraft flying in level flight at an indicated airspeed of 600 km. per hour according to Table 1.

Table 1

Flight altitude at the moment of jumping (above the sea level), m.	Delay in the parachute release, sec.
From 100 to 1000 (low altitudes)	No delay
From 1000 to 7000 (medium altitudes)	Not less than 4.0
From 7000 to 12,000 (high altitudes)	Not less than 15.0
Over 12,000 (stratosphere)	Release the parachute at an altitude not higher than 9000 m.

Note: When jumping with delayed opening, release the parachute at altitudes not lower than 500 m. above the terrain relief.

(c) when jumping over mountains over 4000 m. in height, if the parachute is released only manually with delay in accordance with Table 1.

2. Provided the total weight of the ejection system does not exceed 165 kg, the parachute ensures normal landing when the crew member is jettisoned upward from the aircraft in level flight at indicated airspeeds up to 850 km. per hour with the harness released by the АД-3 mechanism set to 1.5 seconds and the parachute opened by the automatic time release mechanism, type КАП-3, set to 2.0 seconds and an altitude of 500 m. above the terrain relief.

In case of emergency it is permitted to release the parachute by hand with delay after kicking off from the ejection seat, as prescribed in Table 1.

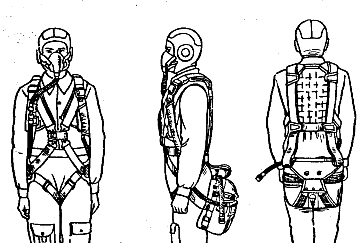

Fig. 1. General View of Parachute in Assembly with Parachute Oxygen Breathing Apparatus, КАП-3 Automatic Time Release Mechanism and Life Boat

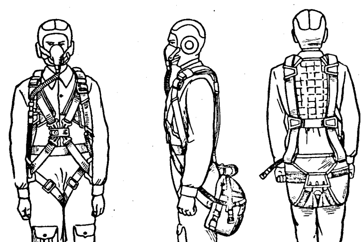

Fig. 2. General View of Parachute in Assembly with Parachute Oxygen Breathing Apparatus without Life Boat

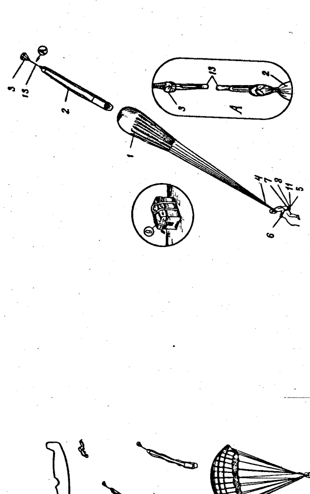

Fig. 4. Parts of Parachute

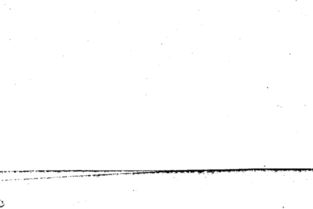

Fig. 3. Diagram of Operation of Parachute in Air

In the event of bailing out by ejecting the seat over mountains over 4000 m. in height the parachute must be opened only manually with a delay prescribed by Table 1.

3. When the total weight of the wearer, the parachute, the oxygen breathing apparatus, automatic time release mechanism, type КАП-3, and the life boat does not exceed 100 kg, the parachute ensures:

(a) 100 m. minimum safe altitude of bailing out of an aircraft in level flight, flying at an airspeed exceeding 180 km. per hour provided the parachute is released immediately.

The time of descent is not less than 2.0 seconds after complete inflation of the canopy;

(b) 150 m. minimum safe altitude when jettisoned upward from an aircraft in level flight flying at an air speed of 400 km. per hour and higher with the harness released by the type АД-3 mechanism set to 1.5 seconds and the parachute opened by the type КАП-3 automatic time release mechanism set to 2.0 seconds and to an altitude of not less than 500 m. above the terrain relief;

(c) 6 m. per second rate of descent reduced to standard atmosphere from 30 to 35 m. to the ground;

(d) impossibility of spontaneous opening;

(e) stability in descent;

(f) loss of altitude during slipping;

(g) no tendency for folding during slipping;

(h) place in the pack for the life boat, type МЛАС-1, and the automatic time release mechanism, type КАП-3, and on the pack, for the oxygen breathing apparatus, type КП-23 or КП-27М;

(i) a 16-kg effort required to pull out the pull ring.

4. The following are maximum dimensions of the pack with the canopy and the КАП-3 automatic time release mechanism placed into it:

(a) without the oxygen breathing apparatus and the life boat - 390x430x215 mm;

(b) without the oxygen breathing apparatus but with the life boat - 400x435x230 mm;

(c) with the oxygen breathing apparatus but without the life boat - 390x430x240 mm;

(d) with the oxygen breathing apparatus and the life boat - 400x435x255 mm.

5. The following is maximum weight (without the travelling bag):

(a) without the oxygen breathing apparatus, the life boat and the automatic time release mechanism, type КАП-3, - 13.307 kg;

(b) without the oxygen breathing apparatus, but with the life boat and the КАП-3 automatic time release mechanism - 17.608 kg;

(c) with the oxygen breathing apparatus, the life boat and the КАП-3 automatic time release mechanism - 22.608 kg.

6. Reliable operation of the parachute prior to base repair in the course of eight years is ensured, provided:

(a) the parachute is used only once at maximum speeds specified in Items 1 and 2 and in compliance with the other items of the present section, and

(b) local repairs are carried out in due time.

The eight years include not less than three years of actual service, the rest of the time being taken up by shipment and storage at depots.

III. Operation of the Parachute in the Air

The parachute is released manually (by pulling out the pull ring with the rip cord cable) or by means of the type КАП-3 automatic time release mechanism.

While the pack is being opened, the locking pins come out of the cones and release the pack flaps. The latter under the action of the pack springs are thrown aside while the bottom piece on the main flap unrolls and releases the pilot chute.

On getting into the stream of air the pilot chute becomes inflated and draws the connecting line out of the canopy pack cover pockets, followed by the pack cover with canopy. This accomplished the shroud lines are drawn out of the pack cover storage pockets. Then the pack cover is drawn off the canopy. After this the canopy becomes inflated and the jumper descends with the canopy open (Fig.3).

The canopy pack cover with the connecting line and pilot chute descends separately.

When alighting in water, the cord locking device, whose pins lock the life boat in the pack, is likewise pulled out.

This makes the life boat detach from the pack. The life boat is held by the cord of the locking device connected to the snap hook of the metal plate on the suit. The life boat actuates the gas cylinder under the action of its own weight, and becomes inflated with gas.

Notes: 1. In case the parachute oxygen breathing apparatus is made use of, it is automatically disconnected from the aircraft oxygen system when the pilot abandons the aircraft.

2. When carrying out training jumps with the parachute, type C-3, series 2, bear in mind that during the descent by a parachute with a canopy which has normally opened it is dangerous to release the reserve parachute ~~because~~ during simultaneous operation of the square-shaped canopy of the reserve parachute and that of the basic parachute, type C-3, series 2, the latter folds. At the same time simultaneous operation of the basic parachute with the circularly shaped canopy of the reserve parachute makes both canopies get together and move apart from time to

time and the jumper rotates round the vertical axis which hinders landing. Therefore, it is STRICTLY PROHIBITED to release the reserve parachute during normal descent by the parachute, type C-3, series 2.

IV. Description of Parachute

The parachute set includes the following parts (Fig.4):

1. Canopy .... 1 piece
2. Canopy pack cover .... 1 piece
3. Pilot chute .... 1 piece
4. Harness .... 1 piece
5. Pack .... 1 piece
6. Pull ring .... 1 piece
7. Flexible hose .... 1 piece
8. Pad .... 1 piece
9. Travelling bag .... 1 piece

10[x]. Automatic time release mechanism, type КАП-3 1 piece

11[x]. Parachute oxygen breathing apparatus, type КП-23 or КП-27М .... 1 piece

12[x]. Life boat, type МЛАС-1 .... 1 piece

13. Connecting line .... 1 piece

Each parachute has a certificate appended to it.

1. Canopy

The canopy is designed to ensure the user's safe descent and landing.

---

x) Not made by the parachute Manufacturing plant; to be assembled by the Customer at the depots.

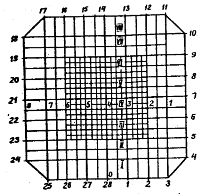

Fig. 5. Schematic Diagram of Parachute Canopy

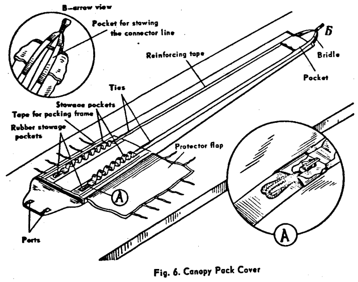

Fig. 6. Canopy Pack Cover

time and the jumper rotates round the vertical axis which hinders landing. Therefore, it is STRICTLY PROHIBITED to release the reserve parachute during normal descent by the parachute, type C-3, series 2.

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The parachute set includes the following parts (Fig.4):

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2. Canopy pack cover .... 1 piece
3. Pilot chute .... 1 piece
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5. Pack .... 1 piece
6. Pull ring .... 1 piece
7. Flexible hose .... 1 piece
8. Pad .... 1 piece
9. Travelling bag .... 1 piece

10[x]. Automatic time release mechanism, type КАП-3 1 piece

11[x]. Parachute oxygen breathing apparatus, type КП-23 or КП-27М .... 1 piece

12[x]. Life boat, type МЛАС-1 .... 1 piece

13. Connecting line .... 1 piece

Each parachute has a certificate appended to it.

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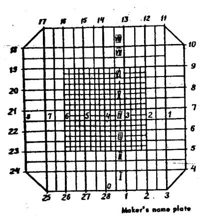

Fig. 5. Schematic Diagram of Parachute Canopy

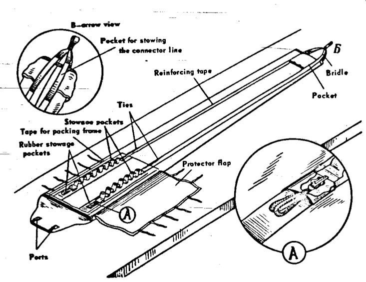

Fig. 6. Canopy Pack Cover

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Fig. 8. Harness

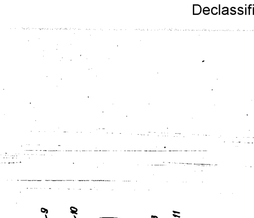

Fig. 7. Pilot Chute

The canopy (Fig.5) is square in shape with out off corners. It is made of eight panels of capron cloth sewn together by an overlapping seam.

The area of the canopy is 56.5 m^2. From the outside the canopy has a reinforcing carcass of 13-mm and 25-mm capron webbing with elongation up to 20 per cent. In addition the central part of the canopy is reinforced with 13-mm capron webbing.

The canopy skirt is reinforced with 25-mm capron webbing. The canopy panels are numbered with Roman numerals while the square sections of the panels are numbered with Arabic numerals. Attached to the canopy skirt are 28 loops serving to secure the shroud lines. The loops are reinforced with 25-mm capron webbing. The shroud lines are secured to the canopy loops by means of single knots and are sewn with zigzag stitching. The other ends of the shroud lines are tied up to the four half-rings of the harness with special knots and are sewn by zigzag stitching.

Seven shroud lines are knotted to each half-ring.

The shroud lines are manufactured of capron cord No.10K.

The length of the shroud lines suspended in a full length position (from the canopy skirt to the half-ring of the harness free end) is equal to 6000 mm.

The length of shroud lines Nos 1 and 27 is 6300 mm, while that of shroud line No.28 is 6500 mm.

The numbers of shroud lines are marked on the canopy skirt to the left of the shroud lines. Due to longer shroud lines 28, 27 and 1 a fin is formed. The fin makes the canopy turn downwind.

Sewn to the centre of the canopy from the outside are two webbings which form a loop which serves to secure the canopy to the table during packing.

To facilitate packing the parachute, shroud line No.14 has identification sleeves made of calico or some other cotton fabric of orange colour and sewn to the line at the canopy skirt and the half-ring.

Fig. 8. Harness

Fig. 7. Pilot Chute

The canopy (Fig.5) is square in shape with out off corners. It is made of eight panels of capron cloth sewn together by an overlapping seam.

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Sewn to the centre of the canopy from the outside are two webbings which form a loop which serves to secure the canopy to the table during packing.

To facilitate packing the parachute, shroud line No.14 has identification sleeves made of calico or some other cotton fabric of orange colour and sewn to the line at the canopy skirt and the half-ring.

At a distance of 500 and 850 mm from the canopy skirt the shroud lines are marked with black innocuous paint. These marks serve to ensure constant slack of the shroud lines before they are looped into the locking double detachable rubber storage pockets.

2. Canopy Pack Cover

The canopy pack cover decelerates the opening of the parachute, which reduces the dynamic shock at the moment the canopy is inflated.

Besides this, the canopy pack cover prevents the canopy from being entangled with shroud lines at the beginning of inflation and ensures its faultless opening.

The canopy pack cover (Fig.6) is made of rayon in the form of a sleeve 3.6 m. long. It is pulled over the packed canopy.

At the bottom the pack cover has seven pairs of non-detachable and one pair of detachable double rubber stowage pockets, a protector flap, two tapes for the frame and a bottom piece to cover the canopy skirt. The non-detachable stowage pockets are designed for looping the canopy shroud lines. They are made of 25-mm cotton webbing.

The double detachable rubber stowage pockets are designed to lock the pack cover bottom flap and to prevent the shroud lines from wedging in the stowage pockets locking the pack cover bottom flap. The detachable rubber stowage pockets are made of pack cord the ends of which are braided with khaki linen thread and are connected by means of a timber hitch to the loops of silk cord No.12 on the pack cover bottom.

The bottom flap has two ports to pass the detachable rubber stowage pockets. The skein of the shroud lines looped into this pair of stowage pockets locks the bottom flap and prevents the canopy from premature emerging out of the pack cover.

The protector flap covering the shroud lines packed into the pack cover stowage pockets is provided with seven ties.

Sewn on both sides of the stowage pockets are two 40-mm cotton tapes which form pockets to receive the packing frame prior to looping the shroud lines into the stowage pockets.

In the upper part the pack cover has two pockets which serve to assist the shroud lines while these are coming out of the stowage pockets. They also make it possible to pull the pack cover off the canopy.

Throughout its length the pack cover is reinforced with four longitudinal 25-mm cotton webbings which form a bridle in the upper part of the pack cover for the connection of the connecting line.

In the upper part of the pack cover two reinforcing webbings have pockets of webbing sewn to them. These pockets are designed to receive the connecting shroud line.

3. Pilot Chute

The pilot chute serves to pull the pack cover with the canopy out of the pack, the shroud lines out of the pack cover stowage pockets and to pull the pack cover off the canopy.

The pilot chute (Fig.7) is a hexahedral in shape made of silk cloth.

The canopy area is 0.48 m^2.

From the outside the pilot chute is provided with a reinforcing carcass of 25-mm half-silk webbing, type ТШБ-25-150.

The skirt of the pilot chute is reinforced by bending the cloth to the outside of the canopy.

The pilot chute has eight shroud lines made of four single cords and one central shroud line.

The ends of the shroud lines are sewn to the canopy skirt by zigzag stitching; the central shroud line is attached to the apex bridle from the inside of the canopy and is sewn by zigzag stitching.

The mid points of the four single cords and the end of the central shroud line are gathered to form a thimble which is braided with waxen linen thread.

The shroud lines are made of capron cord No.12K90, while the central shroud line is made of capron cord No. 12K120.

The length of all the shroud lines suspended in a full length position is 750 mm from the canopy skirt to the shroud line thimble.

4. Harness

The harness is a connecting link between the parachute (canopy with shroud lines) and the pilot. Fitted to the harness is the pack while the half-rings of its free ends are connected to the canopy shroud lines.

The harness can be adjusted to fit the wearer's size.

The harness (Fig.8) is made of capron webbing, types ПЛК-44 and ЛТКкр-43-800. It consists of:

(a) main strap (1);

(b) two (left and right-hand) straps forming the chest link and the waist strap (2);

(c) back (6);

(d) two leg straps (3);

(e) left - and right-hand wadded pads (5);

(f) lock, type ТП (4).

(a) Main Strap

The main strap is manufactured of two thicknesses of webbing stitched together. It branches to form four free ends (7) terminating in half-rings(8).

To each half-ring of the harness free ends seven shroud lines are tied up.

The main strap is provided with two curved buckles (9) designed to connect the main straps to the shoulder straps in the upper part of the harness.

On the left-hand side, pocket for the pull ring (10) is sewn breast-high to the main strap. Below the pockets the flexible hose (11) is stitched in three places; the other end of the hose being sewn to the side flap of the pack.

(b) Shoulder Straps

The shoulder straps are connected to each other by means of a cross-piece stitched to the back and pass through the curved buckles. The left-hand shoulder strap terminates in the lock, type ТП (4) while the right-hand shoulder strap terminates in the lock buckle (12).

The lower ends of the shoulder straps pass through the clamps of the waist strap (13) and terminate in big rectangular buckles (14) which make it possible to adjust the waist strap in length.

(c) Back

The back (6) is manufactured of two plies of aircraft canvas with a layer of wadding between them. The back has a cross piece (15) and four flaps (16). The cross piece is designed to fix the shoulder straps in position on the wearer, while the flaps serve to prevent the free ends of the harness from slipping off the shoulders and from catching at the projecting parts of the aircraft.

(d) Wadded Pads

The left- and right-hand wadded pads are designed to fix the chest link straps in position and to absorb the dynamic shock when the canopy unfolds. The wadded pads are made of two plies of aircraft canvas with a layer of wadding between them. They are sewn to the chest link straps and shoulder straps and are secured to the main strap by means of flaps (17).

(e) Leg Straps

The two leg straps are attached to the main strap by means of buckles (18) and are covered with a case (19) in places of attachment. The leg straps are provided with big rectangular buckles (14) and with the buckles of the TП lock (12).

(f) Lock, Type TП.

The parachute lock, type TП, is designed to fasten the harness on the wearer and to quickly release the parachute at the moment of landing.

The parachute lock (Fig.9) is rectangular in shape and consists of the following main parts:

(1) lock cover with two levers,
(2) lock body,
(3) limiting plate,
(4) moving lock teeth,
(5) spiral spring for opening the lock,
(6) lever spiral spring,
(7) safety latch to prevent the levers from disengaging,
(8) three detachable and one non-detachable lock buckles.

On joining the buckle to the lock the moving locking tooth is countersunk in the limiting plate and then actuated by the spring enters the hole of the buckle, thus locking the buckle of the lock.

To prevent accidental pressing the levers with the locking pins the safety latch is set to the operating position, that is between the levers.

To open the lock, throw the safety latch on to the cover and press the levers together with two fingers.

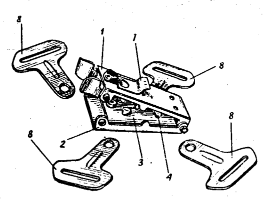

Fig. 9. Lock, Type TП

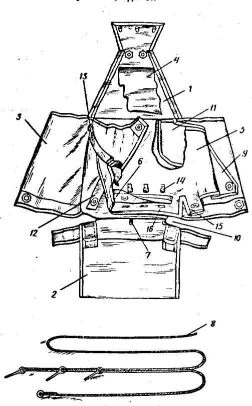

Fig. 10. Pack, Inside View

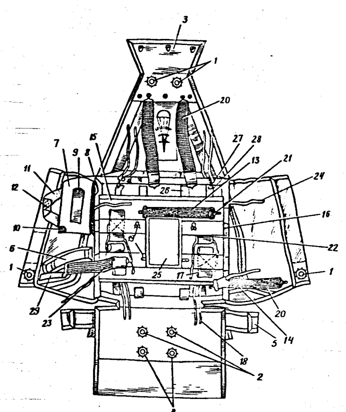

Fig. 11. Pack. Outside View

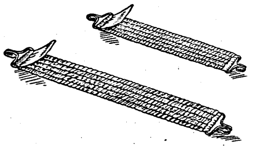

Fig. 12. Pack-Opening Springs

It is prohibited to disassemble, repair or replace separate parts of the ТП lock during service.

5. Pack

The pack is designed for packing the canopy enclosed in its pack cover, part of the harness free ends, pilot chute, life boat, oxygen breathing apparatus and the automatic time release mechanism, type КАП-3.

The pack is made of khaki aircraft canvas.

The pack (Fig.10) is box-shaped; it has four flaps: main flap (1), end face flap (2) and two side flaps (3). The rigid frame fitted in the pack bottom ensures the necessary rigidity. The dimensions of the rigid frame are 380x380 mm. At the bottom of the pack there is a reinforced superposed bottom to which a pocket (11) of aircraft canvas for the КАП-3 automatic time release mechanism is sewn on.

From the inside the pack has an intermediate bottom (5). Sewn to the intermediate bottom are the protector flap of the pins with three grummets (6) to lock the cord loops (7) after the life boat has been placed on the pack bottom, three reinforcing tapes with grummets (12) which are passed through the loops (16), a pocket for the life boat cylinder (13) and four loops (14) to lace the pack intermediate bottom to the main bottom by means of a cord with a tensile strength of 40 kg (when the parachute is packed without the life boat).

The side flaps of the intermediate bottom have slanting edges with a grummet at the ends (9) which are tucked in and stitched at the main flap, forming pockets; the end face side of the intermediate bottom has two corner flaps with grummets.

The cord loops passed through the grummets of the reinforcing webbings, and the flaps are locked with the pins of the cord locking device.

The cord locking device (8) is made of silk or capron cord with a tensile strength of 120 to 200 kg to which three locking pins and a ring 20 mm in diameter are sewn in.

The ring serves to connect the cord with the locking pins to the smaller snap hook with the plate. The plate with the snap hook is sewn to the pilot's suit.

Sewn to the main flap of the pack from the inside is a bottom piece (4) of cotton fabric to wrap the pilot chute.

The bottom of the end face flap has two ports (10) to let the free ends of the harness out of the pack when the latter is closed.

To keep the pack flaps closed, the pack is provided with a locking device (Fig.11) consisting of four grummets (1) and two cones (2) located on the pack flaps. The pack is locked with two locking pins of the rip cord cable.

The whole locking system of the pack is closed with a protector flap (3). The protector flap is the continuation of main flap. It is fastened by three turnstile buttons.

The end face flap of the pack is provided with two pairs of cones; the additional cones (4) are designed for use in packing the parachute with the life boat.

To protect the canopy fabric from dirt, the end face flap has corner flaps with pockets (5).

After packing the corner flaps should be tucked inside the pack.

Sewn to the left-hand side flap from the outside are the hose plate (6), the plate of the КАП-3 (29) mechanism and the pocket flap (7) to prevent the КАП-3 mechanism from falling out of the pocket (8).

The flap of the КАП-3 mechanism pocket is provided with a pocket (9) to stow the cord of the КАП-3 mechanism pin. To render the flap of the КАП-3 mechanism pocket rigid, the former has a rigid plate (10). Sewn to the mechanism flap is webbing (11) with loop (12) to connect it to the pack-opening spring (13).

To the right-hand side flap is sewn on a pocket (14) for the cord locking device.

Stitched from the outside of the pack throughout the pack perimeter is a 40-mm cotton webbing. The pack bottom has a pocket of aircraft canvas sewn on from the outside for the oxygen breathing apparatus. The pocket is reinforced with two 43-mm cotton webbings (16). The position of the pocket makes it possible to insert the oxygen breathing apparatus into it both from the side of the main flap as well as from the side of the end face flap depending on the layout of the oxygen system in the aircraft.

From the side of the main and end face flaps the pocket is tied up by means of four pairs of loops (17) and four capron cords (18). The larger (27) and the smaller (28) loops sewn on to the pack bottom enable the oxygen breathing apparatus to be placed in the pocket along the front or rear edge of the pack rigid frame. Sewn to the reinforcing 43-mm webbings are four wire loops (19) to fasten the pack-opening springs (20). The oxygen breathing apparatus pocket has a wire loops (21) sewn to it to fix the pack-opening spring (13) designed to close the pocket for the КАП-3 mechanism.

The pocket for the oxygen breathing apparatus is provided with four pairs of loops (22) or 40-mm cotton webbing designed to secure the harness to the pack by means of capron cord 10K (23).

To the reinforcing webbings of the left - and right-hand flaps are sewn four webbings (24) to fasten the pad.

The oxygen breathing apparatus pocket has a pocket (25) for the certificate. Sewn to the bottom of the pack are four supports (26) for the oxygen breathing apparatus.

To quickly throw back the flaps and the pilot chute after the locking device has been opened, four pack-opening springs are provided (Fig.12).

The pack-opening elastic consists of a case, two hooks and five springs.

The case is divided into five sections into which the springs are inserted.

The spring eyes are connected to the hooks.

The hooks are sewn to the case.

The hooks of the pack-opening springs are connected to the loops on the bottom of the pack. The hooks on the pack flaps are fixed in position (Fig.11). The length of the pack-opening springs of the main flap is 345 mm while that of the pack-opening springs of the side flaps and the КАП-3 mechanism pocket is 230 mm.

6. Pull Ring

The pull ring is designed for releasing the parachute.

The pull ring (Fig.13) consists of the ring body, clamp, cable with two locking pins and the cable limiter. The ring body (1) is manufactured of steel wire as a trapezium.

To hold the pull ring in position in the harness pocket, it is made concaved on its two opposite sides.

The part of the pull ring protruding from the pocket is curved and painted red. Passed through the hole in the pull ring body and clamp is the cable (2) terminating in the limiter (4).

The locking pins (6) secured to the cable are designed to lock the grummets on the cones of the pack locking device.

The length of the cable from the end of the last pin to the limiter is equal to 957 mm.

7. Flexible Hose

The flexible hose is designed to guide the rip cord cable when the latter is being pulled out and to prevent the rip cord cable from accidental catching.

The flexible hose (Fig.14) is made of special profiled steel band and is covered with khaki cotton tape. The ends of the hose are placed in special caps.

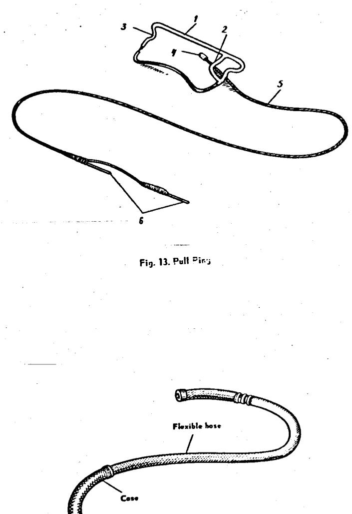

Fig. 13. Pull Ring

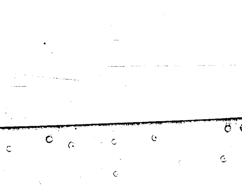

Fig. 14. Flexible Hose

The case is divided into five sections into which the springs are inserted.

The spring eyes are connected to the hooks.

The hooks are sewn to the case.

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Fig. 13. Pull Ring

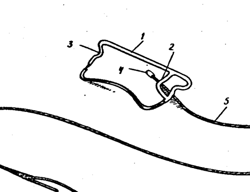

Fig. 14. Flexible Hose

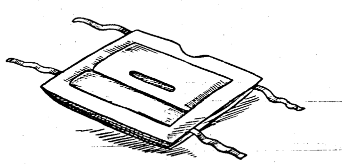

Fig. 15. Pad

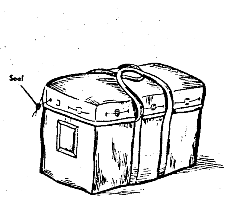

Fig. 16. Travelling Bag

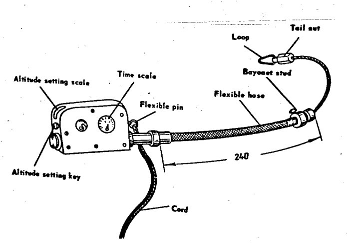

Fig. 17. Parachute Automatic Time Release Mechanism, Type КАП-3

One end of the flexible hose is sewn to the harness at the pull ring pocket and at the clamps of the leg and waist straps while the other end is sewn on to the pack side flap.

The flexible hose is enclosed in a 185-mm capron case which prevents the hose from being worn out due to rubbing against the pan of the aircraft seat. The length of the flexible hose in extended condition amounts to 675 mm.

8. Pad

The pad is provided to make the pilot comfortable during flight.

The pad (Fig.15) is rectangular in shape. It is made of khaki aircraft canvas and is wadded. In the centre the the pad has an opening to pass the free ends of the leg straps.

The pad has four ties sewn to it to secure the pad to the parachute pack.

The overall dimensions of the pad are 330x390 mm.

9. Travelling Bag

The travelling bag is designed for packing the parachute during storage and shipment.

The travelling bag (Fig.16) which is rectangular in shape is manufactured of aircraft canvas and has two handles and a cover fastened by means of seven turnstile buckles.

The cover and the bottom part of the bag have eyelets to pass a thread for sealing purposes.

One end face side of the bag is provided with a pocket and a loop to attach the tally. The overall dimensions of the travelling bag with the parachute packed into it are 260x590x420 mm.

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10. Automatic Time Release Mechanism, Type КАП-3

The automatic time release mechanism, type КАП-3, is designed to release the parachute automatically.

The characteristic, description and operating instructions of the mechanism are given in special instructions appended to each mechanism.

The general view of the КАП-3 mechanism is shown in Fig.17. The length of the mechanism hose is 240 mm.

11. Parachute Oxygen Breathing Apparatus, Type КП-23 and КП-27М

The parachute oxygen breathing apparatus, type КП-23 and КП-27М, are designed to supply the pilot with oxygen during his descent by parachute from a high altitude.

The characteristic, description and operating instructions of the apparatus are given in special instructions.

The general view of the parachute breathing apparatus, type КП-23, is shown in Fig.18.

12. Life Boat, Type МЛАС-1

The life boat, type МЛАС-1, is an individual life-saving appliance designed for use by the pilot in the event of bailing out over water.

The characteristic, description and operating instructions of the life boat, type МЛАС-1, are given in special instructions.

The general view of the life boat is shown in Fig.19.

13. Connecting Line

The connecting line ensures normal operation of the parachute in case the pilot chute catches on the equipment or the jumper's limbs.

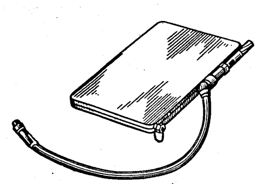

Fig. 18. Parachute Oxygen Breathing Apparatus, Type КП-23

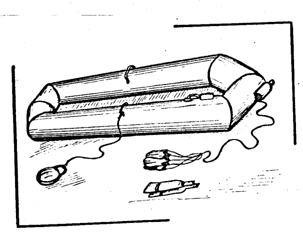

Fig. 19. Life Boat, Type МЛАС-1

The connecting line 1580 mm long is manufactured of capron cord, type ШКК-18-700.

The connecting line terminates at both ends in loops.

One end of the connecting line is attached to the bridle of the canopy pack cover, while its other end is connected to the thimble of the pilot chute.

14. Certificate

The certificate is designed for recording the information concerning the acceptance, handing over, service and repairs of the parachute.

The certificate accompanies the parachute throughout its entire service life and is kept in the parachute pack pocket.

The rules of keeping the certificate are given in the certificate proper.

OPERATING AND PACKING INSTRUCTIONS

I. Packing Equipment

Pack the parachute on a wooden packing table or a travelling packing panel. The packing table should be 9 m. long, 1.2 m. wide and 1 m. high.

The surface of the table should be smooth and thoroughly polished. From its end face the table should have a wooden peg to secure the canopy bridle when packing the canopy.

The packing equipment (Fig.1) includes:

1. Travelling packing panel, 13x1 m.
2. Underlay packing panel, 4.5x1.2 m., with a seven-metre cord.
3. Bag for keeping and carrying the packing equipment.
4. 3 to 5 weights, 450x70 mm each.

The cases for the weights are made of thick cloth (tarpaulin, canvas, aircraft canvas) and are sewn in the middle throughout their length with two stitchings to divide them into two separate sections. The sections are filled with coarse, thoroughly washed sand.

5. Eleven metal pins to fix the panel to the ground.
6. Packing stick, 450x34x6 mm, for trimming the corner flaps and the flaps of the pack during the packing of the parachute.

The packing stick should be polished, its edges should be thoroughly rounded off.

7. Packing fork for packing the connecting line.

8. Hook for looping shroud lines, made of steel wire. The hook should be polished and should have no sharp edges.

9. Two auxiliary pins of steel wire with a cable loop at one end.

The pins are designed for locking the grummets on the pack cones beforehand when packing the parachute. The pins must be polished.

10. Packing frame for drawing the shroud lines into the stowage pockets of the pack cover. The frame must be smooth, its edges must be carefully rounded off.

11. Five tightening cords designed for tightening the pack flaps during the packing of the parachute. It is recommended that silk cord No.15 1 m. long (with a tensile strength of 50 kg) should be used for the purpose.

12. Linen thread with a tensile strength of 15 kg for sealing the travelling bag.

13. Cotton thread No.30 or No.40 for locking and sealing the pull ring locking pins.

14. Sealing presses and seals designed for sealing the pull ring locking pins and the parachute travelling bag.

15. Wooden insert, 105x90x32 mm with cord, designed to ensure room for the КАП-3 mechanism during packing. The insert should be smooth, with rounded off edges.

II. <u>Packing the Parachute with Life Boat,</u>

<u>Type МЛАС-1</u>

Prior to packing the parachute must be thoroughly examined from the outside to determine whether it is fit for service.

The inspection and packing should be carried out by two men: the rigger, who is responsible for the packing and his assistant.

The detected faults should be eliminated:

(a) either by replacing the defective parts by spare ones, or

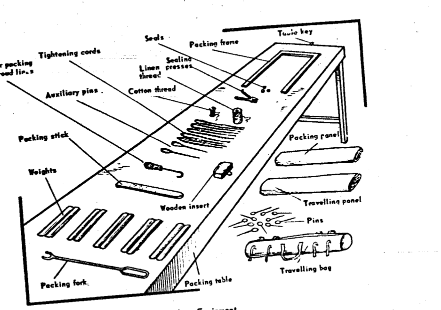

Fig. 1. Packing Equipment

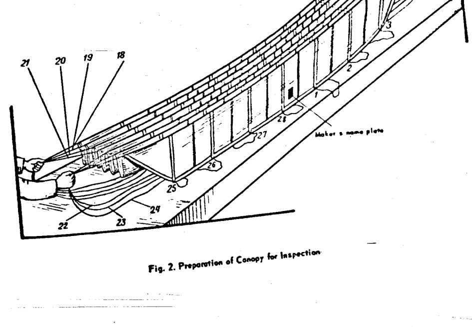

Fig. 2. Preparation of Canopy for Inspection

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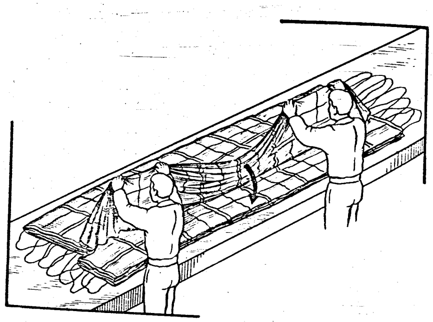

Fig. 3. Inspection of Canopy

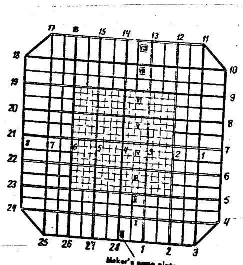

Fig. 4. Schematic Diagram of Canopy

(b) by repairing them inthe using unit, if the parachute does not require base repairs; otherwise the parachute must be rejected as unfit for service.

After the elimination of the faults the parachute can be accepted as fit for service only after it has been checked by the Chief Parachute Service Officer of the unit.

Notes: 1. Repairs of the parachute and replacement of its parts should be performed in compliance with Instructions No.003.

2. The canopy of the parachute, type C-3, series 2, should be repaired as prescribed for silk canopies. Use capron thread No.18 for repair of canopies. The number of stitches per 100 mm is 30+5.

The procedure of packing the parachute includes the following operations:

1. Inspection.
2. Preparation of the parachute for packing.
3. Placing the life boat, type МЛАС-1, into the pack.
4. Packing the canopy.
5. Pulling the canopy pack cover over the canopy and looping the shroud lines into the stowage pockets.
6. Tying up and packing the connecting line.
7. Placing the canopy enclosed in pack cover into the pack.
8. Tightening up the pack.

1. Inspection

To inspect and pack the parachute, remove it from the travelling bag, lay it out at full length on the packing table or travelling packing panel and check whether all the parts of the parachute are present.

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Examine the parachute in the following sequence:
(a) canopy with shroud lines;
(b) harness and lock;
(c) pack with pad and hose;
(d) pull ring;
(e) canopy pack cover;
(f) pilot chute and connecting line;
(g) travelling bag.

(a) Examination of the Canopy with the Shroud Lines

To examine the canopy, the rigger should take hold of shroud lines Nos 18, 19, 20, 21, 22, 23 and 24 at the canopy skirt, while his assistant should take hold of shroud lines Nos 4, 5, 6, 7, 8, 9 and 10. Then they should move in the opposite directions and stretch out the canopy at full length on the table (Fig.2). Place the canopy on the table so that the panel bearing the maker's name plate is on the top. Working from the edges to the centre of the canopy hold up each gore and section in turn to light according to the ordinal numbers (beginning from the first panel) indicated in the schematic diagram of the canopy (Fig.4).

Check to see that the panels, frame webbing, stitches, loops, shroud lines and the zigzag stitching where the shroud lines are tied up to the loops are intact and free of stains.

By means of the loop connect the canopy apex to the table peg. Lay out the parachute at full length on the table and begin examining the shroud lines. For this purpose arrange the shroud lines close to one another and draw them tight.

The rigger should roll the shroud lines on the table with his palms and examine them thoroughly from all sides.

The shroud lines should be examined throughout their entire length from the canopy skirt up to the half-rings.

(b) Examination of the Harness

After the examination of the shroud lines examine the harness and its metal parts: half-rings, curved and rectangular buckles, flexible hose and ТП lock.

When examining the lock, it is necessary to:

1. Check the lock parts for traces of rust.
2. Check whether the lock buckles are not bent.
3. Check the operation of the levers spring. For this close the cover of the lock and make sure that the dowels have fully entered the holes in the lock body.
4. Examine the safety spring and check its operation by closing and opening the safety latch.
5. Insert all the buckles into the lock and check to see that the moving lock teeth get in position and do not project beyond the lock body.
6. Check the operation of the spring which throws aside the cover of the lock. To this end, push the safety latch to the lock cover and press the levers together. The lock cover must rise and release the buckles.

It is prohibited to disassemble, repair or replace separate parts of the ТП lock during the service of the parachute.

On detecting faults of the ТП lock, the parachute must be immediately taken out of use and sent in for repairs to the Manufacturing plant.

(c) Examination of the Pack, Pad and Hose

When examining the pack, pay special attention to the condition of the grummets and cones. Check to see that the loops and the pack-opening springs are present, that they are securely attached to the loops on the pack flaps and that the КАП-3 mechanism plate is properly sewn on. Check the condition of the tapes designed to fasten the pad in position and of the flexible hose and see that the latter is securely sewn.

The plate of the КАП-3 mechanism is sewn on to the left-hand flap of the pack from the left side of the hose plate. The distance from the centre of the grummet to the centre of the plate bayonet hole (Fig. 5A) should be equal to 110 mm. Sew the plate on by hand locking the thread from the inside (Fig. 5Б and В).

Use single linen waxed thread 9.5/6.

(d) Examination of the Pull Ring

Examine the pull ring with the cable and check to see that the cable wire is not torn and the locking pins are securely attached, not bent and are free from burrs and rust.

(e) Examination of the Canopy Pack Cover

When examining the canopy pack cover, check to see that the pack cover fabric, the reinforcing tapes, the bridle, the stowage pockets, the bottom piece ports, the pockets for packing the connecting line are not damaged. Check likewise the condition of the double detachable stowage pockets.

In case the double detachable stowage pockets (locking the canopy pack cover bottom piece) are torn, untie and replace them by new spare ones.

<u>It is strictly prohibited to repair the double detachable rubber stowage pockets</u>.

(f) Examination of the Pilot Chute and Connecting Line

Check to see that the cloth of the pilot chute canopy is not torn, the stitches of different seams are intact and the shroud lines are not damaged.

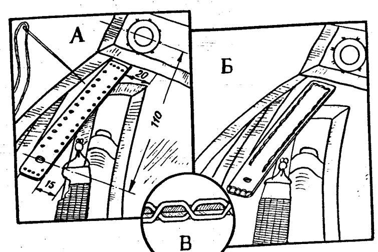

Fig. 5. Sewing Plate of КАП-3 Automatic Time Release Mechanism

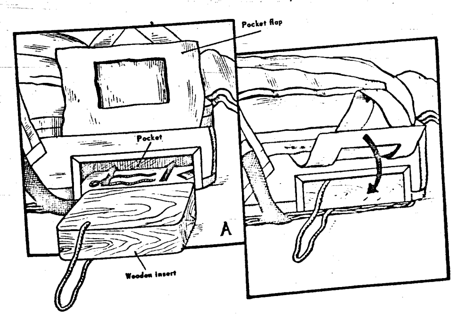

Fig. 6. Preparation of Parachute for Packing

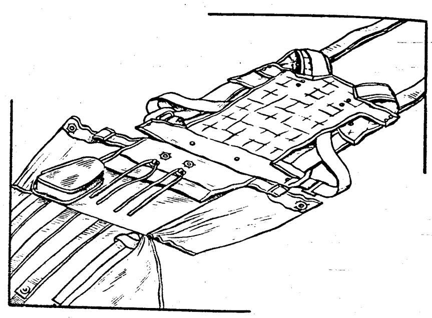

Fig. 7. Correct Position for Harness and Pack when Packing Canopy with Life Boat

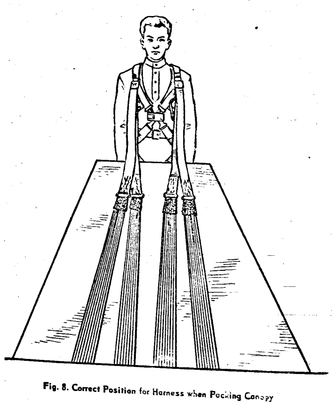

Fig. 8. Correct Position for Harness when Packing Canopy

(g) Examination of the Travelling Bag

When examining the travelling bag, check to see that the bag is not torn and is free from spots and that the turnstile buttons are present and correct.

2. Preparation of Parachute for Packing

The examination of the parachute completed, insert the rip cord into the flexible hose and the pull ring into the harness pocket, put the wooden insert into the pocket on the pack (Fig.6A) and close it with the flap (Fig.6Б).

Pass the tightening cords through the cone holes and the cord loops (Fig.7).

Place the packing equipment on the table close to the pack. Arrange the harness on the table as if it were worn by a man facing the canopy (Fig.8).

The strap with the pocket for the pull ring should be on the left-hand side and should face the surface of the table. The free ends should be arranged in pairs the laces of the half-rings looking inside.

3. Placing МЛАС-1 Life Boat into Pack

Prior to placing the life boat into the pack, it is necessary to remove air from its bladders (Fig.9). To do this, unscrew the plug and roll up the life boat tight. Having made sure that air has been forced out, screw up the plug. This done, straighten out the life boat and place it into the pack so that the width of the folded life boat does not exceed the width of the pack.

Fold the fins together, fasten them to the bailer and place them in a special socket on the bottom of life boat.

Then put the life boat on the bottom of the pack so that the cylinder is at the right-hand side flap of the pack with the head towards the free ends of the harness (Fig.10).

Pass the end of the cord locking device without the ring first through the hole in the cotter pin and then fasten it to the cylinder cotter pin so that the other end of the cord can be secured to the shackle of the cylinder valve (Fig.10).

Pass the reinforcing tapes with grummets through the loops of the intermediate bottom (Fig.10).

This done, place the life boat on the pack bottom in a zigzag manner (Fig.11).

Next, place the intermediate bottom on the life boat and insert the cylinder into the pocket located on the intermediate bottom (Fig.12).

After this, tuck in the slanting edges of the intermediate bottom under the life boat (Fig.12).

Pass the cord mid loop through the grummets of the intermediate bottom slanting edges (Fig.12). By means of the tightening cords (Fig.13) draw the cord mid loop located on the pack bottom into the grummet of the central reinforcing tape and into the grummet located on the intermediate bottom flap; draw the extreme cord loops into the grummets of the reinforcing tapes and corner flaps of the intermediate bottom and then into the extreme grummets of the intermediate bottom flap.

Lock the loops with the pins of the locking device (Fig.14) and pull out the tightening cords.

Pass the end of the cord locking device with the ring through the pack port and place it into a special pocket on the right-hand side flap of the pack (Fig.15).

<u>Note</u>: The plate with a small snap hook designed to connect the ring of the cord locking device must be sewn to the suit of each member of the aircrew provided with the parachute.

When packing the parachute without the life boat, lace up the pack intermediate bottom to the main bottom by means of cord with a tensile strength of not less than 40 kg (Fig.16).

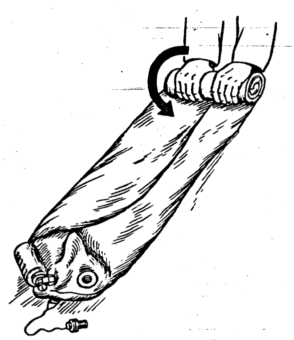

Fig. 9. Removal of Air from Life Boat

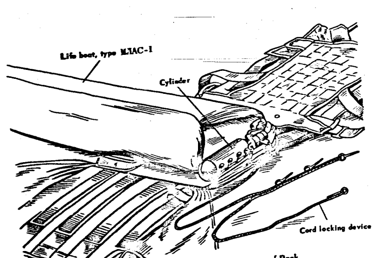

Fig. 10. Packing Life Boat on Bottom of Pack

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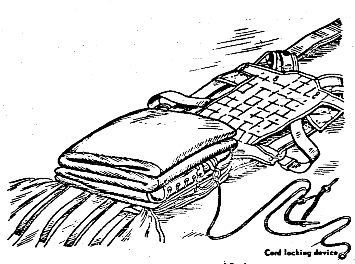

Fig. 11. Packing Life Boat on Bottom of Pack

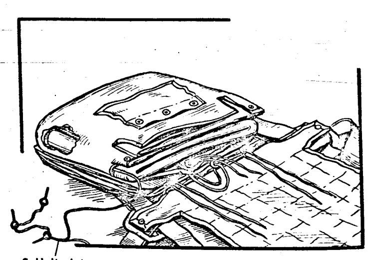

Fig. 12. Placing Intermediate Bottom on Life Boat

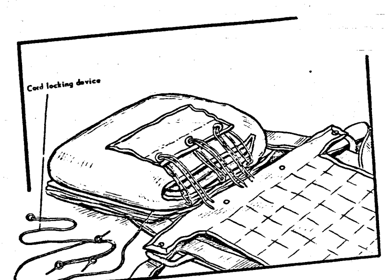

Fig. 13. Preparation for Locking Flap of Intermediate Bottom

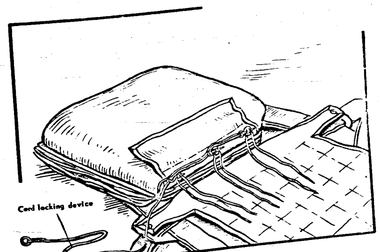

Fig. 14. Locking Flap of Intermediate Bottom

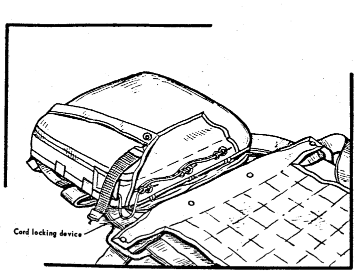

Fig. 15. Pack with Packed Life Boat

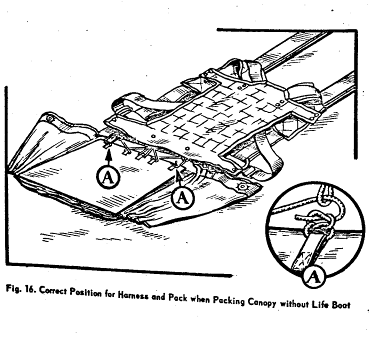

Fig. 16. Correct Position for Harness and Pack when Packing Canopy without Life Boat

4. Packing the Canopy

Prior to packing lay out the canopy with the shroud lines on the table.

The packer standing on the left-hand side of the table should take hold of the left-hand group of shroud lines, while his assistant should take hold of the right-hand group of shroud lines at the free ends of the harness.

The packer and his assistant should take the weights and having divided the shroud lines into two groups should move from the harness free ends to the canopy. Then they should place the weights on the left-hand side near the canopy skirt and divide the canopy into two parts so that the first panel bearing the maker's name should be placed uppermost (Fig.17). To pack the canopy, the assistant should move to the left-hand side of the table. The packer should stand at the canopy skirt facing the apex, with the left hand grasp and lift up the left group of shroud lines and with the right hand take hold of shroud line No.14 with the identification sleeve and keeping it in the middle of the table throw the left-hand half of the canopy over onto the right-hand half of the canopy, as shown in Fig.18.

Then the packer should turn with his left-hand side to the table, with the left hand take hold of the loop of shroud line No.15 and with the right hand the centre of the canopy skirt between the loops of shroud lines No.14 and No.15 and lower the skirt and the loop of shroud line No.15 onto the left-hand side of the table (Fig.19).

Place the loop of shroud line No.15 on that of shroud line No.14 and trim the canopy skirt.

The assistant standing with his right side to the table, (so as to face the packer), should grasp with the right hand the packed loop of shroud line No.15, and with the left hand the canopy skirt where it is bent and press them to the table taking care to prevent the canopy skirt from moving (Fig.20).

Simultaneously the packer should place the panel from the canopy skirt to the apex so that the webbing sewn to it is in the middle of the table (Fig.20).

On completing this operation the packer should return to the canopy skirt and standing with his left side to the table take hold of shroud line No.16 next in turn with the left hand, and with the right hand, the centre of the canopy skirt between the loops of shroud lines No.15 and No.16 . This done, he should repeat the procedure of packing the panel in cooperation with the assistant as prescribed above.

The canopy skirt and its part between the shroud line corner loops, exceeding the rest of the canopy in length, should be trimmed by bending up the excessive length and placing it on top of the folded panel as shown in Fig.23.

The packing of the left-hand half of the canopy (up to the maker's name plate) completed, the packer should place 3 or 5 weights throughout the length of the folded part of the canopy (Fig.21) and should move to the right-hand side of the table together with the assistant.

The packer should stand at the canopy skirt with his face to the apex, throw the right-hand part of the canopy over onto the folded left-hand part and having moved shroud line No.14 2 or 3 cm. from the middle of the table to the right (Fig.22) proceed folding together with the assistant the right-hand part of the canopy on the right-hand side of the table beginning with shroud line No.14.

In a correctly folded canopy the maker's name plate should be on the top panel at the canopy skirt on the right-hand side (Fig.22).

The packing of the canopy completed, the packer should tuck in the right-hand half of the canopy and overlap the right-hand half of the canopy by the left-hand half so that the width of the canopy skirt corresponds to that of the canopy pack cover lower base. This done, put 3 or 5 weights throughout the canopy length (Fig.23).

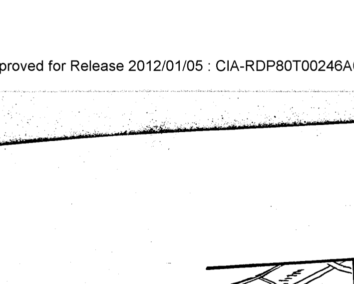

Fig.17. Preparation of Canopy for Packing

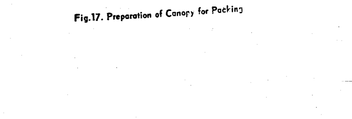

Fig. 18. Preparation of Canopy for Packing

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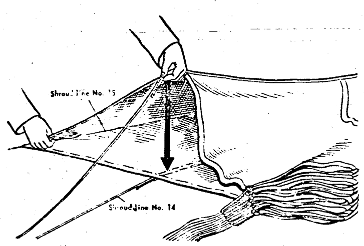

Fig. 19. Packing the Canopy

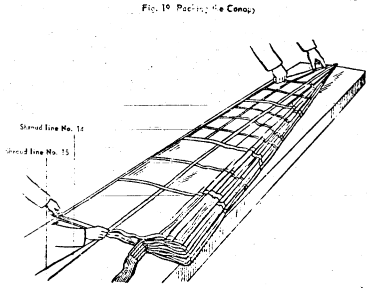

Fig. 20. Packing the Canopy

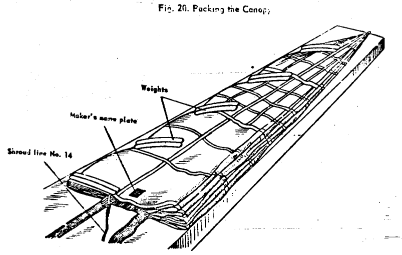

Fig. 21. Packing the Canopy

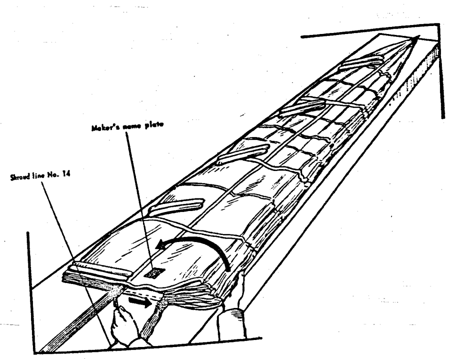

Fig. 22. Packing the Canopy

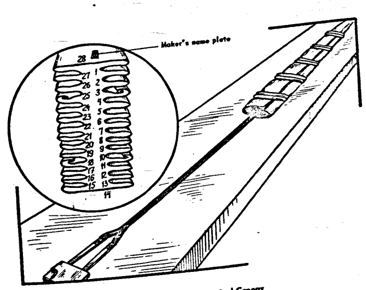

Fig. 23. Packed Canopy

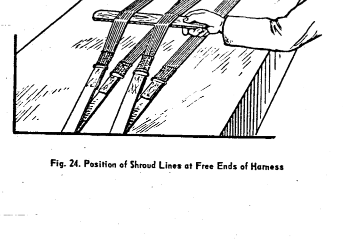

Fig. 24. Position of Shroud Lines at Free Ends of Harness

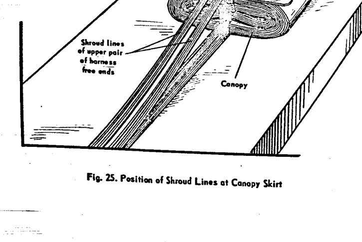

Fig. 25. Position of Shroud Lines at Canopy Skirt

The final packing of the canopy over, the packer and his assistant must check whether the canopy is correctly folded and whether the shroud lines are properly arranged. For this the assistant should take hold of the shroud lines at the skirt of the folded canopy and the packer should place the packing stick under the shroud lines of the harness free ends (Fig.24) and move to the canopy. If the shroud lines are arranged correctly, the whole of the canopy upper half should rise (Fig.25). The packer should take the two inner shroud lines of the harness free upper ends and move the packing stick along them up to the canopy skirt. These shroud lines should lie on top and close to each other.

The excessive length of the shroud lines caused by service should be forced down to the harness half-rings.

5. Pulling Canopy Pack Cover over Canopy and Looping Canopy Shroud Lines into Canopy Stowage Pockets

The assistant should remove the weights from the canopy and put the right hand through the canopy pack cover as shown in Fig.26, take the canopy loop off the table peg and take hold of the canopy apex. The packer should grasp the canopy skirt, pull it over the canopy so that the centre of the folded canopy coincides with the centre of the pack cover (Fig.27) and insert the packing frame into the pack cover pockets as shown in Fig.27A.

This done, the packer should grasp with the left hand all the shroud lines at a distance of 0.5 to 0.8 m. from the canopy skirt, put them on the pack cover between the stowage pockets (Fig.27) and with the right hand cover the canopy skirt with the pack cover bottom piece. Then the packer should pass the double detachable rubber stowage pockets through the bottom piece ports, collect all the shroud lines into a single skein in the left hand and form a loop around the forefinger of the left hand by the first mark. With the right hand he should insert the hook through the right-hand detachable stowage pocket, engage the hook in the loop and draw it into the stowage pocket. This completed, the packer should draw the shroud lines taut with the left hand as shown in Fig.27B and remove the hook. Next, he should take hold of the shroud lines, form a loop round the forefinger of the right hand by the second mark and holding the hook in the left hand, draw them into the left double detached rubber stowage pocket as shown in Fig.27B.

After the bottom piece has been locked up by the shroud lines, that is after the shroud lines have been looped into the double detachable rubber stowage pockets, draw the shroud lines into the upper pair of stowage pockets (Fig. 27B). As the shroud lines are being drawn into the stowage pockets, the harness is pulled up to the canopy. The remaining length of the shroud lines, after the latter have been looped into the stowage pockets must be equal to the length of the pack.

During packing the assistant, who is on the right-hand side of the table, should hold down the shroud lines looped into the stowage pockets with one hand and the canopy in the other hand thus preventing the parachute from shifting.

When packing the shroud lines into the stowage pockets, see that they do not twist.

The shroud lines packed into the stowage pockets, remove the packing frame from the pockets of the canopy pack cover (Fig.28), place the protector flap upon the packed shroud lines and tie up the tapes as shown in Fig. 28Б.

6. Tying Up and Packing of Connecting Line

Tie up one end of the connecting line to the bridle of the canopy pack cover with a timber hitch (Fig. 29A) and the other end, to the thimble of the pilot chute (Fig. 29Б).

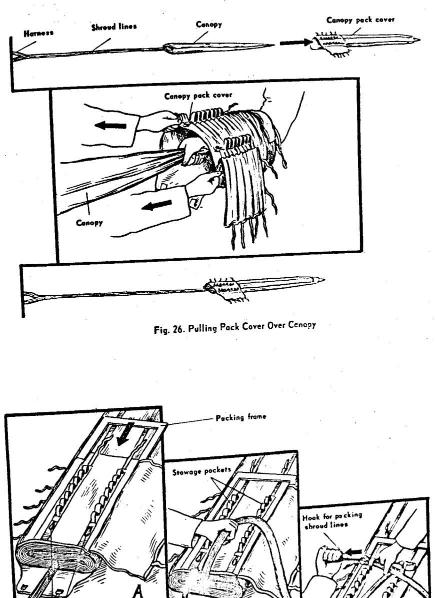

Fig. 26. Pulling Pack Cover Over Canopy

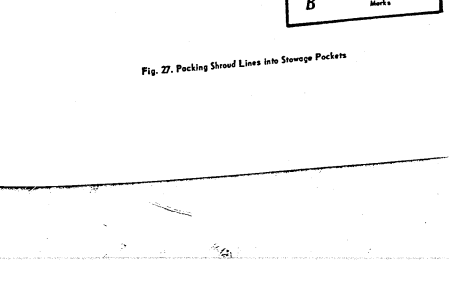

Fig. 27. Packing Shroud Lines into Stowage Pockets

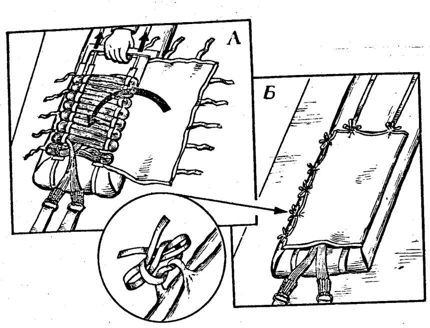

Fig. 28. Removing Packing Frame from Pack Cover Pockets and Tying Up Protective Flap

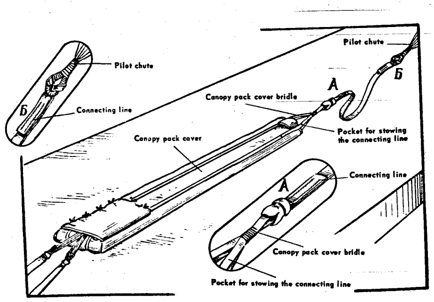

Fig. 29. Tying Up Connector Shroud Line

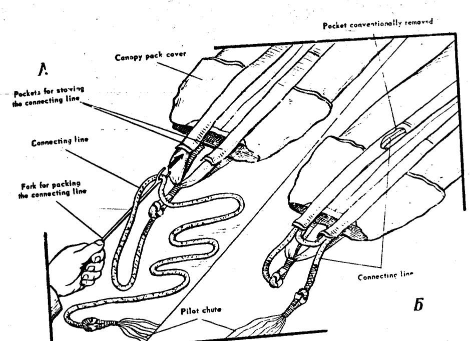

Fig. 30. Packing Connector Shroud Line

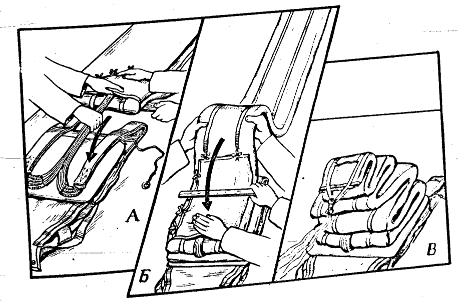

Fig. 31. Packing Free Ends and Canopy on Bottom of Pack

Fig. 28. Removing Packing Frame from Pack Cover Pockets and Tying Up Protective Flap

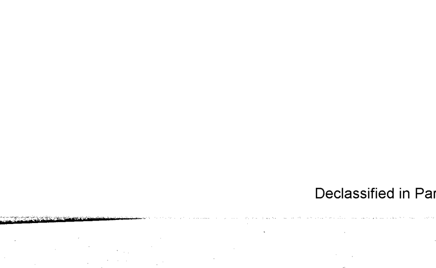

Fig. 29. Tying Up Connector Shroud Line

Fig. 30. Packing Connector Shroud Line

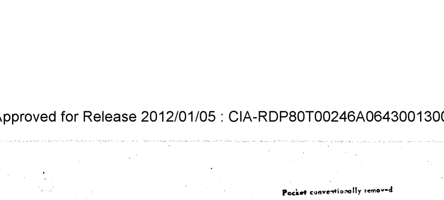

Fig. 31. Packing Free Ends and Canopy on Bottom of Pack

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Fig. 32. Tightening the Pack

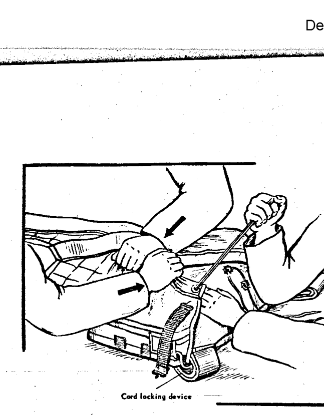

Fig. 33. Tightening the Pack

The distance between the knots should be equal to 1.5 m. Then pack the connecting line into the pockets made of tape and sewn onto two reinforcing webbings in the upper part of the canopy pack cover (Fig. 30).

7. Placing Canopy Enclosed in Pack Cover into Pack

Push the pack to the canopy in the pack cover so that its side with the end face flap faces the canopy. Place the free ends of the harness on the pack ports so that both of the half-rings of the harness are in the middle of the pack, while the shroud lines not packed into the pack cover stowage pockets are arranged as shown in Fig. 31A. Take hold of the canopy pack cover length equal to the length of the pack, place it on the bottom of the pack so that the lower edge of the pack cover lies on the bottom edge from the side of the pack main flap and the shroud lines in the stowage pockets are on top.

Then, holding down the canopy in the pack cover with the left hand the assistant should place the packing stick across the pack cover over the edge of the pack bottom. Simultaneously the packer should grasp again the portion of the canopy in the pack cover equalling the length of the pack and place it so that the pack sides are properly filled as shown in Fig. 31Б and B.

The canopy in the pack cover being placed on the bottom of the pack, the upper part of the pack cover with the pockets should be on top (Fig. 31B) so that the pilot chute is positioned on the side of the pack main flap.

8. Tightening Pack

Tighten the pack only with the wooden insert fitted inside. Pull the flaps from under the pack bottom, tuck up the corner flaps of the end face flap, smooth out the corners and fill them with the fabric of the pack cover so that the canopy is packed into it.

Begin tightening the pack with the tightening of the side flaps.

The packer should pull the right-hand side flap to the left with the right hand and the end face flap to the right with the left hand. The assistant, having passed a tightening cord through the grummet of the right-hand side flap, should pull the cord upward and to the left pulling the second cone into the grummet (Fig. 32); the packer should insert the auxiliary pin into the cone.

Next, with the left hand the packer should pull the left-hand side flap to the right and with the right hand the end face flap to the left and upwards (Fig.33); the assistant should pass a tightening cord through the grummet of the side flap, pull it upward and to the left engaging the cone in the grummet of the left-hand side flap; after which the packer should insert the second auxiliary pin into the cone (Fig. 34).

The packer should fold the pilot chute, having previously collected and drawn taut all the shroud lines at the canopy skirt (Fig. 35A).

Fold the canopy from both sides to the centre as shown in Fig. 35B and roll up the parachute (Fig. 36).

Wrap the rolled pilot chute in the bottom piece of the main flap by one turn, place the shroud lines of the pilot chute on the bottom piece in a zigzag pattern (Fig. 37) and roll up the pilot chute completely. 35Б

Then start tightening up the main flap. For this the assistant should pull the side and end face flaps, while the packer, after having passed the tightening cords through the grummets of the main flap, should pull the main flap over the cones of the end face flap (Fig. 38).

Note: When pulling the main flap of the pack, see that the bottom piece with the pilot chute does not unroll.

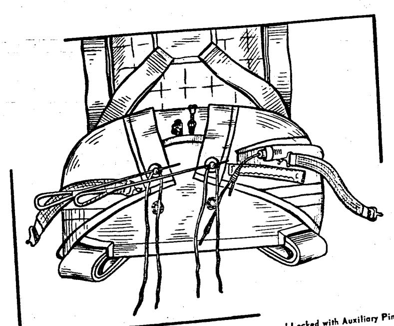

Fig. 34. The Side Flaps Tightened Up on Cones and Locked with Auxiliary Pins

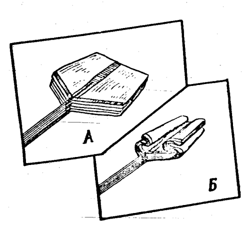

Fig. 35. Packing the Pilot Chute

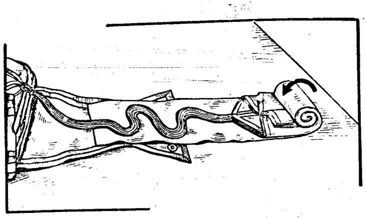

Fig. 36. Wrapping the Pilot Chute in Main Flap Bottom Piece

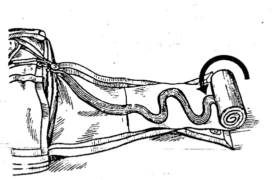

Fig. 37. Wrapping the Pilot Chute in Main Flap Bottom Piece

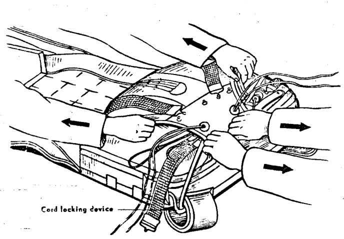

Fig. 38. Tightening Up Main Flap

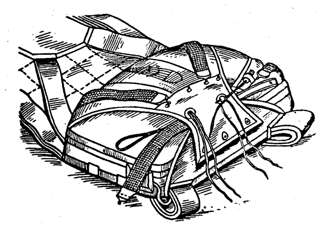

Fig. 39. Inserting the First Pin of Pull Ring

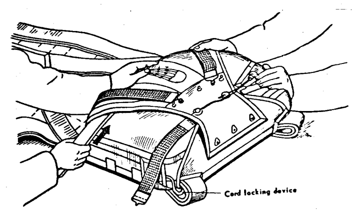

Fig. 40. Trimming the Pack with Packing Stick

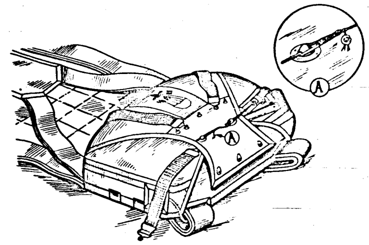

Fig. 41. Sealing the Pull Ring Locking Pin

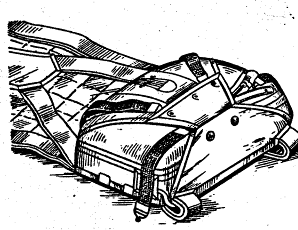

Fig. 42. Fastening the Protective Flap

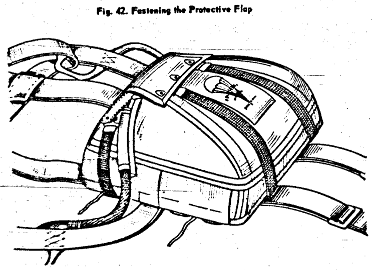

Fig. 43. Packed Parachute

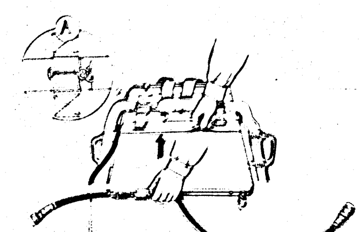

Fig. 44. Mounting the Oxygen Breathing Apparatus

Holding back the main flap with the right hand the packer should engage the cone in the grummet with the left hand and remove the auxiliary pin from the cone with the right hand; then he should insert the first locking pin of the pull ring into the cone pulled out by the tightening cord (Fig.39). After this insert the second locking pin of the pull ring in the same manner and pull both tightening cords out of the cones (Fig.40).

The packer should trim the side flaps by means of the packing stick, the assistant holding down the pack (Fig.40).

Lock the second locking pin of the pull ring with double cotton thread No.30 or No.40 and seal it (Fig.41); fasten the protector flap with the turnstile buttons (Fig.42).

Fix the free ends of the harness to the back plate by means of four flaps fastened with autobuttons (Fig.43).

Check whether the hooks of the pack-opening springs are securely fastened to the loops of the main and side flaps.

Fasten the other ends of the pack-opening springs to the loops on the pocket of the oxygen breathing apparatus only before flight.

A packed parachute is shown in Fig.43.

The wooden insert should be removed from the pack during the installation of the KAP-3 automatic [illegible] release mechanism.

Note: The pack-opening springs 345 mm long are connected to the main flap while those 270 mm long are connected to the side flaps and to the pocket of KAP-3 automatic [illegible] release mechanism.

VII. Mounting KP-23 [illegible] Oxygen Breathing Apparatus on Pack

Mount the oxygen breathing apparatus in the pocket of the pack after the canopy has been packed into the pack.

Prior to mounting the oxygen breathing apparatus, check if the harness is securely attached to the pack. The mounting of the oxygen breathing apparatus is shown in Fig.44A.

Mount the oxygen breathing apparatus as follows:

Insert the breathing apparatus into the pocket of the pack (Fig.44) from the side of the end face or main flap; the lock of the breathing apparatus should be at the bottom of the end face or main flap.

The hose of the parachute breathing apparatus connected to the stationary oxygen breathing apparatus should be arranged depending on the layout of the oxygen system in the aircraft.

Place the breathing apparatus on the pack supports (Fig. 45).

Tie the loops located on the pocket of the oxygen breathing apparatus to the large loops on the bottom of the pack base with capron cord 10k (Fig. 45). The oxygen breathing apparatus mounted, tie up the pad to the pack with four tapes (Fig. 46).

Notes: 1. When mounting the КП-23 oxygen breathing apparatus on the pack for the type M device, tie the loops located on the breathing apparatus pocket to the large loops from the side of the КП-23 apparatus pipe union and from the opposite side to the small loops located on the bottom of the pack base.

2. Mount the parachute oxygen breathing apparatus, type КП-27М, on the pack in compliance with the Operating Instructions of the КП-27М parachute breathing apparatus.

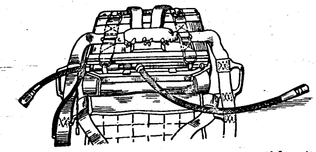

Fig. 45. Arrangement of Oxygen Breathing Apparatus on Pack Supports

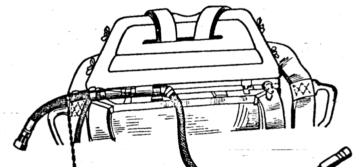

Fig. 46. Tying Up the Pad to Pack

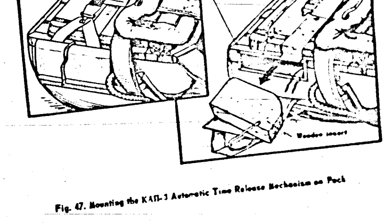

Fig. 47. Mounting the КАП-3 Automatic Time Release Mechanism on Pack

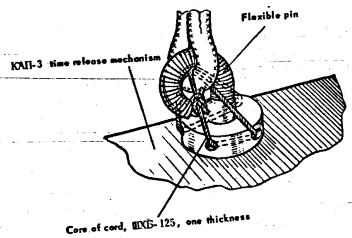

Fig. 48. Locking Flexible Pin

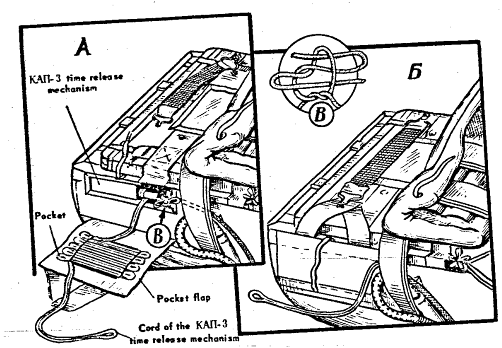

Fig. 49. Mounting the КАП-3 Automatic Time Release Mechanism on Pack

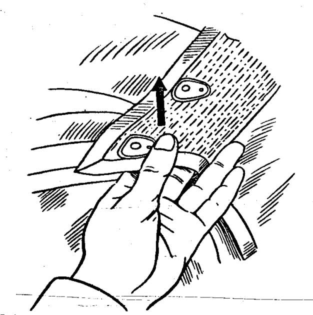

Fig. 50. Unfastening the Turnstile Buttons

IV. Mounting КАП-3 Automatic Time Release Mechanism on Pack

When mounting the КАП-3 automatic time release mechanism on the pack of the parachute, it is necessary to:

1. Untie the pad from the side of the КАП-3 automatic time release mechanism pocket flap (Fig. 47).

2. Open the pocket flap and remove the wooden insert (Fig. 47Б).

3. Cock the КАП-3 automatic time release mechanism and set it to the required time and altitude in compliance with the respective operating instructions.

4. Lock the flexible pin with single thread having tensile strength of 7 kg by passing it through the side holes of the mechanism bush and the flexible pin eye and the loop of the cord. Tie up the ends of the thread (Fig.48).

5. Insert the bayonet stud of the shaped nut on the hose of the КАП-3 automatic time release mechanism into the hole of the mechanism plate sewn onto the left-hand side flap of the pack (Fig. 51).

6. Place the КАП-3 automatic time release mechanism into the pocket on the parachute pack (Fig. 49A).

7. Let the mechanism cord out as shown in Fig. 49 and pack it into the flap pocket in a zigzag pattern.

8. Tie up the КАП-3 automatic time release mechanism as shown in Fig. 49B.

9. Close the pocket flap and pull the pack-opening spring to engage it in the flap loop (Fig. 49Б).

10. Open the protector flap having previously turned the pack over.

Unfasten the turnstile buttons from the side of the point located on the outside of the button by pressing the turnstile buttons upward as shown in Fig.50.

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11. Drive the splined screw with the loop out of the tail nut of the КАП-3 automatic time release mechanism cable and remove the loop from the screw slit (Fig.51Б).

12. Engage the first locking pin of the rip cord in the loop (Fig.51Б).

13. Fit the splined screw over the loop and screw the tail nut of the mechanism cable on it (Fig.51В).

14. Fasten the protector flap by the turnstile buttons (Fig. 52).

15. Tie up the pad with all the ties.

Note: The hose of the КАП-3 automatic time release mechanism is located under the parachute hose.

To check the installation of the КАП-3 automatic time release mechanism mounted on the parachute, untie two ... of the pad, unfasten the pack-opening spring, open the pocket flap, untie the КАП-3 automatic time release mechanism and without disconnecting the hose take out the ..., check it in compliance with the operating instructions for the КАП-3 automatic time release mechanism and then replace it in the pocket again.

V. Adjustment of Harness

Put on and adjust the harness as follows:

1. Take hold of the harness by the main strap at the place where the free ends branch out. Having made sure that the parts of the harness are properly arranged insert first the left and then the right hand into the corresponding loops formed by the main and shoulder straps. The pull ring must be on the left-hand side (Fig.53).

2. Fasten the harness by means of the buckles in the ТII lock.

For this:

(a) close the lock cover;

(b) close the safety latch;

(c) insert the buckle of the shoulder strap right-hand end into the lock (Fig.53);

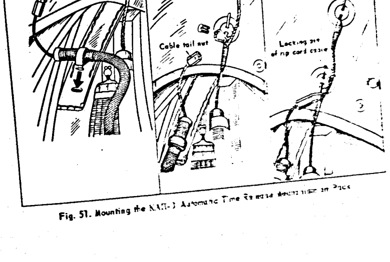

Fig. 51. Mounting the КАП-3 Automatic Time Release Mechanism on Pack

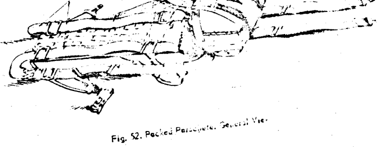

Fig. 52. Packed Parachute. General View

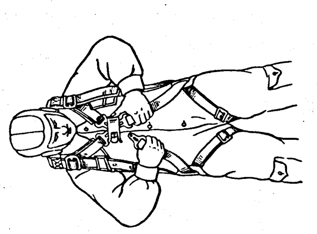

Fig. 55. Putting on the Harness

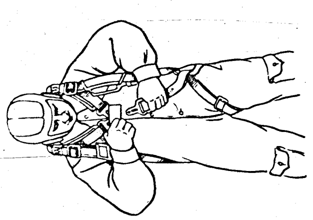

Fig. 54. Putting On the Harness

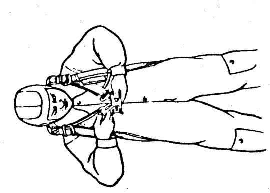

Fig. 53. Putting On the Harness

(d) insert the buckle of the left leg strap into the
lock having passed it first through the left clamp of the
leg strap (Fig.54);

(e) insert the buckle of the right leg strap into the
lock in the same manner (Fig.55).

3. Adjust the harness (Fig. 56) in the standing posi-
tion and then check it in the sitting position.

4. Adjust the main and shoulder straps (3) to fit the
wearer's height by changing the length of the waist strap (4)
by means of two rectangular buckles (5).

The slack of the shoulder straps should be completely
taken up by the waist strap; the cross-piece (6) of the
back (11) must be shifted to the extreme upper position.

To the adjusted shoulder straps fasten the cross
piece (6) of the back (11) (previously shifted to the shoulder
wadded pads)(7), with 2 or 3 stitches of linen thread
with a tensile strength of 15 kg on each shoulder strap.

5. Adjust the leg straps (8) by tightening or loosening
the straps with the rectangular buckles (9).

6. Fasten the free ends of the harness (1) with the
corresponding flaps (10) on the back (11).

If the harness is properly adjusted, it does not
hinder the pilot's movements and does not tire him; the
harness must make a close fit with the body, which prevents it
from catching on the projecting parts of the aircraft,
ensures uniform distribution of the load over the body when
the parachute unfolds and prevents the pilot from falling
out of the harness.

VI. Pre-Flight Inspection Procedure

Prior to flight:

1. Unfasten the protector flap, examine the pins of the
pull ring, check to see that the seal is present. This done,
fasten the flap.

2. Fasten the pack-opening springs to the loops sewn
to the breathing apparatus pocket.

3. Check whether the parts of the parachute breathing apparatus are correctly arranged in relation to each other and whether the apparatus is properly charged.

4. Check the installation of the КАП-3 automatic time release mechanism; see that it has been cocked and set to the required time and altitude.

5. Don the parachute and fasten the harness by means of the buckles in the ТП lock.

6. Check the lock for reliable and correct closing. To do this:

(a) pull energetically at the buckle in the lock and make sure that the buckles are reliably attached;

(b) make sure by the touch that the locking moving teeth do not project from the lock body.

VII. Connecting Hoses of Oxygen Breathing Apparatus, Type КП-23

Connect the hoses of the oxygen breathing apparatus [illegible] the following manner:

[illegible] the shorter hose of the parachute breathing apparatus and the pin through the left-hand port of the aircraft seat [illegible] (Fig. 57).

Connect the shorter hose of the parachute oxygen [illegible] apparatus to the aircraft inboard oxygen system [illegible] to the aircraft side.

[illegible] longer hose of the parachute oxygen [illegible] apparatus to the oxygen mask. For this pass the [illegible] hose under the main strap of the parachute [illegible] and join it to the hose of the oxygen mask.

By means of [illegible] connection mount the hose of the oxygen mask [illegible] on the metal plate of the [illegible] (Fig. 57).

[illegible] the inboard oxygen system in the aircraft is [illegible] the hose of the mask

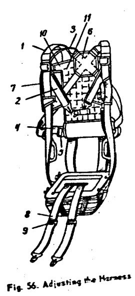

Fig. 56. Adjusting the Harness

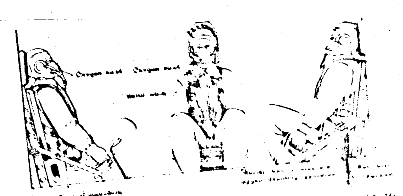

Fig. 57. [illegible]

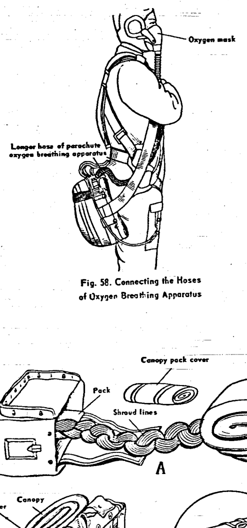

Fig. 58. Connecting the Hoses of Oxygen Breathing Apparatus

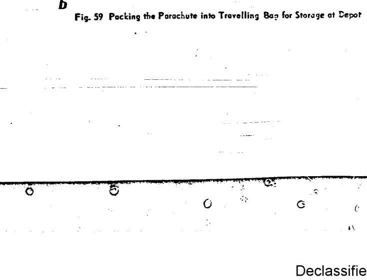

Fig. 59 Packing the Parachute into Travelling Bag for Storage at Depot

and of the oxygen breathing apparatus on the left-hand strap of the harness above the pull ring pocket.

Remove the parachute breathing apparatus from the pocket of the parachute pack and turn it round the longitudinal axis by 180° so that the shorter hose of the parachute breathing apparatus is let out through the right-hand port of the aircraft seat pan. Pass the longer hose of the parachute breathing apparatus under the main strap of the parachute harness.

VIII. Procedure of Folding Parachute after Landing

On landing the jumper should take off the harness, fold it and place it into the travelling bag.

For this grasp the parachute canopy by the apex, stretch it out to its full length, shake and fold it to fit the size of the travelling bag.

Holding the folded canopy on the knees collect its shroud lines in a slip loop.

This done, pack the parachute into the bag in the following order; put the parachute pack in the middle of the bag; place the harness on one side of the pack and the canopy, canopy pack cover and shroud lines on the other side closing them with the main flap. Then close the bag cover and fasten all the turnstile buttons.

IX. Maintenance and Storage of Parachute

On completing the jump it is necessary to air and shake up the parachute and to clean the pack from dirt and earth. In the event of alighting in a swamp or sea wash the parachute with clean fresh water and dry it. It is prohibited to wring the parachute.

In winter the parachute must be cleaned from snow and dried.

As a rule, parachutes are dried indoors or in special drying rooms. It is permitted to dry the parachutes outdoors (in summer) provided they are protected from the sun light and the weather is neither wet nor dusty.

After use the pack-opening springs should be released.

The travelling bag must be dried separately.

Take care that neither benzine nor oil comes in contact with the parachutes.

Once in three months subject all the parachutes in current use to inspection so as to determine whether they are fit for further service.

The parachutes which require local unit repairs must be taken out of service.

Carry and store the folded parachute in the travelling bag only. For this purpose place the parachute into the travelling bag so that the rigid frame is in the vertical position and pack the harness from the side of the pad. This done, fasten the bag by all the turnstile buttons. If the parachute is not in current use, it is necessary to open it and to pack into the bag for storage at the depot.

For this open and air the parachute. Stretch out and fold the canopy. Collect the shroud lines in a slip loop and roll up the folded canopy (Fig. 59A).

Place the harness with its metal parts on the outside bottom of the pack and cover it with the pack side flaps.

Place the pack with the harness packed into it on the rib into the bag so that the harness is close to the front side of the bag; put the canopy, the canopy pack cover, the shroud lines and the pilot chute on the other side of the pack and cover them with the pack main flap (Fig. 59B).

Fasten all the buttons of the bag and by means of the auxiliary pin lace up the bag with linen thread and seal it (Fig. 59B).

Parachutes must be stored in premises adapted for storage.

The parachutes in current use should be dried and repacked not less than once a month, while those stored at depots should be dried and repacked not less than once in three months.

The МЛАС-1 life boat, the КАП-3 automatic time release mechanism and the parachute oxygen breathing apparatus must be stored separately in compliance with special instructions. After each case of application of the parachute (jumps, packing, airing, repairs, handing over from unit to unit) and in the event of special occurrences during descent, make special entries in the certificate.

All the entries should be legible and made in ink.

No erasure and corrections are permitted.

AUTOPILOT Model АП-28Д

OPERATING INSTRUCTIONS

AUTOPILOT Model [illegible]

OPERATING INSTRUCTIONS

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These instructions for operating the [illegible] autopilot in [illegible]-12 aircraft consists of the following parts:

Part I. Pre-Flight and After-Flight Preparation of Autopilot.

Part II. Flying the [illegible]-12 Aircraft under [illegible] Autopilot Control. Adjustment and Check of Autopilot in Flight.

Part III. Adjustment of [illegible] Autopilot When Replacing Individual Units.

PART I

PRE-FLIGHT AND AFTER-FLIGHT PREPARATION OF АП-28Д AUTOPILOT

I-I. Pre-Flight Preparation of Autopilot

The autopilot pre-flight preparation must be performed before each flight.

If several flights are made during a day, and the autopilot operates reliably, perform pre-flight preparation only before the first take-off.

The pre-flight preparation includes:

a) External inspection of the autopilot units installed in places accessible for inspection. Inspection of the units installed in hardly accessible places is performed when carrying out the periodic maintenance operations or repair in the area of these units.

b) Checking the operation of the autopilot energized .

1. External Inspection of Autopilot Units

When externally inspecting the autopilot units, proceed as follows:

a) make sure that the seals are not broken;

b) examine the units for freedom from external damage;

c) check the shock mount for condition and units for security of attachment;

d) check the units plug connectors locking.

2. Checking the Operation of the Autopilot Energized

To check the operation of the autopilot energized, proceed as follows:

a) Unlock the controls.

b) Supply pressure to the hydraulic system.

c) Switch on the ABC circuit breakers and switches required for the operation of the autopilot and IMM-I gyro flux-gate compass.

d) Check the controls for free travel by deflecting them from one extreme position to the other.

e) Press and, after synchronizing, release the IMM-I "SYNCHRONIZING" button.

f) Set the "CONTROL TRANSFER" selector switch on the control panel in the "PILOT" position.

g) Engage the servo units by the "SERVOS" switch on the pilot's instrument panel.

3. Checking the Autopilot Switching on and Starting the Autopilot

Set the "POWER" switch on the control panel in the "ON" position. In 30-180 sec. the amber "READY" light on the control panel should come on. The amber light steady illumination indicates that the starting is completed and the autopilot is ready for engaging the servo units.

Check the accuracy of the MVG-2 master vertical gyro erection by the indicator, located on the control panel.

With the aircraft in level flight position, the indicator pointer should nearly coincide with the zero index, with the "PITCH" button on the control panel either pressed or released.

4. Checking the Autopilot Operation in the Synchronizing Mode.

a) When checking the autopilot operation in the synchronizing mode, observe the amber "READY" light on the control panel, deflecting the controls in turn from one extreme position to the other. In case of sharp change in the controls position the light must go out, after the controls stop moving, the light must come on. After checking, set the controls in neutral position.

NOTE: With the pedals and control column deflected more than 2/3 of their travel the amber "READY" light on the control panel may remain off.

b) Disengage the servo units. The amber "READY" light must go out. Press the autopilot "ON" button. The green "AP ON" light on the control panel should not come on. Applying a force to the controls, make sure that they move freely. Engage the servo units, the amber "READY" light must come on.

5. Checking the Autopilot Operation in the Stabilization Mode.

1. To check the autopilot operation in the stabilization mode, press the autopilot "ON" button. The amber "READY" light on the control panel must go out, and the green "AP ON" light adjacent to it must come on. In this case the pedals may deflect from the neutral position.

Applying a force to the controls, make sure that the servo units are engaged. (The servo units prevent the controls from moving). Check that the servo units can be overridden, by deflecting in turn the control wheel, control column and pedals.

2. Check the signals transmission from the MVG (master vertical gyro) and the [illegible] compass gyro unit. To do this:

a) Press the "RETURN [illegible] FLIGHT" button at the pilot's or navigator's station.

b) Deflect in turn the [illegible] and [illegible] compass gyro unit at small angles (within their shock absorbers limits), the controls must move slightly.

3. Check the transmission of signals from the altitude corrector, its switching on and off. Press the autopilot "ON" button.

Press the altitude corrector (БК) switching button. The green light, warning about the altitude corrector switching, comes on. Having connected the [illegible] test unit to the altitude corrector static line holes, make up a pressure and vacuum of ±100 mm.H_2O. In this case the control column should move.

Then pressing the "OFF" button or deflecting the autopilot control hand-grip in the longitudinal direction, with the autopilot ON, the green light, warning about the altitude corrector switching on, should go out.

6. Checking the Autopilot Operation in the Control Mode

Check to see that the "CONTROL TRANSFER" selector switch on the control panel is set in the "PILOT" position.

Deflect the autopilot control hand-grip for the right and left bank, climb and descent.

The deflection of the autopilot control hand-grip must result in deflecting the control column and the control wheel in the proper direction.

The control pedals, with the autopilot control hand-grip deflected for bank, should be set in the approximately neutral position, and the control column must slightly deflect back.

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Deflect the control wheel for the right and left bank by the autopilot control hand-grip. Set the "CONTROL TRANSFER" selector switch on the control panel in the "NAVIGATOR" position. The amber "CONTROL TRANSFER" light on the control panel must come on. The control wheel must return to the middle position.

Deflection of the navigator's turn control knob for the right and left bank should cause the control wheel proper deflection. Set the navigator's turn control knob at zero. Set the "CONTROL TRANSFER" selector switch on the control panel in the "PILOT" position. Press the autopilot "OFF" button.

7. Checking the Autopilot Operation from the "RETURN TO LEVEL FLIGHT" Buttons and "RECOVERY FROM BANK" Button

Fully deflect the control wheel for the right bank and the control column for climb. Press the "RETURN TO LEVEL FLIGHT" button on the pilot's instrument panel.

The control wheel and column should return to the neutral position. Press the autopilot "OFF" button, fully deflect the control wheel for the left bank and the control column for descent. Press the "RETURN TO LEVEL FLIGHT" button at the navigator's station.

The control wheel and column should return to the neutral position.

Perform the above mentioned check, having pressed the autopilot "ON" button and deflected the control wheel by means of the autopilot control hand-grip.

Press the autopilot "ON" button. Deflect the control wheel for the right and the control column for dive by the autopilot control hand-grip. Press the "RECOVERY FROM BANK" button on the pilot's instrument panel and hold it in this position till the control wheel returns to the middle position. The control column must remain deflected. Release the "RECOVERY FROM BANK" button. Using the autopilot control hand-grip, deflect the control wheel and control column in the opposite direction and repeat the checking, having pressed the "RECOVERY FROM BANK" button. The control wheel must return to the middle position and the control column must remain deflected.

8. Disengaging the Autopilot

1. Press the autopilot "OFF" button.
2. Switch off the "POWER" switch on the control panel.
3. Switch off the "SERVOS" switch.
4. Cut off the hydraulic system pressure.
5. Lock the controls.

I-II. After-Flight Inspection and Check of AP-28K Autopilot

The autopilot after-flight check is performed after each flight as specified in paragraph 1-6, Section I-I, "Pre-flight Preparation of Autopilot". If several flights are made during a day and the autopilot operates reliably, it is permitted to carry out the after-flight inspection and check after the last flight.

PART II

FLYING THE AIRCRAFT UNDER АП-28Д AUTOPILOT CONTROL; ADJUSTMENT AND CHECK OF AUTOPILOT IN FLIGHT

II-I. Checking the Autopilot Before Flight

1. Before starting the engines the pilot must:

a) Make sure that the "POWER" switch on the control panel is in the "OFF" position.

b) Set the "CONTROL TRANSFER" selector switch on the control panel in the "PILOT" position.

c) Switch on the circuit breakers and switches required for operation of the autopilot, ГИК-I flux-gate compass and hydraulic system.

d) Unlock the controls and check them for free travel, deflecting them from one extreme position to the other.

2. Before starting the engines the navigator must:

Make sure that the turn control knob is in the neutral position.

3. After starting the engines the pilot must:

a) Switch on the "POWER" switch on the control panel. Engage the servo units. In 1-3 min. the amber "READY" light on the control panel should come on.

b) Press and, after synchronizing release the ГИК-I compass "SYNCHRONIZING" button.

c) Check the MVG for correct erection by the MVG indicator on the control panel, pressing the "PITCH" button.

Before and after pressing the "PITCH" button on the control panel the indicator pointer must be at the zero index. The green "MVG" (" ШТБ " light on the control panel should glow.

d) Sharply deflect the controls half way (in turn). The amber "READY" light on the control panel should go out, and after the controls stop moving the light should come on. Set the pedals in the neutral position or approximately so.

NOTE: When deflecting the pedals and the control wheel more than 2/3 of the travel, the amber "READY" light on the control panel may remain off.

e) Disengage the autopilot servo units. The amber "READY" light must go out. Press the autopilot "ON" button. The green "AP ON" light on the control panel must not come on.

By applying a force to the controls, make sure they freely move. Engage the servo units, the amber "READY" light must come on.

f) Press the autopilot "ON" button. The amber "READY" light on the control panel must go out and the green "AP ON" light - come on. In this case the control pedals may be shifted towards neutral position.

By applying a force to the controls, ensure that the servo units are engaged.

(The servo units prevent the controls from moving). Be sure that the controls can be overriden by deflecting the control wheel, control column and pedals in turn.

g) Deflect in turn the autopilot control hand-grip for the right and left banks, climb and descent. The control hand-grip deflection must result in deflection of the control wheel and control column in the proper direction. With the autopilot control hand-grip deflected for bank, the pedals must be set in the approximately neutral position. Keep the control wheel and the control column deflected for bank and altitude.

i) Press the "RETURN TO LEVEL FLIGHT" button. The control wheel and the control column must return to the approximately neutral position. The green "BK" ("Altitude corrector") light on the control panel should come on.

Press the autopilot "ON" button. Using the autopilot control hand-grip, deflect the control wheel for the right or left bank.

j) Transfer the control to the navigator by setting the "CONTROL TRANSFER" selector switch on the control panel in the "NAVIGATOR" position. The amber "CONTROL TRANSFER" light on the control panel should come on. The control wheel should return to neutral position.

<u>NOTE</u>: During the check as specified in paragraphs "i" and "j" the altitude corrector light may go out when pressing the "ON" button or transferring the control to the navigator in the returning to level flight mode.

4. <u>After the autopilot control is transferred to the navigator, he must:</u>

a) Turn the autopilot turn control knob for the right and then for the left bank. In this case the control wheel should deflect in the proper direction.

Leave the control wheel deflected for bank.

b) Press the "RETURN TO LEVEL FLIGHT" button. The control wheel must return to the approximately neutral position. Set the turn control knob at zero.

5. <u>The pilot must:</u>

a) Set the "CONTROL TRANSFER" selector switch on the control panel in the "PILOT" position. The amber "CONTROL TRANSFER" light on the control panel must go out.

Press the autopilot "ON" button.

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b) Press the autopilot "OFF" button observing the control panel. The green "AP ON" light should go out, and the amber "READY" light should become illuminated.

c) Check the controls for free travel by deflecting them from one extreme position to the other. After checking, set the controls in the neutral position.

d) Disengage the autopilot servo units. The "READY" amber light should go out.

WARNING

Perform taxying, take-off and landing, with the АП-28И auto-pilot power supply on but with the servo units disengaged.

ATTENTION

If the autopilot is repeatedly switched on after an interval less than 1 minute the "READY" amber light on the control panel may remain off. In this case press the "M.V.G. CAGE" button.

WARNING

If the АП-28И autopilot does not meet these instruction requirements, never use the autopilot in flight.

II-II. Flying the Aircraft Under АП-28И Autopilot Control

It is permitted to use the autopilot within the altitude range of 1,000 to 10,000 m. at I.A.S. not less than 320 km./hr.

Engage the autopilot at the bank and pitch angles, given in the flight operating instructions, but not exceeding 30°.

When flying at an altitude more than 8,000 m. and under adverse weather conditions, with the autopilot engaged, make turns with a

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bank not exceeding 20°. Should an engine fail and the aircraft is retrimmed by the trim-tabs, never engage the autopilot.

When engaging the autopilot during turns, climb or descent the aircraft maintains the established flight condition in which it was, when engaging the autopilot.

I. Level Flight

a) After reaching the required flying altitude but not less than 1,000 m. set the level flight condition, and thoroughly trim the aircraft by the trim-tabs; after that:

- synchronize the [illegible] gyro flux-gate compass;
- engage the autopilot servo units;
- press the autopilot "ON" button on the pilot's A.P. control hand grip. The "READY" amber light should go out, and the "ENGAGED" green light should come on.

b) If a more precise maintenance of altitude in level flight is required, switch on the altitude corrector by pressing the "[illegible]" (altitude corrector) button on the control panel.

In this case the "BK" (altitude corrector) green light on the control panel must come on.

With the altitude corrector on, it is possible to accomplish turns using the pilot's control hand grip. When switching on the altitude corrector, the aircraft vertical speed should not exceed 1.5m/sec.

Bear in mind that, with the pilot's control hand grip deflected for climb or descent, the altitude corrector is switched off automatically and the "BK" (Altitude corrector) green light on the control panel goes out.

To switch on the altitude corrector repeatedly, bring the aircraft to level flight, set the pilot's control hand grip in neutral position and press the "BK" (Altitude corrector) button on the control panel.

c) The autopilot permits changing the flying speed (acceleration or deceleration) without retrimming the aircraft by the trim-tabs within the range of 50-60 km/hr., both with the altitude corrector switched on and off, and flying with the cargo door open.

d) When performing a level flight, climb or descent, it may happen that the autopilot does not hold the aircraft on the established heading. It is caused by engaging the autopilot as the aircraft banks. To hold the aircraft on the established heading in level flight, after the autopilot is engaged, it is recommended to press the "RECOVERY FROM BANK" button (located on the pilot's instrument panel) and keep it pressed till the aircraft recovers from the bank.

WARNING:

1. When disengaging the autopilot, the elevator may jerk due to change in the aircraft trimming. To avoid this, it is recommended to disengage the autopilot periodically and to retrim the aircraft.
2. If the aircraft C.G. position was shifted once due to the cargo drop, acceleration or deceleration, the pilot must be ready to counteract the elevator jerk, when disengaging the autopilot.
3. When deflecting the autopilot control hand grip for pitch, after accelerating or decelerating the aircraft with the autopilot engaged and the altitude corrector on, the elevator may jerk.

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2. <u>Control from Pilot's A.P. Control Hand Grip</u>

<u>To make turns the pilot must:</u>

a) Deflect the pilot's A.P. control hand grip for the right or left bank. When the aircraft reaches the required bank, return the control hand grip to neutral position. The aircraft in a stable bank, will make a coordinated turn.

b) For recovering the aircraft from turn, recover the aircraft from bank by deflecting the autopilot control hand grip in the opposite direction.

After the turn recovery press the "RECOVERY FROM BANK" button to bring the aircraft back to exact level flight position (in bank).

<u>To perform climb and descent the pilot must:</u>

a) Deflect the autopilot control hand grip for climb or descent. When the aircraft reaches the required angle of a positive pitch or dive, smoothly release the autopilot control hand grip to the neutral position.

The aircraft, with the pitch angle settled, will continue flight.

b) To bring the aircraft to level flight position, deflect the autopilot control hand grip in the opposite direction.

c) Before performing an extended climb or descent, which causes considerable change in the engine rating, disengage the autopilot (by the autopilot "OFF" button), obtain the required engine rating, set the aircraft for climb or descent at the required speed, trim the aircraft with the trim-tabs and engage the autopilot by the "AP ENGAGING" button.

<u>The pilot must:</u>

Remember that the autopilot control hand grip deflection angle for the right or left bank, climb or descent is proportional to the

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rate of roll or pitch.

NOTE: When entering or recovering from a turn, the rudder control pedals may slightly jerk.

3. Aircraft Control from Navigator's Turn Control Knob

The navigator must make sure that the turn control knob is in the neutral position.

The pilot must set the "CONTROL TRANSFER" selector switch on the control panel in the "NAVIGATOR" position. The "CONTROL" amber light on the control panel should be illuminated.

The navigator must:

a) To make a turn, deflect the turn control knob for the right or left bank.

When the aircraft reaches the required bank angle, stop rotating the turn control knob and leave it turned. The aircraft, with the bank settled, will make a coordinated turn.

b) To stop turning, recover the aircraft from bank by setting the turn control knob in the neutral position.

c) Bear in mind that proportional to the turn control knob position is the aircraft bank angle.

The navigator

must make sure that the turn control knob is in the neutral position.

The pilot

must set the "CONTROL TRANSFER" selector switch on the autopilot control panel in the "PILOT" position.

The "CONTROL" amber light on the control panel should go out.

WARNING: With the turn control knob turned the pilot is not permitted to set the autopilot "CONTROL TRANSFER" switch to the "PILOT" position.

A T T E N T I O N

The pilot and the navigator

With the turn control knob turned use the "RETURN TO LEVEL FLIGHT" button only in emergency to prevent sharp change in the ailerons' position.

4. Returning the Aircraft to Level Flight Position

If it is necessary to return the aircraft to level flight the pilot or the navigator must press the "RETURN TO LEVEL FLIGHT" button. In this case the aircraft will be automatically brought in bank and pitch to a position corresponding to straight level flight.

After the aircraft is returned to level flight, the altitude corrector is switched on automatically and the green "AC" (altitude corrector) light on the control panel comes on. It is permitted to press the "RETURN TO LEVEL FLIGHT" button with the autopilot both engaged (the green "ENGAGED" light on the control panel glows) and disengaged (the amber "READY" light on the control panel [illegible]).

After pressing the "RETURN TO LEVEL FLIGHT" button, the aircraft cannot be controlled by the pilot's A.P. control hand grip and the navigator's turn control knob.

The pilot:

After the aircraft is returned to level flight under ordinary flight conditions, press the autopilot "ON" button on the pilot's control hand grip to obtain the normal control.

After the aircraft is brought back to level flight under other flight conditions, to avoid jerk, during pitch control, caused by the altitude corrector switching off, it is recommended to disengage the autopilot and trim the aircraft before pressing the autopilot "ON" button.

5. Disengaging the Autopilot

To disengage the autopilot, the pilot must press the autopilot disengaging button on the control wheel.

Before landing disengage the autopilot servo units.

ABNORMAL OPERATION WITH THE AUTOPILOT ENGAGED

I. As the autopilot is not provided with an automatic device disengaging the autopilot if it fails in flight, when the aircraft is flying under the autopilot control, the pilots must constantly check the autopilot operation. In case of defects which result in sharp change in the aircraft pitch or bank, disengage (or override) the autopilot, bring the aircraft to the required flight condition and control the aircraft without employing the autopilot.

2. Should one of the engines fail in flight, with the autopilot engaged, at first the autopilot prevents the aircraft sharp bank and deviation from the heading.

But further it is necessary, by disengaging or overriding the autopilot, to bring the aircraft to the required flight condition and to control the aircraft without employing the autopilot.

II-III. Flight for Adjusting and Checking the [illegible] AUTOPILOT

Flight for adjusting and checking the autopilot is performed after the autopilot is installed in the aircraft.

Some instructions for the autopilot adjustment flight, given in paragraphs I and IV of the typical task may be performed after replacing the following units: control unit, control panel, [illegible]-2 master vertical gyro and feedback transmitter in accordance with the instructions for replacing the unit, after testing it on the ground.

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The autopilot adjustment consists in selecting the proper position of the centering potentiometer "T"("Pitch), "K"("Bank) and "H" (Direction) on the pilot's control panel to make turns with minimum slipping and to return the aircraft to level flight by pressing the "RETURN TO LEVEL FLIGHT" button.

Flying time, required for complete adjustment of the autopilot in the preset flight condition, is about an hour (without taking into consideration the time for climb and descent).

<u>It is permitted</u> to adjust the autopilot in a complex flight.

Adjust the autopilot in accordance with the autopilot adjustment flight instructions given below.

INSTRUCTIONS FOR A TYPICAL TASK

To the crew of aircraft No......... for AP-28 autopilot adjustment in flight " " ____________ 196....

I. At an altitude of 6,000-8,000 m and 350-370 km/hr I.A.S. trim the aircraft with the trim tabs and adjust the return-to-level-flight control system proceeding as follows:

a) Press the autopilot "ON" button. Press the "RECOVERY FROM BANK" button for 3-7 sec. Smoothly rotating the "K" (Bank) potentiometer on the pilot's control panel, set the aircraft in the zero-bank position and adjust the return-to-level-flight system in pitch in the following manner:

- push the "RETURN TO LEVEL FLIGHT" button.

After the "BK" (Alt.corr.) light has become illuminated press the autopilot "ON" button.

For finer adjustment of the return-to-level-flight control system cut off the altitude corrector as follows:

- slowly move the pilot's A.P. control hand-grip in pitch direction through a small angle till the "ALT" CORR." light goes out. Just at the moment the light is off return the control grip to the neutral position. When the light goes out, a jerk on the elevator control may occur.

Smoothly rotating the "T" (Pitch) potentiometer on the control panel decrease the vertical speed to zero (the aircraft descends when the potentiometer is turned clockwise).

Check the adjustment accomplished proceeding as follows: operating the pilot's control grip, bank the aircraft to the left at 10-15° and descend at a rate of about 10 m/sec (the pitch angle being about 3°).

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[illegible] Press the "[illegible]" [illegible] evaluate precision of the aircraft returning to level [illegible] position. Not more than 3 damp[illegible] oscillations of the aircraft are permitted.

[illegible] Press the autopilot "[illegible]" button [illegible] pilot's control hand grip. [illegible] rating the pilot's control grip lower the right wing through 5 to [illegible] [illegible] ascent [illegible] rate-of-climb of [illegible].

[illegible] Press the "[illegible] TO LEVEL FLIGHT" button. Evaluate precision of the aircraft returning to level flight from this position.

[illegible] Switch off the autopilot by pressing the autopilot "OFF" button. Enter the evaluation data in Table No. [illegible].

III. At an altitude of 6,[illegible] m and [illegible] km/hr I.A.S. [illegible] the accuracy of stabilization proceeding as follows:

a) thoroughly trim the aircraft in straight and level flight at [illegible] established altitude and speed and then press the autopilot "ON" button. Press the "[illegible]" button for 5–7 seconds and keep the aircraft in level flight position for 5–7 minutes with the altitude corrector off.

b) Ascertain and evaluate accuracy of the aircraft stabilization by the autopilot in yaw, roll and pitch.

The accuracy of stabilization [illegible] maximum deviation from the established pitch, yaw and roll angles. [illegible] deviations up to [illegible]-second duration are neglected.

c) Press the "ALT. [illegible]" button and keep the aircraft in level flight position for [illegible]–10 minutes, [illegible] and evaluate [illegible] stabilization of the aircraft when under the autopilot control and with the altitude corrector ON.

To evaluate the aircraft stabilization accuracy [illegible] the following instruments and units: [illegible] aircraft controls, [illegible] [illegible] horizon, [illegible]-I gyro flux-gate compass, ГПК-52 directional gyro, rate-of-climb indicator, altimeter, airspeed indicator and ЭУП-53 electrical bank-and-turn indicator (fill in Table No.2).

III. Test the autopilot for proper operation in straight and level flight at an altitude of 0.9 of the service ceiling and at an airspeed of 1.1-1.3 of the minimum speed for the given altitude.

a) When recovering to straight and level flight position at a given altitude and speed, thoroughly trim the aircraft and then press the autopilot "ON" button and press the "RECOVERY FROM BANK" button for 3-7 seconds. Proceed with level flight for 5-7 minutes with the altitude corrector OFF.

b) Determine and evaluate accuracy of the aircraft stabilization in yaw, roll and pitch.

c) Press the "ALT.CORR." button and keep the aircraft in level flight position for 10-15 minutes. Evaluate accuracy of the altitude stabilization of the aircraft under the autopilot control with the altitude corrector ON.

To evaluate the aircraft stabilization accuracy observe the following instruments and units:
the aircraft controls, АГБ-52 artificial horizon, ГИК-I gyro flux-gate compass, ГПК-52 directional gyro, rate-of-climb indicator, altimeter, airspeed indicator and ЭУП-53 bank-and-turn indicator (fill in Table No.3).

d) Moving the pilot's A.P. control hand-grip, descend the aircraft. Operating the pilot's A.P. control hand grip bring the aircraft to level flight position at an altitude of 4,000-5,000 m.

Disengage the autopilot by pressing the autopilot "OFF" button.

IV. Adjust the autopilot operation in turn at an altitude of 4,000-5,000 m, airspeed of 0.8-0.9 of the maximum airspeed for the given altitude.

a) trim the aircraft with the trim tabs in straight and level flight at the established altitude;

b) switch on the autopilot by pressing the autopilot "ON" button and press the "RECOVERY FROM BANK" button for 3-7 seconds (the altitude corrector is off);

c) operating the pilot's A.P. control hand-grip, lower the left wing of the aircraft through 5-7°. Observe the ball position of the bank-and-turn indicator.

If the ball is shifted from the zero position (side-slipping appears) eliminate the side-slipping by rotating the "H" (Direction) potentiometer on the control panel; the ball should return to the zero position within 1/4 of its diameter.

NOTE: 1. When the "H" (Direction) potentiometer is rotated clockwise, the ball will move to the right.

2. During turn entry and recovery from turn the rudder pedals may slightly jerk.

Lowering the right wing through 6-7°, check that there is no slipping. Repeat the adjustment, if necessary. Lowering the left wing through 25-30°, check the position of the ЭУП-53 bank-and-turn indicator ball and vertical speed indicated by the rate-of-climb indicator (for 20-30 sec.). Recover from bank. Lower the right wing through 25-30°. Check the position of the ЭУП-53 bank-and-turn indicator ball and vertical speed.

If required, readjust the side-slipping by the "H" (Direction) potentiometer so that at a 25° bank the ball deflection towards the bank would not exceed half of the ball diameter.

Recover from bank. Obtain the initial altitude (under the autopilot control). Proceed with level flight and switch on the altitude corrector.

Lower the left wing through 25-30°. (If the altitude corrector is switched off at the moment the aircraft begins banking, switch it on again by pressing the "ALT.CORR." button).

Ascertain the ЭУП-53 bank-and-turn indicator ball position and established altitude.

Check whether the aircraft is slipping or the altitude changed during a right turn with a 25-30° bank. (Shifting of the ball towards the bank should not exceed 1/2 of the ball diameter).

Without recovering from the right turn, transfer the autopilot control to the navigator; this done, the aircraft should recover from bank.

Test the aircraft in turn from the navigator's control.

After the aircraft has recovered from bank the navigator must bank the aircraft to the left by turning the navigator's turn control knob full way to the left, the pilot must determine the bank amount, check the ЭУП-53 turn-and-bank indicator ball position and altitude obtained.

The navigator must make the aircraft recover from the left bank and bring it into the right bank (by turning the A.P. control knob full way to the right). The pilot must ascertain the right bank amount, check the ЭУП-53 bank-and-turn indicator ball position and altitude obtained.

The navigator must move the turn control knob to the neutral position to recover from bank.

Enter the test results in Table No.4.

The pilot must set the control transfer switch to the "PILOT" position.

Disengage the autopilot.

V. When adjusting the autopilot in flight, the crew must complete the following form:

RECORD

of autopilot adjustment flight results

Aircraft No.______________ Date ______________

1. Altitude __________________ I.A.S.______________

Return-to-level flight mode.

Table No.1.

Channel	Parameters	Vertical speed (initial angle)	Accuracy Required	Accuracy Actual
Pitch	From dive	m/sec	Level[x)] flight	
	From climb	m/sec		
Bank	Left	degs	$\pm 1^\circ$	
	Right	degs		

x) NOTE: After the aircraft is returned to level flight the altitude is maintained to within ± 30 m.

2. Altitude ___________________ I.A.S.______________

Accuracy of the aircraft stabilization under the autopilot control in straight and level flight.

Table No.2.

Channel	Heading (degs)		Bank (degs)		Vertical speed (m/sec)		Altitude (with alt.corr. on)	
Parameters	Required	Actual	Required	Actual	Required	Actual	Required	Actual
Stabilization accuracy	$\pm 1^\circ$		$\pm 0.5^\circ$		Not more than 2		20 m	

3. Altitude ________________ I.A.S.________________

Accuracy of the aircraft stabilization under the autopilot control in straight and level flight.

Table No.3.

Channel / Parameters	Direction (degs.)		Bank (degs)		Vertical speed (m/sec)		Altitude (with alt. corr.on)	
	Required	Actual	Required	Actual	Required	Actual	Required	Actual
Stabilization accuracy	±1		Within width of Art. Hor. index		Not more than 2		±20m	

4. Altitude ________________ I.A.S.

Turns performed from the pilot's and navigator's controls.

Table No.4.

Parameters / Controls used	Maximum bank	Vertical speed change in stable flight conditions with alt.corr.OFF		Altitude established with alt.corr. on	Position of bank indicator ball		Turn angle (degs).
		Required	Actual		Required	Actual	
Pilot's A.P. control hand-grip	Left Right	Not more than 3 m/sec			Not more than 1/2 ball dia.		
Navigator's turn control knob	Left Right	Not more than 3 m/sec.			Not more than 1/2 ball dia.		

Pilot ____________________________

Navigator ____________________________

PART III

ADJUSTMENT OF AUTOPILOT WHEN REPLACING ITS SEPARATE UNITS

III-I. Instruments and Units

1. D.C. voltmeter having a degree of precision 2.5 with scale range of up to 10 v and inner resistance not less than 1 Kohm/volt.

2. Turn table and special bracket for the master vertical gyro installation.

3. Angular velocity stand and a special bracket for a rate gyro installation.

4. 63698/G25 unit (reference unit).

5. Special gauges to measure deflection of the aircraft control surfaces in the planes perpendicular to the axes of the controls rotation to within .5°.

NOTE: All the above listed instruments and units (except the gauges) are comprised in the AAA-2C autopilot test equipment and tools set.

III-II. Adjustment Conditions

The autopilots with a unit replaced must be adjusted and tested under the following conditions:

1. Aircraft electrical system supply voltage should be 27±[illegible] v.

2. Pressure in the hydraulic system should be 60 to 210 atm., and the hydraulic fluid temperature during the adjustment should not exceed +70°C.

3. An ambient air temperature should be within the range of +25 to -20°C.

4. Install the master vertical gyro, removed from the aircraft

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on the turn table by a special bracket which ensures horizontal position of the master vertical gyro to within 3° when the turn table platform is level.

5. Install the rate gyro, removed from the aircraft, on the angular velocity stand in a position that would ensure its rotation about the axis of the channel tested.

6. Remove the ГИК-I compass gyro unit and install it on the turn table.

7. Connect the master vertical gyro, rate gyro and ГИК-I compass gyro unit to the autopilot by cables.

8. Before checking the autopilot according to this instruction (except para. III-III, 1) after any of the units is replaced, energize the servo units, ГИК-I gyro flux gate compass and turn on the "POWER" switch on the control panel. Synchronize the ГИК-I compass gyro unit by pressing the synchronizing button on the instrument panel.

9. Set the master vertical gyro in the level position for which purpose with the autopilot power supply on set the turn table with the master vertical gyro to the zero position according to the scale marks and turning the table legs, adjust the indications of the voltmeter connected in due sequence to the "T-cp" and "Z-cp" terminals on the control unit face side so that they do not exceed 0.25 volts; with the master vertical gyro in this position the M.V.G. indicator pointer should be approximately at the scale "zero" mark when the "PITCH" button is pressed and released.

10. The "CONTROL TRANSFER" switch on the control panel must always be set in the "PILOT" position during all the adjustment procedures, if not specially specified.

11. Attach special gauges on the ailerons, elevator and rudder; these gauges permit measuring the control surfaces deflection in the plane perpendicular to their axes of rotation to within 0.5°.

12. When checking the direction of the rudder deflection and the rudder transmission ratio, mount the IIK-I compass gyro unit on the turn table.

NOTE: When replacing the control units observe the requirements given in III-II. (Adjustment conditions). When replacing other units observe only the requirements referring to the given unit test procedure.

III-III. Adjusting the Autopilot when Replacing the Control Unit

1. Checking the autopilot switching on.

Switch on the "POWER" switch on the control panel. After the expiration of 30-180 sec. the "READY" amber light on the control panel should come on.

The stable illumination of the amber light indicates that the autopilot is ready for energizing the servo units.

(Before this period is completed the amber light may momentarily come on).

2. Setting engagement angles

Install the master vertical gyro on the turning table as described in paragraph III-II, 4,7. Unlock the controls. Build up a pressure in the hydraulic system. With the master vertical gyro in horizontal position, switch on the autopilot by pressing the "RETURN TO LEVEL FLIGHT" button. By means of the "K" (Bank) magnetic amplifier centering potentiometer on the control panel set the ailerons in neutral position. Set the elevator to the neutral position by operating [illegible] (Pitch) magnetic amplifier centering potentiometer.

Press the autopilot "OFF" button and stop the hydraulic pump. Tilt the master vertical gyro for diving through the angle at which the "READY" amber light on the control panel goes off.

This angle should be [illegible] 7.5±2.5°.

If the master vertical gyro tilt angle is beyond the tolerable limits, then set the [illegible] (Pitch) "ENGAGEMENT ANGLE" potentiometer in the control unit to the position at which the "READY" light on the control panel will go out.

Tilt the master vertical gyro for positive pitching and check the angle at which the "READY" light goes out.

If the engagement angles are beyond the tolerable limits, readjust the autopilot by the same potentiometer. To adjust the roll engagement angles tilt the master vertical gyro for banking by the [illegible] (Bank) "ENGAGEMENT ANGLE" potentiometer in the control unit according to the above described procedure.

After the test set the master vertical gyro in horizontal position. Release pressure in the hydraulic system.

3. Checking the control surfaces movement direction

Press the ГМК-I compass synchronizing button.

Unlock the controls. Set the control wheel, column and rudder pedals in approximately neutral position. Supply pressure to the hydraulic system. Press the "RETURN TO LEVEL FLIGHT" button.

Press the autopilot "ON" button.

Deflecting the ГМК-I compass gyro unit, rate gyro, MVG and autopilot control hand-grip as specified in steps 1-8 of Table No.1 observe the control surfaces movement direction, which should correspond to steps 1-8 of Table No.1.

Set the "CONTROL TRANSFER" selector switch on the control panel to the "NAVIGATOR" position. Turning the navigator's turn control knob as specified in step 9, Table No.1, observe the control surfaces movement which should correspond to step 9, Table No.1.

Press the "BK" altitude corrector button. Creating vacuum in the altitude corrector, observe the elevator movement which should correspond to step 10, Table No.1.

After testing set the "CONTROL TRANSFER" selector switch on the control panel in the "PILOT" position. Press the autopilot ("OFF") disengaging button and stop the hydraulic pump.

Table No.1.

No.	Direction of transmitters and autopilot controls movement	Direction of control surfaces deflection
1.	ГИК-1 compass gyro unit for right turn (clockwise).	Rudder to the left(left pedal forward).
2.	Rate gyro for right turn.	Rudder to the left (left pedal forward).
3.	M.V.G. for right bank	Right aileron down (control wheel for left bank).
4.	Rate gyro for right bank.	Right aileron down (control wheel for left bank).
5.	M.V.G. for diving.	Elevator up (control wheel--column backward).
6.	Rate gyro for diving.	Elevator up (control wheel--column backward).
7.	AP control hand-grip for right bank.	Right aileron up.Elevator up (Control wheel for right bank control column backward.

No.	Direction of transmitters and autopilot controls movement	Direction of control surfaces deflection
8.	AP control hand-grip for diving.	Elevator down (control wheel-column forward)
9.	Navigator's turn control knob for right bank.	Right aileron up. Elevator up. (Control wheel for right bank, control column backward).
10.	Altitude corrector for climb (vacuum).	Elevator down (control wheel - column forward).

4. Checking the Rate Gyro Centering

Remove the " [illegible] " and " [illegible] " plugs from the control unit. Connect the 63689/025 ([illegible]) test unit to the " [illegible] " and " [illegible] " plug connectors.

Set the control pedals and the control wheel in approximately neutral position. Press the "RETURN TO LEVEL FLIGHT" button. Press the autopilot "OFF" button and switch off the hydraulic pump. Switch on the switches on the test unit. Setting the test unit switches for a required channel (bank, pitch, direction), check the current on the milliammeter (3) precision dial. Press the autopilot "ON" button. If the current changes its value by more than 0.2 ma according to the milliammeter (3), adjust the rate gyro centering potentiometers ("K" - for bank, "T" - for pitch and "H" - for direction) in the control unit so that, with the autopilot on and off, the current indicated by the milliammeter (3) would not change.

NOTE: 1. If it is impossible to obtain the same current, with the autopilot on and off, difference in current must not exceed 0.2 ma.

2. In all cases (with the autopilot on and off) the milliammeter (3) readings must not exceed 1 ma.

Press the autopilot "OFF" button.

5. Checking the Angle Ratio

Check the angle ratio with the " K" and " T" plugs removed from the control unit and 63689/025 test unit connected. (The B1 and B2 switches of the test unit are on).

Install the MVG and IMK-I compass gyro unit on the turn table, as specified in paragraphs III-II, 4,7,9. Press the IMK-I gyro-rate compass synchronizing button.

a) Set the control wheel, column and pedals in approximately neutral position. Supply pressure to the hydraulic system. Press the "TURN TO LEVEL FLIGHT" button. Note the position of the ailerons and elevator. Deflect the M.V.G. 10°for diving. Check the amount of the elevator movement from the noted position. Set the M.V.G. in level position. Deflect the M.V.G. 10° for nosing up and again check the amount of the elevator movement. To obtain the ratio, divide the amount of the elevator deflection by 10°.

Proceed as specified above, deflecting the M.V.G. for bank and using the "K" RATIO" (Bank Angle Ratio) potentiometer. The values obtained should correspond to these given in Table No.2.

If the ratios are off the tolerances, adjust them to the required value by turning the "T"RATIO" (Pitch Ratio) and "K"RATIO" (Bank Angle Ratio) potentiometer.

Set the M.V.G. in level position. Note the rudder position.

Note the IMK-I compass gyro unit position. Turn the IMK-I compass gyro unit 10 deg. from the noted position.

Note the amount of the rudder deflection. By turning the IMK-I compass gyro unit, return the rudder to the noted position. Note the IMK-I compass gyro unit position. Turn the IMK-I compass gyro unit 10° in the opposite direction. Note the amount of the rudder movement again. To obtain the ratio divide the amount of the rudder deflection by 10°. The values obtained should correspond to those given in Table No.2. If the ratios are off the tolerances, adjust them to the required value by turning the "H" RATIO" (Direction Angle Ratio) potentiometer.

After that adjust the servo gain factor.

b) Adjust the servo gain factor for pitch and bank as follows:

Turn the "T" (Pitch) "Servo Gain Factor" potentiometer fully clockwise, and, if the elevator starts oscillating when a signal is transmitted from the M.V.G., turn the "T" (Pitch) "Servo Gain Factor" potentiometer counter-clockwise till the elevator stops oscillating.

Release the hydraulic system pressure. With the 63689/025 test unit switches B1 and B2 on, set the selector switches for the channel to be checked. Deflecting the M.V.G. for pitch, transmit a signal, at which the difference in the V_1 and V_2 voltmeters reading will be 30-[illegible] V. Using the "T" (Pitch) "Servo Gain Factor" potentiometer knob, decrease the above voltage difference to 20 V. Return the M.V.G. to the position in which the difference in the voltmeters readings is zero, and supply pressure to the hydraulic system.

Proceed as specified above, deflecting the M.V.G. for bank and using the "K" (Bank) "Servo Gain Factor" potentiometer.

c) Adjust the gain factor of the direction channel servo as follows:

Turn the "H" (Direction) "Servo Gain Factor" potentiometer fully [illegible]ise and, if the rudder starts oscillating, turn the "H" (Direction) [illegible] Gain Factor" potentiometer counterclockwise till the oscillation [illegible]. Release the hydraulic system pressure. Set the (KMT) test [illegible] selector switches at "[illegible]". Quickly proceed as follows: by [illegible] of the IMK-1 compass gyro unit transmit a signal ~~at which the~~ [illegible]ference in the V_1 and V_2 voltmeter readings will be 30-35 V. [illegible] this difference to 2[illegible] V by means of the "H" (Direction) [illegible] Gain Factor" potentiometer knob.

[illegible] the IMK-1 compass gyro unit to the position in which the [illegible] in the voltmeter readings is zero and press the autopilot "[illegible]" button.

[illegible] checking, disconnect the test unit and install the plugs.

NOTE: 1. The above ratio from the IMK-1 gyro flux-gate compass is determined as arithmetical mean for 4 rhumbs every 45°. Deviation to a new rhumb is obtained by turning the magnet placed adjacent to the [illegible] flux-gate detector, with the autopilot disengaged by the AP "OFF" button (the amber "[illegible]" light on the control panel is ON).

2. Due to asymmetrical deflection of the aileron up and down, the ratio from the M.V.G. is determined by the average value or as arithmetical mean of the left and right ailerons deflection.

[illegible]. If turning the "Gain Factor" knob clockwise does not cause a control surface oscillation, reduce the voltage difference 30% (from [illegible] to 20 V) by turning the potentiometer knob clockwise from the extreme position.

Record the position of the "GAIN FACTOR" knob in the General Certificate.

4. If the gain factor adjustment is performed at a temperature below $-15^{\circ}C$, do not reduce the gain factor by 30%.

Table No.2.

Channels	Control surface angle-to-aircraft angle ratio, deg.
Bank (ailerons)	1.4 ± 0.15
Pitch (elevator)	0.9 ± 0.1
Direction (rudder)	1.1 ± 1.15

5. If the angle ratio adjustment causes a control surface oscillation, eliminate it by turning the oscillating channel "SERVO GAIN FACTOR" knob.

6. Centering the Direction Channel in Control Mode

Set the rudder and elevator in neutral position and supply pressure to the hydraulic system. Press the autopilot "ON" button.

By deflecting the autopilot control hand-grip for bank move the ailerons 10-15°. Using the "H" (direction) potentiometer on the control panel set the rudder in zero position. Check the centering performed as follows:

Press the "RETURN TO LEVEL FLIGHT" button. Move the rudder to the stop by means of the ГМК-I compass gyro unit.

Press the autopilot "ON" button. By deflecting the autopilot control hand-grip for bank, move the ailerons 10-15°. The rudder should return to zero position with an accuracy of 0.5°

Repeat the check, deflecting the [illegible]-I compass gyro unit and the autopilot control hand-grip in the opposite direction. If the rudder returns to zero position asymmetrically, repeat the centering procedure to obtain symmetry. After checking, press the autopilot "OFF" button and release the hydraulic system pressure.

7. Checking the Angular Velocity Ratio

Place the rate gyro on the test unit for presetting the angular velocities, in a position corresponding to the channel to be checked (bank, pitch, direction). Set the ailerons, elevator and rudder in neutral position by means of the control wheel, column and pedals.

Press the "RETURN TO LEVEL FLIGHT" button.

Presetting the angular velocity of 6 deg./sec. in [illegible] directions for the rate gyro, note the movement of the corresponding control surface.

To obtain the ratio, divide the amount of the control surface movement by the value of the angular [illegible] preset. The values obtained should correspond to those given in Table No. [illegible]. If the ratios are off the limits, adjust them to the required value by turning the "ANGULAR VELOCITY RATIO" ("K" - for bank, "T" - for pitch and "[illegible]" - for direction) potentiometers.

Press the autopilot "OFF" button. Release the hydraulic system pressure.

After determining ratios for angular velocity, check the rate [illegible] zeros centering as specified in paragraph III-III, 4 and check the signal from the autopilot control hand-grip as specified in paragraph III-III, 8, of these Instructions.

NOTE: Due to asymmetrical deflection of the ailerons up and down, determine the ratio by the average value or as arithmetical mean of the left and right ailerons deflection.

Table No.3.

Channels	Angular speed ratio (control.surf.deg. / deg./sec.)
Bank (Ailerons)	0.75 ± 0.1
Pitch (Elevator)	0.4 ± 0.05
Direction (Rudder)	1.1 ± 0.15

8. Checking the Signal from Autopilot Control Hand-Grip

Set the ailerons and elevator in neutral position by the control wheel, and column. Supply pressure to the hydraulic system. Press the A.P. "ON" button.

Fully deflect the autopilot control hand-grip for the right bank.

After 30-40 sec. return the autopilot control hand-grip to zero position. Deflecting the M.V.G. in the same direction set the ailerons in zero position. After that proceed as follows:

Fully deflect the autopilot control hand-grip for the right bank. Make sure that the ailerons are deflected 4.8 ±1deg. If the ailerons deflection is off the limits, adjust it to the required value by turning the "K" "SIGNAL FROM A.P. CONTROL HAND-GRIP" potentiometer.

Repeat the check, deflecting the M.V.G. and the autopilot control hand-grip for the left bank, diving and nosing-up.

with the autopilot control hand-grip deflected for pitch the amount of the elevator deflection must be 2.2 ± 0.5.

When diving or nosing up perform adjustment by using the "T"(pitch) "SIGNAL FROM AP CONTROL HAND-GRIP" potentiometer.

After checking, set the M.V.G. in zero position.

Press the autopilot "OFF" button and release the hydraulic system pressure. After setting the signal from the A.P. control hand-grip check the angular velocity ratio as specified in paragraph III-III, 7 of these Instructions.

9. Checking the Rate of Bank and Pitch Controlled from the A.P. Control Hand-Grip

Operating the control wheel and column set the ailerons and elevator in neutral position.

Supply pressure to the hydraulic system. Press the "RETURN TO LEVEL FLIGHT" button. Note the position of the elevator and the ailerons. Press the autopilot "ON" button. Deflect the M.V.G. 20° for diving.

Deflect the autopilot control hand-grip for diving and simultaneously start the stop-watch. Stop the stop-watch when the elevator passes the noted value obtained in the previous paragraph (paragraph III-III,8).

Return the elevator to middle position by operating the autopilot control hand-grip.

Perform the above check, deflecting the M.V.G. and the autopilot control hand-grip for nosing-up, right and left bank.

To obtain the rate, divide the M.V.G. deflection angle by the time.

The rate obtained should be:

for pitch .... 1.75 ± 0.4 deg/sec.

for bank .... 3 ± 0.5 deg/sec.

If the rates are off the limits, turn the "P_{kp}" and "P_{κ}"

("$P_{кр}$" – for bank and "P_T" – for pitch) potentiometers so that the rates

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After checking, press the autopilot "OFF" button and release the hydraulic pressure.

NOTE: After adjusting the rate of bank and pitch controlled by the pilot's control hand-grip, check as specified in paragraph III-III 4,7, 8 of the Instructions and adjust if necessary.

10. Checking the Rate of Return to Level Flight from Bank and Pitch

Set the Master Vertical Gyro in horizontal position.

Operating the control wheel, column and rudder pedals, set the ailerons, elevator and rudder in neutral position. Supply pressure to the hydraulic system. Note the position of the ailerons and the elevator. Press the autopilot "OFF" button. Deflect the M.V.G. 20° for the right bank. Press the autopilot "ON" button.

Set the M.V.G. in neutral position. Press the "RETURN TO LEVEL FLIGHT" button and simultaneously start the stop-watch. Stop the stop-watch when the ailerons stop moving. To obtain the rate of return to level flight, divide the M.V.G. deflection angle by the time. The rate should be 4 ± 1.2 deg/sec.

Perform the above check deflecting the M.V.G. for the left bank, diving and nosing up.

The rate of return to level flight from pitch should be 1.2±0.3.

If the rates are off the limits turn the "$P_{кр}$" (Bank) and "$P_{пик}$" (Diving) potentiometers so that the rates would meet the above requirements.

After checking, press the autopilot "OFF" button and release the hydraulic system pressure.

NOTE: The $\Gamma_{\text{кабр.}}$ (nose-up) potentiometer, decreasing the rate of return to level flight from nosing up, must be short circuited (fully turned clockwise).

11. Checking the "RECOVERY FROM BANK" Button Operation

Set the M.V.G. in horizontal position. Supply pressure to the hydraulic system. Press the autopilot "ON" button. Using the autopilot control grip fully deflect the control wheel for the right bank.

Set the autopilot control hand-grip in neutral position. Press the "RECOVERY FROM BANK" button, on the pilot's instrument panel, and hold it pressed. The control wheel should move towards neutral position. After the control wheel covers approximately 1/2–1/4 of the distance (to neutral position) release the "RECOVERY FROM BANK" button.

The control wheel must stop. Press the "RECOVERY FROM BANK" button again. The control wheel must move. When the control wheel stops in approximately middle position, release the "RECOVERY FROM BANK" button.

Perform a similar check, deflecting the control wheel by the autopilot control hand-grip for the left bank. Release the hydraulic system pressure.

12. Checking the Bank Angle Set by the Navigator's [illegible] Knob

Set the control surfaces in neutral position by the control wheel and rudder control pedals.

Set the M.V.G. in horizontal position. Supply pressure to the hydraulic system. Press the autopilot "ON" button.

Set the "CONTROL TRANSFER" selector switch on the control panel in the "NAVIGATOR" position. Note the ailerons position. Fully turn the navigator's turn control knob clockwise. By turning the M.V.G. for the right bank set the ailerons in the noted position.

Note the M.V.G. turn angle. Fully turn the navigator's turn control knob counterclockwise and by turning the M.V.G. for the left bank set the ailerons in the noted position.

Note the angle of the M.V.G. turn from zero position. The M.V.G. turn angle should be 20±2.5° in both cases. If the turn angles are off the limits, turn the "BANK ANGLE FROM NAVIGATOR" potentiometer so that the M.V.G. turn angles would meet the requirements.

After checking set the selector switch on the control panel in the "PILOT" position and press the autopilot "OFF" button. Release the hydraulic system pressure.

13. Checking the Altitude Compensation when Executing Turn by Autopilot Control Hand-Grip

Set the control surfaces in neutral position by the control wheel and the rudder control pedals. Supply pressure to the hydraulic system.

Press the "RETURN TO LEVEL FLIGHT" button. After 2-3 sec. press the autopilot "ON" button. Fully deflect the autopilot control hand--grip to the left. Note the amount of the elevator deflection. Fully deflect the autopilot control hand-grip to the right. The amount of the elevator deflection in one direction from the initial position should be 1.4±0.4 in both cases. If the amount of the elevator deflection is off the limits, turn the "ALTITUDE COMPENSATION" potentiometer so that this amount would meet the requirements. After checking press the autopilot "OFF" button and release the hydraulic system pressure.

14. Checking the Altitude Compensation when Executing Turn by the Navigator's Control Knob

Set the control surfaces in neutral position by the control wheel and/the rudder control pedals.

Supply pressure to the hydraulic system. Press the "RETURN TO LEVEL FLIGHT" button. After 2-3 sec. press the autopilot "ON" button.

Set the "CONTROL TRANSFER" selector switch on the control panel in the "NAVIGATOR" position. Note the elevator position. Fully turn the navigator's control knob clockwise. Determine the amount of the elevator deflection from the noted position. Fully turn the navigator's control knob counterclockwise. Again determine the amount of the elevator deflection from the noted position.

In both cases the elevator must deflect in one direction from the noted position for a value of 0.6 ± 0.3 deg.

If the amount of the elevator deflection is off the limits, turn the "KBH" potentiometer so that these value would meet the requirements. After checking set the selector switch on the control panel in the "PILOT" position. Press the autopilot "OFF" button and release the hydraulic system pressure.

15. Checking the Ratio from the Altitude Corrector

Set the control surfaces in neutral position by the control wheel, column and rudder pedals. Supply pressure to the hydraulic system. Press the autopilot "ON" button. Set the elevator in zero position by deflecting the autopilot control hand-grip for change in pitch. Press the altitude corrector button on the control panel.

Note the elevator position. Apply vacuum of 100 mm.W.C. to the altitude corrector connection. Note the elevator deflection.

Supply a pressure of 100 mm.W.C. and determine the amount of the elevator deflection in the direction opposite to the previously noted position. The elevator deflection required to make up vacuum or a pressure of 100 mm.W.C. should be 6.0° ± 0.7°.

If the elevator deflection is off the limits, turn the "BK" (altitude corrector) potentiometer so that the elevator deflection [illegible] meet the requirements.

After checking press the autopilot "OFF" button and release the [illegible]aulic system pressure.

After replacing the control unit and performing the above check [illegible] ground, it is necessary in the first flight with the autopilot [illegible], to adjust the autopilot as specified in paragraph I-III of [illegible] Instructions, steps I and IV of the instructions for a typical [illegible].

III-IV. Replacing the Master Vertical Gyro

When replacing the M.V.G., perform check and, if necessary, adjustment in bank and pitch according to paragraph III-III, 2,3,5 which [illegible] with the bank and pitch channels; after that check the sensitivity as specified in paragraph III-XVI "a". After replacing the M.V.G. and adjusting it on the ground, in the first flight adjust the return to level flight from bank by the "K" potentiometer and the return to level flight from pitch by the "T" potentiometer located on the pilot's control panel, as specified in paragraph II-III of these Instructions, step I of the instructions for a typical task.

III-V. Replacing the Rate Gyros

When replacing the rate gyros perform the check and, if necessary, adjustment as specified in paragraphs III-III 3,4,7.

III-VI. Replacing the Altitude Corrector

When replacing the altitude corrector, perform the check and, if necessary, adjustment as specified in paragraphs III-III 3,15.

III-VII. Replacing the Autopilot Control Hand-Grip

When replacing the autopilot control hand-grip check as specified in paragraph III-III, 3.

III-VIII. Replacing the Navigator's Turn Control Knob

When replacing the navigator's turn control knob, check as specified in paragraph III-III, 3.

III-IX. Replacing the Control Panel

When replacing the control panel, perform the ground check and, if necessary, the following adjustment:

a) as specified in paragraph III-III, 6 of these Instructions;

b) besides, perform the ground centering of the "K" and "T" potentiometers, located on the control panel, as follows: in the synchronizing mode (the "READY" amber light on the control panel glows) set the ailerons, elevator and rudder in neutral position by the control wheel, column and pedals.

Supply pressure to the hydraulic system. Press the "RETURN TO LEVEL FLIGHT" button. Using the "K" and "T" potentiometers on the control panel, set the control surfaces in neutral position.

c) Then, in the first flight adjust the centering by the "K" and "T" potentiometers in the "RETURN TO LEVEL FLIGHT" condition and eliminate slipping during a turn by the "H" potentiometer on the control panel as specified in paragraph II-III of these Instructions, steps I and IV of the instructions for a typical task.

III-X. Replacing the BK-53PB Erecting Cut-Out Switch and Inverter

When replacing the BK-53PB erecting cut-out switch, special check and adjustment are not required.

III-XI. Replacing the [illegible] Compass Gyro Unit

When replacing the gyro unit, check it as specified in paragraphs III-III,3,5 which deal with the direction channel.

III-XII. Replacing the Servo Units

When replacing the servo unit in one of the autopilot channels, measure the forces of the newly-installed servo unit as follows:

To measure the servo units forces, use the devices 6362/405 and 6362/407 included in the test equipment set. It is permitted to use the dynamometrical pedals and control wheel.

a) Forces of Ailerons Servo Unit

1. Set the control wheel in neutral position.

2. Attach the dynamometer to the pilot's control wheel in accordance with dwg. No.1.

NOTE: Place the dynamometer so that a force applied to it would act along the tangent to the control wheel circumference.

3. Engage the autopilot and deflect the autopilot control hand-grip for the left bank and release it after the control wheel stops moving.

4. Apply a manual force to the control wheel in the same direction increasing the dynamometer readings by 15-20 kg., after that smoothly release the force applied to the control wheel, trying to preserve the dynamometer maximum readings.

5. Manually deflect the control wheel in the opposite direction, having overriden the servo unit action and smoothly release the force applied, trying to preserve the minimum readings of the dynamometer.

Note and record the dynamometer reading. A half-sum of the measured values should be 13.5 ± 2 kg.

6. Disengage the autopilot.

b) Forces of Elevator Servo Unit

1. Set the control column in neutral position.

2. Attach the dynamometer to the control column according to dwg. No.2 so as to measure the forces at a distance of 900 mm. from the control column rocking centre.

3. Engage the autopilot and deflect the autopilot control hand-grip for diving; release it when the control column stops moving.

4. Apply a manual force to the control column in the same direction, increasing the dynamometer readings by 15-20 kg., after that smoothly release the applied force, trying to preserve the maximum reading of the dynamometer. Note and record the dynamometer final reading.

5. Manually deflect the control column in the opposite direction having overridden the servo unit action, and smoothly release the force applied, trying to preserve the minimum reading of the dynamometer. Note and record the dynamometer reading.

6. A half-sum of the measured values in steps 4 and 5 should be 19 ± 3 kg.

7. Disengage the autopilot.

c) Forces of Rudder Servo Unit

1. Set the rudder control pedals in neutral position.

2. Attach the dynamometer to the right pedal, according to dwg.No.3 through the lightening hole in the pedal bracket.

<u>NOTE</u>: Place the dynamometer so that a force applied to it would act along the tangent to the pedals movement arc.

3. Engage the autopilot. By deflecting the ГМК-I gyro flux-gate compass simulator or the flux-gate detector, move the right pedal fully forward.

4. Apply forces to the pedals in the same direction increasing the dynamometer reading by 15-20 kg., after that smoothly remove the applied forces, trying to preserve the maximum reading of the dynamometer. Note and record the dynamometer reading.

5. Move the pedals in opposite direction overriding the servo unit action and smoothly release the forces applied, trying to preserve the dynamometer minimum reading.

6. Disengage the autopilot.

7. Attach the dynamometer to the left pedal.

8. Engage the autopilot and make measurements as specified above.

NOTE: Repeat each measurement for all channels two or three times and determine the average value. When working in the open, make measurements under still air conditions.

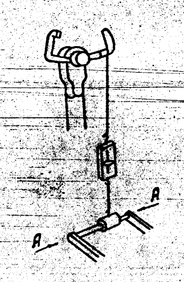
9. A half-sum of the measured values should be 16 ± 5 kg. in both cases.

After checking the servo units forces, adjust the gain factor as specified in paragraphs III-III, "b", "c", of these Instructions; after that check the sensitivity of the channel with the unit replaced as specified in paragraph III-XVI of these Instructions.

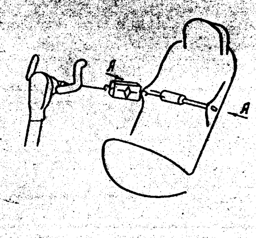
III-XIII. Replacing the Feedback Transmitters

When replacing the feedback transmitters, connect the УШ (63689/025 unit to the control unit) "A" and "Д" plug connectors and set the "A4" milliammeter pointer at zero by turning the feedback transmitter. In this case the rudder must be in neutral position.

When measuring, place the dynamometer along the tangent to the control wheel circumference. Secure the "AA" rod in the seat rails.



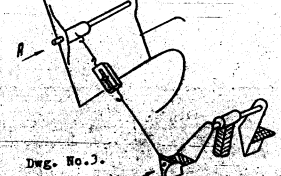
Dwg. No.1.



Dwg. No.2.

Set the dynamometer perpendicular to the control wheel. Secure the "AA" rod in the seat arm-rests brackets.

Place the dynamometer along the tangent to the pedal movement arc. Secure the "AA" rod in the seat arm-rests brackets, attach the dynamometer to the rod and to the pedal lightening hole.



Dwg. No.3.

Pedal lightening hole

When replacing the feedback transmitter, perform check in one of the autopilot channels as specified in paragraph III-III, 5a and 7, (Do not adjust the servo gain factor).

Besides, perform the following checks and adjustments:

1. When replacing the bank or pitch feedback transmitter, check and adjust them as specified in paragraph III-IX "b" for the channel with the feedback transmitter replaced.

Next, in the first flight adjust the channels to be checked in the "RETURN TO LEVEL FLIGHT" condition as specified in paragraph II-III of these Instructions, step I of the instructions for a typical task.

2. When replacing the feedback transmitter of the direction channel, perform the ground check and, if necessary, the adjustment according to paragraph III-III, 6, of these Instructions.

Next, in the first flight perform the adjustment to eliminate slipping as specified in paragraph II-III of these Instructions, step IV of the instructions for a typical task.

III-XIV. Replacing the Vibrator

When replacing the vibrator set the ailerons, elevator and rudder in neutral position by the control wheel, column and pedals. Supply pressure to the hydraulic system. Press the autopilot "ON" button.

The ailerons, elevator and rudder should vibrate at a frequency of 2.7 ± 0.3 c.p.s., the double amplitude of the control surfaces vibration should be $0.1-0.3^{\circ}$. If the vibration frequency is off the limits, adjust the frequency to the required value by the "FREQUENCY" potentiometer.

If the double amplitude of any control surface vibration is off the limits, obtain the required value of the double amplitude by the "AMPLITUDE" potentiometers (K - for ailerons, T - for elevator, H - for rudder).

After checking press the autopilot "OFF" button and release the hydraulic system pressure.

III-XV. Replacing the Control Unit Electronic Valves

When replacing the electronic valves in the control unit, adjust the gain factor of the channel with the valve replaced as specified in paragraph III-III, 5 "b" or "c", of these Instructions and check the autopilot for reliable operation. Set the control wheel, column and pedals in approximately middle position. Supply pressure to the hydraulic system. Press the "RETURN TO LEVEL FLIGHT" button.

Press the autopilot "ON" button. Deflect the [illegible] compass gyro unit clockwise and counterclockwise. The rudder must move in both directions.

Deflect the autopilot control hand-grip for the right and left bank. The ailerons should move in both directions. Deflect the autopilot control hand-grip for diving and nosing up. The elevator must move in both directions.

After checking disengage the autopilot by pressing the "OFF" button and release the hydraulic system pressure.

III-XVI. Checking the Sensitivity after Replacing the M.V.G. or Servo Units

a) Checking the sensitivity in bank and pitch.

Remove the M.V.G. from the aircraft, having noted its position. Place the M.V.G. on a turn table in accordance with paragraph II-III, 4, and connect it to the system by a lengthening wire harness.

Switch on the switches and circuit breakers required for the autopilot operation. Switch on the servo units switches. Switch on the

"POWER" switch on the control panel. Supply pressure to the hydraulic system. After the "READY" amber light on the control panel comes on press the "RETURN TO LEVEL FLIGHT" button.

Deflecting the M.V.G. in both directions about the axis of the channel being ~~checked~~, see when the controls start moving. Note the angles at which the controls start moving in both directions. The difference between these angles should not exceed 0.5°. Press the autopilot "OFF" button. Install the M.V.G. in the aircraft in the noted position.

b) Checking the sensitivity in direction channel.

Remove the [illegible] compass gyro unit from the aircraft and place it on the turn table.

Switch on the switches required for the autopilot operation. Switch on the servo units switch. Switch on the "POWER" switch located on the control panel.

Supply pressure to the hydraulic system. After the "READY" amber light on the control panel comes on press the "RETURN TO LEVEL FLIGHT" button. Deflecting the [illegible] compass gyro unit clockwise and counter-clockwise, note the beginning of the control pedals movement in both directions. Note the angles at which the pedals begin moving in both directions. The difference between these angles must not exceed 1°. Disengage the autopilot by pressing the "OFF" button. Cut off the hydraulic system. Switch off the switches, switched on for the autopilot operation.

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IIB-23Y GUN ARMAMENT SYSTEM MAINTENANCE

AND

OPERATING INSTRUCTIONS

[redacted]

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IIB-237 (9-A-299) GUN ARMAMENT SYSTEM

MAINTENANCE AND OPERATING INSTRUCTIONS

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ПВ-23У(9-А-299) GUN ARMAMENT SYSTEM MAINTENANCE AND OPERATING INSTRUCTIONS

PREFACE

These instructions are intended for technical personnel and gunners responsible for the maintenance of the ПВ-23У gun system. They deal with:

- system maintenance on the ground and in flight;
- preparation of the system for carrying out combat and training tasks;
- use of the system in air combat;
- remedying of the units malfunctioning caused in operation.

Before studying the instrutions, make the acquaintance of the ПВ-23У system design and operation by the Technical Description and study the Instructions on Operation of the AM-23 gun, КПС-53А sighting set, ВБ-257-I computing unit and "Gamma"542" range finder radar.

Bear in mind, that it is mandatory to fill in the certificates for the units incorporated in the gun system. Otherwise operations on accomplishment of the instructions requirements cannot be taken into account.

WARNING:

The turret reliably operates only in case of proper operation, thorough and periodic maintenance of the turret units and accessories according to the instructions requirements.

Use lubricant indicated in the instructions.

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When operating the turret, use the aircraft tools only.

Study the Technical Description and the Maintenance and Operating Instructions and only then operate the turret.

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SECTION I

GUN ARMAMENT SYSTEM MAINTENANCE

1. PRESERVATION AND DEPRESERVATION OF TURRET

The turret to be subjected for the extended storage (for more than a month) should be preserved. Preserve all the external parts except those covered with varnish coating.

Preservation consists in coating of the external unprotected parts with corrosion-preventive coating. When lubricating use neutral waterless vaseline, ГОСТ 782-59.

All the parts to be preserved should be preliminarily cleaned from dirt and oil by wiping them with a cloth dampened in waterless kerosene and dried for 10-20 minutes.

NOTE: Do not touch the places deprived of oil with bare hands.

Cover the surface with a thin layer of corrosion-preventive lubricant by a brush.

Wrap the places preserved with oil paper and tie with a string.

After 6 months of storage inspect the turret and renew the preventive coating if necessary. When depreserving the turret remove lubricant with a cloth dampened in waterless kerosene, then wipe the places cleaned from lubricant with a dry cloth till kerosene is completely removed and cover the working surfaces with lubricant No.9.

NOTE: When depreserving the turret prevent waterless kerosene from getting on the bundles of electric wires, pneumatic hoses and electric units.

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2. REMOVING AND INSTALLING OF TURRET GUNS

WARNING: Do not install the guns till the latter are discharged. Do not recharge with the guns removed as such rechargings may cause jamming of the junction valve piston.

A. REMOVING TURRET GUNS

1. Switch off the "UNIT" and "FIRE" safety switches located on the left side of the turret attachment frame.

2. Manually unlock the elevation mechanism friction clutch and set the gun in azimuth.

WARNING: When removing guns turn the turret down at an angle of 5-10 deg.

3. Manually unlock the azimuth mechanism friction clutch. Turn the turret fully to the left stop, unfasten the locks of the right housing with a special wrench, using the hook open in the upper section the lock, connecting the right and left parts of the housing and remove the housing right portion. Turn the turret in the opposite direction, unfasten the locks of the left housing and remove the latter.

Disconnect internal flexible hoses.

WARNING: When turning the turret manually, do not strike the stops to protect them from damage.

4. After firing, check that the guns are discharged; to do this open the gun covers and make sure that there are no cartridges in the ammunition containers.

5. Disconnect the gun electric plug connectors.

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WARNING: Do not disconnect electric plug connectors of the gun with the "AUX." switch on the SH-54M aux. panel On.

6. Disconnect the internal flexible hose and hang it on the cable. Unfasten the locks of the throat and remove the latter from the turret. At the same time remove the cartridge belt from the throat.

Pull the latch of the ejection chute sleeve movable shutter; after that open the shutter down.

7. Release the gun front attachment; to do that, remove the pin and turn the front attachment lever to the horizontal position and then to the barrel side.

8. Move the gun in the direction of the barrel till the rigid fork is disengaged, lower the gun slightly and move it away from the carriage till the pneumatic cylinder adapter leaves the turret pneumatic coupling valve, take the gun out of the rear attachment guides by moving the gun in the direction of the barrel and then remove the gun from the turret.

Remove the second gun in the same manner.

WARNING: Do not place the gun on the link ejection chute. Put the gun removed in the vertical position, or place it in a special box so that the link ejection chute is not loaded by the gun weight.

9. Inspect, clean and prepare the gun for firing according to the Operating Instructions.

B. INSTALLING TURRET GUNS

1. The guns should be prepared for firing according to the Operating Instructions.

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NOTE: a) the guns ammunition supply (right and left) should correspond to their position on the turret;

b) the front attachment rigid forks should be secured behind the carriage; do not change the forks position from one side of the carriage to the other.

2. Install the link ejection chute, the gun feed-block frame and front attachment fork on the gun.

3. Install the pneumatic adapter on the gun cylinder.

4. Set the turret in the middle position in azimuth and lower it 5-10 deg. in elevation.

WARNING: With the guns removed do not rotate the turret by the attachment bracket of the right, upper shutter.

5. Place the gun in the rear guides and move it back so that the rigid fork slots (when moving up and forward) enter the front attachment.

NOTE: Install the slides of the guns rear attachment unit so that the pointers on the slides indicate the direction of fire.

6. Using a special screwdriver remove plug by screwing the plug stop screw.

After turning the stop screw till it contacts the [illegible] trunnion end the screw should be unscrewed 1/4 of a turn.

7. Fasten the lock of the front attachment unit and install the pin.

8. Close the movable shutter, install the throat and latch the locks.

9. Connect the guns plug connectors and attach the right bundle of electric wires in the clips installed on the turret and on the [illegible]

right lower shutter, left bundle - in the clip installed on the throat; see that the length of the bundle section from the trigger unit to the clip is 250-300 mm.

10. Connect internal flexible sleeves; install the housing and latch the locks.

3. TURRET OPERATION CHECK

The turret operation check consists in checking the operation of all the turret units.

When operating the turret, use the power source of 27 V, d.c. $\pm$10%, 115 V. a.c. $\pm$4%, 400 c.p.s.$^{+40}_{-20}$ c.p.s. and three-phase a.c. of 36 V $\pm$10%, 400 c.p.s. $\pm$5%.

A. REDUCTION GEAR OPERATION CHECK

1. Manually check the gun movement in elevation and turret azimuth rotation within the entire range.

Check with the solenoid clutches of the elevation and azimuth drive electric motors disengaged.

2. When rotating the gun manually the reduction gears should operate smoothly without jerks and knocks.

NOTE: The turret starting torque at a temperature of $+20^\circ \pm 5^\circ$C should not exceed 40 kgm in elevation and 45 kgm - in azimuth.

3. After checking the reduction gear, lock the solenoid clutches of the drive electric motors.

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B. FEED SYSTEM ELEMENTS AND LINK AND CASE EJECTION SYSTEM CHECK

1. Check the ammunition belt motion along the entire feed line by pulling the ammunition belt of 15-20 cartridges; the ammunition belt should move along all the sleeves without seizing.

2. With the gun feed-block cover closed check the links motion along the ejection chute passage by pulling 3-5 links; the links should move freely without seizing with a force of not more than 9 kg.

3. Check the feed line elements and case-and-link ejection chute for security of attachment.

WARNING: When rotating the turret manually with flexible sleeves folded on the cables, the flexible sleeves links may overlap each other.
When setting the sleeves into operating position eliminate the links overlapping.

C. AMMUNITION BOOSTER ACTUATORS CHECK

1. Switch on the aux. circuit switch on the БП-54М aux. control panel and check the ammunition boosters switching from the button on the КЭП-4 ammunition booster box.

2. Check current with the ammunition booster friction clutch sliding; to do this:

a) unscrew the Ш2 plug connector on the КЭП-4 box and connect the КП-ДК-7 unit between the plug and socket;

b) lock the sprocket of the ammunition booster checked by a wooden wedge;

c) switch on the switch located on the КЭП-4 box corresponding to the ammunition booster checked and switch off the other switch on the КЭП-4 box.

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d) press the button on the КЭП-4 box and check current in the ammunition booster motor armature;

e) adjust the ammunition boosters sliding current by pressing the spring washer by the nut till a definite value of current is obtained. After adjusting, cotterpin the nut, to ensure alignment of the hole in the ammunition booster axle and slot in the nut place the washer of a required thickness between the ammunition booster bushing and nut.

Current during the ammunition booster friction clutch sliding should be:

for rear (far from guns) ammunition boosters .... 25-28 a

for front (near the guns) ammunition boosters........ 24-26 a

3. Switch off the switches on one side of both ammunition boosters on КЭП-4 box; switch on the switches on the other side of both ammunition boosters and check them as the first ones.

NOTE: Terms of checking the ammunition boosters sliding currents are given in section VII, para.3 step "b".

4. After checking switch on four switches on the КЭП-4 box and connect bundles to the Ш2 plug connector on the КЭП-4 box.

WARNING: If the switches on the КЭП-4 box are not switched on the ground it may cause jamming when firing in air.

5. Switch on the switch in the КУК-543 control box and check the ammunition boosters actuation from the boosters switching button located near the turret.

D. PNEUMATIC SYSTEM CHECK

1. Before checking the system make sure the system is under pressure of 65±3 kg./cm^2.

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2. Check the alignment of the non-spill coupling piston and adapter of the gun pneumatic cylinder connection by the mark on the non-spill coupling rubber ring after recharging.

To obtain a clear mark non-spill coupling rubber ring is painted. In this case of misalignment of the valve piston, adjustment is performed by moving the non-spill coupling attachment bracket (after removing the pin from the coupling) on account of oval attachment holes. Additional adjustment is performed by placing distance grommets under the non-spill coupling attachment bracket. Misalignment of the non--spill coupling and adapter should not exceed 1 mm. After adjustment secure the non-spill coupling attachment bracket with the 4Ш 1,5x12 pin, secure the bracket attachment screws and screws for attaching the adapter with a wire. With the change in the pin and hole dimensions use a spare pin and another hole on the bracket.

NOTE: Check the alignment during replacement of the guns and non-spill coupling. When installing the adapters pay attention to the inscriptions "right", "left".

3. Inspect all the pneumatic connections, non-spill coupling plunger; replace the non-spill coupling piston if the plunger sealing rubber ring is projecting.

4. In case of air leakage, find the place of leaking and remedy the leaks in the pneumatic system by tightening the coupling nuts.

5. After expiration of the half of the service life but not less than once a year, drain sediment from the pneumatic system bottle. To do this, remove the bottle from the system. After sediment is drained, install the bottle in the system and check the bottle-to--pipes joints for leakage.

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4. REMOTE CONTROL SYSTEM OPERATION CHECK

WARNING: Before checking the turret control system, inspect the turret and check the guns to see that they are not charged, check the chutes, link ejection chutes and other elements connections to prevent them from damaging during the turret movement. When turning the turret with the left gun removed pay attention to the pneumatic hose position (the latter should not overlap the rear attachment pipe).

A. GENERAL INSTRUCTIONS

1. During ground testing, use the power source of 27 V.d.c.±10% not less than 5 kw.

To prevent the contactors, actuating the БА-3Ц motor-generator unit, from damaging see that during the БА-3Ц motor-generator unit starting voltage at the КУА-54В control box inlet does not reduce below 20 V.

2. Before checking make sure by the instruments that the aircraft system is energized with direct and alternating current.

3. The turret control system should be inspected by two persons. One should be at the sighting set and should control the turret, the other should inspect the turret and inform the first about the turret movement by signals or through the interphone system.

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B. TURRET MOTION CONTROL SYSTEM CHECK

To check the control system, switch on the switches "AUX". "A.C." and "UNIT" on the ПУ-54М control panel, Check to see that with the "UNIT" switch On the БА-2К motor -generator unit is not started. After checking, switch on the "UNIT" safety switch lo_cated on the left side of the turret attachment frame.

1. TURRET AND SIGHTING SET ALIGNMENT CHECK

Press the actuating lever on the sighting set and check alignment of the turret and sighting set motion by turning the sight to the right, to the left, up and down.

2. GUN SETTING ON LIMIT SWITCHES CHECK

Slowly rotating the sight, turn the turret to the extreme position, moving it by turns to every stop and make sure the turret stops on the stop. In this case the motor-generator speed should not reduce considerably which is determined by ear. When moving the sight back to the working position make sure the turret moves away from the stop smoothly.

NOTE: Do not strike against the stops if unnecessary.

3. ELECTRODYNAMIC BRAKING SYSTEM OPERATION CHECK

Rotating the sight at a speed of 20 deg./sec. strike each stop of the turret 3-5 times. In this case after actuation of the limit switch the turret speed is reduced without sharp impact against the stops.

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4. STOWED POSITION CIRCUITS CHECK

Turn the turret in any position using the sight; after this release the actuating lever on the sighting set.

The turret should be automatically set in the stowed position in which the gun is directed along the aircraft C.L. with deviation from zero position of not more than 4 deg. both in azimuth and elevation. The turret should be locked in the stowed position by electric motor solenoid clutches.

5. TURRET LOCKING CHECK

After switching off the motor-generator unit, check the turret locking by trying to turn the turret manually (pushing the guns) in azimuth and elevation. The turret should not move.

6. STATIC ERROR ANGLES CHECK

1. To measure the static error angles, use [illegible] voltmeter and test plug connector of the [illegible] control box.

2. To check the error angles switch on the system and press the actuating lever of the sighting set.

3. By adjusting the sighting set place the turret in 5-10 positions evenly spaced in the firing zone. In each position measure the electrical static error angles by the voltmeter.

4. To determine the static error angle in elevation switch on the ZB-1 voltmeter in jacks 6 and 7 and, in azimuth - in jacks 4 and 7 of the [illegible]-54B control box test plug connector.

The static electrical error angle should be not more than ±25V.

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5. Gun self-oscillations are permitted but in this case the error angle should not exceed 2 V.

7. SETTING CURRENTS CHECK

To check the setting currents, proceed as follows: connect the bundle CC 1 to the plug connector of MY-550TY azimuth electric motor and KH-AK-7 unit. Set the guns on the limit switch and check azimuth setting current by the KH-AK7 unit. Check the elevation setting current in the same manner.

Setting current should be within 12-16 a.

Setting current is adjusted by means of A9 variable resistors in azimuth and A10 resistors - in elevation; the resistors are installed in the KVK-54B control box.

To adjust current open the "SETTING CURRENT ADJUST." cover, remove the safety spring from the screw, by rotating the resistor screw with the screwdriver, move the slider till the definite value of setting current is obtained.

After adjusting, install the safety spring on the screw and close the "setting current adjust" cover.

C. FIRING AND RECHARGING CIRCUITS CHECK

WARNING: Before checking the firing circuits make sure the gun and turret chutes are free from ammunition.

1. Switch on the "FIRE" safety switch located on the left side of the turret attachment frame.

2. Switch on the aux. circuits switch on the PT-54M aux. panel.

3. Recharge in turn each gun; to do this press in turn the

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the "RECHARGING" buttons on the OH-54T main control panel.

4. Switch on the switches "ALTERNATING CURRENT", "UNIT" and "FIRE" on the control panels.

5. Press the sighting set actuating lever and direct the guns barrels in the safe direction by rotating the sight.

6. Press the firing trigger and keep it so - two double rechargings with ammunition boosters energizing should occur.

7. After the recharging are accomplished press several times the trigger and check each gun firing solenoid actuation; in this case the "FIRE" warning light located on the aux. panel should be illuminated.

8. Set the turret in turn on each stop. At the stop the fire control circuit should be automatically de-energized. (The "FIRE" light on the aux. panel goes out).

9. Check the fire interrupters operation; to do this, press the actuating lever and trigger and continuously move the sighting set preventing alignment of the turret and the sight; in this case the "FIRE" warning light on the aux. panel should be out.

Stop the sight. After the turret is set in the aligned position the "FIRE" light on the aux. panel should come on.

10. Switch off the "FIRE" safety switch located on the left side of the turret attachment frame and check, as shown above, to see that the guns firing units are de-energized. After checking switch on the "FIRE" safety switch.

D. CAMERA GUN CIRCUITS CHECK

1. Switch on the camera gun switch.

2. Press the fire control button on the sighting set with the

system alive. In this case the camera gun electric motor should operate which is determined by ear and the warning light of the camera gun should on if it is charged.

[illegible]. COMPUTER AND SIGHTING SET CHECK

1. Switch on the switches "A.C." and "COMPUTER" on the [illegible] panel and set the "[illegible]-ATTACK" switch into the "ATTACK" position. Set on the [illegible]-257-I speed and density transmitter and ATS-157 charge temperature transmitter the adjustment values indicated in the check table of the certificate for the computer.

Set on the sighting set by the knob the range shown in the table. Press the actuating lever and moving the sight in azimuth and elevation, as indicated in the check table given in the certificate for the ASB-257-1 unit, check the automatic air firing unit operation using the dials.

2. To check the corrections for angular velocity introduced by the gyro relay, switch on the panels the switches "AIR.CURRENT." "UNITS", "COMPUTER" and computer switch on the sight. Press the actuating lever, turn the sight at a speed of 10-20 deg./sec. and then stop the sight. With the gyro relay operating properly, the turret should pass the aligned position

Then read the correction in the direction opposite to the sight motion.

3. By switching on and off the computer switch on the sighting set, check with the turret in different positions for proper direction of the correction introduced by the computer. The correction is adjusted to the sighting station deviation.

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4. By rotating the base lever on the sight check the base installation operation.

5. Check the lighting lamp filament by turning the rheostat knob.

6. By rotating the range knob on the sight check the operation of the sight framing grid.

F. "GAMMA 54T" RANGE FINDER RADAR CHECK

1. Check the units and connecting cables for freedom from external damage.

Check condition of the antenna-feeder system; check the caps on the matching transformer and measuring connector of the directional coupler for secure tightening.

Check the antenna for security of attachment.

2. Check condition of the silica-gel in the dehydrator installed at the feeder pressurization connection; the selica-gel colour is to be blue. If the selica-gel is brown, dry it according to the instructions applied to the dehydrator or replace it.

3. Check unit No.1 for air tigatness; to do this, pump unit No.1 up to a pressure of 1.0 atm. through the "EXTERN. PRESSURIZING" connection. Pressure is checked by the pressure gauge connected to the lower valve on the cover of unit No.1.

The unit is sufficiently airtight if the pressure gauge readings remain unchangeable for 15 min.

4. Pump unit No.1 up to a pressure determined in accordance with the ambient air temperature (See Table VI "OPERATION INSTRUCTIONS ON "GAMMA-54T" RANGE FINDER RADAR").

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After pumping screw tightly the plug on the "EXT.PRESSURIZING" connection, remove the pressure gauge and install the plug on the valve.

5. Connect the C-9 test unit to the range finder radar by connecting through the cable the MP-301 plug connector of the test unit to the MP $\frac{801}{901}$ plug connector of the junction box.

6. Connect the power supply source of 27 V d.c. ±10% and 115 V ±4% a.c., 400 c.p.s. $^{+7}_{-5}$%.

7. Switch on the "GAMMA" and "TRANSMITTER" toggle switches located on the БИ-54М auxiliary panel; in this case the green light on the КПС-53А sight and light of unit No.3. adapter may be illuminated (for 15-20 sec. after switching).

Approximately after 3 min. the warning light indicating that the range finder radar is ready for operation comes on; the warning light is located on the ОП-54Т main control panel.

8. Check by the C-9 test unit the values of voltages (115 V (400 c.p.s.); +27 V; +250 V; +150 V; -150 V); check crystal and heterodyne current (the normal value of crystal and heterodyne current is determined 10-15 minutes after the range finder radar is switched on).

Check the value of the transmitter current after switching on the "TRANSMITTER" toggle switch located on the C-9 unit.

(The values of the crystal and heterodyne currents should be within the limits indicated on the C-9 unit dial and heterodyne current should be 17-23 ma).

9. Remove the protective cover from the antenna. With the range finder radar operating a reflected pulse from one of the neighbouring objects should be received by the range finder radar, which is indicated by illumination of the green light on the КПС-53А sight.

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If the range does not exceed 1900 m. the red light on the ПКС-53А sight also comes on.

If locking is not obtained, turn the turret till it is obtained.

When locking on the targer at a distance exceeding 1900 m. a continuous signal of 400 c.p.s. tone is heard in the intercommunication system; if the distance to the target is less than 1900 m. an intermittent signal is heard.

The distance to the target locked is determined by the C-9 unit dial or by unit No.3 adapter dial (for target situated at a distance of not more than 2000 m.).

10. Abruptly press "NEAREST TARGET" and "DISTANT TARGET" switches located on the СП-54Т panel and set the range finder radar for locking the nearer or more distant target.

Check to see that the warning lights located on the ПКС-53А sight come on properly and signal in the intercommunication system is sent properly.

11. Switch off the "TRANSMITTER" and "GAMMA" toggle switches located on the СП-54М aux. panel.

If the flight is delayd for more than 30 min. due to ice crust or excessive dust put the protective cover on the natennae.

Remove the cover from the antennae directly before the flight.

5. LOADING AND UNLOADING AMMUNITION BOXES, CHARGING AND DISCHARGING THE GUNS

a) Loading Ammunition

1. Open the ammunition box cover.

2. Load the required number of cartridge, in the ammunition box according to the diagram of loading and number of cartridges indicated on the ammunition wall.

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WARNING: When loading the ammunition belt the cartridges should not be doubled or trebled.

3. Close the ammunition box cover.

4. Before pulling the ammunition belt along the rigid and flexible chutes, remove the housing from the turret.

5. Draw the ammunition belt using the hook for inserting the belt and puller ОД-I-II/Н-НБ-23? along the rigid and flexible chutes to the gun feed-block in the direction of the belt movement.

NOTES:

1. To pull the ammunition belt through the ammunition boosters (two per gun), place 1 or 2 cartridges under the booster sprocket, and, having switched on the auxiliary circuit switch on the ЛГ-54Н auxiliary control panel, the switch on the ЛГ-54В control box and ammunition booster switches located on the РЗП-4 ammunition booster box, press the ammunition booster button which is near the turret. To facilitate the belt movement, use the hook.
2. When loading the turret, mark the last link of the belt with red paint and after firing the ammunition set withdraw the last link from further use.
3. When loading the ammunition, thoroughly check that the cartridges are properly inserted in the belt.

Load the ammunition for the other gun in a similar way.

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B. CHARGING THE GUNS

1. Open the gun cover and the gun feed-block cover.

2. Draw the ammunition belt from the rigid chutes into the gun feed-back, placing the belt beyond the delivering pins.

3. Close the gun feed-block cover and the gun cover.

Charge the other gun in a similar way.

C. DISCHARGING THE GUNS

CAUTION: When discharging the gun, be careful and warn the personnel of the gun discharging procedure.

1. Remove the housing. If the ammunition set is fully fired, and the guns moving parts are in the front position, open the gun covers to make sure that the gun barrels and feed-blocks are free from cartridges.

NOTES: a) The number of rounds is determined by the cartridge counter, installed on the UH-34T main control panel and by the number of cartridges in the flexible and rigid chutes and ammunition boxes.

b) With the gun moving parts in the front position, the red lights on the UH-34T panel should be illuminated.

If the ammunition set is not completely fired and the gun moving parts are in the front position, proceed as follows:

a) Open the gun cover, release the links from the ammunition belt not completely fired, remove the link from the link chutes, place the belt in the rigid ammunition chute and close the gun cover.

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b) Move the gun moving parts to the rear position by hand, using recuperator and remove the cartridge or recharge the gun, if the pneumatic system is under pressure.

c) Set the gun moving parts in the front position if they were moved backward by hand.

d) Discharge the other gun in a similar way.

In case of fire stoppage, discharge the gun as follows:

Insert the gun moving parts recuperator through the hole in the gun butt and move the gun moving parts by the recuperator back to the position required for eliminating the fire stoppage, after that eliminate the stoppage.

NOTE: If the recuperator cannot be inserted, turn the turret in order to insert it, having ensured that the gun barrels are directed to a safe place.

D. UNLOADING UNFIRED AMMUNITION SET

1. Open the gun covers and the gun feed-block covers.
2. Disconnect the flexible chute from the turret lower throat.
3. Remove the ammunition belt from the turret throats.
4. Remove the ammunition belt from the flexible and rigid chutes and from ammunition boxes; to facilitate their removal, switch on the ammunition boosters.

CAUTION: Never pull the ammunition belt from the flexible and rigid chutes back into the ammunition box.

5. Close the gun feed-block covers, connect the flexible ammunition chutes to the throats and install the screen.

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6. CLEANING, INSPECTION AND LUBRICATION OF TURRET ASSEMBLIES AND UNITS

a) In operation clean and lubricate the turret after each flight but not less than twice a month.

Remove dirt, dust and burning with clean dry rags and then wash the parts with dehydrated kerosene.

To do this, use rags or a brush dampened with kerosene. After washing, wipe all the structural elements of the turret with dry clean rags until the kerosene is completely removed.

CAUTION: When cleaning the turret, prevent kerosene from getting on the bundles of wires, electric motors, selsyns and other electric units; after cleaning thoroughly inspect the turret.

b) Examine all the parts and assemblies of the turret for freedom from cracks and other damage.

Check the bolted, screw and rivet joints, lockings and seals of the parts and assemblies for presence and condition. Check the condition of the corrosion-preventive coating, particular attention should be given to units and parts made of magnesium alloy especially in places of their contact with the moving and removable parts.

Repair the varnish coating as specified in paragraph 11, Section I.

c) Examine the flexible ammunition chutes.

d) Examine the ammunition boxes, feed lines and link and case chutes for freedom from burrs, scores and dents. Check the shutters of the link and case ejection chutes on the gun mount and the case ejection chutes tongues for condition. There should be no jamming. The link and case ejection chute tongue should overlap the link and case ejector wall not less than 10 mm.

Perform the check, with the gun in the extreme lower position

e) Check the mechanisms, motors, selsyns front and rear gun attachment fittings, rigid chutes, swinging throats, case ejectors, stops, limit switches and other units and assemblies for security of attachment on the turret.

f) Using a plug connector wrench, check the plug connectors for reliable connection.

g) In case of considerable leakage (exceeding [illegible] atm./hr.) check the hoses joints using soap solution. Eliminate leakage through the pipeline joints by tightening the coupling units.

Immediately remedy all the defects detected in accordance with the given instructions.

After inspection of the turret and elimination of the defects lubricate:

1. With a thin coating of lubricant No.9 ([illegible] -53) the operating surfaces of the turret structural elements:

a) drives output gears and toothed sectors;

b) guides of the rear and front attachment fittings;

c) ammunition feed lines (rigid chutes, flexible chutes, chute throats, inner surfaces of case and link ejection chutes).

NOTE: It is permitted to coat the ammunition feed lines (rigid chutes, flexible chutes, chute throats, and case and link ejection chutes inner surfaces) with [illegible] lubricant.

2. Cover with a thin coating of lubricant No.9([illegible] -53) all the accessible places of bolts, screws and nuts, zink-plated, cadmium-plated and blue steel parts. Lubricate the above parts not less than once every six months.

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3. To prevent from carbon deposit, apply a thick coating of lubricant No.9 ([illegible]-53)to the non-operating surfaces of the turret units and parts located close to the guns: guides of case and link ejection chutes, frames installed on the gun feed-block, front and rear attachment fittings, gun carriage on the side of the guns (especially in the front part); link pullers, the inside of the upper shutters, the lower shutters on the side of the guns, the housing from the inside in the area of the gun-port and in the rear part.

4. For further operation of the system after expiration of the guaranteed service life replenish the lubricant of the carriage and frame turret rings, using a syringe. To replenish lubricant of the carriage turret ring, proceed as follows: unlock and remove the plug from the hole for lubrication located in the right upper part of the frame; fully moving the turret in elevation, syringe OKB-122-7 lubricant into the turret ring through the hole in the frame. For uniform distribution of lubricant in the ring, manually move the turret to the stops for 3-5 min.

NOTE: The hole in frame for replenishing lubricant of the gun-mount turret ring was introduced in April 1960.

To replenish lubricant of the frame turret ring, remove the plug of the hole for filling the balls, which is located on the left side of the frame horizontal part; manually rotating the turret in azimuth to the stops, syringe OKB-122-7 lubricant into the turret through the hole for the balls filling.

To ensure uniform distribution of lubricant in the ring, manually rotate the turret in azimuth to the stops for 3-5 min.

NOTE: 1-1.5 syringe containing 100-150 cm^3 of lubricant is used per turret ring. When rotating the turret, do not strike the stops.

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7. REPAIR OF BOLTED AND SCREW JOINTS AND THEIR LOCKING

Immediately repair all the defective bolted and screw joints (worn and scored thread, scores on edges and splines, self-unscrewing of bolts, screws and nuts).

Replace bolts, screws and nuts with damaged thread, edges and splines with new ones.

Reliably secure and lock the newly-installed bolts, screws and nuts. Tighten and securely lock self-unscrewed screws, bolts and nuts. If the above parts are punch or secured with a pin, coat the punching place and the hole for a pin with a gun grease or lubricant No.9.

8. REPAIR OF RIVET JOINTS

Replace rivets damaged*in operation (deformation of heads, deformation or stretching of shanks etc.)

NOTE: Do not replace rivets with slight scores on the heads surface.

Expand the holes of the damaged rivet joint to receive rivets of the nearest large diameter and replace the rivets respectively.

Wipe the places around the newly-installed rivets with cotton rags dipped in kerosene, dry them in the open air for 10 min. and then coat with OKB-122-7 lubricant.

9. REPAIR OF DAMAGED FEED LINES SURFACES

Immediately repair damages (scores, dents, scratches, corrosion and burnt spots) on the surface of the feed lines and ejection chutes, which affect the belt movement and case and link ejection.

Wipe the damaged surface of the feed line and case and link ejector with cotton rags dipped in kerosene, until dust, gun-powder burning dirt and lubricant are removed; dry it in the open air for 10 min.; after that file the damaged place with a fine file and smooth with cloth No.220 ensuring smooth passages in the damaged places without affecting the feed line general configuration.

Remove the products of cleaning with a hair brush dampened in kerosene, wipe with cotton rags and coat with lubricant ЦКБ-122-7 or No.9.

10. REPAIR OF DAMAGED BRAIDINGS

Remedy the braidings damages (partial breaking, local wear, bristling) by placing a wire bandage on each bundle of wire (not more than in three places).

Use a soft locking wire, 0.5-0.8 mm. for bandages. The bandage should not be more than 40-50 mm. long.

If more than 3 places are damaged, repair the bundle of wires in a special shop equipped for turret repair.

11. REPAIR OF DAMAGED VARNISH COATING

If the external layer of the enamel and prime coating is damaged up to the metal, carefully clean the edges of the varnish coating near the damaged place with cloth No.220 without affecting the oxid film.

Remove the products of cleaning. Wipe the damaged area with a clean cloth dipped in gasoline and then with a clean dry cloth and dry in the open air for 30 min.

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Next, place a layer of quick-drying АГ-10С prime coating on cleaned area. Dry the part at a temperature of +12 to 27° C for 3-5 hours, if possible, and place another layer of АГ-10С coating adding 2% aluminium powder.

After covering the damaged area with prime coating, dry the part for 3-5 hours and, using a brush, place a layer of АГ-10С enamel adding 2% aluminium powder.

NOTE: Small damaged areas of 2-3 cm², may be covered with one layer of АГ-10С coating. It is recommended to dry the enamel at a temperature of +12° to 27°C for 4-6 hours.

After drying thoroughly and carefully smooth the entire surface with cloth No.220, remove the products of cleaning with a hair brush, coat with ХВЭ-4 enamel and dry, if possible at a temperature of +12 to 17°C for not less than 8 hours.

If the enamel upper layer is damaged, without the prime coating being damaged, employ the following procedure:

smooth the damaged area with cloth No.200-220 and wipe with a dry clean cloth. Using a brush coat the damaged area with a layer of ХВЭ-4 enamel adding 2% aluminium powder.

Dry at +12° to 17°C for not less than 6 hours, slightly smooth the painted area with cloth No.220, remove the product of cleaning with a hair brush, place another layer of ХВЭ-4 enamel and dry at a temperature of +12° to 17°C for a period not less than 8 hours.

Removal of corrosion products and repair of varnish coating should be performed either directly on the turret or after removing the parts from the turret(depending on access to them and degree of damage).

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12. ELECTRICAL UNITS CHECK

A. MOTOR-GENERATOR UNIT AND DRIVE MOTORS CHECK

1. After every 10 hours of the drive operation under load visually inspect the commutator of the motor-generator unit and drive motors for condition.

2. To inspect the brushes and the commutators, remove from the motor-generator unit the cap or tape covering the inspection holes.

In case of blackening (grease, dull or black coating) wipe the commutator with a clean rag slightly dampened in gasoline. If the blackening is not removed smooth the commutator with a strip of sand paper not less than "00" grade, turning the electric unit armature by hand.

After smoothing the motor-generator unit commutator blow it out with compressed air.

3. Make sure that the brushes are properly fitted to the commutators and freely, without sticking move to the commutators and freely, without move in the brush-holders.

The springs pressing ends should easily, without distortions and sticking enter the brushes slots and press the brushes to the centre of the slots.

4. Replace worn brushes of the electric units with spare ones of the same dimensions and grade.

Permissible height of the brushes should be not less than 16 mm for the ВА-3Д motor-generator, not less than 14 mm. for the generator, not less than 12 mm. for the МУ-550ТУ drive motor, not less than 8 mm. for the ammunition booster motor.

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3. If no defects were detected during inspection, but the motor-generator unit does not operate properly, remove it from the aircraft and inspect it more thoroughly.

In operation prevent objects, which can cause jamming from getting inside the electric units.

B. SELSYNS CHECK

1. Should a selsyn fail, do not repair it but replace with a new one. Replace the selsyn as specified in the given instructions (See paragraph 2. section VI, f).

2. When inspecting the selsyns, remove the covers from them and check the condition of the sockets in the covers and the pins in the casings; if dirt or oil is detected in them wipe the sockets with a clean rag dampened in pure Б-70 gasoline.

In case of the sockets deformation the covers may be replaced.

If the selsyn pins are deformed, carefully straighten them. Install the selsyn cover in place very carefully, see that the centering boss key enters the cover slot. The cover distortion is not permitted. When tightening the coupling nut, keep the cover from turning.

NOTE: Do not remove the covers from the selsyns unless it is urgent.

C. У-2М-1М MAGNETIC AMPLIFIER AND У-2М-1БМ AMPLIFIER UNIT CHECK

1. When checking the У-2М-1М magnetic amplifier, make sure that A.C. and signals are supplied to the amplifier. To do this,

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connect the MB-4 voltmeter to the test plug connector of the control box:

a) pins 2 and 8 - for determining presence of A.C.

b) pins 4 and 7 - for determining presence of fine signal in azimuth channel;

c) pins 3 and 7 - for determining presence of coarse signal in azimuth channel;

d) pins 5 and 7 - for determining presence of course signal in the elevation channel.

e) pins 6 and 7 - for determining presence of fine signal in the elevation channel.

2. If the magnetic amplifier does not operate properly, check the condition of the magnetic amplifier and its unit; to do this, unseal and remove the cover from it, check the resistors, capacitors, soldering places and valves to-panels joints for good condition.

Switch on the "A.C." switch on the auxiliary control panel and see that all the valve filaments are heated.

If it is detected during check that not all the valve filaments are heated replace the valves with spare ones.

3. When replacing the valves, ensure that the balancing potentiometer is properly installed (See Section VI, § [illegible]).

The neon tubes illumination potential in the [illegible] amplifier is adjusted by the Mfr's plant within 1.7-[illegible].7 V.

13. ELECTRICAL CONTROL BOXES CHECK

1. If the electrical control box does not operate reliably remove the cover from the box, having unsealed it, and visually inspect to detect:

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a) damage to hookup wires insulation;

b) unreliable connection and attachment of wires (bad soldering);

c) unreliable of positive and negative wires in terminals.

Tighten the screws if loosened;

d) damages to resistors, relay coils, capacitors, bad contacts due to wires overheating.

2. Using a test unit, check the box wiring by the wiring diagram given on the box cover.

Having detected the defect, remedy it.

NOTE: The construction of all contactors and relays, incorporated in the electrical boxes ensures the proper operation during the entire service life without inspection and repair at the normal supply voltage.

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SECTION II

OPERATIONS PERFORMED WITH GUN ARMAMENT SYSTEM AT AIRCRAFT DELIVERY TO USING ORGANIZATION

When the aircraft is delivered to the operator, prepare the armament system for combat application; to do this:

a) depreserve the turret as in Section I,1;

b) remove the guns as in paragraph 2, section I, "a";

c) examine, clean and lubricate as in paragraph 6, Section I;

d) Inspect the turrets units as in paragraph 3, Section I;

e) Check the remote control system operation as in paragraph 4, Section I;

f) Check the system alignment and boresighting.

SECTION III

OPERATIONS PERFORMED WITH GUN ARMAMENT SYSTEM WHEN PREPARING AIRCRAFT FOR FLIGHT

When preparing the aircraft for flight perform the following operations:

a) remove the guns from the turret as in paragraph 2, Section I, a;

b) inspect, clean and lubricate the turret units as in paragraph 6, Section I;

c) clean and prepare the guns for combat application in accordance with the operating instructions and the certificate for the AM-23 gun and install the guns in the turret (according to paragraph 2, Section I,f).

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d) check the turrets, computer and range finder radar according to paragraph 3, Section I, except step "C" and paragraph 4, Section I, except step "f" 2, 3, 5 and 8.

e) load the ammunition and charge the guns according to paragraph 5, Section I.

CAUTION: Before flight make sure that the "Unit" and "Fire" safety switches, located on the left of the turret attachment frame, and the switches on the KOH-4 ammunition booster box are on.

SECTION IV

INSPECTION AND MAINTENANCE OF THE SYSTEM IN FLIGHT

This section is intended for gunners and other crew members, operating the gun armament system of the AN-12 aircraft in flight.

I. A FEW INSTRUCTIONS FOR GUNNER

a) At landing and take-off the guns should always be in stowed position.

b) The guns are established in stowed position when the gunner releases the operating lever on the sighting set.

CAUTION: Do not switch off the turret units until the turret is set in stowed position.

c) The turret is provided with two automatic rechargers to eliminate misfire and other fire stoppages which can be eliminated by recharging. The automatic recharger performs two successive rechargings and then it is cut off.

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d) The turret has a fire interrupter, which interrupts fire when misalignment angle between the sight and the turret reaches 0.5-3 deg.

2. SETTING THE SYSTEM IN OPERATION

a) After take-off switch on the auxiliary circuits switch and charge the guns by pressing each "Recharging" button, left and right. The counters warning lights normal illumination indicates that the guns are ready for fire.

b) Having entered an area of possible encounter with enemy, switch on the "A.C.", "Unit" and "Computer" switches on the RT-54M auxiliary control panel and the " Computer" switch on the sighting set.

Set the "Attack-Direct" switch in the position corresponding to the present conditions ,(in the "Attack" position - in the event of curvilinear pursuit, in the "Direct" position if the enemy aircraft pursues our aircraft on parallel courses or attacks its tail).

c) Switch on the "Fire" switch just before starting fire.

CAUTION: On no account change the above switching sequence.

3. GUNS AND SIGHT ALIGNMENT IN-FLIGHT CHECK

Having pressed the sighting set operating lever, turn the sighting set up, down, right and left, watching the guns. The guns should follow the sight.

CAUTION: Do not keep the turret in extreme positions if it is not necessary.

4. "GAMMA 54T" RANGE FINDER RADAR IN-FLIGHT CHECK

1. Switch on the range finder radar in accordance with step 7, Section I, 4, f.

2. When flying at an altitude exceeding 3000 m. with an aircraft in the sight field at a distance less than 2500 m., the range finder radar locks on the aircraft; in this case the green light on the KHC-53A comes on and a continuous audio signal (400 c.p.s.) is heard in the CHY intercommunication system; if the distance of the aircraft (target) is less than 1900 m., the red light on the KHC-53A also comes on and an intermittent audio signal is heard in the CHY intercommunication system.

If there are several aircraft in the sight field the range finder radar determines the distance of the nearest aircraft.

This check is possible only with other aircraft in the range finder radar operating zone.

3. If there are no aircraft in the sight field, to check the range finder radar, turn the turret down at the largest angle and press the "CHECK" button on the OH-54T main control panel, when flying at an altitude of 3000-15000 m. The range finder radar search range increases approximately 10 times and seizes pulses reflected from the ground, which is indicated by illumination of the light on the KHC-53A sight and by signal in the CHY intercommunication system.

At altitudes less than 3000 m. the range finder radar seizes pulses reflected from the ground without pressing the "CHECK" button, which can be used for checking the range finder radar at climb.

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5. MEASURES TAKEN IF GUNS DO NOT FOLLOW SIGHT

a) Check that all switches are off.

b) Using the instruments located on the panel check that the electrical system voltage is 27 V, 115 V and the A.C. voltage is 36 V.

c) Check the fuses in the BП-54M auxiliary panel for good condition, having switched on all the switches.

d) If the above actions did not help, switch off the turret units.

6. THE FIRE CONTROL IN-FLIGHT CHECK

Direct the gun to the zone of permitted fire, press the firing button. This must cause fire from both the guns.

7. MEASURES TAKEN IF GUNS FAIL TO FIRE

a) Check position of the switches on the panel.

b) See that the fuses in the BП-54M auxiliary control panel are in good condition.

c) If the gun warning light is illuminated, recharge the gun by pressing the "Recharging" buttons on the CП-54T main control panel and check the fire control again.

CAUTION: Never press the "Recharging" button more than once, if the gun moving parts are not in the front position (the counter light is off) and the pneumatic system pressure is less than 35 kg/cm^2.

d) If firing is not resumed switch off the turret units.

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6. PROCEDURES PERFORMED ON RETURN TO AIR BASE BEFORE LANDING

a) Switch off all the switches after setting the turret in stowed position.

b) Lock the sighting set.

SECTION V

OPERATIONS PERFORMED WITH GUN ARMAMENT SYSTEM AFTER FLIGHT

On the aircraft return after flight remove the housing and thoroughly inspect the turret for freedom from damage affecting the guns discharging and ammunition boxes unloading.

Remedy damages, if detected.

Discharge the guns, in accordance with paragraph 5, Section I,C.

Check the "Gamma-54T" range finder radar in accordance with steps 1,2,3,5,6,7,8,9,10 of paragraph 4, Section I,E.

CAUTION: When discharging the guns, be careful and instruct the personnel on guns discharging procedure!

Clean the guns, inspect, remedy defects and lubricate the turret in accordance with these instructions.

SECTION VI

REPLACEMENT OF INDIVIDUAL UNITS AND PARTS OF TURRET

Individual parts of the system failed in operation should be replaced.

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When replacing individual units of the system, proceed as follows:

1. De-energize the system.

2. Inspect the chutes, boxes and guns for no cartridges.

3. Remove the turret housings.

4. Remove the housings and open the access doors (as necessary).

5. Remove the guns (if necessary).

6. Switch off the "Unit" and "Fire" switches located on the left side of the turret attachment frame.

1. REPLACING THE GUNS

When replacing the gun, install the gun feed-block frame, link ejection chute, recharging cylinder adapter (lock it), rigid fork and install the gun on the turret.

Next, adjust the gun for parallel setting, to do this:

a) Place a bore sight target at a distance of 50 m. (do not perform the aircraft rigging).

b) Unlock the turret in azimuth and elevation, manually rotating the turret, aim the gun, which is not to be replaced, by means of the boresighting tube so that the tube cross hair is aligned with the proper cross on the target and lock the turret.

c) Using the boresighting tube inserted into the gun barrel adjust the rear attachment fitting so that the boresighting tube is aligned with the cross on the target and lock the rear attachment fittings.

d) Check as specified in paragraph 3, Section I, d.2.

e) Make the proper entry in the turret certificate about the gun replacement.

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f) After adjusting the guns for parallel setting, check the clearances between the guns moving parts and the turret elements. The clearance should not be less than 1 mm. during recoil and recuperation of the guns.

CAUTION: When replacing the guns, pay attention to the recuperator locking pin head design. The pin should have a step head, which ensures proper joint of the front attachment fitting with the gun.

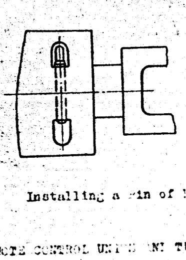

Fig.1. Installing a Pin of New Design

2. REPLACING THE REMOTE CONTROL UNITS AND TURRET PARTS

A. GENERAL INSTRUCTIONS

1. When replacing the units to be subjected to [illegible], clean their proper places.

Install the units immediately after cleaning.

2. When replacing the wires, clean the end of each wire, tightly twist and tin it till the smooth cylindrical surface is obtained. Tin only with ПОС-40 solder using colophony as flux.

CAUTION: Never use other fluxes. Insulate soldering places with chlorvinyl pipes of proper diameter.

Before installing the chlorvinyl pipe, mark the wires. To ensure good condition of the soldered places, tighten the bundle of wires with the plug connector clamp having placed felt under the clamps.

3. After replacing the unit, immediately check the new unit operation.

B. REPLACING THE У-2М-IМ MAGNETIC AMPLIFIER AND У-2М-IБМ UNIT

1. Having ensured that the amplifier or unit is defective, disconnect the plug connector and grounding wire, unscrew the attachment bolts and remove the amplifier or the unit.

2. Install a new amplifier or unit, connect the plug connector and grounding wire to it.

After replacing the amplifier check its balancing.

To check the amplifier balancing, switch on the system (the switching on procedure was described above) and press the operating lever on the sighting set.

Having switched the МВ-4 voltmeter to the test plug connector of the КУК-543 control box (to pins 4 and 7 for the azimuth channel and pins 6 and 7 for the elevation channel), rotating the adjusting resistors in the У-2М-IМ amplifier (R15 for azimuth channel and R16 for elevation channel) obtain the voltmeter minimum readings (not more than 1.25 V).

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C. REPLACING AD-1AM FIRE INTERRUPTER

If the fire interrupter is inoperative, replace it as follows:

a) disconnect the plug connector from the fire interrupter;

b) unscrew the fire interrupter base from the panel;

c) install a new fire interrupter;

d) connect the plug connector.

The fire interrupter does not require additional adjustments.

D. REMOVING AND INSTALLING MY-550TY ELECTRIC DRIVE MOTORS

CAUTION:

1. To prevent the electric motors from turning, before removing them from the drive mechanisms make marks on the flanges of the electric motors and the drives casings; align the marks when installing the electric motors.

2. Prior to the electric actuator installation, coat the conical gear teeth with lubricant No.9.

3. If there are gaskets between the electric motors flanges and the drives casings, install the latter in the proper places.

4. Secure the electric motors attachment nuts to the drives with lock wire.

a) Elevation drive:

1. Remove the upper gun.

2. Remove the upper right shutter.

3. Remove the clamp, securing the bundles of wires, on the left side of the frame.

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4. Disconnect the electric motor bundle of wires plug connector.

5. Uncotterpin and remove the axle connecting the drive releasing trigger to the cable.

6. Unlock the electric motor-to-drive attachment nuts having removed the lock wire.

Unscrew the nuts by means of 05/E-AD-35A wrenches and a flat wrench, S-10, from the tool kit.

7. Remove the electric motor. Install the electric motor in reverse order.

8. If it is necessary to remove the reduction gear, set the unit in zero position in elevation, and lock it. Unlock and unscrew four vertical bolts attaching the reduction gear to the bracket; using the 0007/E-AD-35A device, press out two pins from the reduction gear casing.

NOTE: To press out the pin, place the device special bolt on the pin so that the pin head would enter the bolt slot. Fully tighten the device nut with a wrench, S-19.

Remove the drive mechanism from the bracket and make marks on the output gear tooth and the reduction gear casing.

9. Install the reduction gear reverse the removal procedure, with the unit in zero position in elevation.

CAUTION: Align the marks on the output gear and those on the reduction casing. Install all the washers, removed during the drive mechanism disassembly, in their proper places.

b) Azimuth drive:

1. Remove bandages from the bundles of wires passing near the azimuth drive.

2. Remove the selsyn covers.

3. Disconnect and remove the plug connectors from the angle bracket and the electric motors.

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4. Remove from the angle bracket the plug connector of the bundle of wires passing from the drive micro switches.

5. Turn the unit to the left in azimuth at an angle of approximatly $+65^{\circ}$ and lock it.

6. Unlock and remove 4 horizontal bolts attaching the drive to the bracket.

7. Remove the cover which closes the output gear.

8. Make marks on the output gear tooth and the edge of the bracket hole. Lock the electric motor.

9. Knock out the drive cover-to-lower bracket attachment pin.

10. Remove the pins, unscrew the nuts and remove the bolts attaching the drive to the bracket.

11. Remove the drive, having pressed out two pins from the reduction gear by means of the C607/M-AB-35A device (it is permitted to remove the drive leaving two pins in the bracket sockets; to prevent the reduction gear wall breaking, when removing rest on the mounting plates).

NOTE: See the note in paragraph 8, Section IV,d.

12. Brake the output gear, preventing its turning for a complete revolution.

13. Unlock the electric motor attachment nuts having removed the lock wire. Unscrew the nuts with flat wrenches, S=10, from the tool kit.

14. Remove the electric motor. Install the electric motor and the drive mechanism reversing the removal procedure. Align the marks on the output gear and the bracket holes.

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E. REPLACING БА-ЗД MOTOR-GENERATOR UNIT

1. Disconnect the bundles of wires from the motor-generator unit.
2. Unscrew the motor-generator unit attachment bolts.
3. Install and secure a new motor-generator unit.
4. Connect the bundles of wires to the motor-generator unit.
5. Check the motor-generator unit starting.
6. Check the turret control with the new motor-generator unit.
7. Balance the magnetic amplifier as specified in paragraph 2, Section VI, b.

F. REPLACING THE SELSYNS

1. To replace the selsyns of the turret reduction gears:

a) Unscrew the selsyn nut-cover;

b) Unscrew the screws of the clamp pressing the selsyn to the mounting place and remove the selsyn;

c) remove the link from the selsyn and check the link ball-to--reduction gear for tight connection. The link ball should tightly enter the reduction gear without play.

Check the link centering part-to-reduction gear joint.

NOTE: When replacing the selsyn on the elevation reduction gear, remove the upper right shutter.

2. Install a new selsyn:

a) install the link, removed from the selsyn to be replaced, on the new selsyn shaft;

b) set the selsyn in the proper recess of the reduction gear, see that the link end entered the mating part slot and the link centering part entered the mating groove in the gear.

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To avoid play, it is mandatory to keep unchanged the size of the mounting slot in the gear for the link pin.

c) install the screws and pressure washers on the reduction gear;

d) use a screwdriver to tighten the selsyn attachment bolts, ensuring the possibility of the selsyn casing rotation, when it is aligned with the system;

e) align the selsyn, tighten the attachment, lock it (align according to the boresighting instructions) and make marks indicating zero position;

f) check the turret control.

C. REPLACING THE AMMUNITION BOOSTERS

1. Remove the front ammunition booster as follows:

a) unscrew the plug connector from the electric motor;

b) remove the rigid chute secured on which is the ammunition booster;

c) remove the ammunition booster from the rigid chute;

d) remove the bracket from the ammunition booster;

e) install a new ammunition booster in reverse order;

f) connect the electric motor plug connector;

g) check the ammunition booster operation and adjust the friction clutch by the current required for the clutch slipping.

2. Remove the rear ammunition boosters as follows:

a) unscrew the plug connector from the electric motor;

b) disconnect the ammunition booster from the bracket;

c) disconnect the ammunition booster output shaft from the sprockets axle;

d) remove the ammunition booster;

e) remove the sprockets from the new ammunition boosters, install the adapter bushing, removed from the old ammunition booster and install sprockets;

f) install the ammunition booster on the bracket;

g) connect the electric motor plug connector:

h) switch on the ammunition booster and adjust the friction clutch by the current required for the clutch slipping.

H. REPLACING АП-27 AUTOMATIC RECHARGER

1. Unscrew the plug connector and the automatic recharger attachment bolts.

2. Install a new automatic recharger, connect the plug connector.

<u>NOTE</u>: Do not subject the automatic recharger to any kind of adjustment.

3. Check the newly installed automatic recharger for reliable operation; to do this, check the number of rechargings which the automatic recharger performs with the guns uncharged; the automatic recharger should perform two rechargings and after that it is switched off.

I. REPLACING КЗН-4 AMMUNITION BOOSTER BOX

1. Disconnect the plug connectors and, having unscrewed the attachment bolts, remove the box.

2. Install a new box, connect the plug connector and tighten the attachment bolts.

3. Test the box for reliable operation; to do this, having energized the box, press the booster motor manual switching button on the box or on the web of 68(58) frame. The booster motor should operate.

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J. REPLACING OK-48 ELECTRO-PNEUMATIC VALVE

1. Disconnect the OK-48 valve plug connector.
2. Disconnect the pneumatic pipes.
3. Unscrew the attachment clamps screws and remove the OK-48 electro-pneumatic valve.
4. Install a new OK-48 valve and connect the plug connector.
5. Test the new OK-48 valve by recharging the gun using the manual recharging button and the AP-27 automatic recharger.

K. REPLACING CM AND MH LAMPS

To replace CM and MH lamps: unscrew the filtering caps, remove defective lamps, place new lamps and check their illumination, screw on the light - filtering caps.

L. REPLACING 204K BUTTON

To replace the 204K button, employ the following procedure:

1. Remove the unit, the button of which is to be replaced.
2. Open the unit removed.
3. Unsolder the current-carrying wires from the button.
4. Unscrew the button-to-unit structure attachment screws and remove the button.
5. Install a new button and secure it with screws. Further installation is performed in reverse order.

NOTE: Coat the wire soldering places with "[illegible]" [illegible] varnish.

M. REPLACING 0C105-2A FLEXIBLE HOSES

To replace the flexible hoses, proceed as follows:

1. Discharge the air from the pneumatic system without pneumatic recharging of the guns.

2. Remove the locking, unscrew the coupling nuts and disconnect the defective hoses.

3. Install new hoses, tighten and lock the coupling nuts.

4. Fill the pneumatic system till 65+3 atm. pressure is obtained and perform 4 rechargings of the gun with a dummy cartridges belt.

N. REPLACING THE WASHERS IN VERTICAL STOP

To replace 0101-28/AE-35A and 0101-30/BE-35A washers, proceed as follows:

1. Remove the upper right shutter (for the upper stop), disconnect the inner flexible chute from the hinged throat.

2. Set the turret in elevation so as to provide free access to the stop.

3. Remove the cotter pin, unscrew the nut and remove the rod.

4. Replace the washers with new ones.

5. Assemble the stop in reverse order in accordance with paragraph 3; the stop should project 5+0.5 mm. beyond the casing end.

6. Check the turret firing angles in elevation according to the dials.

7. Check as specified in paragraph 4, Section I, B,2.

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O. REPLACING THE WASHERS IN HORIZONTAL STOP

To replace the 0101-29/[illegible] -35A and 0101-30/[illegible] -35A washers, proceed as follows:

1. Set the turret in the extreme position in azimuth without reaching the stop 15°.

2. Unscrew the plugs holding the rod, measure the pack dimensions.

3. Replace the washers with new ones.

4. Assemble the stop maintaining the dimensions according to paragraph 2. Insert the assembled pack into the stop casing, tighten the plug until it reaches the rubber, [illegible] plug, when tightening, and maintain 6±0.5 projection of the stop beyond the casing end on both sides. Punch the plug [illegible] the rod in four points. Cover the punching places with [illegible] coating.

5. Check the turret firing angles in azimuth according to the dials.

6. Check according to paragraph 4, section [illegible].

P. REPLACING THE GYRO [illegible]

Remove defective gyro relays from the [illegible] new ones so that the white mark [illegible] on the [illegible] channel and the red mark [illegible] on the gyro [illegible] channel coincide with the white mark on the [illegible]

Q. REPLACING THE [illegible] VALVE

Proceed as follows:

1. Discharge air from the pneumatic system.

[illegible]

2. Remove the defective valve from the bottle and install a new one.

3. Check the valve operation (air discharging) which should not exceed 80 atm., the closing pressure should not be lower than 68 atm.

NOTE: At a pressure of 68 atm. the valve should be airtight.

R. REPLACING THE NON-SPILL COUPLING PARTS

Replace the 02-3/2T-219, 02-1/2T-219, 02-87/2T-219 and c 6 02-1/2T-219 parts in the following manner:

1. Unscrew the coupling nut attaching the elbow to the pneumatic pipe.

2. Remove the non-spill coupling, having removed pins and screws.

3. Remove the bracket from the non-spill coupling.

4. Replace the valve parts with new ones.

5. Assemble and install the non-spill coupling reversing the removal procedure.

6. Check the non-spill coupling and pneumatic adapter, installed on the gun, for alignment according to paragraph 3, Section I,d,2.

S. REPLACING THE BRUSHES AND BRUSH SPRINGS OF MU-550T7 DRIVE MOTORS

To replace the brushes and brush springs of the drive motor.

1. Remove the upper shutter (for elevation motor).

2. Remove the electric motor from the reduction gear according to paragraph 2, Section VI,d.

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3. Remove the protective tape, having unscrewed the hold-down bolt.

4. Replace a defective brush or spring.

a) When replacing, do the following:

1. Unscrew the current-carrying wire-to-brush holder attachment screw, remove the brush from the guide, having taken out the brush spring.

2. Place new brushes in the guides, secure the current-carrying wire to the brush holder, fit the brush to the spring.

<u>NOTE</u>: Fit the new brushes, when necessary, blow out the motor cavity with compressed air.

b) To replace the spring: remove the locking pin holding the spring on the stem, and remove the spring. Install a new spring on the stem. Insert the cotter [illegible] in into the hole on the stem, set the tips apart.

5. After replacing a defective brush or spring, place a protective tape and tighten its screw.

6. Install the electric motor on the reduction gear in accordance with paragraph 2, Section VI, [illegible].

T. REPLACING THE CONICAL GEAR OF [illegible]

If the conical gear installed on the drive motor is damaged, replace the gear, and install it from the failed electric motor on a new one, using a special device furnished with the system. The device provides the gear installation on the electric motor shaft at a proper distance from the shaft end, which is required for proper engagement of the electric motor gear with the reduction gear.

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U. PROCEDURE OF REPLACING THE GEAR

1. Remove the electric motor from the reduction gear as specified in paragraph 2, Section VI, d.

2. Install the device on the electric motor so that the inclined planes of the bracket (6) seize the conical gear mounted on the electric actuator (Fig.2).

3. Secure the device casing on the electric motor flange with screws (7).

4. Tighten the bushing (2), pressing it to the end of the gear teeth, and secure it with the screw (10); the washer (4) should not touch the gear.

5. Remove the device from the electric motor.

6. Knock out the pin and remove the gear from the electric motor shaft.

7. Install the conical gear to be installed on the inclined planes of the bracket (6) and attach it by pressing with a washer.

8. Install the device with the gear attached on the new electric motor. Secure the casing (3) to the electric motor flange and drill the shaft according to the gear installed, having ensured that the holes on one side of the gear are aligned with the hole in the electric actuator shaft.

After drilling, remove the device from the electric motor, release the gear and, having reinstalled on the electric motor, secure it with 4Г-15 pin.

CAUTION: Punch the pin in two points on both sides.

9. Install the electric motor on the reduction gear in accordance with paragraph 2, Section VI, d.

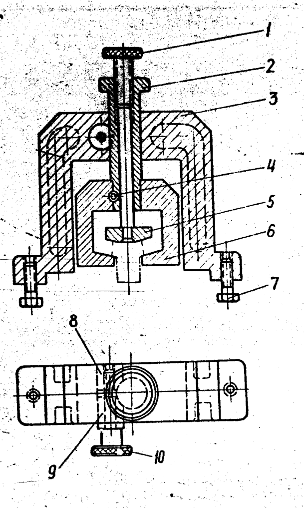

Fig.2. Device for Replacing the Conical Gear of [illegible]

1 - Screw; 2 - bushing; 3 - casing; 4 - pin; 5 - washer; 6 - bracket; 7 - screw; 8 - bushing; 9 - bushing; 10 - screw.

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S E C T I O N VII

I. PERIODIC MAINTENANCE OF GUN ARMAMENT SYSTEM IN OPERATION

The periodic maintenance operations of the gun armament system are performed to check the system condition and prevent failure of the system units during operation.

According to the time performed the periodic maintenance operations are divided into:

a) maintenance performed after 10-hours of the system operation;

b) maintenance performed when changing from winter to summer operation and vice versa.

2. 10-HOUR PERIODIC MAINTENANCE OPERATIONS

1. Examine the units and remedy the defects detected according to paragraphs 6,7,8,9,10,11 of Section 1.

2. Check operation of the turret reduction gear in accordance with paragraph 3, Section 1, a, and check the locking of the reduction gears shaped discs (attachment screws) (by examining the locking, with the reduction gears covers removed.

3. Inspect the elements of the ammunition feed and case and link ejection systems according to paragraph 3, Section 1,b.

4. Check the turret pneumatic system according to paragraph 3, Section 1,d.

5. Check operation of the remote control system according to paragraph 4, Section 1.

6. Check the control circuits as follows:

a) check the turret and sighting set alignment according to paragraph 4, Section 1,b.

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b) check operation of the limit switches for the extreme position and actuation of electro-dynamic braking of drive motors with the guns set against the stops, according to paragraph 4, Section 1,b.

c) check the gun movement to stowed position according to paragraph 4, Section 1,b;

d) check the turret locking, after the motor-generator unit is switched off, according to paragraph 4, Section 1,b.

7. Check the firing and recharging circuits according to paragraph 4, Section 1,c.

8. Check the camera gun circuits according to paragraph 4, Section 1,d.

9. Check the corrections presented by the computer on the turret according to the gun barrels movement, as specified in paragraph 4, Section 1,e.

10. Check the magnetic amplifier and amplifier unit for condition according to paragraph 12, Section 1,c.

11. Check the electric boxes for condition according to paragraph 13, Section 1.

12. Check the condition of the commutators and brushes according to paragraph 12, Section 1,a:

a) motor-generator unit;

b) drive electric motors;

c) ammunition boosters.

13. Check the setting currents according to paragraph 4, Section 1,b, step 7.

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3. MAINTENANCE PERFORMED WHEN CHANGING FROM WINTER TO SUMMER OPERATION AND FROM SUMMER TO WINTER OPERATION

a) Perform all the 10-hour periodic maintenance operations;

b) check the ammunition boosters according to paragraph 3, Section 1, c, if during winter or summer operation less than 1500 rounds are made per gun; if during winter or summer operation more then 1500 rounds are made, check the ammunition boosters after every 1500 rounds;

c) check the boresighting according to the boresighting instructions;

d) check the condition of the limit switches and stowed position switches on the elevation and azimuth reduction gears.

To do this, remove the reduction gears covers. After checking the limit switches for reliable condition and operation, close the covers, tighten the screws and secure them with wire.

When removing and installing the cover, see that the adjusting screws are not turned in a new position.

It is recommended to place wooden wedges between the screw head and the casing.

NOTE: To perform the periodic maintenance operations, use the operating instructions for the computer, AM-23 gun and [illegible]-53A sight.

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SECTION VIII.

GUN ARMAMENT SYSTEM POSSIBLE TROUBLES

Trouble	Probable Causes	Methods of trouble shooting
1	2	3
1. Swinging of guns in azimuth or elevation about aligned position with immovable sighting set.	1. Misaligned zero positions of coarse and fine selsyns(receivers or transmitters).	1. Check gun control by fine channel, having removed both neon tubes from magnetic amplifier.
	2. One of fine selsyn stator windings broken.	2. Using test unit check stator windings circuits.
	3. Stabilization circuit broken.	3. Check, using test unit, to find broken place in circuit. Check capacitor for condition.
	4. Poor adjustment of magnetic amplifier.	4. Check neon tubes ignition range.
2. Swinging of guns about stops.	Poor adjustment of limit switches.	Check adjustment of limit switches.
3. Turret is not controllable from sighting set.	1. A.C. circuit broken.	1. Check valves filament in magnetic amplifier. Measure voltage across terminals P1-P2 of selsyn-transmitters

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1	2	3
		covers and across terminals of magnetic amplifier power transformer primary windings.
	2. Control relay circuits broken.	2. Check, using test unit, to find broken place in circuit.
	3. Motor-generator unit inoperative.	3. Check motor-generator unit electric motor.
4. Turret is controllable neither in azimuth nor in elevation.	1. Armature circuit or drive excitation winding circuit broken.	1. Check voltage at drive motor input. Check excitation winding and armature winding.
	2. Burning of filament or loss of emission of magnetic amplifier output valve Л-I or Л-3.	2. Relocate Л-I and Л-3 valves.
	3. Motor-generator unit generator excitation windings are not connected to magnetic amplifier.	3. Check currents at motor-generator unit generator output.

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1	2	3
5. Turret is controllable in one direction and is not controllable in the other. With the sighting set immovable, turret goes on rotating slowly.	1. One arm of magnetic amplifier control winding broken. 2. One arm of generator excitation winding broken.	1. Check magnetic amplifier control winding circuits. 2. Check currents at generator input. Check generator excitation windings.
6. Turret is stiff to follow sighting set.	1. Defects in generator or drive motor. (improperly fitted brushes, dirty commutator, armature, winding coil short-circuiting etc.)	1. Check drive motor input voltage.
7. Turret is stiff to follow sighting set in one direction and normally follows it in the other.	Intercoil short-circuit of one of generator excitation windings or magnetic amplifier operating winding.	Check resistance of generator excitation winding.
8. With sighting set slowly rotating(not more than 10 deg/sec.) turret smoothly follows sighting set.	1. Broken circuit of coarse selsyn-transmitter or selsyn-receiver.	1. Check that A.C. is supplied to selsyn-transmitter rotor. Check selsyn-transmitter rotor winding.

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1	2	3
After changing sighting set position, turret follows sighting station but lags behind.	2. Simultaneously breaking in circuits of coarse selsyns two stator windings.	Check selsyn-receiver rotor circuit. 2. Check stator windings circuits.
	3. Burning of filament or loss of emission of coarse channel amplifier valve (Л-2 and Л-4).	3. Relocate Л-2 and Л-4 valves.
	4. Both neon tubes in one channel defective.	4. Relocate neon tubes of azimuth and elevation channels.
	5. Short-circuiting of magnetic amplifier C1 or C1"a" capacitor.	5. Check capacitors for good condition.
9. With sighting set slowly rotating, turret follows it by jerks.	1. Broken circuit of fine selsyn-transmitter or selsyn-receiver rotor.	1. Check that [illegible] selsyn-transmitter rotor. Check selsyn-transmitter [illegible] ing. [illegible] receiver rotor [illegible]
	2. Simultaneous breaking in circuits of fine selsyns two stator windings.	2. Check circuits of selsyn-stator windings.

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1	2	3
10. With sighting set rotating turret is not controllable and occupies a definite position relative to aircraft. With sighting set in some positions, turret is set against extreme stop.	Broken circuit in one of coarse selsyns stator windings.	Check selsyns stator windings circuits.
11. With sighting set slowly rotating, turret follows it by jerks, and after changing sighting set position, it is stiff to settle or continue swinging.	1. Asynchronous zero positions of coarse and fine selsyns (receivers or transmitters). 2. Broken circuit of one of fine selsyns stator windings.	1. Check gun control by fine channel, having removed both neon tubes from magnetic amplifier. 2. Use test unit to check stator winding circuits.
12. Turret is normally controlled from sighting set, but is not set in stowed position, with operating lever released.	Stowed position circuit broken.	Measure voltage in stowed position circuit.

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[redacted]

IB-237 GUN ARMAMENT SYSTEM

DESCRIPTION

Part I

[redacted]

Secret
Copy No.____

HB-23Y (9-A-299) GUN ARMAMENT SYSTEM

DESCRIPTION

Part I

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SECTION I

MAIN DATA OF [illegible] (S-A-[illegible]99) SYSTEM

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I. GENERAL

The UB-237 gun armament system is designed to protect the rear hemisphere of the AH-12 aircraft; it consists of the KB-257 tail turret, MIC-53A sighting set with the BK-257-I computer, remote control units and "Gamma-54T" range finder radar.

The KB-257 tail turret with two 23 mm. AM-23 guns is a gun installation with an electric follow-up drive.

The MIC-53A sighting set is designed for controlling the tail turret and together with the BK-257-I computer it ensures aimed fire from the turret.

The sighting set incorporates a collimator sight and a HAY-457 camera gun.

The electric remote control of the tail turret movement is based on the synchronous - follow-up drive employing the electronic-magnetic amplifier which provides a high accuracy of following the sight by the guns.

Installed on the turret are the antenna and the waveguide of the "Gamma-54T" range finder radar designed for determining the distance to the target and for sending to the sight through the computer electrical signals, which are functions of the distance to the target measured as the time required for the electromagnetic pulse to pass from the range finder radar antenna to the target and back.

Note: For information on the MIC-53A sighting set, BK-257-I computer and "Gamma-54T" range finder radar see their descriptions.

The turret is provided with an automatic electro-pneumatic recharging system employing an AB-27 automatic recharger.

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2. OPERATING CONDITIONS

The gun armament system reliably operates under the following conditions:

a) at a relative air humidity up to 95-98% and a temperature of $+20^{\circ} \pm 5^{\circ}$C;

b) at ambient air temperature change of $+50^{\circ}$ to -60°C;

c) at altitudes above sea level up to 12000 m.;

d) at max. speed of aircraft up to 650 km/hr.

3. TACTICAL AND TECHNICAL DATA

A. [illegible]-65V TAIL TURRET

1. Armament .... two 23 mm. A[illegible]-23 guns.
2. Ammunition .... 720 cartridges (360 cartridges per gun).
3. Firing angles
   a) in azimuth .... $70^{\circ}-2^{\circ}$ right
      $70^{\circ}-2^{\circ}$ left
   b) in elevation .... $+60^{\circ}-2^{\circ}$ up
      $-40^{\circ}-2^{\circ}$ down
4. Drive type .... electrical
5. Armament rotation speed:
   a) Minimum:
      in azimuth .... 0.25 deg./sec.
      in elevation .... 0.25 deg./sec.
   b) Steady ultimate:
      in azimuth .... 30 deg./sec.
      in elevation.......... 30 deg./sec.

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6. Fire and gun movement control ......electrical, remote.

7. Gun recharging .... automatic, electro-pneumatic.

8. Case-and-link ejection .... overboard

9. Weight of the turret with antenna and inner wave guide of "Gamma-54T" radar range finder without armament, ammunition, ammunition boxes and rigid chutes .... not more than 225 kg.

B. [illegible] SIGHTING SET

1. Sighting angles:
   a) in azimuth .... 80° right, 80° left
   b) in elevation ....+65° up, -45° down

2. Weight .... 20.5 kg.

C. REMOTE CONTROL SYSTEM

1. D.C. power source voltage .... 27 V ± 10%

2. A.C. power source voltage .... 115 V ± 4%

3. Frequency .... 400 c.p.s. +10% -5%

4. A.C. power source voltage .... 36 V ± 1[illegible]

5. Frequency .... 400 c.p.s. ±5%

6. Power consumed by the system from D.C. power sources............. 5000 W

7. Power consumed by the system from A.C. power sources .... 500 VA

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D. HB-23V SYSTEM

1. Weight of system with NIC-53A sighting set, BB-257-I computer, part of "Gamma-54T" range finder radar installed on turret, ammunition feed lines (ammunition boxes and feed chutes) without armament, ammunition and external cables..... not more than 415 kg. with complete set of "Gamma-54T" range finder radar .... not more than 460 kg.

2. Weight of system with armament and ammunition .... not more than 825 kg.

4. GUARANTEED SERVICE LIFE

The service life of the units is 6000 shots ~~per barrel~~ at all permissible firing angles and at different angular speeds of the guns movement.

The service ~~life of the~~ drive and the remote control system is 75 hours of reliable operation under load and 150 hours at idle travel. The drive operates for 15 minutes under load ~~followed~~ by 15 minutes of idle travel etc. during the engine mission after that an interval should be made for complete cooling.

NOTES. The following operating conditions for the BB-257-I computer were set forth:

1. Continuous switched "on" condition of the filament circuit is allowed during the entire mission and at the same time the following is admissible:

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a) periodical switching-on of the actuating lever for the computers located outside the pressurized cabin, at a flight altitude more than 8,000 m., for a period of 15 minutes, with 15-min. intervals between switchings during the entire mission;

b) switching-on of the actuating lever for the computers located outside the pressurized cabin, at a flight altitude below 8,000 m., and for the computers located in the pressurized cabin at any flight altitude, twice for a period of 15 minutes with a 15-min. interval between switchings; after that the computer should be cooled to the ambient air temperature.

2. On the ground, at an ambient air temperature of 50 ± 5^{o}C the computer is allowed to operate for 5 minutes with the actuating lever off, then for 10 minutes, with the actuating lever on, the operation should be followed by cooling the computer to the ambient air temperature.

During the operating period the guns simultaneously move in elevation and rotate in azimuth at a speed of 10-20 deg./sec. with a reverse travel after 5 sec. under a load changing by the law $M=M_{max.} \cdot \sin^3 d$, where d - the gun turn angle in elevation and azimuth. The torque is 100 kgm. at $d=70^{o}$ in azimuth and 80 kgm at $d=60^{o}$ in elevation.

At idle travel the drive operates in 5-hour cycles, followed by intervals for complete cooling of the drive.

During the idle travel all the units are switched on but the guns

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a) periodical switching-on of the actuating lever for the computers located outside the pressurized cabin, at a flight altitude more than 8,000 m., for a period of 15 minutes, with 15-min. intervals between switchings during the entire mission;

b) switching-on of the actuating lever for the computers located outside the pressurized cabin, at a flight altitude below 8,000 m., and for the computers located in the pressurized cabin at any flight altitude, twice for a period of 15 minutes with a 15-min. interval between switchings; after that the computer should be cooled to the ambient air temperature.

2. On the ground, at an ambient air temperature of $50\pm5^{\circ}C$ the computer is allowed to operate for 5 minutes with the actuating lever off, then for 10 minutes, with the actuating lever on, the operation should be followed by cooling the computer to the ambient air temperature.

During the operating period the guns simultaneously move in elevation and rotate in azimuth at a speed of 10-20 deg./sec. with a reverse travel after 5 sec. under a load changing by the law $M=M_{max.} \cdot \sin^3 d$, where d - the gun turn angle in elevation and azimuth. The torque is 100 kgm. at $d=70^{\circ}$ in azimuth and 80 kgm at $d=60^{\circ}$ in elevation.

At idle travel the drive operates in 5-hour cycles, followed by intervals for complete cooling of the drive.

During the idle travel all the units are switched on but the guns

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are immovable (the control button is released). Guaranteed service lives are shown in the unit sertifices.

5. SYSTEM COMPLETING LIST

No.	Designation	Name	Q-ty per set	Remarks
1.	ДБ-65У	Tail turret	1	set
2.	КПС-53А	Sighting set	1	
3.	БВ-257-I	Computer	1	set
4.	Gamma-54T	Range finder radar	[illegible]	set
5.	ОП-54Т	Main control panel	[illegible]	
6.	ВП-54М	Auxiliary control panel	[illegible]	
7.	[illegible]-54В	Control box	1	
8.	[illegible]-4	Ammunition booster box	2	
9.	[illegible]	Motor-generator unit	1	
10.	[illegible]	Amplifier	1	
11.	[illegible]	Amplifier unit	1	
12.	АП-27	Automatic gun recharger	2	
13.	АС-[illegible]	Fire interrupter unit	1	
14.		Rigid chute, right	1	set
15.		Rigid chute, left	1	set
16.		Ammunition box, right	1	
17.		Ammunition box, left	1	
18.		External cables	-	set

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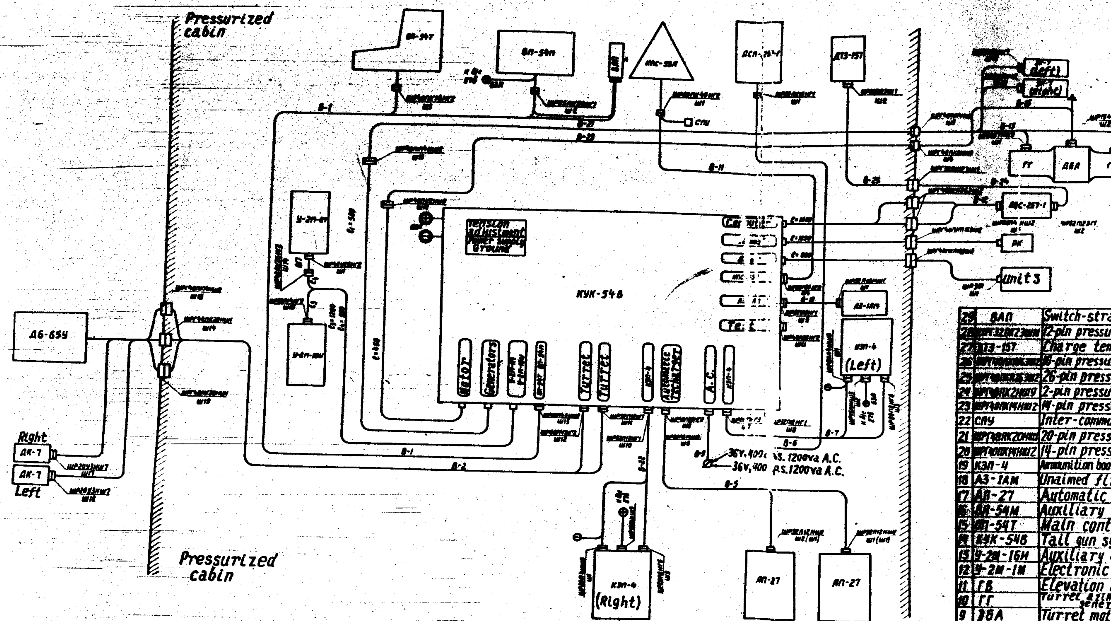

Block diagram.

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No.	Code	Item	Q	Type	Location
29	ВАП	Switch-straight attack	1	В-45	
28	ШРГ32ПК12ЭШ1	12-pin pressurized plug connector	1	ШРГ32ПК12ЭШ1	Pressurized cabin wall
27	ДТЗ-157	Charge temperature transmitter	1	ДТЗ-157	In aircraft
26	ШРГ40ПК16ЭШ2	16-pin pressurized plug connector	2	ШРГ40ПК16ЭШ2	Pressurized cabin wall
25	ШРГ48ПК26ЭШ2	26-pin pressurized plug connector	2	ШРГ48ПК26ЭШ2	Pressurized cabin wall
24	ШРГ48ПК2НШ9	2-pin pressurized plug connector	1	ШРГ48ПК2НШ9	Pressurized cabin wall
23	ШРГ40ПК14НШ2	14-pin pressurized plug connector	1	ШРГ40ПК14НШ2	Pressurized cabin wall
22	СПУ	Inter-communication system	1	СПУ	Pressurized cabin
21	ШРГ48ПК20НШ1	20-pin pressurized plug connector	2	ШРГ48ПК20НШ1	Pressurized cabin
20	ШРГ40ПК14НШ2	14-pin pressurized plug connector	1	ШРГ40ПК14НШ2	Pressurized cabin wall
19	КЭП-4	Ammunition booster box, left and right gun	2	КЭП-4	Tail pressurized cabin
18	АЗ-1АМ	Unaimed fire interrupter	1	АЗ-1АМ	Tail pressurized cabin
17	АП-27	Automatic recharger	2	АП-27	Tail pressurized cabin
16	ВП-54М	Auxiliary control panel	1	ВП-54М	Tail pressurized cabin
15	ОП-54Т	Main control panel	1	ОП-54Т	Tail pressurized cabin
14	КУК-54Б	Tail gun system control box	1	КУК-54Б	Tail pressurized cabin
13	У-2М-16М	Auxiliary amplifier unit	1	У-2М-16М	Tail pressurized cabin
12	У-2М-1М	Electronic-magnetic amplifier	1	У-2М-1М	Tail pressurized cabin
11	ГВ	Elevation mechanism generator	1	Г6А-3Д	6А-3Д
10	ГГ	Turret azimuth drive mechanism generator	1	Г6А-3Д	6А-3Д
9	ДБА	Turret motor-generator unit	1	М6А-3Д	6А-3Д
8	ЭК-7	Ammunition booster electric	2	ЭК-7	Outside the
7	ЭК-7	motor, right and left guns	2	ЭК-7	pressurized cabin
6	Unit 3	Third unit of "Gamma-54T" range finder radar	1	Unit 3	Outside the pressurized cabin
5	РК	Junction box, "Gamma-54T" range finder radar	1	РК	Outside the pressurized cabin
4	ДСП-257-1	Air speed and density transmitter	1		Tail pressurized cabin
3	АВС-257-1	Automatic air firing unit	1	ВБ-257-1	Outside the pressurized cabin
2	КПС-53А	Tail sighting set	1	КПС-53А	Tail pressurized cabin
1	ДБ-65У	Remote control turret	1	ДБ-65У	Outside the pressurized cabin

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SECTION II

ДБ-65У TAIL TURRET

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I. TURRET DESIGN

The [illegible] tail turret is a spherical structure, 900 mm. dia., designed for attaching two 23 mm. AM-23 guns with restricted movement in elevation and azimuth for obtaining the required firing angles.

The turret is based on the production [illegible] turret of the "3M" aircraft.

But unlike the latter the [illegible] turret is provided with the "Gamma-54 [illegible]" range finder radar. Modified are the [illegible] boxes, the external ammunition feed line from the [illegible] turret and the turret-to-aircraft attachment.

The main elements of the turret are: upper attachment fitting, frame, gun carriages, lower support, azimuth [illegible] mechanisms, shutters, ammunition feed system, [illegible] ejection system, pneumatic system and housing.

The turret is attached to the rear [illegible] of the aircraft [illegible] by means of two brackets: upper and lower [illegible] support. The upper attachment fitting takes [illegible] forces acting on the turret.

The lower attachment fitting (lower support) takes only horizontal forces, as it has an axial freedom within a range [illegible] in the ballbearing connecting the lower support to the frame.

Such support-to-frame attachment with the [illegible] spherical roller bearing provided in the upper attachment fitting [illegible] tension in the turret attachment fittings and ensures constant moment of the turret [illegible] in azimuth.

The upper fitting is a cast bracket made of magnesium alloy with a semi-circular boring inserted in which is a ~~spherical roller~~ bearing covered with a cover having a semi-circular groove for bearing.

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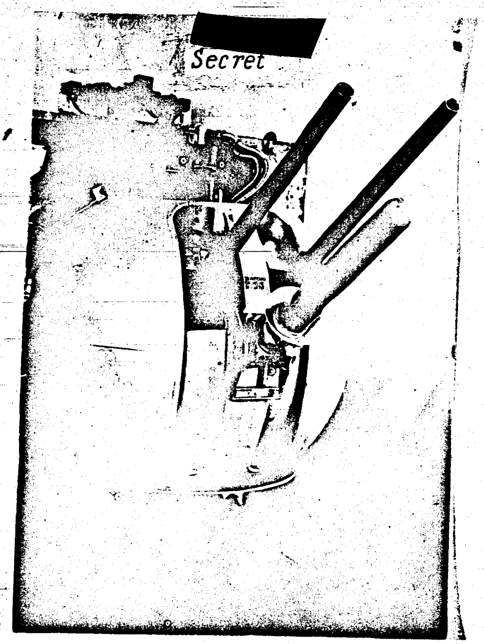

Fig.1a. ДБ-65У Turret

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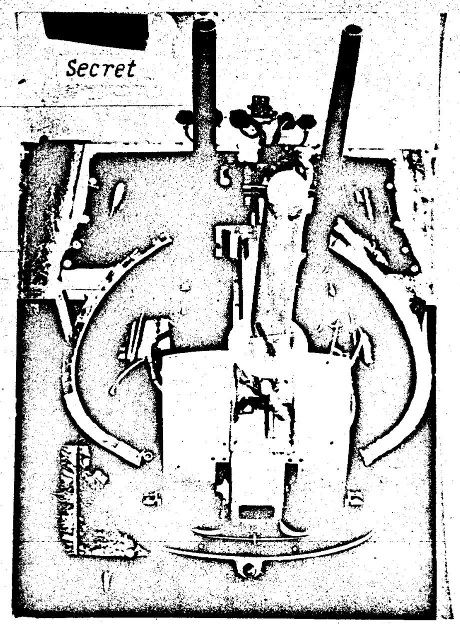

Fig.2. [illegible]-C5Y Turret (front view without housing)

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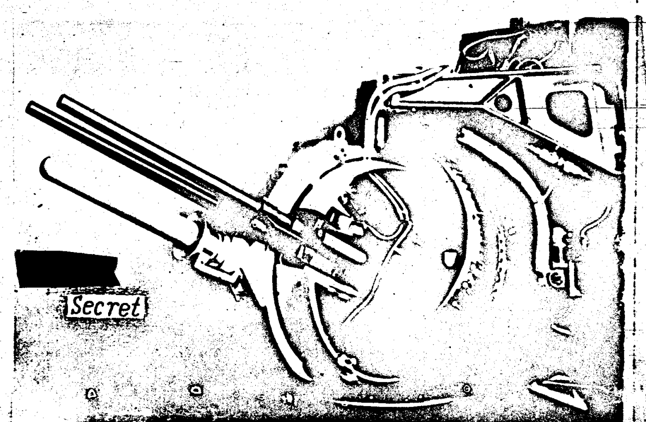

Fig.3. [illegible] Turret (left view without housing)

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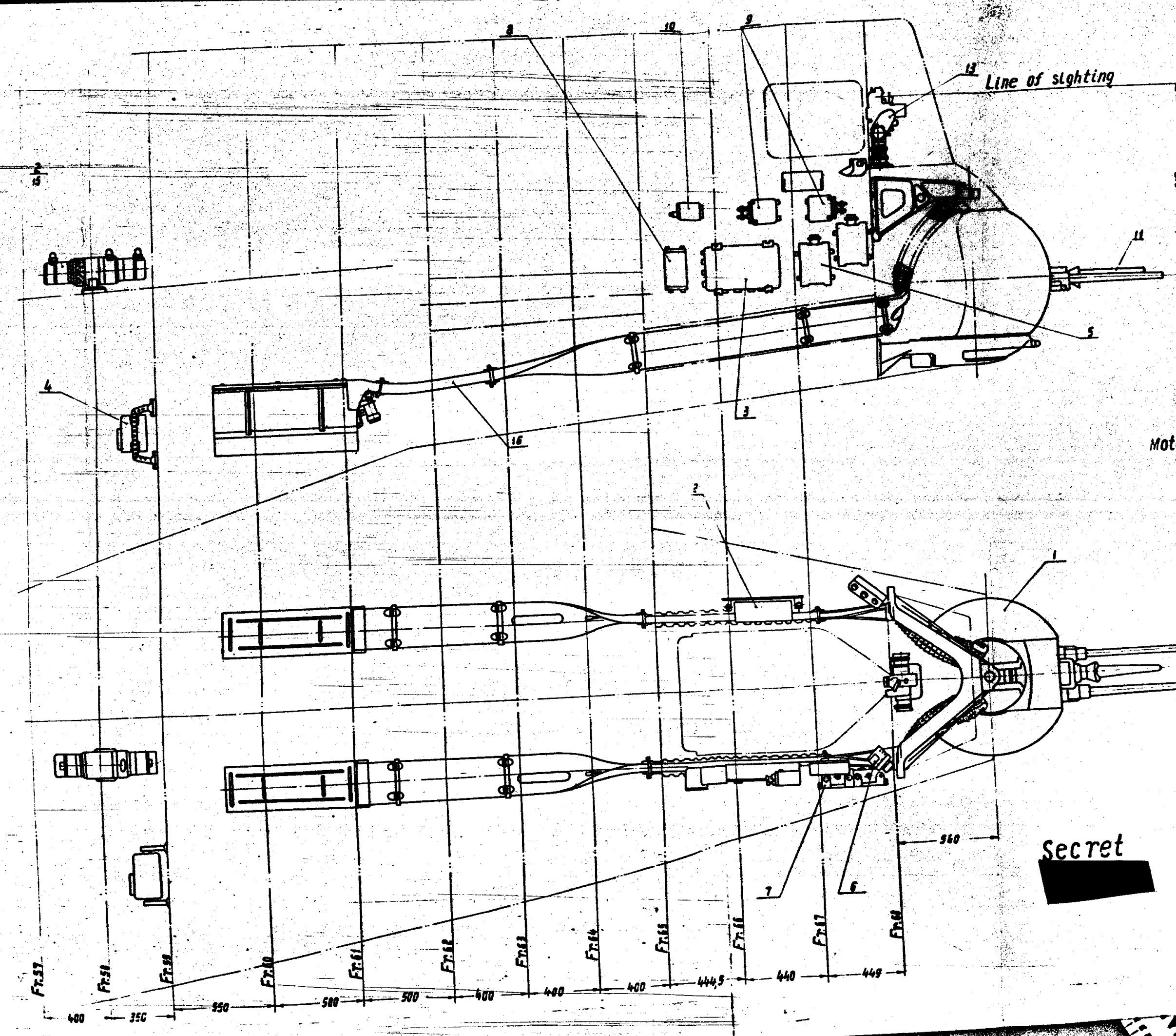

Notes: 1. The azimuth feed line (16) completing is performed according to the aircraft type.
2. The bundles of wires (14) are not shown.

16		Ammunition feed line	1 S
15	8-1	Cover	1
14		Bundles of wires	1 S
13	[illegible]	Tail sighting set	1
12	[illegible]	Amplifier	1
11	[illegible]	CPD-2 range finder radar	1 S
10	[illegible]	Fire interrupter	1
9	[illegible]	Ammunition booster box	2
8	[illegible]	Additional amplifier unit	1
7	[illegible]	Auxiliary panel	1
6	[illegible]	Main panel	1
5	[illegible]	Automatic recharger	[illegible]
4	[illegible]	Computer	[illegible]
3	[illegible]	Tail control box	[illegible]
2	[illegible]	Motor-generator	[illegible]
1	[illegible]	Rear gun installation general view	[illegible]
No.	Code	Item	

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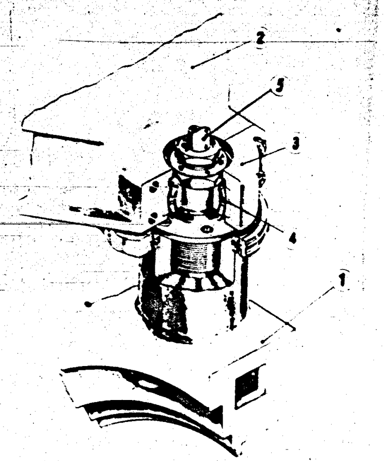

Fig.5. Turret Upper [illegible]

1. frame; 2 - bracket; 3 - cover; 4 - roller [illegible] 5 - [illegible]

link.

The cover is attached to the bracket by 4 bolts.

The frame and the gun carriage make up the main load-carrying part of the turret. They are connected by bearings so that they form a ballbearing in which, the frame serves as the outer race and the gun carriage as the inner race. Installed on the gun carriage either side is a gun.

The turret is rotated in azimuth by the azimuth drive motor which is mounted on the lower support.

The carriage with the guns installed on it is moved in elevation by the elevation drive motor mounted on the carriage.

The azimuth and elevation drive mechanisms each are provided with a fine selsyn-receiver and a coarse selsyn-receiver which ensure together with the sighting set selsyn-transmitters automatic alignment of the gun and [illegible] position.

The casings of the elevation and azimuth mechanisms house the limit switches and the stowed position switches.

The limit switches are actuated when the guns are turned to the extreme position, in this case the [illegible] motor is electrodynamically braked and the gun-to-stop pressing circuits are energized.

After releasing the sighting set control handle the stowed position switches energize the electrical circuit which returns the gun to the stowed position.

The mechanical stops serve to restrict the turret motion in azimuth and elevation. The stops have rubber shock absorbers to prevent a hard impact.

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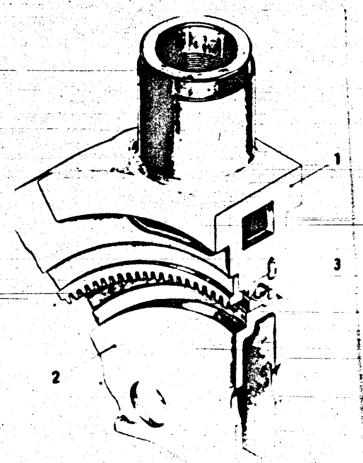

Fig.6. Frame-to-Gun Carriage Attachment

1 - Frame; 2 - gun carriage; 3 - ball.

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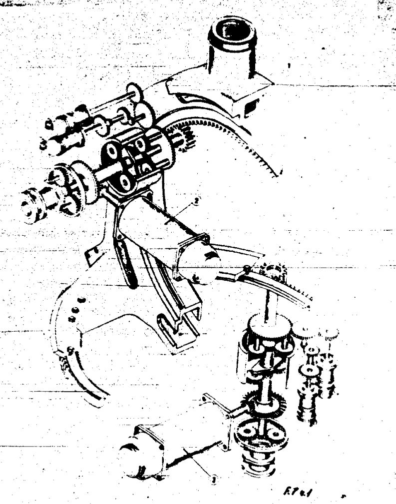

Fig.7. Turret Kinematic Diagram.

1 - Frame; 2 - elevation drive mechanism; 3 - azimuth drive mechanism.

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The turret ammunition is stored in the ammunition boxes located in the aircraft fuselage. To provide constant ammunition feed laid from the ammunition boxes to the gun feed-blocks are ammunition feed lines consisting of rigid chutes and flexible sections in places where fixed parts of the turret change into movable parts.

Due to a considerable length of the ammunition feed lines, to provide constant ammunition feed two ammunition boosters are installed in each line (for right and left gun) which are used to deliver the ammunition left inside the turret, when firing.

Cases and links are ejected through proper chutes overboard.

The shutters [illegible] form [illegible] surface which protects the turret from atmospheric phenomena.

The shutters cover the turret part [illegible] the guns [illegible] elevation.

Installed on the turret are [illegible] range finder [illegible] aids.

The antenna is [illegible] the [illegible] antenna move [illegible] at an [illegible].

The antenna [illegible] in [illegible] the turret.

The [illegible] the antenna in elevation [illegible] bracket, which [illegible] carriage. The fixed bracket [illegible] to the [illegible].

The fixed bracket [illegible] through [illegible] a [illegible] connection [illegible] the movable bracket [illegible] by a split bushing and a nut [illegible] the antenna.

[illegible]

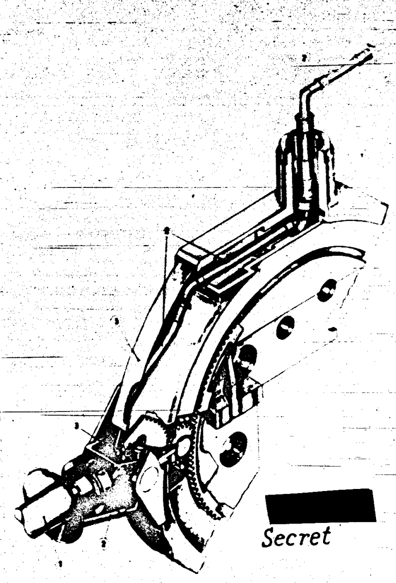

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Fig.8. Kinematic Diagram of "Gamma-54T" Range Finder Waveguide.

1 - antenna; 2 - waveguide links; 3 - capacitive swivel connection; 4 - rotating adapter; 5 - casing.

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The unit-type gear is attached through an axle to the frame. The gear of the unit engages with the gun carriage sector, the other - with the movable bracket sector.

The waveguard is located outside the turret and only two of its upper links are inside the turret.

The outer links are attached to the frame through two brackets and are covered with a casing.

Vertically located on the antenna rotation axis is a swivel connection which ensures the antenna scanning.

The waveguide is brought out of the turret through the axle of the turret upper attachment ballbearing.

To ensure the turret rotation in azimuth, another swivel connection is provided in the upper ballbearing axle.

The waveguide section above the rotating adapter is brought out of the turret through the bushing in the frame upper part and is attached to the aircraft structure. Further the waveguide stretches in the fuselage towards the "Gamma-54?" range finder radar computing equipment.

The movable part of the turret is connected to the remote control fixed units by flexible electric wiring.

I. F R A M E

The frame is made of magnesium alloy in the form of two rings: horizontal ring of a blunt angle section and a large vertical ring of a box section with lightening holes, which is inserted into the horizontal ring.

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The horizontal (lower) ring has a mounting groove and holes for attaching the lower support horizontal toothed sector which also serves as the outer race of the ballbearing connecting the frame to the support.

The lower ring outer surface is of spherical shape to ensure proper joint with the spherical housing.

Attached to the side walls of the frame vertical ring are the round-link ejectors. Attached on the right side of the frame vertical ring are two stops which restrict the guns movement in elevation, and the vertical sector engaged with the outlet gear of the elevation mechanism secured on the gun carriage. To attach the [illegible], three fasteners are installed on each ring of the frame: [illegible] on the vertical ring side walls and one [illegible] of the frame lower ring.

In the lower rear part of the frame is a mechanism which restricts the turret rotation in azimuth. With the turret in the [illegible] position, it rests against the [illegible] of the lower support bracket.

[illegible] the frame [illegible] the vertical [illegible] and holes in [illegible] of the azimuth [illegible] mechanism [illegible] is installed.

In the frame front part there are pins for attaching the [illegible] range finder [illegible] fixed bracket and a cutout for the [illegible].

The front upper part has a port for the wave guide.

[illegible] boss made in the form of a cylinder aligns with the lower ring in the frame upper part. Screwed into the cylinder is a bushing used to attach the frame by means of the turret upper attachment fitting roller bearing to the aircraft.

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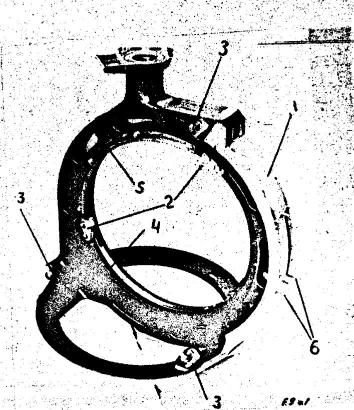

Fig.9. Frame

1 - Frame; 2 - vertical stops; 3 - housing locks, 4 - race;
5 - vertical sector; 6 - pins.

The lower ring and the upper cylindrical boss are designed for attaching the frame to the support and the upper fitting so that it can rotate about the vertical axis.

Secured to the frame upper trunnion by means of two ball-bearings is a bracket with upper ammunition feed throats.

Beneath the cylinder is a plate, secured on which is a rigging lug.

Attached by a bracket in the left upper part of the frame is an bungle of electric wires.

Pressed in the inner boring of the frame vertical ring is a

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steel ring with a groove for the balls, which provide the gun carriage-to-frame moving connection. To ensure the ring reliable pressing it is additionaly pinned.

The balls are placed through a hole in the frame lower part which is then covered with a plug.

The frame rear part is covered with a stainless steel casing, which protects the casting from being damaged by the bundle of electric wires, with the gun carriage moving in elevation.

Thus, the frame as the main load-carrying element of the turret is used for mounting the gun carriage, and for moving it in elevation; it carries the weight of the whole turret, takes through the gun carriage the guns recoil forces and transmits all the loads to the aircraft fittings.

2. GUN CARRIAGE

The gun carriage is made of magnesium alloy in form of a ring box section. The ring inner hole is of rectangular shape for locating the link ejection chutes.

On both sides of the gun carriage are bosses for installing the guns front and rear attachment fittings and the brackets attaching the upper shutters and the non-spill couplings.

In the right upper side of the gun carriage is a bracket for attaching the lower shutters. The stop restricting the gun carriage movement in elevation is secured on the right side above the drive mechanism bracket.

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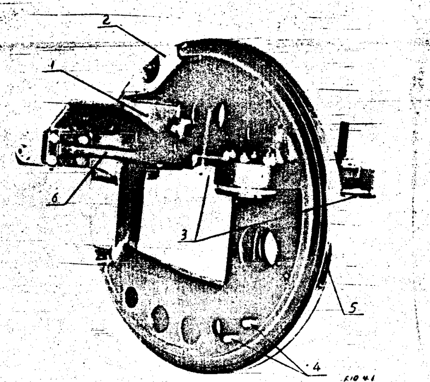

Fig.10. Gun Carriage

1 - Bracket for the elevation mechanism; 2 - stop; 3 - front attachment fitting locks; 4 - pins; 5 - race; 6 - bots for the rear attachment fitting.

The sector secured on the left side in the main ... in the antenna elevation mechanism.

The stainless steel cover plates installed on the carriage protect the casting from damage, when installing or removing the guns.

Pressed on the casting is a race with a groove for balls, which provide the gun carriage-to-frame moving connection.

Front attachment fitting - the main load-carrying attachment fitting of the gun, taking the recoil force and aerodynamic loads, is mounted in the gun carriage front part on ... ends.

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The front attachment fitting consists of a special washer with projections and a locking device, which move in the washer groove. Installed on the gun recuperator trunnions is a bracket with a fork, whose slots receive the washer projections. By turning the locking ring the bracket is secured in the closed position.

One of the fork two lugs has a threaded hole in which a lug is screwed till it rests against the recuperator trunnion end.

The plug is designed for eliminating the recuperator trunnions axial play in the lugs.

The locking ring is prevented from turning inadvertently, when firing, by a handle, which with the ring closed, turns 90° up and enters the slot of the restrictor secured to the gun carriage base.

The gun angular motion required for adjusting fire is permitted in the front attachment fitting.

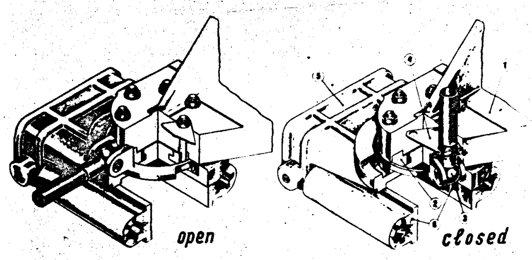

Fig.11. Front Attachment Fitting (left)

1 - Gun carriage; 2 - washer; 3 - lock; 4 - restrictor; 5 - bracket; 6 - recuperators.

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Rear attachment fitting serves as additional support for the gun and is used for the gun adjustment during adjusting fire.

The rear attachment fitting is a cast steel bracket, secured in which is an eccentric bolt. Placed on the eccentric bolt (threaded bushing) is a guide assembly, along whose slots the gun slides at recoil and recuperation. Turning the threaded bushing in either direction moves the guide assembly and consequently the gun right and left.

Turning the eccentric bolt in the bracket raises and lowers the gun. These mutually perpendicular movements accomplish the gun required adjustment in two planes.

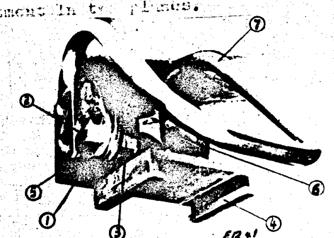

Fig.12. Rear Attachment Fitting (Left)

1 - bracket; 2 - eccentric bolt; 3 - bushing; 4 - guide assembly; 5 - eccentric bolt stop; 6 - bushing stop; 7 - [illegible] tube.

After adjustment the bushing and the eccentric bolt are locked. The rear left attachment fitting is provided with a supporting tube to prevent damage of the left flexible shaft.

LOWER SUPPORT

The lower support is a magnesium alloy bracket with a large ballbearing, whose movable ring is connected to the frame.

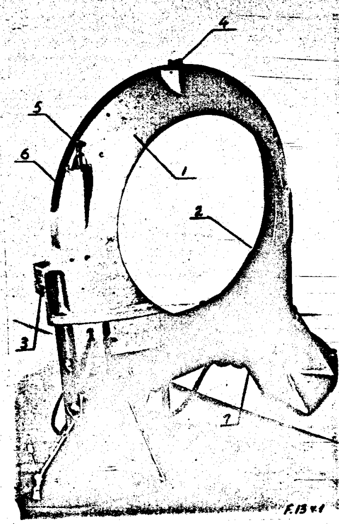

Fig.15. Lower Support

1 - Bracket; 2 - ballbearing; 3 - stop; 4 - KS-59 tail light; 5 - clutch unlocking mechanism; 6 - dial; 7 - azimuth drive mechanism.

The bracket front part is of spherical shape.

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Mounted on the bracket are: the azimuth drive motor, [illegible] tail light with bundle of electric wires passing from it to the aircraft and the azimuth drive motor clutch unlocking mechanism.

The bracket has two stops which restrict the turret rotation in azimuth.

In the lower part of the bracket is a round hole which is covered [illegible] with the case-and-link ejector.

The rear part of the bracket has two lugs for attaching to the aircraft.

The ballbearing consists of the inner race secured [illegible] outer race, which also serves as toothed sector for the [illegible] mechanism, and of balls laid between the inner race and the [illegible] proper grooves.

The balls are laid through a hole covered with [illegible].

The outer race has holes for attaching to the frame.

The lower support ballbearing is designed for [illegible] components of the guns recoil forces.

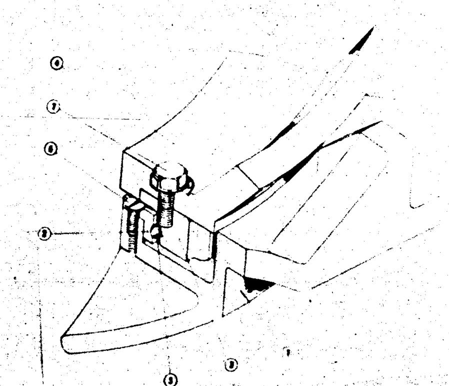

Fig.14. Ballbearing Section
1 - Bracket; 2 - inner race; 3 - outer race; 4 - frame; 5 - ball; 6 - screw; 7 - bolt.

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4. AZIMUTH DRIVE MECHANISM

The azimuth drive assembly is an electric mechanism designed for the turret rotation and automatic alignment of the guns and the sight in azimuth.

The azimuth drive mechanism is mounted on the lower support. The drive outlet gear is engaged with the gear sector, installed on the movable race of the lower support ballbearing and secured on the frame.

During the azimuth drive operation its outlet gear turns in azimuth the toothed sector, connected with the frame, [illegible] the whole turret.

To align the gun and sight the drive outlet gear shaft is kinematically connected to the rotors of the fine and coarse selsyn-receivers which are electrically connected to the sighting set selsyn-transmitters.

The azimuth drive mechanism consists of the following main elements:

a) power reduction gear;

b) selsyn reduction gear;

c) limit and stowed position [illegible] unit;

d) [illegible] electric motor;

e) two ГС-4 selsyn-receivers.

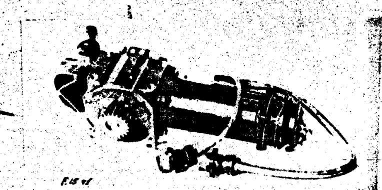

Fig.15. Azimuth Drive Mechanism

Power reduction gear incorporates an outlet gear, two cylindrical planetary stages and a conical pair.

The conical pair small gear is placed on the electric motor shaft.

The gears shafts rest against the ballbearings or have metal-ceramic bushings.

Due to application of the planetary gear the azimuth drive mechanism has a compact structure and a high gear ratio.

The gear ratio from the electric motor shaft to the outlet gear is 1:89, 34. The gear ratio from the electric motor shaft to the horizontal sector and the gun is 1:4072.

The power reduction gear is mounted in the drive casing cast of magnesium alloy, closed with a cover and provided with threaded holes for the drive attachment. The cover has two holes for the drive mechanism additional attachment.

Selsyn reduction gear is mounted in a separate casing attached to the reduction gear casing through a special boss.

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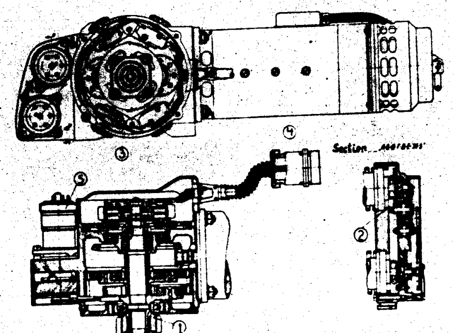

Fig.16. Azimuth Drive Mechanism Section

1 - Power reduction gear; 2 - selsyn reduction gear;

3 - limit and stowed position switches unit;

4 - [illegible] electric motor; 5 - [illegible] selsyn-receiver.

The selsyn reduction gear transmits the turret rotation in azimuth to the rotors of the [illegible] coarse and fine selsyn-receivers.

The gear placed on the drive outlet shaft is the driving gear of the selsyn reduction gear. The selsyns are connected to the selsyn reduction gear transmission by means of couplings free from play.

Motion is transmitted to the fine selsyn rotor inside the drive by a pair of external engagement cylindrical gears through the intermediate satellite gear. The gear ratio from the lower support horizontal sector to the fine selsyn rotor is 3t times as high as the turret turn angle.

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The azimuth drive fine selsyn-receiver controls the turret rotation in azimuth from [illegible] to [illegible], i.e. till the guns and the sight are aligned.

Motion is transmitted to the coarse selsyn rotor inside the drive through 3 pairs of outer engagement cylindrical gears.

The lower support horizontal sector-to-coarse selsyn rotor gear ratio is equal to 1, therefore the coarse selsyn rotor turns at an angle equal to the turret turn angle in azimuth.

The coarse selsyn-receiver of the azimuth actuator controls the turret rotation in azimuth till it reaches a position which differs from the synchronized position in an angle of 3°–5°.

The selsyns are installed on a special boss of the reduction gear casing and each is secured by two special rings and two screws. When adjusting the selsyns (turning them about their axis) loosen the screws. After adjustment tighten the screws, secure them with wire and seal.

The limit and stowed position switches unit is located inside the drive mechanism casing and consists of a planetary transmission, two shaped discs and four switches: two KB-3 limit switches and two [illegible] stowed position switches.

The switches are mounted on hinged brackets pressed by springs to the shaped discs.

When turning, the discs lugs press the switches to special screws in the casing, in this case the switches are actuated.

The switches actuating moment is adjusted by turning the shaped discs and adjusting screws located in the casing.

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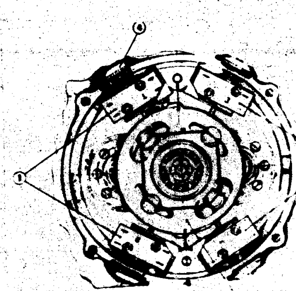

Fig.17. Position diagram of limit switches and Stowed Position Switches.

1 - Limit switches; 2 - stowed position switches; 3 - shaped disc. 4 - adjusting screw.

To increase the cams scale, i.e. to decrease the [illegible] error, the shaped discs make two revolutions during one revolution of the turret.

The limit switches actuating in the turn angle restriction area, energize the electric circuit, decreasing the electric motor moment to the pressing to the stop value, and accomplishing [illegible] braking.

After releasing the sighting set control handle, the stowed position switches energize the electric circuit returning the guns to stowed position.

MV-550 TY electric motor is attached to the drive mechanism casing.

The electric motor has an electromagnetic braking clutch used for the armature locking.

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The braking clutch prevents inadvertent rotation of the turret when the latter is de-energized.

To facilitate the turret operation on the ground, the electromagnet clutch can be cut out by turning the switch provided on the electric motor.

The electromagnetic clutch of the electric motor is cut-out by an unlocking mechanism mounted on the lower support bracket and consisting of a cable, one end of which is secured to the switch, the other is provided with a handle.

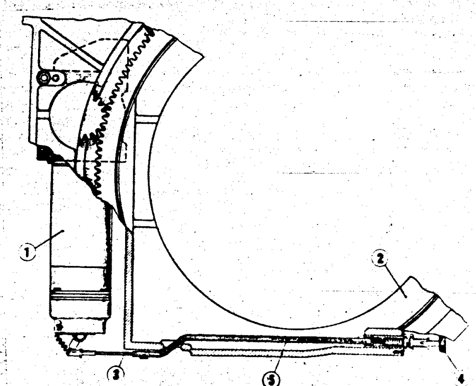

Fig.18. Azimuth Drive Motor Clutch Unlocking Mechanism.

1 - Electric motor; 2 - lower support; 3 - cable; 4 - handle; 5 - casing.

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5. ELEVATION MECHANISM

The elevation electrical mechanism assembly is designed to move the turret and align the gun and the sight in elevation.

The elevation mechanism is installed on the gun carriage.

The mechanism outlet gear is engaged with the toothed sector secured on the frame.

During the mechanism operation its outlet gear rolls up and down the toothed sector and moves the gun carriage with the guns, installed on it, in elevation.

To align the gun and the sight in elevation, the shaft of the mechanism outlet gear is kinematically connected with the rotors of the fine and coarse selsyn-receiver which are electrically connected to the sighting set selsyn-receivers.

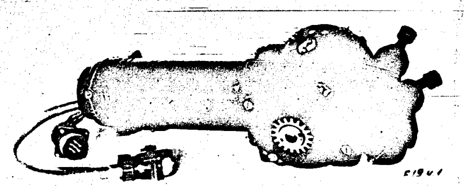

Fig. 19. Elevation Mechanism.

The construction and operation of the elevation mechanism are similar to those of the azimuth drive mechanism.

The elevation mechanism differs from the azimuth drive mechanism in:

a) power reduction gear outlet which has 18 teeth instead of 20 (the gear ratio of the drive and the transmission from the electric motor shaft to the gun being the same);

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b) shaped discs of limit switches unit (as the gun turning angles in elevation differ from the turret turning angles in azimuth).

The МУ-550ТУ electric motor electromagnetic clutch unlocking mechanism is mounted on the front right-hand bracket and consists of a cable secured on the electric motor clutch switch and a trigger.

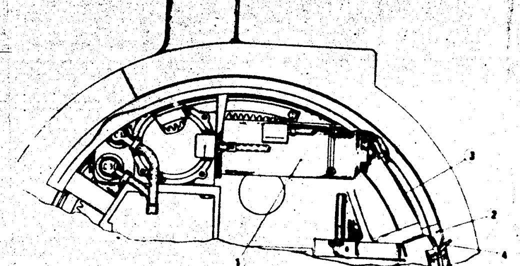

Fig.20. Elevation Motor Clutch Unlocking Mechanism

1 - Motor; 2 - front r.h. bracket; 3 - cable; 4 - trigger.

6. SHUTTER

The shutters cover the turret ports, when guns move in elevation.

The turret is provided with upper and lower shutters on either side of the gun carriage.

The upper shutters (right and left) are made of a ... steel sheet.

The upper right shutter is attached to the brackets by bolts and anchor nuts, which makes the shutter easy-removable and facilitates the selsyns adjustment.

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Riveted to the upper left shutter are two brackets: front and rear, which are secured on the gun carriage.

The lower shutters (right and left) are shaped parts cast of magnesium alloy; they have channels, coated with a stainless steel sheet, for links passage.

Suspended in each channel in the shutter front part is an ejector. At the upper angles the ejectors provide a direction required for the links passage and prevent the links from being scattered during the gun carriage rotation.

The lower shutters are attached to the gun carriage by pins.

The shutters are provided with ports for installing and removing the guns. The ports are closed with special plugs and fastened with locks.

Fig.21. Shutter Upper Right

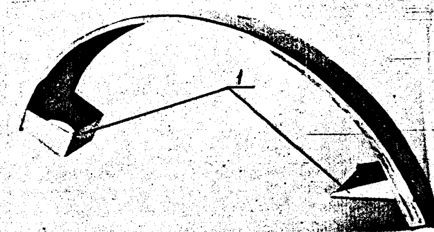

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Fig.22. Shutter, Upper Left

1- Brackets.

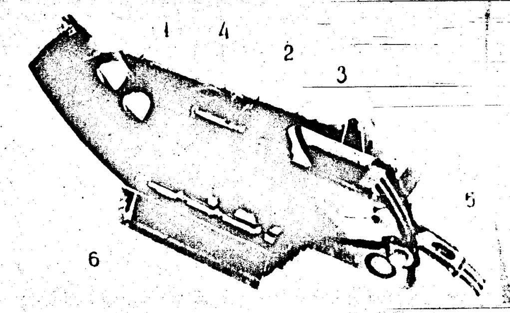

Fig.23. Shutter, Lower Left, with Case Ejection Chute and Rigid Feed Throat.

1 - Shutter, 2 - ejector; 3 - plug; 4 - lock; 5 - case ejector chute; 6 - rigid feed throat.

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Attached to the lower chutters are case ejector chute and rigid feed throats.

The shutters lower part is covered with cover plates.

7. AMMUNITION FEED SYSTEM

The ammunition feed system of each gun consists of the following units:

a) ammunition box;

b) rigid chutes;

c) outer flexible chute;

d) inner flexible chute;

e) rigid throat;

f) feed-block throat.

Placed on each gun feed-block is a special frame with a horn to receive the ammunition belt.

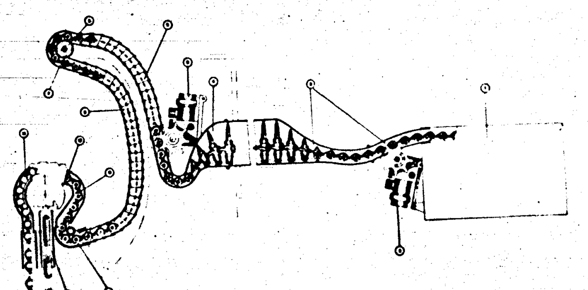

Fig.24. Ammunition Feed and Case and Link Ejection System.

1 - Ammunition box; 2 - ammunition booster; 3 - ammunition feed line rigid chute; 4 - outer chute throat; 5 - flexible outer chute; 6 - outer chute ammunition booster; 7 - flexible inner chute throat; 8 - pulley; 9 - flexible inner chute; 10 - rigid throat; 11 - feed-block throat; 12 - frame; 13 - link ejection chute; 14 - case ejection chute.

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The system provides the ammunition feed at all azimuth and elevation angles of the guns.

Ammunition boxes (right and left) are designed for housing ammunition belts. Each box contains 200 rounds.

An ammunition box is a box of riveted construction and consists of two parts. Installed inside the box at the box opening and at the partitions are pulleys which facilitate the ammunition belt movement. In the upper parts of the boxes are detachable covers; secured on each box is an ammunition booster. The boxes are attached to the aircraft structure by means of special brackets.

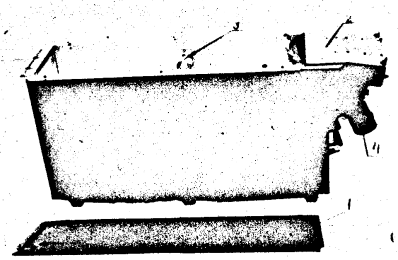

Fig.25. Ammunition Box.

1 - Cover; 2 - ammunition box throat; 3 - roller; 4 - ammunition booster.

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The ammunition belt by the booster is supplied from the ammunition box into the rigid chutes of the ammunition feed line.

Rigid chutes are designed for sending the ammunition belt from the ammunition box to the external flexible chutes whose throats serve as continuation of the rigid chutes.

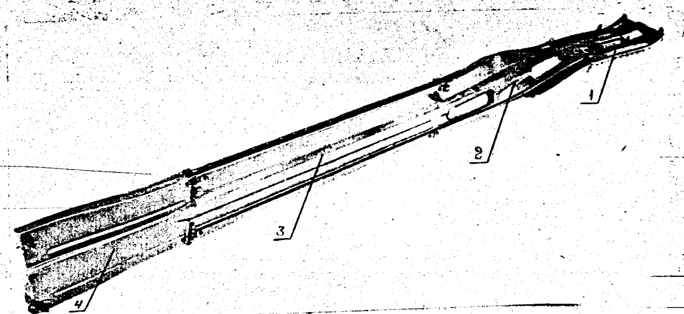

Fig.26. Rigid Chute of "" Aircraft Ammunition Feed Line.

1 - Ammunition box end section; 2 - twisted section; 3 - straight section; 4 - flexible chute end section.

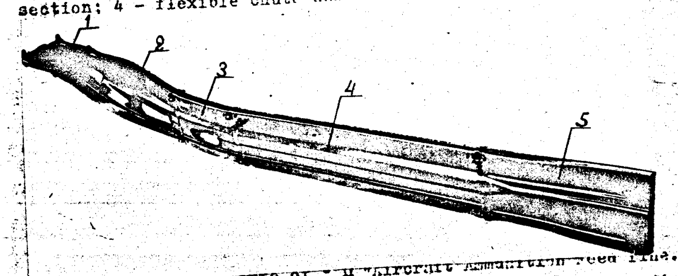

Fig.26a. Rigid Chute of "" Aircraft Ammunition Feed Line.

1 - Ammunition box end section; 2 - twisted section; 3 - intermediate section; 4 - straight section; 5 - flexible chute end section.

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Each rigid feed chute for the "T" aircraft consists of the following parts: ammunition box end section, twisted section straight section and flexible chute end section; the rigid feed chute for the " П " aircraft consists of the following parts: ammunition box end section, twisted section, intermediate section, straight section and flexible chute end section.

The rigid chutes are made of a steel sheet and are attached to the aircraft structure.

Outer chutes consist of throats which serve as continuation of the rigid chutes and the flexible chute riveted to the throat.

The flexible outer chutes pass over the housing and have a quick-disconnect joint with the upper throats of the inner flexible chutes through adapters.

The outer chute throat is welded of stainless steel sheets. The throat is provided with a bracket for the ammunition booster attachment.

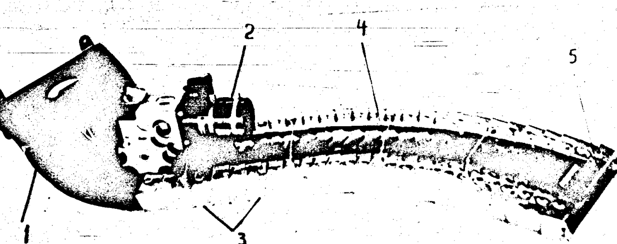

Fig.27. Outer Chute, Left.

1 - Throat; 2 - ammunition booster; 3 - links; 4 - cable; 5 - adapter.

Each rigid feed chute for the "T" aircraft consists of the following parts: ammunition box end section, twisted section straight section and flexible chute end section; the rigid feed chute for the " H " aircraft consists of the following parts: ammunition box end section, twisted section, intermediate section, straight section and flexible chute end section.

The rigid chutes are made of a steel sheet and are attached to the aircraft structure.

Outer chutes consist of throats which serve as continuation of the rigid chutes and the flexible chute riveted to the throat.

The flexible outer chutes pass over the housing and have a quick-disconnect joint with the upper throats of the inner flexible chutes through adapters.

The outer chute throat is welded of stainless steel sheet. The throat is provided with a bracket for the ammunition booster attachment.

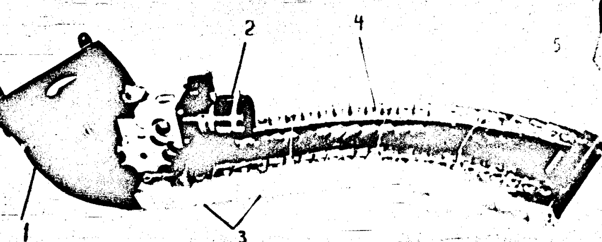

Fig.27. Outer Chute, Left.

1 - Throat; 2 - ammunition booster; 3 - links; 4 - cable; 5 - adapter.

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The ammunition booster operates as follows: as soon as the guns electric firing solenoid circuit is energized the ammunition booster electric motor starts operating, and the RK -7 ammunition belt placed under the sprockets is delivered from the rigid chute into the outer chute.

When a considerable tension on the ammunition belt occurs in the outer chute and the sprockets are unable to rotate, the friction clutch slides.

The friction clutch sliding moment can be adjusted by pressing the washers. As soon as the ammunition belt tension is relieved, when firing, the belt is delivered again.

To provide the required supply of the ammunition belt in the chute [illegible] the beginning of firing, with the ammunition booster [illegible] circuit being accelerated, incorporated in the ammunition [illegible] time delay relay, which de-energizes the ammunition booster electric motor not immediately after finishing firing but after [illegible] time required for the booster to deliver the necessary ammunition belt supply to the chute before the next round of fire.

The flexible outer chutes are designed [illegible] deliver [illegible] the ammunition belt from the rigid chutes through the throats [illegible] the flexible [illegible] chutes throats.

The flexible outer chutes consist of links which [illegible] the required flexibility.

The links are made of stainless steel and connected [illegible] one another by washers and rivets, which permit relative movement of the links.

The links of the flexible outer chutes are provided with tightening cables.

Flexible chutes serve as continuation of outer chutes and consist of two throats connected to each other, links and an adapter.

Throats (1) right and left are welded of stainless steel sheets.

On the outside they have brackets to attach the brackets placed on the frame cylindrical part and two clamps for the pneumatic line attachment.

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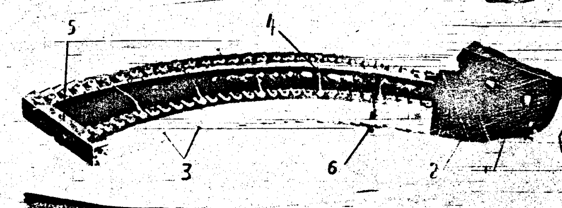

Fig.28. Flexible Chute.

1 - Throat; 2 - intermediate throat; 3 - links; 4 - cable; 5 - adapter; 6 - clamp.

Inside the throats are rollers which ensure smooth movement of the ammunition belt.

Intermediate throats (2) are connected to the flexible chutes consisting of links attached to one another by washers and rivets.

The links are provided with tightening cables and a clamp attaching the pneumatic line.

Attached to the last link is the adapter (5) used to secure the chute to the rigid throat by means of an easy-detachable fastener.

Rigid throats are attached on the lower shutters and used for delivering the ammunition belt from the flexible chutes into the feed-block throats.

The pulley mounted in the throat is used to facilitate the ammunition belt movement.

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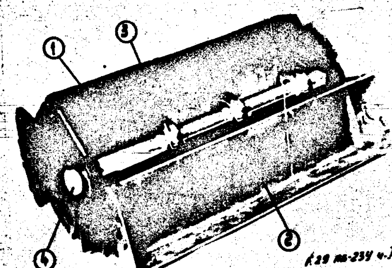

Fig.29. Rigid Throat, Left

1 - Fixed throat; 2 - throat; 3 - roller; 4 - shaft.
The feed-block throat is installed on the bushings which are placed on the shaft.
The feed-block throat delivers the belt through the frame into the gun feed-block.

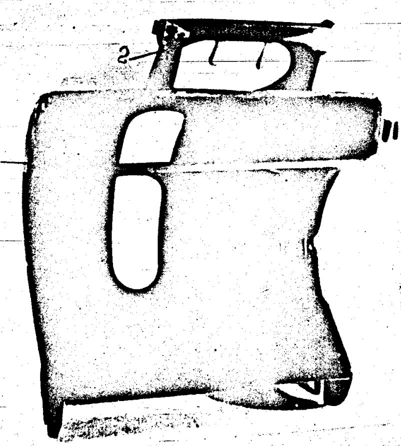

Fig.30. Feed-Block Throat, Left

1 - Feed-block throat; 2 - fastener.

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By means of cutouts the feed-block throat is placed on the bushings of the rigid throat shaft.

The fastener mounted in the upper part of the feed-block throat, is attached to a special bracket on the gun carriage. The fastener construction ensures quick removal of the throat. The feed-block throat upper part has a horn ensuring the guns recoil and recuperation.

8. CASE-AND-LINK EJECTION SYSTEM

The case-and-link ejection system for each gun consists of a case ejection chute and a case-and-link ejector.

Case ejection chute is designed for ejecting the cases and misfired cartridges into the case-and-link hopper through which they are ejected overboard.

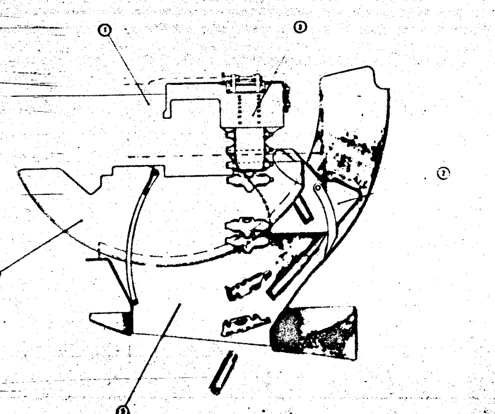

Fig.31. Links, Cases and Misfired Cartridges Ejection Diagram
1 - Gun; 2 - case ejection chute; 3 - link ejection chute; 4 - lower chutter. 5 - case-and-link ejector hopper.

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The case ejection chute is a steel box inside which is a movable panel for directing the cases and clips into the case-and-link ejector hopper.

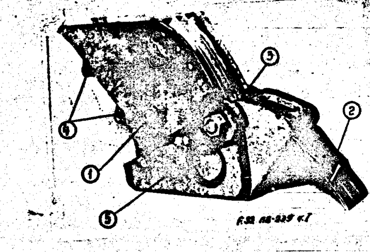

Fig.32. Case Ejection Chute.

1 - Box; 2 - panel; 3 - spring; 4 - bushing; 5 - bracket.

The case ejection chute is attached to the lower shutter by means
of two welded bushings ~~with holes~~, bracket and holes in the side wall.
Link ejection chute is used to eject links from the ~~guns~~ through
the channels in the lower shutters into the case-and-links ejector
hopper through the ports of which they are ejected overboard.

The link ejection chute is secured on the gun and comprises a frame with a latch, ~~for attaching~~ to the gun feed-block, and two guide sections.

Separate parts of the link ejection chute are riveted to one another. The case-and-link ejector is designed for ejecting links, cases and misfired cartridges overboard.

The case-and-link ejector consists of the right and left hoppers and bottom.

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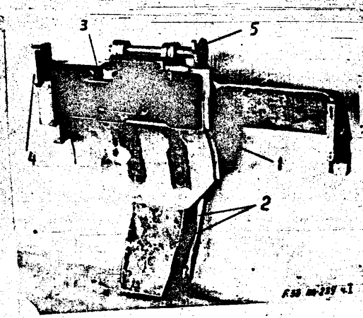

Fig.33. Link Ejection Chute, Left.

1 - frame; 2 - guide sections; 3 - extractor; 4 - latch; 5 - pin.

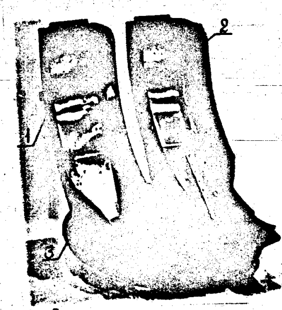

Fig.34. Case-and-Link Ejector

1 - right hopper; 2 - left hopper; 3 - bottom.

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The case-and-link ejector bottom is of spherical shape and has two ports through which the cases, cartridges and links are ejected overboard.

The case-and-link ejector is attached to the frame.

9. AUTOMATIC RECHARGING SYSTEM

The automatic pneumo-electric gun recharging system permits the gunner not to watch the guns condition and ensures the gun recharging in case of fire stoppages.

The turret pneumatic system is supplied from the aircraft pneumatic system.

Air under a pressure of 65+3 kg/cm.^{2} passes from the aircraft pneumatic system through a pipe into a bottle secured in the upper bracket. The bottle is provided with a safety valve.

From the bottle the air passes to the ЭК-48 electro-pneumatic valves located on the lower surfaces of the upper bracket, one on each side.

Secured by slamps to the flexible chute throat are pneumatic hoses connected to the ЭК-48 valve. Between the ЭК-48 valve and the flexible chute throat the pneumatic hose forms a loop which ensures the turret rotation in azimuth.

Next, the hose extends along the flexible chute in clamps, welded to the chute links, and forming a loop is connected to the elbow secured to the gun carriage by means of a bracket. The loop ensures the gun movement in elevation.

The pipe which stretches from the elbow has a sleeve connected to the non-spill coupling secured on the gun carriage.

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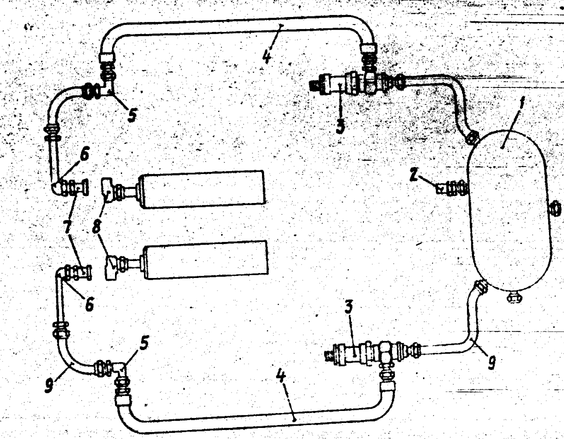

Fig.35. Pneumatic System Diagram

1 - Bottle; 2 - safety valve; 3 - ЭК-Ш electro-pneumatic valve; 4 - pneumatic hoses; 5 - elbow; 6 - pipe connection; 7 - non-spill coupling; 8 - adapter; 9 - pneumatic pipes.

From the non-spill coupling the air passes through the adapter into the gun recharging cylinder.

Absence of rigid non-spill coupling-to-gun connection facilitates the gun removal.

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10. TURRET INNER ELECTRIC WIRING

All the inner electric cables of the turret are shielded. The turret power supply is made through the bundle of wires having taps extending to the turret, azimuth drive mechanism, ammunition boosters and to the aircraft frame bonding point.

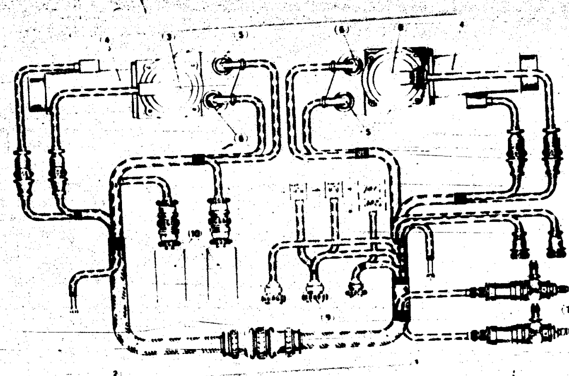

Fig.36. Turret Inner Wiring Diagram.

1- Common bundle of wires; 2 - gun carriage bundle of wires; 3 - elevation mechanism; 4 - electric motors; 5 - fine selsyns (C-J 1); 6 - coarse selsyns (C-1); 7 - electro pneumatic valve ЭК-48; 8 - azimuth drive mechanism; 9 - pressurized plug connectors; 10 - recharging cylinders.

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The bundle of wires entering the turret is attached to the upper bracket and forms a loop, which ensures the turret rotation in azimuth. Next, the bundle is attached to the frame and then, forming a loop, is attached to the gun carriage. The loop ensures the guns motion in elevation. Next, the bundle branches to the elevation mechanism, guns and to the aircraft frame bonding point. The plug connectors are secured to the brackets.

11. H O U S I N G

The housing is used to protect the turret inside from [illegible] [illegible] phenomena and air flow, it consists of [illegible] removable parts, [illegible] provide an access to the turret inside. [illegible]
The shield is screwed to the frame by two [illegible] fasteners.
[illegible] for access to the [illegible] [illegible].
When assembled, the housing is of [illegible]

The housing removable parts are attached to the [illegible] [illegible] fasteners, which facilitates the housing removal [illegible] [illegible] [illegible] rein- [illegible] to the edges of the housing [illegible] forcing sections. Three lugs are provided [illegible] attachment.

In the rear upper part, both [illegible] are connected by an easy-removable fastener.

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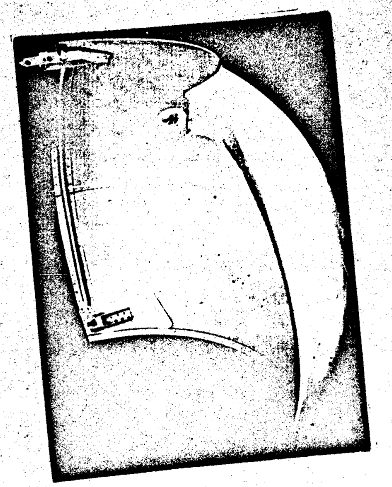

Fig. 57. Removable Part of Housing.

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Single Set of Aircraft

Spare Parts and Equipment

Complete List

No......

Container No. 1/32

Ground Equipment

Nos.	Description	Drawing No.	Quantity	Notes
1	2	3	4	5
1.	Ground equipment container with platform Э9050-60	Э9999-210	1	
2.	Thrust jack	П9103-400	1	
~~3.~~	~~Warming cover for propeller spinner~~	~~Т0020-0~~	Не применяется	
4.	Device for fixing L.G. nose strut in extended position	Э9217-100	1	
5.	Feet cleaning grating	П9238-0	2	
6.	Dip stick for checking kerosene level in tanks	П9222-0	1	
7.	Float gauge	Т9244-0	2	
8.	Device with winch [illegible]-47 for loading photoflash bombs [illegible]-100-60	Т5803-20	1	
9.	Plug for engine air cooling intake	Т9225-00	4	
10.	Plug for thermal element blowing port of fuel control unit	Т9225-40	4	
11.	Adapter ЕТЗ-200 for hose П9239-0	П9239-10	1	
12.	Locking device for nose strut	П9220-40-0	1	
13.	Adapter for warming up the engine	Э9241-0	4	

1	2	3	4	5
14	End piece for КПУ-3 of ТП-156 tube	Т9251-0	1	
15	Vacuum fitting for КПУ-3 of static pressure tubes	У9234-50	1	
16	Pipe union for filling L.G. shock-absorbers with fluid	П9235-1	1	
17	Pivot pin complete with roller t8508-70/2 (attached to БЛ-47)	Т8503-115	1	
18	Plug	Т9225-550/5	3	
19	Plug	Т9225-500	2	
20	Device	Т9222-250	4	
21	Plug	Т9225-700	2	
22	Vacuum cleaner		1	
23	Valve for charging undercarriage shock-absorbers	Т9941-48	1	
24	Air hose with adapter П9123-100	Т9122-212	1	

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Box No. 2

Spare parts

Nos.	Description	Drawing No.	Quantity, pieces	Notes
1	2	3	4	5
	Power Plant			
	АВР-2В			
1.	Spare parts in case, wrapped		4	
	МКм-3а			
1.	Spare parts in case, wrapped		1	
	АПД-54			
1.	Shock absorber, "Lord" type	271043-1-1	6	
	НФ-2Т-1			
1.	Packing ring	РЗ-012	2	
2.	Same	РЗ-041	1	
3.	Wrench	МН-235	1	
	ЭМ-44 (НФ-2Т1)			
1.	Spare parts in case, wrapped		4	
	АВ-68И			
1.	Spare parts in sealed box		4	
2.	Mounting tools in sealed box		1	
	АИ-20			
1.	Aircraft carried tool bag, sealed		2	
2.	Spare parts in sealed box		4	

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1	2	3	4	5
	435 BФ			
1.	Spare parts in case, wrapped		2	
	623			
1.	Spare parts in case, wrapped		2	
	ГА-171/18			
1.	Packing ring	452.025	4	
	BF-01			
1.	Spare parts in sealed case		1	
	ГА-36			
1.	Packing ring	452.104	8	
2.	Same	452.105	4	
3.	Locking wire, steel, cadmium-plated, ∅ 0.5, 1=1 m		2	
	ГА-159/3			
1.	Packing ring	452-058	6	
2.	Washer	16198	4	
	CCУ-5			
1.	Cork membrane		80	
2.	Gasket		[illegible]	
3.	Buffer		[illegible]	
4.	Spring		[illegible]	
5.	Thrust ring, small		[illegible]	
6.	Safety diaphragm		[illegible]	
7.	Plug		[illegible]	
8.	Sight		[illegible] for [illegible] aircraft	
9.	Handwheel		[illegible]	

1	2	3	4	5
10.	Wrench		1)	for three
11.	Socket wrench		1)	aircraft
	Brakewheel 1050x3008			
1.	Spare parts in sealed case		one pack	
	СС-8М			
1.	Packing ring	Г 3 3-07	6	
2.	Clamping ring	Г 2 3-04	6	
3.	Membrane		6	
4.	Handwheel		1	
5.	Wrench	СС820	1	
6.	Base	СС830	1	
7.	Plug		1	
8.	Plug		12	
9.	Ring	ЭДП10.35	12	
10.	Gasket	-008-6	6	
	Electric Equipment			
	ИС-750			
1.	Spare parts in case, wrapped		1	
	ПАГ-14П			
1.	Spare parts in case, wrapped		1	
	ПТ-500Ц			
1.	Spare parts in case, wrapped		2	
	СГО-12			
1.	Spare parts in case, wrapped		4	

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1	2	3	4	5
	Б6100-40 МЗК-2			
1.	Spare parts in case, wrapped		5	
2.	Spare parts in case, wrapped		3	1:5
	НС102-40 МЗК-3			
1.	Spare parts in case, wrapped		10	
	ЭР-10			
1.	Brush	~~[illegible]~~	2	
	ЭТ-11			
1.	Spare parts in case, wrapped		1	
	ДБ-3			
1.	Spare parts in case, wrapped		5	
	МБ-300			
1.	Spare parts in case, wrapped		2	
	ФАРА-ФПС-200			
1.	Spare parts in case, wrapped		3	
2.	Lamp СМФ-[illegible], 26V 600W 28V 180W		3	
3.	Screw	4x10	12.	
	ШПС-23			
1.	Lamp	СМ-31	5	
	КФЛ-37 ~~[illegible]~~			
1.	Spare parts in pack		4	
	РВЗ-45			
1.	Spare parts in pack		1	

1	2	3	4	5
	~~ВК-41~~			
~~1.~~	~~Spare parts in pack~~		Не прикладывается	
	2ТЦР-47			
1.	Spare parts in pack		1	1:2
	ЭКСП-39			
1.	Wrench		1	
2.	Drift		1	
3.	Brush		1	
4.	Cleaning rod		1	
5.	Handle		1	
6.	Pilot lamp in case or in can		5	
7	Stem co-axiality control gauge		Не прикладывается	
	АП-28 Д			
1.	Spare parts in sealed box		2	
	4Г-44/I			
1.	Spare filtering elements		4	
	ТВГ-26			
1.	Spare parts in case, wrapped		2	
	СЭ9			
1.	Membrane		5	
	12ТФ-29			
1.	Filtering element	340025	16	
2.	Packing ring	2709С54-25-2.5Г	32	
3.	Same	ТФ6-202	16	
	15 ГФ17 and 15ГФ 17А			
1.	Filtering element	340023	12	

1	2	3	4	5
2.	Packing ring	212039	12	
3.	Same	212019	12	
4.	Same	212075	12	
5.	Same	212037	9	
	Spare parts for ССП-2А			
1.	Transmitter	ДПС-1А	8	
~~2.~~	~~Socket~~	~~P-417~~	~~12~~	
	52 Т4-26-1			
1.	Washer	431022	8	
2.	Ring	Т16-202	16	
3.	Same	2709054-35-3-Г	8	
4.	Washer	728028/5	8	
	ДВ-1К			
1.	Spare parts in case, wrapped		1	

Box No. 3

Spare Parts

Nos.	Description	Drawing No.	Quantity, pieces	Notes
1	2	3	4	5
	Radio Equipment			
	ОТО Y7100-16/7			
1.	Spare parts in sealed case		1	
	MPH-56H			
1.	Spare parts in sealed box		1	
	KPH-1			
1.	Spare parts in sealed box		1	
	FPH-2			
1.	Spare parts in sealed box		1	
	СД-12			
1.	Spare parts in sealed box		1	
	APK-5			
1.	Spare parts in sealed box or in case		2	
	ЭДУ and APK-5			
1.	Spare parts in box sealed		2	
1.	~~Valve 6H60~~		[illegible]	
	1-PCG-70			
1.	Spare parts in sealed box		1	
	CBC-5 (Viola)			
1.	Spare parts in sealed box		1	

1	2	3	4	5
	YC-8			
1	Spare parts in sealed box		1	
	P-805			
1	Spare parts in sealed box		1	
	PПО ("Lazur")			
1	Spare parts in sealed box		1	
	P-801П			
1	Spare parts in sealed box		2	
2	Screwdriver	ЯД 2009.001	2	
	INSTRUMENTS			
	ИИ-13			
1	Screwdriver		2	
	ГИП-1			
1	Spare parts in case, wrapped		1	
2	Screwdriver		2	
	09ТС-260В			
1	Spare parts in case, wrapped		1	
	АИК-Д65			
1	Direction finder head		1	
2	Holder with silicagel		1	
3	Dipole	Е/-8226	1	

1	2	3	4	5
4	Wrench		1	
	МО-1			
1	Capacitor		1	
2	Resistor		1	
	НИ-50 БМ (art. 101)			
1	Screwdriver		1	
2	Fuse	ПЦ-30-2	3	
	ПТ-56К РТМС			
1	Thyratron	ТГ1-0.1/1.3	4	
	УПРТ-2			
1	Special wrench		4	
	УЗП			
1	Special wrench		1	
	КПЖ-30			
1	Spare parts and tools in sealed box		5	in the odd aircraft; 4 in the even one.

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1	2	3	4	5
	CASE No 4			
	ARMAMENT			
	БЯ-47			
1	Spring	0-8	2	
2	Spring	0-16	1	
3	Right hand spring	0-41	1	
4	Left hand spring	0-40	1	
5	Pin	0-35	2	
6	Split pin	0-22	2	
7	Cable	ass.-31	3	
[illegible]	Wrench	ass.	1	
[illegible]	Nut	ass. 26	1	
	ДЯ-СС-АТ			
[illegible]	Cocking cam wrench		1	
[illegible]	Drive		1	
3	Drive		1	
4	Standard		1	
5	Standard		1	
6	Lamp	CM-31	6	
7	Fuse locking fork		6	
	HKПБ-7			
1	Course indicator with pivot assembled		1	
2	Level in mounting		1	
3	Transparent reflector		1	
4	Dim reflector		1	

1	2	3	4	5
5.	Lamp СМ-16	26x15	2	
6.	Lamp МН-18	26x0.15A	2	
7.	Flannel cloth 200x200		1	
8.	Cover		1	
9.	Socket		1	
	СМ-52			
1.	Spare parts in sealed box		1	
2.	Cable	assy 1-20, 1=60 m	1	
3.	Cable	assy 1-24, 1=20 m		
4.	Grammometer		Не прикладывается	
5.	Grease		Не 500гр [illegible]	
	КПС-53 and (Э-...-020)			
1.	Spare parts in sealed box		1	
2.	Gyro relay	ГР-5А	1	
	ПБ-253			
1.	Selsyn-receiver	БС-4	1	
2.	Lamp	СМ-31	3	
3.	Push-button	204К	2	
4.	Flexible hose		2	
5.	Lamp	СМ-15	2	
6.	Washer	5	5	
7.	Locking wire, zinc-plated, 0.8		4 metres	
8.	Cartridge belt loading and unloading machine	сб-2 МДБ-34а	1	
9.	Brush	03-07	8	
10.	Washer	0101-28	8	
11.	Same	0101-29	4	
12.	Spring	03-10	4	

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1	2	3	4	5
13.	Safety valve	KN-38	1	
14.	Washer	0101-30	9	
15.	Same	0101-27	4	
16.	Gear	0104-43	2	
		assy-02-1		two sets 2
17.	Piston	2r-219 02-3		
18.	Valve	2r-219, 02-87		
19.	Bushing	2r-219, 02-7		
20.	Ring	2r-219		
	Tools in bag			
1.	Hook for fitting in the belt	GB1-1 [illegible]	1	
2.	Portable lamp	[illegible]-36	1	
3.	Socket wrench for rear			
3.	attachment unit	C104		
		[illegible]-35A	1	
4.	Handle for rear attachment unit	0-8 [illegible]-35A	1	
5.	Wrench for air line	0-2 [illegible]-35A	1	
6.	Wrench for removing screen	1-204-[illegible] [illegible]-239	1	
7.	Wrench	GB1-6 [illegible]-34A	1	
8.	Screw-driver B175x0.7		1	
9.	Adjusting washer	0-10 [illegible]-35A	1	
~~10.~~	~~Bunched wire~~	~~05106-2A~~ ~~[illegible]~~	~~1~~	
11.	Pin	0100-63 9H-039	2	
12.	Lamp	MH-5	1	

1	2	3	4	5
13.	Wrench	C5-03 И-Д6-35А	1	
14.	Wrench for dismantling motor, 10x11	C5-C5 И-Д6-36А	1	
16.	Screw-driver for trunnion plugs	C51-2 ИД6-34А	1	
16.	Panel for measuring belt feeder slipping currents	БП-ДЧ-7	1	
17.	Wrench, 9x11	State Std ГОСТ 2840-54	1	
18.	Wrench, 19x22	State Std ГОСТ 2840-54	1	
19.	Adjusting washer	D-9 И-Д6-33А	1	
20.	~~Wrench, 19x24~~ Hook	3 И-Д6-34А	1	
~~21.~~ 21.	~~Hook~~ П.Т.С.		Не прикладывается Не прикладывается	
	3Д-С6			
1.	Lamp	26x115А	2	
	Э-СГ-16М			
1.	Shock absorber		6	
2.	Nut		32	
	Э-ДД-1			
1.	Spare parts in sealed box		1	
	ЭК-48			
1.	Screw	4216307	2	
	ДП			
1.	Brush	Д6-4-2А	2	

1	2	3	4	5
	ДП-4			
1.	Brush	C5-4-2A	2	
	БА-3Д			
1.	Spare parts in case, wrapped		1	
	N 5812-0			
1.	Case, wrapped		2	
	НАУ-457-2 м			
	Parts in box			
1.	Feed spool with strap		1	
2.	Take-up spool with strap		1	
3.	Light filter	ЖС-16	1	
4.	Same	СС-12	1	
5.	Lamp МН17	26 0.16A	4	
6.	Nut for holding head piece		4	
7.	Socket wrench		1	
8.	Screw-driver		1	
9.	Brush		1	
10.	Cloth, 200x200		1	
11.	Spare tape		600 м	
12.	Feed magazine		2	
13.	Optical adjustment device		1	
	ВС-267-1			
1.	Spare parts in sealed box		1	
	АП-27			
1.	Damper	АП-2	1	
2.	Screw	8886317	1	

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1	2	3	4	5
3	Screw	1315C51-3-12	28	
4	Screw	1315C51-3-14	4	
5	Nut	1125A50-3	32	
	519 б			
1	011 ЛНМЗ 36/1 in container, 385gr		1	
	9-A-035			
1	Tool bag, sealed		1	
2	Bag for parts 2-34 and 6-15, sealed		2	

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1	2	3	4	5
3	Screw	1315051-3-12	28	
4	Screw	1315051-3-14	4	
5	Nut	1125A50-3	32	
	519 б			
1	Oil #HM3 36/1 in container, 385gr		1	
	9-A-035			
1	Tool bag, sealed		1	
2	Bag for parts 2-34 and 6-15, sealed		2	

Box No. 5

Spare parts.

Nos	Description	Drawing No.	Quantity	Notes
	Tail Warning Radar (Сирена-2)			
1.	Spare parts in sealed box		1	1:5
	PB-R			
1.	Spare parts in sealed box		1	
	PGH-3			
1.	Spare parts in sealed box		1	
2.	Tools in sealed box		1	
3.	Spare parts in metal sealed box		1	
4.	Draw-tube from unit 7 "Д"		1	
	ГАММА-54Т			
1.	Spare parts in sealed box		1	
	9-А-035			
1.	Toolkit, sealed		2	
	~~[illegible]~~			
~~1.~~	~~Rod~~		~~[illegible]~~	
	СИ-1			
1.	Spare parts in sealed box		1	
2.	Cover		1	
3.	Silica gel holder can		1	
4.	Plug for drying pipe union		1	
	18 САМ-28			
1.	Blind slushing plugs with washers		84	

1	2	3	4	5
2.	Valve plugs		42	
3.	Rubber washers (installed on plugs)		42	
	Р-601 П (РСУ-4П)			
1.	Unit "M" (in cardboard box)		1	
	КПЖ-30			
1.	Plug		7	
2.	Cap		21	

Box No. 6

Ground Equipment

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Cover for wing	T9031-0,1,2,3, 4,5,6	1 set	
2.	Cover for stabilizer	T9034-0	2	
3.	Cover for L.G. nose strut wheels	T9036-0	1	
4.	Cover for L.G. main wheels	T9035-0	2	
5.	Cover for propeller blade	T9037-0	16	
6.	Cover for propeller spinner	T9038-0	4	
7.	Cover for fuselage nose part	T9032-0	1	
8.	Cover for transmitter of C4 set	T9041-20	1	
9.	Cover for engine nacelle	T9039-0	4	
10.	Cover for MRП set	T9041-10	1	
11.	Cover for Py-11A dynamotor	T9041-30	1	
12.	Cover for P3-2 tranceiver	T9041-40	1	
13.	Cover for ГРН-2 and KPH-?	T9041-50	2	
14.	Cover for units	T9041-60	1	
15.	Cover for CPO-1	T9041-70	1	
16.	Cover for unit	T9041-100	1	
17.	Cover for tail section of fuselage and tail mount	T903[illegible]-0	1	
18.	Cover for autopilot control handle	T9041-110	1	
19.	Cover for ПТ-200Ц converter of autopilot	T9041-120	1	
20.	Cover for angular speed transmitter of autopilot	T9041-130	1	
21.	Cover for master vertical flight gyro	T9041-140	1	

1	2	3	4	5
22.	Cover for autopilot control unit	T9041-150	1	
23.	Cover for autopilot oscillator	T9041-170	1	
24.	Cover for autopilot altitude corrector	T9041-180	1	
25.	Cover for amplifier	T9041-160	1	
26.	Cover for PB-2 aerial	T9042-10	2	
27.	Cover for KPП-4 aerial	T9042-20	1	
28.	Cover for AмC-1 aerial	T9042-30	2	
29.	Cover for tail mount sight	T9041-190	1	
~~30.~~	~~Cover for CPO-1~~	~~T9041-30~~	~~1~~	Не прикладывается
31.	Cover for upper unit	T9041-220	1	
32.	Cover for upper unit	T9041-210	1	
~~33.~~	~~Cover~~	~~T9041-230~~	~~1~~	Не прикладывается
34.	Cover for upper unit	T9041-240	1	
35.	Cover for unit No. 2 (gamma 54T)	T9041-270	1	
36.	Cover for unit No. 1 (gamma 54T)	T9041-280	1	
37.	Cover	T9041-290	1	
38.	Cover	T9041-300	1	
39.	Cover for unit No. 4	T9041-310	1	
40.	Cover for unit No. 3	T9041-320	1	
41.	Cover for tail warning set	T9041-330	1	
42.	Cover	T9041-340	1	
43.	Cover for ЯС-8 set	T9041-350	1	
44.	Cover for PCБ-70 transmitter	T9041-360	1	
~~45.~~	~~Cover for amplifier of СПУ-7~~	~~T9041-250~~	~~1~~	Не прикладывается

1	2	3	4	5
	CASE № 7			
1	Clock	АБР-М	3	
2	Clock	АЧХО	2	
3	Stopwatch	НКПБ -7	1	
4	Oxygen masks	КМ-30	6	
5	Board share bag	П7516-150	5	
6	Mirror	Т7916-300	1	
7	Rugs	Т7615-200/3,5,9	3	
8	Portable lamp	ПЛ-36	4	
9	Portable hose	Т7801-81	5	
10	Vacuum flask	1 litre	5	
11	Cable	П9404-0	22	L=7500
12	Strap	Т9404-40	10	
13	Cable	П9404-0	14	L=4000
14	Jack	П9407-100	2	
15	Supporting blocks	Т9405-20	2	
16	Telephone		8	
17	Network	П9402-40	2	
18	Network	П9402-50	4	
19	Back support for cargo ramp	Т9403-300	2	
20	Front support	Т9403-320	2	
21	Support	Т9403-460	2	
22	Cargo distributor	Т9405-0	2	
23	Ramp	Т9700-200	2	

1	2	3	4	5
	CASE № 7			
1	Clock	АВР-М	3	
2	Clock	АЧХО	2	
3	Stopwatch	НКЛБ -7	1	
4	Oxygen masks	КМ-30	6	
5	Board share bag	П7516-150	5	
6	Mirror	Т7916-300	1	
7	Rugs	Т7615-200/3,5,9	3	
8	Portable lamp	ПЛ-36	4	
9	Portable hous	Т7801-81	5	
10	Vacuum flask	1 litre	5	
11	Cable	П 9404-0	22	L=7500
12	Strap	Т9404-40	10	
13	Cable	П 9404-0	14	L=4000
14	Jack	П 9407-100	2	
15	Supporting blocks	Т9405-20	2	
16	Telephone		8	
17	Network	П 9402-40	2	
18	Network	П 9402-50	4	
19	Back support for carge ramp	Т9403-300	2	
20	Front support	Т9403-320	2	
21	Support	Т9403-450	2	
22	Cargo distributer	Т9405-0	2	
23	Ramp	Т9700-200	2	

Packing No. 6

Ground Equipment.

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Chocks for L.G. wheels	9103-200	4	

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Box No. 9

Ground Equipment

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Chocks for L.G. wheels	9103-200	4	

Box No. 10

Ground Equipment

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Extension piece	[illegible]-584	60	
2.	Cover for L.G. well	[illegible]9043-0	2	
3.	Propeller spinning device	[illegible]9208-100	1	

Ground Equipment

Nos	Description	Drawing No.	Quantity, pieces	Notes
1	2	3	4	5
	Container No. 11			
1.	Container for aircraft-carried tools and filling vessels, with platform 99050-0	H9999-100	1	
2.	Plug for duct of AM-20 engine oil cooler	MJ9224-0	4	
3.	Plug for ПТ-156 tube and plugs for static pressure openings	П9225-400	2	
4.	Plug for kerosene system drain tube	9225-100	1	
5.	Plug for L.G. fairing air intake	9225-200	1	
6.	Plug for electric flare gun	9225-500	3	
7.	~~Adapter for filling pressurized fuel~~	~~J9201-200~~	~~1~~	Не прикладывается
8.	Device for checking pressure in pneumatic tyres	99211-0	1	
9.	Portable lamp	[illegible]-36	2	
10.	Aerial guard CA-1M	T7109-2	2	
11.	Aircraft technician's tools, boxes Nos 1 and 2		2	
12.	Aircraft technician's tools, boxes Nos 3 and 4		2	
13.	Aircraft technician's tool kit, group "B"		1	
14.	Aircraft-carried tools for radar equipment		1	

N 1	2	3	4	4
15.	Aircraft radio equipment technician's tool kit		1	
16.	Aircraft electric equipment technician's tool kit		1	
17.	Aircraft oxygen equipment and instruments technician's tool kit		1	
18.	Tester	TT-1	1	From electrician's tool box
19.	Fuel drain hose	T9234-60	2	
20.	Oil drain hose	H9240-0	1	
21.	Measuring can	H9999-3	1	
22.	10 lit. bucket	H9999-20	1	
23.	6 lit. bucket	H999[illegible]-400	1	
24.	Funnel	T9[illegible]-20/1.2	2	
25.	Scavenged fuel drain hose	[illegible]9239-0	1	
26.	Ground CH/ equipment cable	[illegible]9242-0	1	
27.	A.C. bunched wire	T7[illegible]-390	1	
28.	Hose	95001-1[illegible]	1	
29.	Hand drill with chuck up to 1[illegible] mm	54010-[illegible]72	1	
~~30.~~	~~[illegible]~~ ~~[illegible] tapes~~	~~[illegible]~~	[illegible]	
~~31.~~	~~Frame~~	~~[illegible]~~	[illegible]	
32.	Filter for hose 95001-10	[illegible]-371	1	
33.	Pail for draining sediment from tank	T9255-0	2	
34.	Blacking cap for AM-20 engine	[illegible]9223-10	4	
35.	Same	MY 9223-20	4	
36.	Same	MY 9223-30	4	

1	2	3	4	5
37	Cover for work on wing surface	T9225-0	4	
38	Safety device for operating work on wing surface y9213-100			
	a) reel	y9213-170	1	
	b) snap hook	y9213-130	6	
	c) cable	y9213-120/1	1	
	d) cable	y9213-120/2	1	
	e) belt	y9213-110	1	
39	End piece	2561-A2	1	
40	Safety device y9213-200			
	a) safety belt	y9213-110	1	
	b) snap hook	y9213-130	2	
	c) cable	y9213-120-1	1	
41	Box	H9972-0	2	
42	Case	T9030-0	1	
43	Wrench for oil tank drain corks	ЭТ98-540	1	
44	Device for oxygen charging	y9210-0	1	
45	Adapter	y9257-10	2	
46	Ladder	y9060-0	1	
47	Cupnut	y9225-1000	1	
48	Hose	1y24-15ТУ-МХП-1767-58	1	
49	Clamp	1729с52-38	1	

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Box No. 12

Spare Parts

Nos	Description	Drawing No.	Quantity, pieces	Notes
1	2	3	4	5
	1. Fuselage Spare Parts			
1.	Rubber gasket for door at frame No. 0	[illegible]-60/12	1	
2.	Rubber gasket	70209-0/145	1	
3.	Cork gasket	70209-0/145	1	
4.	Cork gasket for glass panel, 28x1500 mm	[illegible]-0/26	1	
5.	[illegible] gasket for glass panel, 15x700	[illegible]-0/19	2	
6.	Cork gasket for glass panel, 15x4000	[illegible]-0/31	1	
7.	[illegible] gasket, [illegible]x600	[illegible]-0/25	1	
8.	Attachment bolt for fuselage [illegible] ear glass panels	AH[illegible]-6-56	5	
9.	Same	[illegible]-4[illegible]	22	
10.	Same	AH[illegible]-6-[illegible]4	2	
11.	Same	AH235-6-46	3	
12.	Same	AH273-6-54	23	
13.	Attachment bolt for glass panels	AH233-6-56	2	
14.	Same	AH233-6-58	9	
15.	Same	AH273-6-62	9	
16.	Same	AH233-6-60	9	
17.	Same	AH237-6-64	6	
18.	Nuts for bolts	1096063-6	90	
19.	Body	AH140-6	90	
20.	Washer	AH141-6	90	

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1	2	3	4	5
21.	Attachment screw for fuselage nose cap glass panels	963A51-5-28	12	
22.	Same	963A51-5-30	4	
23.	Same	942A51-5-28	15	
24.	Same	942A51-5-30	4	
25.	Washer for screw	J0228-11	45	
26.	Same	233A-30-0.8-5-10	16	
27.	Gasket for glass panel, rubber	J0228-0/10	1	
28.	Same, cork	J0228-0/22	1	
29.	Same, cork	J0228-0/23	1	
30.	Same, rubber	J0228-0/21	1	
31.	Same, rubber	J0250-270/19	1	
32.	Same, rubber	J0250-270/21	1	
33.	Same, rubber	J0250-270/23	1	
34.	Same, rubber	J0250-270/25	1	
35.	Same, rubber	J0250-270/17	1	
36.	Same, cork	J0250-270/31	3	
37.	Same, cork	J0250-270/33	8	
38.	Same, cork	J0250-270/34	5	
39.	Glass panel attachment bolt	1305C51-5-44	4	
40.	Same	1301C51-5-20	2	
41.	Same	942A51-5-20	60	
42.	Same	942A51-5-26	6	
43.	Same	963A51-5-44	10	
44.	Nut	1397C53-5	20	
45.	Gasket	H0227-0/21	2	
46.	Same	H0227-0/23	1	
47.	Same	H0227-0/29	1	
48.	Same	H0227-0/17	2	

1	2	3	4	5
48a.	Bolt	3055A-3-16	10	
48b.	Washer	2[illegible]-6	10	
48c.	Nut	1441 [illegible] 51-3	10	
49.	Washer	23[illegible]-0.3-5-10	20	
50.	Pressurization profile	[illegible]0250-300/11, assy	1	
51.	Same	30250-[illegible]0/1[illegible], assy	1	
52.	Door pressurization profile, rubber, lined with caprone	[illegible]0213-50/27	1	
53.	Stop	[illegible]0223-0/33	2	
54.	Plate	[illegible]0323-0/22	1	
55.	Gasket for glass panel	70371-100/7	7	
56.	Serrated flooring for foot steps	30223-0/45	3	
57.	Hatch locks	[illegible]1200-2[illegible]	4	
58.	Catch spring	[illegible]0370-21[illegible]	1	
59.	Pressurizer for nose cabin glass panels	[illegible]0371-[illegible]0	1	
60.	Bulb for cabin glass panels	30371-[illegible]	2	
61.	Cargo hatch pressurization profile, lined	[illegible]027[illegible]-[illegible]/2	1	
62.	Same	[illegible]037[illegible]-[illegible]5/3	1	
63.	Glass panel attachment bolt	3[illegible]1-4-20	20	
64.	Same	3[illegible]1-4-22	80	
65.	Nut	1297050-4	100	
66.	Washer	23[illegible]50-1-4-3	100	
67.	Spare keys for door locks, 90370-50, 90370-150	30470-171	2	
68.	Pressurization profile for cargo hatch front door	T0420-60/249	1	
69.	Same	T0420-60/251,252	2	
70.	Same	T0420-60/293	2	

1	2	3	4	5
71.	Pressurization profile for hatch rear door	T0420-100/139	2	
72.	Pressurization profile for cargo hatch rear door	T0420-100/67	1	
73.	Pressurization profile for air camera hatch door	T0420-100/68	1	
74.	Pressurization profile for access hole gard plate	T0411 0/29	1	
75.	Same	T0411 0/30	1	
76.	Serrated flooring of foot step on front cargo hatch door	[illegible]	18	
77.	Foot step serrated flooring on rear cargo hatch door	150x440	6	
78.	Serrated flooring for foot step at frame 62	[illegible]	1	
79.	Pressurization profile for emergency hatch door	T0431-55/11	1	
80.	Hatch lid attachment bolt, on cargo floor, between Frames Nos 62 and 67	951a51-6-20	1	
81.	Same	951a51-6-16	10	
82.	Same	951a51-6-24	3	
83.	Hatch lock	9120-22-27	4	
84.	Bolt for securing lid of hatch housing the camera hatch door control motor	951a51-6-14	2	
85.	attachment bolt for cargo hatch rear door	1514351-12-45-4.5	2	

1	2	3	4	5
86.	Nut	1406051-12	2	
87.	Washer	234A50-1.5-12-18	2	
88.	Attachment bolt for cargo hatch front doors	T0426-1	2	
89.	Nut	1406051-12	2	
90.	Washer	234A50-1.5-12-16	2	
91.	Oil can	E06A50	2	
92.	Attachment bolt for cargo hatch front door actuating mechanism	T0415-5	2	
93.	Same	1314051-12-32	1	
94.	Same	1314051-12-76	1	
95.	Same	1314051-12-42	2	
96.	Nut	1425051-12	4	
97.	Washer	234A50-1-12-22	5	
98.	Attachment screw for removable wall section at frame No. 11	351A[illegible]-4-12	15	
99.	Rubber gasket for glass panels	T0602-0/3	1	
100.	Same	T0602-0/4	1	
101.	Rubber gasket for glass panels	T0602-0/5	1	
102.	Same	T0602-0/6	1	
103.	Same	T0602-0/7	1	
104.	Same	T0602-0/8	1	
105.	Same	T0602-0/9	1	
106.	Same	T0602-C/10	1	
107.	Same	T0602-C/11	1	
108.	Same	T0602-0/12	1	
109.	Same	T0602-0/13	1	
110.	Same	T0602-0/14	1	
111.	Same	T0602-0/15	1	
112.	Washer	234A50-2-10-20	2	

1	2	3	4	5
113.	Nut	1425051-10	2	
114.	Rubber gasket for glass panels	T0602-0.16	2	
115.	Same	T0602-0/17	1	
116.	Same	T0602-0/18	2	
117.	Glass panel attachment screws	945A51-6-20	10	
118.	Same	945A51-6-26	1	
119.	Same	951A51-6-46	7	
120.	Same	945A51-6-24	8	
121.	Same	951A51-6-24	20	
122.	Same	951A51-6-26	8	
123.	Rubber profile	П0601-0/23	1	
124.	Hatch lid attachment screws, П0690-20	951A50-4-12	4	
125.	Hatch lock spring, T0670-70	1291C50-0.5-414	3	
126.	Special hatch lid pressurization profile	Ю0360-0/343, assy	2	
127.	Same	Ю0360-0/177, assy	2	
128.	Same	Ю0360-0/179, assy	2	
129.	Same	Ю0360-0/183, assy	2	

2. Spare Parts for Inner Wing and Wing

1.	Inner wing removable panel attachment screws	963A51-5-26	10	
2.	Same	963A51-5-22	120	
3.	Wing-band-to-inner-wing attachment screws	945A51-4-10	130	
4.	Wing-fillet-to-fuselage attachment screws	951A51-5-14	30	
5.	Fillet-to-fuselage attachment screws	951A51-5-16	50	
6.	Same	334AM5-16	30	

1	2	3	4	5
7.	Wing-fillet-to-fuselage attachment screws	951A51-6-20	10	
8.	Fin attachment bolt	334AH-5-21	100	
9.	Joint band attachment screw	945C51-4-8	25	
10.	Same	945C51-4-8	35	
11.	Removable panel attachment bolts	91100-4	2	
12.	Same	334AH-6-34	12	
13.	Same	334AH-6-26	20	
14.	Same	334AH-6-30	500	
15.	Anchor nut, self-locking	1954A56-6	25	
16.	Hatch lid for trimming tab actuator	П3702-0/17, 18	2	
17.	Same	П3702-0/19, 22	2	
18.	Hatch lid attachment bolt	945C51-4-14	20	
19.	Same	945C51-4-16	100	
20.	Same	945C51-4-22	100	
21.	Same	945C51-4-18	100	
22.	Nut	1958A56-4	10	
23.	Same	521AE-4	10	
24.	Wing tip attachment bolt	334AH-5-25	80	
25.	Same	334AH-5-21	50	
26.	Same	334AH-5-13	400	
27.	Same	334AH-5-23	150	
28.	Fin fairing attachment screw	334AH-5-17	50	
29.	Floating nut	П2024-6	1	
30.	Anchor nut	1145A50-6	10	
31.	Outer wing trailing panel lock	91200-25-3	32	
32.	Same	91200-25-5	10	
33.	Same	91200-25-1	22	
34.	Outer wing trailing panel attachment screw	960A51-4-14	50	

1	2	3	4	5
35.	Anchor nut for propeller	AH72-4	4	
36.	Hatch lid attachment screw	947151-5-14	36	
37.	Anchor nut	11901-30/1, 2	4	
38.	Nut	1954A56-5	30	
39.	Floating nut, anchor	1954A56-4	20	
40.	Anchor nut	1954A52-5	70	
41.	Hatch lid attachment bolt, 92600-60, 70, 80, 100, 110	304AH-5-21	20	
42.	Fuel level gauge lid attachment bolts of tanks Nos 3, 4, 6, 7	259AH6-26	4	
43.	Same	259AH-25	8	
44.	Fuel level gauge lid attachment nuts of tanks Nos 3, 4, 6, 7, 9	260A55	10	
45.	Same	260A52	10	
46.	Drain cock lid attachment bolts of tanks Nos 3, 4	259AH-6-23	8	
47.	Same	259AH-6-26	10	
48.	Fuel level gauge lid attachment bolt of tank No. 8	260AH-6-26	10	
49.	Drain cock lid attachment bolts of tanks Nos 6,7,9	259AH-6-24	6	
50.	Hatch lock 91200-100	91200-25-1	1	
51.	Drain cock lid attachment bolt of tank No. 2	91004-45	4	
52.	Drain cock lid attachment nut of tank No. 2	AH250-6	4	
53.	Tip fairing attachment screw	1620C51-5-14	5	
54.	Hatch lid locks, 91200-110	91200-25-7	2	
55.	Same, 91200-110	91200-25-5	46	

1	2	3	4
	III. Spare Parts for Tail Unit		
1.	Elevator trimming tab actuator hatch lid attachment bolt	960A52-4-12	6
2.	Elevator trimming tab nut	521A5-4	6
3.	Screw for fastening trimming tab actuator hatch lid in elevator front section	945A51-4-18	25
4.	Same	945A51-4-16	25
5.	Anchor nut	1955A56-4	8
6.	Screw for fastening removable lid under elevator balance weight	960C51-4-16	25
7.	Same	960C51-4-18	4
8.	Fillet attachment screw	951A51-4-14	65
9.	Slotted band attachment screw	951A51-4-14	50
10.	Same	951A51-4-16	40
11.	Same	951A51-4-12	60
12.	Same	951A51-6-28	4
13.	Stabilizer leading edge attachment bolt	93100-1/1	200
14.	Same	93100-1/2	140
15.	Anchor nut	1954A56-4	20
16.	Trimming-tab-unit-to-rudder attachment bolt	9П3304-111/1, 2, 3	3
17.	Servo compensator unit attachment bolt	93200-1	8
18.	Fin leading edge attachment bolt	93100-1/1	180
19.	Same	П3400-2/1	2
20.	Same	П3400-1	6

1	2	3	4	5
21.	Bolt for fastening lid at fin rib No. 13	960[illegible]51-4-14	6	
~~22.~~	~~Fillet attachment screw~~	~~[illegible]~~	[illegible]	
23.	Elevator removable front section attachment bolt	334[illegible]-4-16	100	
24.	Nut	4951A6[illegible]	6	
25.	Screw for fastening access hatch lid of rudder trimming tab control mechanism	[illegible]6[illegible]51-4-12	15	
26.	Screw for fastening access hatch lid of rudder servo compensator control mechanism	960[illegible]51-4-12	5	
27.	Same	960[illegible]51-4-14	4	
	IV. Spare Parts for Landing Gear			
1.	Nose gear axle nut fixing bolt	1541[illegible]-5-24	4	
2.	Washer	[illegible]4450-1-6-12	4	
3.	Nut	145[illegible]51-6	4	
4.	Felt packing ring	94[illegible]-6	2	
6.	Locking bolt	[illegible]4200-9	4	
6.	Wheel disc attachment bolt	[illegible]-6	4	
7.	Nut	[illegible]106[illegible]-1[illegible]	4	
8.	Washer	[illegible]4450-1.6-10-[illegible]	4	
9.	Charging connection	B420[illegible]-100	2	
10.	Oil can for landing gear units	40 H-759	9	
11.	Felt ring	B4201-[illegible]1	2	
12.	Washer for taking up axial play in nose gear torque link joint (from 0.4 to 1.2 mm)	94201-243	1 set	

1	2	3	4	5
13.	Washer, 0.4 mm		1	
14.	Same, 0.6 mm		2	
15.	Same, 0.8 mm		1	
16.	Same, 1.0 mm		1	
17.	Same, 1.2 mm		1	
18.	Pipe-line for steering cylinder	114204-200	1	
19.	Oil can for landing gear units	2065A50	3	
20.	Follow-up system turnbuckle screw	114200-8	2	
21.	Hub washer	94100-6	2	
		90A-001	2	
22.	Oil can for L.G. units	2065A50	[illegible]	
23.	[illegible]	94104-163	2	
24.	Lock mechanism spring	94104-165	2	
25.	Same	94104-163	[illegible]	
26.	[illegible] lock hook spring	94102-7	4	
27.	[illegible] clamp nut pin			
28.	[illegible] clamp nut fixing	[illegible]	[illegible]	
	[illegible]	[illegible]	4	
29.	[illegible]	94102-6	[illegible]	
30.	[illegible] washer	9410[illegible]	[illegible]	
31.	[illegible]	94101-6	[illegible]	
32.	Washer for [illegible]	94100-2-2	[illegible]	
33.	Shock absorber stabilizer [illegible]	94100-2-1	[illegible]	
34.	Same	94201-5	2	
35.	Torque link bolt, centre	1412C51-16	[illegible]	
36.	Nut	234A50-1.5		
37.	Washer	16-23	2	
38.	Torque link bolt	94101-60, assy	1	
		1412C51-20	1	
39.	Nut			

1	2	3	4	5
40.	Washer	234A50-2-20-34	1	
41.	Same	234A50-1.5-10	4	
42.	Insert for nose gear steering control	14204-207	2	
	bell crank	3342-213	1	
43.	Nose gear steering cylinder rod lug	1875051-8-26-4	2	
44.	L.G. bay door rod coupling bolt	234A50-1.5-8-16	2	
45.	Washer	1408081-8	24	
46.	Nut	1875051-8-22-4	2	
47.	Rod coupling bolt	1875051-8-26-4	2	
48.	Bolt	1408081-8	4	
49.	Nut	234A50-1.5-8-15	4	
50.	Washer	91200-25/15,27	4	
51.	Lock	94101-102	2	
52.	Insert	94101-103	2	
53.	Same	94104-215	2	
54.	Collar			

V. Spare Parts for Aircraft

Control System

1	2	3	4	5
1.	Control column cable with turnbuckles	3161-40/1, 2	4	
	and attachment fittings (for port and	95190-810	4	
	starboard control columns)	95100-20	2	
2.	Cover for control column	472050-100-10	2	
3.	Control column pulleys	472050-100-15	2	
4.	Same	501AH	25	
5.	Control cable guide pulleys	95700-178	25	
6.	Pulley pin	233A50-0.6-5-10	25	
7.	Pulley pin washer			
8.	Elevator trimming tab control	472050-50-7	8	
	cable pulley			

1	2	3	4	5
9.	Same	35112-260	2	
10.	Elevator trimming tab control cable pressure seals	[illegible]0052-2.5	4	
		35100-40/3,4	2	
11.	Elevator trimming tab cable	35200-150	1	
12.	Same	35111-10/1,2	2	
13.	Same	35111-10/3,4	2	
14.	Same	35200-140/9,12	2	
15.	Same	35200-70/1,2	2	
16.	Same	35103-23[illegible]/1,2	2	
17.	Same	35701-60	1	
18.	Same	35[illegible]02-70	1	
19.	Same	35[illegible]02-[illegible]0/1,2	2	
20.	Same	35[illegible]02-40/1,2	2	
21.	Same	H5[illegible]01-[illegible]0/1,2	2	
22.	Same	H5[illegible]01-[illegible]0/2,2	4	
23.	Same	H5701-[illegible]	10	
24.	Locking ring	35701-[illegible]	3	
25.	Bonding strip (for drawing 35701-10)	H5[illegible]01-[illegible]	4	
26.	Jack [illegible]	H5701-52	4	
27.	Same	1214[illegible]1-6-[illegible]	2	
28.	Rod attachment bolt	1214[illegible]1-[illegible]-[illegible]	2	
29.	Same	1214[illegible]1-6-3[illegible]-[illegible].5	2	
30.	Same	1400051-6	6	
31.	Nut	224450-1.5-6-12	4	
32.	Washer	234450-2-6-12	2	
33.	Same			
34.	Rubber gasket for control system sealing unit	35201-62	2	
35.	Locking ring for screw jack	H5701-21	4	

1	2	3	4	5
36.	Felt gland for nut #5701-90 of screw-jack	[illegible]	4	
37.	Cable	95200-155	1	
38.	Grease gun, with valve	9CH-759	4	
39.	Rod sealing packing ring	#5111-44	7	
40.	Same	95111-7	6	
41.	Same	613AH00-4-M	1	

VI. Spare Parts for Hydraulic System

1	2	3	4	5
1.	Packing ring for hydraulic accumulator charging connection	[illegible]	2	
2.	Packing ring for hydraulic accumulator tee piece	2609C52-13--6-	2	
3.	Hydraulic accumulator float collar	#5005-4	2	
4.	Gasket for tank plug	2609C5-80--3-M	2	
5.	Solenoid coils for cocks #5308-200		3	

VII. Spare Parts for Fuel System

1	2	3	4	5
1.	Fuel non-return valve	#5100-100/1	2	
2.	Non-return valve, two-way	96100-80	1	
3.	Fuel non-return valve	9610X-20	1	
4.	Fuel system hose	96100-3/11	2	
5.	Same	96100-G/7	2	
6.	Rubber packing gasket	#6100-19	3	
7.	Gasket for non-return valve	#6100-132	2	
8.	Fuselage connection packing ring	2261A-84	3	
		2261A-88	3	
		2261A-79	3	

1	2	3	4	5
9.	Packing gasket for pump	У6100-106	1	
10.	Flexible pipe for fuel pressure			
	transmitter	Л6100-205/1	2	
11.	Same	[illegible]6100-405/2	2	
12.	Fuel system flexible pipe	15[illegible]4-25-[illegible]	2	
13.	Locking ring (spring)	Л6105-6	2	
14.	Inert gas bottle discharge			
	warning lamp ring	Л6105-7	2	
15.	Filler neck rubber gasket, upper	[illegible]	5	
16.	Fuel tank hatch door attachment bolt	1302С51-6-18	30	
17.	Tank drain cock attachment bolt	1302С51-6-28	6	
18.	Washer	233А50-0.8-5-10	6	
~~19.~~	~~Packing gasket for filler neck~~	~~Л6105-144~~	Не прикладывается	
		У6102-0/3	6	
20.	Durite hose	1918А3,5-35-78-Н	1	
21.	Spring	У6102-200/3	10	
22.	Coupling	ЭТ61-251-2	10	
23.	Metal band			
24.	Packing ring for pipe connection			
	at centre wing	2609С52-50-5-Г	2	
25.	Filler neck rubber gasket, lower	2608С58-10-2Г	5	
		У6100-0/16	14	
26.	Flexible coupling	1685С52-37	8	
27.	Clamp	ЭТ61-251/2	14	
28.	Strip	У6100-0/18	23	
29.	Flexible coupling	1685С52-37	20	
30.	Clamp	ЭТ61-251/1	23	
31.	Strip	У6101-0-14	Не прикладывается	
32.	Flexible coupling	Т6101-44-1	14	
33.	Clamp	ЭТ61-251-3	28	
34.	Strip			

1	2	3	4	5
35.	Flexible coupling (... C83-10)	1T32-16a-75	Не прикладывает	
36.	Clamp	T6101-44-1	12	
37.	Strip	9T61-251-3	6	
38.	Seal for flexible coupling	1053A 50	26	
39.	Clamp	1669050-22	3	
40.	Same	1669050-26	2	
41.	Same	1669050-14	4	
42.	Same	1669050-60	1	
43.	Same	1669050-28	1	
44.	Same	1669050-20	6	
45.	Same	1669050-12	4	
46.	Same	1669050-10	4	
47.	Same	1677052-26	2	
48.	Same	1674052-26	1	
49.	Same	T6101-44-1	2	
50.	Ring	2608c52-8-16-8-A	1	
51.	Clamp	96102-200/4	10	
52.	Same	1677052-28	6	
[illegible]	Same	1678052-33	3	
54.	Same	1677052-20	2	
55.	Same	1688052-37	4	
56.	Same	1677052-12	2	
57.	Clamp attachment bolt	942A51-5-16	20	
58.	Same	942A51-6-14	2	
59.	Same	942A51-6-18	17	
60.	Same	942A-51-4-20	8	
61.	Same	942A-51-4-18	4	
62.	Nut	1397050-5	42	
63.	Same	1397050-4	2	

1	2	3	4	5
64	Clamp attachment bolt	942A51-4-14	4	5
65	Washer	234A50-0,8-5-10	42	
66	Washer	234A50-8,5-4-8	8	
67	~~Flexible coupling~~	~~Y6101-0/12~~	не ...	
68	Flexible coupling	Y6101-0/13	1	
69	Ring	1584A65	1	
70	Cup	Y6200-0-20	3	
71	Cup	Y6200-0-21	1	
72	Cup	Y6101-0-22	6	
	VII Spare Parts for Oil System			
1	Drain cock	MY6204-130	1	
	Gasket for oil tank connection	MY6205-12	4	
2		2609C52-40-3-B	8	
3		2609C52-18-2-D	4	
4		MY6205-8	1	
5	Gasket for oil dip stick	П6201-33	1	
6		MY6200-0/7	1	
7	Flexible coupling	MY6200-0/10	1	
8	Flexible coupling	1666C50-28	2	
9	Clamp	Y6200-6	2	
10	Paronite gasket for oil cooler	1666C50-50	2	
11	Clamp	1399C53-4	1	
12	Nut	1399C53-5	8	
13	Nut	942A51-5-16	2	
14	Bolt	942A51-4-16	1	
15		П6200-5	2	
16	Paronite gasket	Y6202-23	4	
17	Gasket under M3C	1214-15	1	
18	Flexible coupling (1597A19)	1606A24	2	
19	Clamp	1605A135	2	
20	Strip	A127-15	2	
21	Flexible coupling (1597A40)	1606A37	4	
22	Clamp	1605A135	2	
23	Strip	942A51-5-12	2	
24	Clamp fastering bolt			

1	2	3	4	5
25	Clamp fastening bolt	942A51-5-20	2	
26		942A51-5-24	2	
27	Flexible coupling (1597A63)	4M40-15	2	
28	Clamp	1606A55	4	
29	Strip	1605A135	2	
30	Flexible coupling (1958A16)	~~4M40-15~~ 4Ш62.00-0/3	2	
31	Clamp	1606A55	2	
32	Strip	1605A175	[illegible]	
33	Clamp	1666050-18	2	
34		1666050-34	2	
35		1669050-6	1	
36		1669050-14	1	
37		1672052-28	1	
38		1669050-12	1	
39		1674050-20	2	
40		1669050-16	1	
41		1675052-28	1	
42		1606A55	2	
43		1606A37	1	
	IX. Spare Parts for AИ-20 Engine Mount and Control System			
1	Bolt for brace strut	Y6400-7/5	2	
2	Bolt for brace strut	Y6400-9/5	2	
3	Washer	234A50-1,5-10-20	5	

1	2	3	4	5
21.	Generator air scoop tube packing gasket	426804-10/21	8	
22.	Propeller blade root fairing	96901-40	2	
23.	Control cable pulley	472050-50-4	10	
24.	Cable pressure seal (cores)	8446062-2.5	8	
25.	Bolt lock washer	T6800-5	192	
	X. Spare Parts for AI-20 Engine Nacelle			
1.	Air intake duct attachment bolt	404AM12-70	2	
2.	Hatch lid attachment bolt	945A51-6-14	5	
3.	Cover attachment bolt	404AM8-66	5	
4.	Cover-to-nacelle-frame attachment bolt	46906-20	2	
5.	Door sealing profile	436909-90	2	
6.	Duct slot pressurization band, 460x140	436909-0/3	4	
7.	Band attachment screw	942A51-5-15	10	
8.	Same	49620-125	10	
9.	Anchor nut	1956A53-4	10	
10.	Hatch lid lock	36912-50	8	
	Spare Parts for Electric, Radio, and Instrument Equipment			
1.	Static eliminator	552AM	17	
2.	Low pressure hose for instrument connection, dia. 4	B1819-42	1 metre	
3.	Instrument board damper	271049-1-5	8	
4.	Same	271049-2-35	4	
5.	Same	271049-2-12	8	
6.	Same	271049-3-15	2	
7.	Special washer	97909-12	1	
8.	Extension cable	47710-106	3	
9.	Pipe attachment clamp	1609080-6	10	

1	2	3	4	5
10.	Same	1674052-6	5	
11.	Rod washer	77710-204	4	
12.	Push-button	296AH	80	
13.	Vynil chloride tape	297AH	20 metres	
14.	Wire terminal	609101	10	
15.	Same	609102	10	
16.	Same	609104	10	
17.	Same	609105	10	
18.	Same	609103	10	
19.	Same	6091010	5	
20.	Same	609204	5	
21.	Same	609208	5	
22.	Screw	131504-14	10	
23.	Same	131504-8	10	
24.	Same	131505-32	10	
25.	Same	131505-40	10	
26.	Same	131504-26	10	
27.	Nut	1126050-4	20	
28.	Same	1126050-5	20	
29.	Electric lamps for lighting and warning systems	CM23	1	
30.	Same	CM25	7	
31.	Same	CM22	2	
32.	Same	CM24	3	
33.	Same	CM30	25	
34.	Same	CM15	25	
35.	Same	CM37	5	
36.	Dampers	272049-2-10	8	
37.	Special terminal for electric wires	T7200-13	10	

1	2	3	4	5
38.	Textolite plate for switch	97202-376	4	
39.	Same	97202-377	4	
40.	Terminal block	AH86-8	4	
41.	Electric lamps for lighting and warning systems	СМ-31	5	
42.	Fuses of various types	СП-10	3	
43.	Same	СП-2	14	
44.	Same	СП-20	1	
45.	Same	СП-5	27	
46.	Same	СП-25	3	
47.	Same	СП-15	2	
48.	Same	МП-10	1	
49.	Same	МП-15	3	
50.	Same	МП-20	9	
51.	Same	МП-200	1	
52.	Same	МП-250	4	
53.	Same	МП-5	1	
54.	Same	МП-50	4	
55.	Same	МП-75	2	
56.	Same	МП-100	2	
57.	Same	МП-150	3	
58.	Same	МП-30	3	
59.	Same	ТП-400	10	
60.	Same	ТП-600	9	
61.	Same	СП-1	25	
62.	Bonding strip	AH99-1-100	2	
63.	Same	AH99-2-100	2	
64.	Same	AH99-4-220	1	
65.	Same	AH99-7-30	2	

1	2	3	4	5
66.	Same	[illegible]-7-100	1	
67.	Same	A899-7-120	2	
68.	Same	A899-7-140	2	
69.	Same	A899-7-160	2	
70.	Same	A899-7-200	2	
71.	Same	[illegible]-8-200	1	
72.	[illegible]	T7203-[illegible]	2	
73.	Insulator	"[illegible]"	5	
74.	[illegible] strip	[illegible]-3-140	2	
75.	[illegible]	[illegible]-11-100	2	
76.	Same	[illegible]	[illegible]	
77.	Same	[illegible]-11-120	1	
78.	Same	[illegible]	1	
79.	Same	[illegible]	1	
80.	Same	[illegible]	1	
81.	Same	[illegible]	[illegible]	
82.	Same	[illegible]	[illegible]	
83.	[illegible]	[illegible]-7	[illegible]	
84.	Same	[illegible]	[illegible]	
85.	Same	[illegible]	[illegible]	
86.	Same	[illegible]	[illegible]	
87.	Same	[illegible]	[illegible]	
88.	Same	[illegible]-10	[illegible]	
89.	Same	942A51-[illegible]-24	1	
90.	Same	942A51-6-14	1	
91.	Same	942A51-5-16	1	
92.	Same	942A51-6-16	1	
93.	Nut	1387083-4	10	
94.	Same	1387083-5	2	

1	2	3	4	5
95.	Washer	60570-4,3	20	
96.	Washer	60570-5,3	2	
97.	Same	60560-6	2	
98.	Same	~~60560-7~~	2	
99.	Same	232A50-0,8-5-10	2	
100.	Plug	1042A65-14	1	
101.	Glasses for fuses, Oil type	AH-31	15	
102.	Same	AH-32	15	
	XXI. Spare Parts for Altitude Equipment, De-Icing System, and Door Pressurization System			
1.	Washer for pressure gauge	700A50-3-5-10	1	
~~2.~~	~~Pins at exhaust clamp~~	~~160966-6~~	[illegible]	
3.	Same	1360050-6	8	
4.	Expansion pipe	97602-80	1	
5.	Clamp	97606-20-37	4	
6.	Same	97606-20-66	6	
7.	Regulator box gasket	97606-[illegible]/17	1	
8.	Gasket	97602-1/3	16	
9.	Same	97602-1/8	16	
10.	Same	97602-16	2	
11.	Clamp	289AH26	9	
12.	Clamp	289AH-38	8	
13.	Same	97606-20-50	12	
14.	Same	97606-20-65	16	
15.	Same	97606-20-80	28	
16.	Same	97606-20-100	4	
17.	Same	289AH-48	11	
18.	Same	289AH-65	4	

1	2	3	4	5
19.	Gasket	37602-1/5	4	
20.	Bonding strip	8578053-115	2	
21.	Bonding strip	8578053-70	3	
22.	Flexible hose	37604-1/1	1	
23.	Same	37604-1-[illegible]	1	
24.	Same	37604-1-7	1	
25.	Same	37604-1/15	1	
26.	Same	37604-1-[illegible]1	1	
27.	Flexible coupling (854053-10)	8542053-10-1	3	
28.	Strip	8578053-[illegible]	3	
29.	Compensator	37602-170	1	
30.	Clamp	289AH-30	2	
31.	Same	289AH-42	2	
32.	Same	289AH-45	4	
33.	Same	289AH-40	2	
34.	Same	289AH-53	2	
35.	Same	289AH-[illegible]4	1	
36.	Same	408AH-[illegible]	2	
37.	Same	408AH-72	2	
38.	Same	408AH-[illegible]	2	
39.	Same	408AH-[illegible]	2	
40.	Same	408AH-98	1	
41.	Gasket	3976-266-[illegible]1	2	
42.	Gasket	3976-266-11	2	
43.	Bonding strip	8578053-76	6	
44.	Bonding strip	8578053-68	3	
45.	Same	8578056-98	1	
46.	Same	8578053-170	3	

1	2	3	4	5
	XIII. Spare Parts for Aerial Photography Equipment			
1.	Rubber gasket	T7303-0/7	1	
2.	Rubber profile	H063-1-202-2	2	
3.	Camera hatch door profile attachment screw	945A51-3-12	15	
4.	Nut	1399063-3	15	
5.	Washer	234A50-1-3-7	15	
6.	Bonding strip	AH99-5-100	1	
7.	Same	AH99-4-120	1	
8.	Same	AH99-1-100	1	
9.	Heating element	J7701-50	2	
10.	Plug	H7703-53	1	
11.	Nut	1397050-6	12	
12.	Washer	234A50-1-6-12	12	
13.	Pipe union	T7701-	2	
	XIV. Spare Parts for Utility Equipment and Water Supply System			
1.	Lock for ceiling hatch 116	T7995-46/1	25	
2.	Same	T7995-46/2	3	
3.	Ash tray	J7916-0	1	
4.	Cloth, cream-coloured	AHKA	8 metres	
5.	Bolt	951a 51-4-12	30	
6.	~~Same~~	951a 51-4-14	50	
7.	Same	951a 51-4-22	35	
8.	Same	951a 51-4-24	10	
9.	Same	945a 51-4-14	20	

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1	2	3	4	5
10.	W.C. bowl pump sylphon	Y7954-16	1	
11.	Metal ring, inner	Y7954-23	2	
12.	Sylphon attachment clamp	Y7954-510	1	
13.	Screw	1293C52-518	1	
14.	Nut	1398C53-5	1	
15.	Washer	233A50-0.8-5-10	1	
16.	Rubber gasket for glass panel	Y7954-18	2	
17.	Glass panel attachment bolt	951A51-5-18	6	
18.	Water pipe connection hose	Y7954-10/6	2	
19.	Same	Y7954-10/7	1	
20.	Hose attachment clamp	1685C52-34	2	
21.	Hose attachment clamp	1685C52-32	2	
22.	Rubber valve	Y7954-322	2	
23.	Packing ring	312AH22-4-[illegible]	1	
24.	Same	312AH80-5-[illegible]	2	
25.	Drain valve collar	Y7954-287	2	
26.	W.C. bowl lock	Y7954-25	1	
27.	Rubber hose for tank	T7958-20/13	1	
28.	Clamp	406AH-28	2	
29.	Locking pin	280AH5-40	3	
30.	Glass panel edging	Y7906-1-2	3	
31.	Curtain	T7958-0-3 assy	1	
32.	Same	T7958-0-4 assy	1	
33.	Same	T7958-0-5 assy	1	

XV. Spare Parts for Crew Seats

1.	Bolt	963A51-6-28	5	

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1	2	3	4	5
2.	Slide rails attachment bolt	963A51-6-38	2	
3.	Slide rails attachment bolt	1302C51-6-32	10	
4.	Nut	1397053-6	14	
5.	Bolt	942A51-6-16	4	
6.	Nut	1397053-6	14	
7.	Bolt	1314051-8-36	6	
8.	Seat upholstery spring	1282050-1,5-8,35	10	
9.	Technician's seat back operating spring	1290050-1,5-6-36	2	
10.	Technician's seat retaining spring	1291051-1-9-31,5	1	
11.	Seat riser retainer spring	1291050-1.6-43,5	2	
12.	Navigator's seat retainer spring	128901.5-9-18	2	
13.	Navigator's seat retainer spring	1291050-1,5-11-40	2	
14.	Pilot's seat retainer spring	1291050-1,5-11-40	2	
15.	Same	1291050-1,5-11-52	2	
16.	~~Shock absorber~~	~~6606654-14-430~~	~~2~~	
17.	Bolt	963A51-6-30	9	
18.	Bolt	963A51-6-28	4	
19.	Nut	12970-53-8	6	
20.	Shock absorber	Y7502-315	4	

XVI. Spare Parts for Handling Equipment

1	2	3	4	5
1.	Screw	T3801-851	20	
2.	Same	951A51-6-18	20	
3.	Same	1301051-6-16	20	

1	2	3	4	5
4.	Strut attachment bolt	T9701-20	10	
5.	Strut attachment bolt	T9701-21	10	
6.	Fastening unit	T9406-10	2	
7.	Same	T9406-30	1	
8.	Ring	T9406-1	2	
9.	Strap	T9406-5	1	
10.	Cramp	T9406-6	1	
11.	Lock for strut	T9701-30	2	
12.	Strap	T9406-2/1	1	
13.	Same	T9406-2/3	1	
14.	Same	T9406-2/2	1	
15.	Same	T9406-3/1	1	
16.	Strap	T9406-3/2	1	
17.	Same	T9406-3/3	2	
18.	Same	T9406-3/4	1	
19.	Same	T9406-2/4	1	
20.	Chute divider attachment bolt	T9601-040	4	
21.	Fastening screen lock	П9405-41	10	
22.	Fastening cable with lock	П9404-0/1	2	
23.	Same	П9404-0/2	4	
24.	Guide pulley for A-300 mechanism	П99052-40-5	2	
25.	Loading cable	T9400-106/5	1	
26.	Same	T9400-106/7	1	
27.	Same	T9400-106/9	1	
28.	Same	T9400-20	1	
29.	Same	T9400-108	1	
30.	Cable for rip cord coiling winch (see drawing T9306-10)	7x7-1,8 ГОСТ 2172-46	2	17 m

1	2	3	4	5
31.	Same	2172-48	2	13,5 m
	XVII. Spare Parts for group "B"			
1.	Fairing attachment bolt	951A51-5-18	10	
2.	Same	883A52-5-14	4	
3.	Same	883A52-5-20	2	
4.	Neck locking spring	ПЕ602-115	2	
5.	Fairing locks	6903-10/2	2	

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Packing No. 13

Ground Equipment

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Step-ladder to be used when servicing engine nacelle and ceiling in fuselage compartment No. 3 (F-3)	T9002-0-1	1	

1	2	3	4	5
	CASE № 14			
	Ground Equipment			
1	Step-ladder for servicing engines	T9002-0-2	1	

1	2	3	4	5	
	C A S E № 15				
	Loading cable	T9400-20	1		tos
2	Lifting hook	T8500-80	1		
3	Support roller	T9400-150	1		
4	Cable with fittings	T9400-106/5	2		
5	The same	T9400-106/7	1		
6	The same	T9400-106/9	1		
7	Lock, front	П9407-30	8		
8	Aligning cable	T9400-108	1		
9	Frame	T9400-310	1		
10	Unit	T9400-350	4		
11	Strap	T9400-330	1		
12	Planking for ramp	T9403-550/1	1		
13	Knot	T9406-10	16		
14	Extender	T9406-40	5		
15	Block	T9400-124	2		
16	Headlight	C[illegible]-100	1		

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Packing No. 16

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Step-ladder, aircraft-carried	T9013-0	1	

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Packing No. 17

Ground Equipment

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Step-ladder for wiping glass panels and for putting covers on aircraft units	93010-0	1	

CASE No 18

1.	Soft cover for ramp	T9403-60	1	
2.	Planking for cargo floor	T9403-570	2	

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Packing No. 12-20

Ground Equipment

Nos	Description	Drawing No.	Quantity, pieces	Notes
1.	Step-ladder for operations on engine and at ceiling of fuselage compartment No. 3	?D900-20	2	

Packing No. 21

Ground Equipment

Nos	Description	Drawing No.	Quantity	Notes
1.	Step-ladder, light-weight	99090-C	1	

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Packing No. 22

Nos	Description	Drawing No.	Quantity	Notes
1.	Oxygen mask	KM-19	96	

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Box No. 25

Ground Equipment

Nos	Description	Drawing No.	Quantity	Notes
1.	Trolley for loading and unloading equipment	TC3.1-52	1	

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1	2	3	4	5
	CASE No 24			
1	Aerodrome feeding plait	H9972-30	2	
	CASE No 25			
1	Aerodrome feeding plait	H9972-30	2	
	CASE No 26			
1	Soft cover for cargo ramp	T9403-60	1	
2	Planking for ramp	T9403-550/2	2	
3	Planking for ramp	T9403-550/1	1	
	CASE No 27			
1	D.C. socket	Y9249-0	2	
	CASE No 28			
1	Distributor block	П9405-0	6	
	CASE No 29			
1	Cargo distributor	T9405-30	2	
	CASE No 30			
1	Packing box	B6-257-1	1	
2	Packing box	КПС-53	1	
3	Packing box	СП-1	1	
4	Packing box	Wave guide of "Gamma" unit	1	
5	Packing box	"Gamma-54T"	2	

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1	2	3	4	5
	CASE No 31			
1	Stretcher		10	
2	Bracket	T9705-1	14	
3	Bolt	1302a51-5-16	28	
4	Nut	1399053-5	28	
5	Washer	234A50-08-5-10	28	
	CASE No 32			
1	Stretcher		9	

Inspector Зюзин

"28" V 1961

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FUEL FLOWMETER

Model PTMCI,2-BI

DESCRIPTION AND OPERATION AND MAINTENANCE

INSTRUCTIONS

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A. DESCRIPTION OF PTMC1,2-Б1 FUEL FLOWMETER

I. GENERAL

The PTMC1,2-Б1 flowmeter (Fig.1) of hourly and total fuel consumption is designed to measure hourly consumption and reserve of fuel in fuel tanks for one engine (provided the fuel pipe lines and tanks are not damaged).

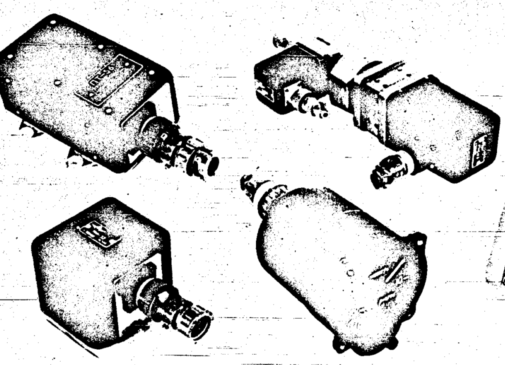

Fig.1. PTMC1,2 – Б1 Fuel Flowmeter

1 – PTMC1,2A transmitter; 2 – PTMC1,2- БI indicator; 3 – ПТ-56 thyratron breaker; 4 – TPП-52 transformer.

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II. COMPLETING

The flowmeter set comprises:

1. РТМС1,2А total and hourly fuel consumption transmitter with one three-pin and five-pin plug connectors.................. 1

2. РТМС1,2-Б1 indicator with one seven-pin plug connector 1

3. ПТ-5С thyratron breaker with one seven-pin plug connector 1

4. ТПТ-52 transformer with one five-pin plug connector (for two sets).................... 1

5. ТГ1-0.1/1.3 thyratron (spare)..................... 1

III. PRINCIPLE OF OPERATION

The wiring schematic diagram of the fuel flowmeter is given in Fig.2.

The sensing elements of the fuel flowmeter transmitter are two spiral impellers one of which measures total fuel consumption and the other - hourly fuel consumption.

The flowmeter operates as follows:
fuel flowing through the transmitter at a definite speed makes both impellers rotate; the speed of the impellers is proportional to that of the flow and thus it is proportional to both hourly consumption and quantity of fuel flowing through the transmitter.

The impeller (Fig.3,4) designed to measure total fuel consumption, rotates the core of the inductive-pulse device by means of the reduction gear.

The electrical diagram of the inductive-pulse device is an a.c. bridge.

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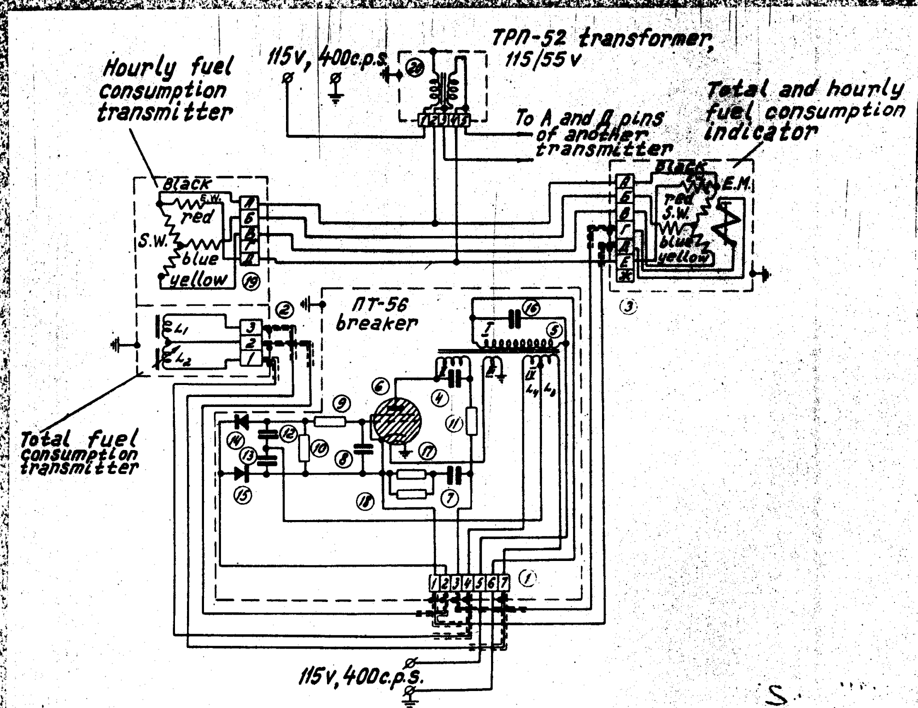
Fig. 2. Schematic Wiring Diagram of PTMC1,2-Б1 Fuel Flowmeter



Key to Fig. 2.

1 - ШР-56 plug connector (plug connector contacts 1,2,3,4,5,6,7);
2 - PTMC1,2A total consumption transmitter (transmitter plug connector contacts 1,2,3);
L_1 - transmitter permanent inductance coil;
L_2 - transmitter variable inductance coil;
3 - PTMC1,2-Б 1 indicator;
E.M. - electromagnet;
E.W. - indicating selsyn excitation winding;
S.W. - indicating selsyn synchronization winding;
А,Б,В,Г,Д,Е,Ж - plug connector contacts;
4 - capacitor, 1 mf, 200 v;
5 - power transformer;
I - primary winding;
II, III, IY - secondary windings;
L_3 and L_4 - inductances of two halves of winding IY;
6 - ТГ1-0.1/1.3 thyratron;
7 - capacitor, 10 mf, 200 v;
8 - capacitor, 0.1 mf, 600 v;
9 - МЛТ resistor, 10 kohms, 0.5 w;
10 - МЛТ resistor, 91 kohms, 0.5 w;
11 - ПЭВ resistance, 75 ohms, 10 w;
12, 13 - capacitor, 2x0.1 mf, 400 v;
14, 15 - Д2Д germanium diods (rectifiers);
16 - capacitor, 0.5 mf, 600 v;
17, 18 - МЛТ resistor, 100 ohms, 0.5 w;
19 - hourly fuel consumption transmitter;
E.W. - transmitting selsyn excitation winding;
S.W. - transmitting selsyn synchronization winding;
А, Б,В,Г,Д transmitter plug connector contacts;
red;
black;
blue;
yellow - selsyn connecting wires cod colours;
20 - ТРП-52 step-down transformer, 115/55 v.

Two arms (L_3 and L_4) of the bridge, formed by the winding (IV) of the transformer with a center tap are in the thyratron breaker and have constant inductance and two other arms formed by inductance coils (L_1 and L_2) are in the transmitter.

One of the coils (L_1) have constant inductance and the other coil (L_2) - variable inductance. Variable inductance is achieved due to rotation of a steel core in the coil magnetic field during operation of the transmitter; the steel core is linked to the impeller through the reduction gear.

The rotating core approaches the П-shaped core of the inductance coil and changes its magnetic flux and thus its inductance.

Due to change in inductance of the coil L_2 the bridge is disbalanced and voltage with frequency equal to that of the supply voltage (400 c.p.s.) appears on the bridge diagonal line.

This voltage is supplied via the rectifier and filter to the thyratron grid so that the grid potential would be negative relative to the cathode.

The full-wave voltage doubling rectifier consists of two germanium diods [illegible] (14 and 15) and two capacitors (12 and 13) of 0.1 mf. each.

The filter is a [illegible]-kohm resistor element (9) and 0.1 mf. capacitor (8). The latter are used to smooth rectified voltage supplied to the thyratron grid.

Every 30 revolutions of the impeller the inductive-pulse device sends one pulse through the rectifier to the grid of the TT 1-0.1/0.3 thyratron (6) which is used for power amplification of signals from the inductive-pulse device.

The winding of the indicator solenoid (ЭМ) is connected in the thyratron anode circuit which is supplied with 48 volts, 400 c.p.s.

Two arms (L_3 and L_4) of the bridge, formed by the winding (IV) of the transformer with a center tap are in the thyratron breaker and have constant inductance and two other arms formed by inductance coils (L_1 and L_2) are in the transmitter.

One of the coils (L_1) have constant inductance and the other coil (L_2) - variable inductance. Variable inductance is achieved due to rotation of a steel core in the coil magnetic field during operation of the transmitter; the steel core is linked to the impeller through the reduction gear.

The rotating core approaches the Π-shaped core of the inductance coil and changes its magnetic flux and thus its inductance.

Due to change in inductance of the coil L_2 the bridge is disbalanced and voltage with frequency equal to that of the supply voltage (400 c.p.s.) appears on the bridge diagonal line.

This voltage is supplied via the rectifier and filter to the thyratron grid so that the grid potential would be negative relative to the cathode.

The full-wave voltage doubling rectifier consists of two germanium diods [illegible] (14 and 15) and two capacitors (12 and 13) of 0.1 mf. each.

The filter is a 1?-kohm resistor element (9) and 0.1 mf. capacitor (8). The latter are used to smooth rectified voltage supplied to the thyratron grid.

Every 30 revolutions of the impeller the inductive-pulse device sends one pulse through the rectifier to the grid of the TГ 1-0.1/0.3 thyratron (6) which is used for power amplification of signals from the inductive-pulse device.

The winding of the indicator solenoid (ЭМ) is connected in the thyratron anode circuit which is supplied with 48 volts, 400 c.p.s.

A.C. from the power transformer (5) winding (II).

When the bridge is balanced the voltage across the bridge diagonal line is zero. In this case the thyratron grid potential is zero too and nominal anode voltage of 48 v is sufficient to actuate the thyratron.

When the thyratron is actuated it closes the circuit of the indicator solenoid winding through the pins (1 and 3). The solenoid pulls up the armature. That corresponds to a pulse.

When the bridge is unbalanced, voltage across the bridge diagonal line changes depending on the position of the steel core in the magnetic field of the coil (L_2). In this case the grid potential has the value at a certain moment when anode voltage of 48 v is not sufficient to actuated the thyratron. The thyratron is blocked, anode current does not flow and the solenoid of the indicator release the core. That corresponds to an interval as the core speed is proportional to that of the impeller, the solenoid number of actuations is proportional to the impeller r.p.m. and thus to fuel total consumption.

When the indicator solenoid is actuated, it turns the ratchet wheel notch which is geared to the counter drums. When the drums rotate they indicate at any moment of counting the fuel reserve in one tanks group as a difference between quantity of fuel filled and quantity of fuel which has flown through the fuel flowmeter transmitter. Resistor (10) of 91 kohm is a leak resistance. The latter accelerates the capacitor (8) discharge and thus actuation of the thyratron which is necessary in case of high pulse frequency.

Resistors (11) of 75 ohms and (17, 18) of 100 ohms each are intended to limit average value and amplitude of the thyratron rectified anode current to permissible values.

The capacitor (7) of 10 mf. serves to tap the anode current alternating component off the indicator solenoid.

The capacitor (16) of 0.5 mf and capacitor (4) of 1.0 mf are intended to decrease interferences to radio reception due to the fuel flowmeter operation.

The inductance windings of the transmitters (L_1) and (L_2) are connected to the windings of the transformers (L_3) and (L_4), through the transmitter pins (1 and 3) and thyratron breaker pins (4 and 7) and to the rectifier through the pins (2) of the corresponding plug connectors.

The impeller, intended to measure hourly fuel consumption (Fig.5,6) rotates the permanent magnet attached to the impeller shaft. In the rotating field of the magnet is a cup made of AM $_{\Pi}$ alloy; the cup is attached to the transmitting selsyn rotor shaft. The magnet and cup are the inductive mechanism of the transmitter.

When the magnet rotating field crosses the cup walls electromotive force is generated which cases eddy currents. Due to interaction of the magnetic field and eddy currents torque is created, which is proportional to the magnet rotation speed; the magnet tends to draw the cup in the direction of its rotation.

Due to the torque, the cup turns and winds two spiral springs which cause counteracting moment on the cup shaft.

The angle of the cup deflection depends on the value of inductance in the air gap, magnet speed, electrical resistance of the cup material, value of the spiral springs counteracting moment and design parameters of the inductive mechanism.

The angle of the cup deflection depends only on the magnet speed and springs counteracting moment as the inductance in the air gap and resistance of the cup are constant in other similar conditions.

Thus a definite angle of turn of the cup shaft corresponds to each value of the impeller speed.

The transmitter is graduated at a temperature of $+20 \pm 5^{\circ}C$.

If the temperature of the air surrounding the transmitter is changed, electrical resistance of the cup, magnetic induction and springs torque are changed respectively; this causes an error in the flowmeter reading.

To decrease this error, temperature compensating provision is used in the transmitter. Installed parallel to the permanent magnet and closely contacting it is a thermomagnetic shunt made of material having a negative coefficient of magnetic inductivity.

At a normal temperature a part of the permanent magnet flux is branched through the shunt. With increase in temperature the magnetic inductivity of the shunt decreases; due to that the shunt bypass effect decreases and magnetic inductance in the operating gap increases; with decrease in temperature the shunt magnetic inductivity increases, due to that the shunt bypass effect increases and inductance in the operating gap decreases.

Thus, a change in eddy currents is compensated; change in the electrical resistance of the cup and its turning angle does not almost depend on the ambient air temperature.

For remote actuation of the turning angle, the synchronous [illegible] inductive system is used in the [illegible]1,2-Б fuel flowmeter; the system operates on mag slips. The system comprises the transmitting selsyn and indicating selsyn.

The selsyn is an A.C. induction machine. Placed on the mag-slip stator are the excitation (E.W.) and synchronization (S.W.) windings (see Fig.2).

As it was mentioned above the cup is attached to the transmitting selsyn rotor axle. Thus, if the transmitting selsyn rotor is forced to turn, the indicating selsyn rotor turns respectively;

attached to the indicating selsyn rotor axle is the pointer which displays fuel hourly consumption on the dial.

The selsyns excitation windings are supplied with 55 v from the ТРП-52 transformer.

The synchronization windings of the indicating and transmitting selsyns are star connected and lead out to the pins of the plug connectors (A,Б and В) by the wires coloured black, blue and yellow.

The excitation windings have one common contact with one of the synchronization winding phases (black colour). The other end of the excitation winding is connected to the pin (Г) of the indicator and pin (Д) of the transmitter by a red wire.

IV. D E S I G N

TRANSMITTER

The PTMC1,2- B 1 fuel flowmeter transmitter comprises two transmitters:

a) total fuel consumption transmitter (Fig.3,4) - to measure total fuel consumption;

b) hourly fuel consumption transmitter (Fig.5,6) - to measure hourly fuel consumption.

Both transmitters are connected by a common nut (Fig.1).

a) TOTAL FUEL CONSUMPTION TRANSMITTER

(Fig.3,4)

Fig.3 illustrates the interior arrangement of the transmitter and Fig.4 - its kinematic diagram.

The total fuel consumption transmitter consists of a hollow casing (1) with a passage of 24 mm.dia.

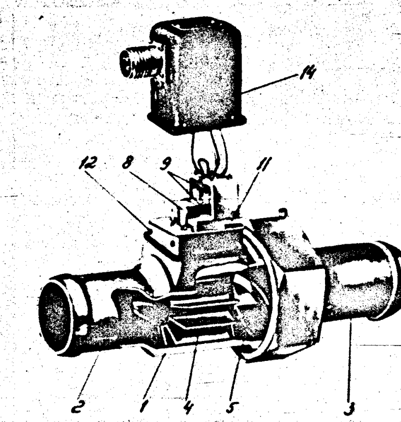


Fig.3. Total Fuel Consumption Transmitter

1 - Hollow casing; 2,3 - pipe connection; 4 - guide vanes; 5 - impeller; 6 - worm gear; 7 - steel core; 8 - protective cap; 9 - cores; 10 - inductive coils; 11 - plate; 12 - lock screws; 13 - magnetic shunt; 14 - cover.

One end of the casing is a pipe connection (2) which connects the transmitter to the fuel pipeline.

On the outside of the other end of the casing is the thread for connection to the casing of the hourly consumption transmitter by a common nut.

Fuel supplied to the pipe connection (2) passes the guide vanes (4) and flows to the spiral blades of the impeller (5).

The impeller shaft runs in stainless steel ball-bearings located in the guide vanes assembly.

The impeller operates due to the fuel flow supplied to its blades. The blades are set at an angle to the direction of the fuel flow, in case of maximum fuel consumption of 1200 kg/hr the impeller speed is approximately 1500 r.p.m.

To adjust the impeller to a preset speed the impeller and passage (in which the impeller is located) are made in a form of a cone. The change in speed is obtained by the impeller axial movement.

Through a worm gear (6) located inside the guide vanes, the impeller rotates the bushing with a steel core (7) placed inside the protective cap (8) 30 times slower.

Near the cap (8) on the outside of it are two inductive coils (10) (which are placed one above the other) with steel П- shaped cores (9); the cores windings form two arms of the inductive bridge.

One revolution of the core corresponds to a change in inductance of the lower coil which causes unbalancing of the bridge consisting of the transmitter inductive coils and windings of the transformer which supplies the thyratron breaker (See Section III).

The impeller is designed so that each 0.383 kg of fuel passing through the transmitter corresponds to one current pulse in the winding of the indicator solenoid (2.557 pulse/kg.).

On the outside of the other end of the casing is the thread for connection to the casing of the hourly consumption transmitter by a common nut.

Fuel supplied to the pipe connection (2) passes the guide vanes (4) and flows to the spiral blades of the impeller (5).

The impeller shaft runs in stainless steel ball-bearings located in the guide vanes assembly.

The impeller operates due to the fuel flow supplied to its blades. The blades are set at an angle to the direction of the fuel flow, in case of maximum fuel consumption of 1200 kg/hr the impeller speed is approximately 1500 r.p.m.

To adjust the impeller to a preset sp[illegible] the impeller and passage (in which the impeller is located) are made in a form of a cone. The change in speed is obtained by the impeller axial movement.

Through a worm gear (6) located inside the guide vanes, the impeller rotates the bushing with a steel core (7) placed inside the protective cup (8) 30 times slower.

Near the cup (8) on the outside of it are two inductive coils (10) (which are placed one above the other) with steel П-shaped cores (9); the cores windings form two arms of the inductive bridge.

One revolution of the core corresponds to a change in inductance of the lower coil which causes unbalancing of the bridge consisting of the transmitter inductive coils and windings of the transformer which supplies the thyratron breaker (See Section III).

The impeller is designed so that each 0.388 kg of fuel passing through the transmitter corresponds to one current pulse in the winding of the indicator solenoid (2.577 pulse/kg.).

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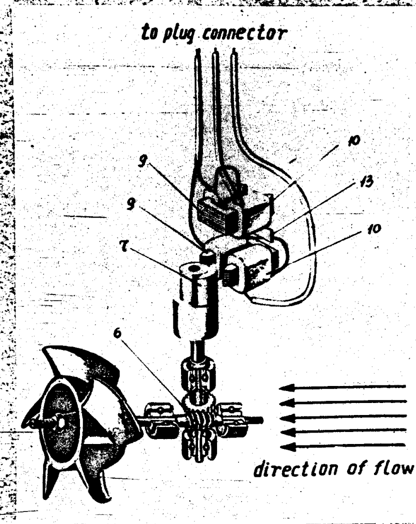

Fig.4. Total Fuel Consumption Transmitter Kinematic Diagram

(For Ref.Nos.see key to Fig.3)

Both inductive coils are installed on the plate (11) which is attached to the transmitter casing by four lock screws (12) and covered with a protective cover (14). To re-establish the initial balance of the bridge, the magnetic shunt (13) is provided; the shunt is attached by a lock screw near the upper inductive coil.

The magnetic shunt position is set during the bridge adjustment at the Manufacturing plant.

The transmitter is provided with a three-pin plug connector installed on the protective cover (14) for connection to the thyratron breaker.

b) HOURLY FUEL CONSUMPTION TRANSMITTER

(Fig. 5 and 6)

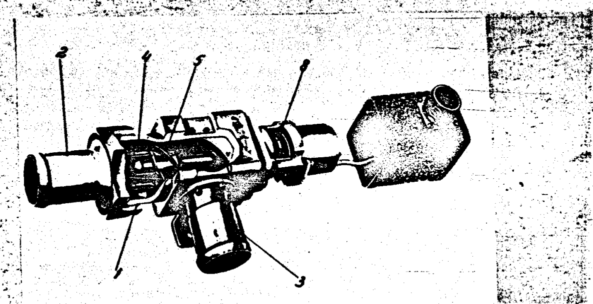

Fig.5. Hourly Fuel Consumption Transmitter

1 - Hollow casing; 2 - connecting pipe; 3 - connecting pipe; 4 - guide vanes; 5 - impeller; 6 - four-pole magnet; 7 - cap; 8 - spiral springs; 9 - cap; 10 - thermomagnetic shunt: 11 - transmitting selsyn; 12 - bracket; 13 - disc.

Fig. 5 illustrates the interior arrangement of the hourly consumption transmitter and Fig.6 - its kinematic diagram.

The hourly fuel consumption transmitter has a hollow casing with a passage of 24 mm.dia. As well as the total consumption transmitter, one end of the hourly consumption transmitter casing is threaded for connection to the total consumption transmitter casing by a common nut.

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b) HOURLY FUEL CONSUMPTION TRANSMITTER

(Fig. 5 and 6)

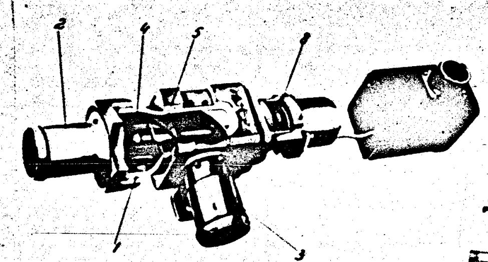

Fig.5: Hourly fuel Consumption Transmitter

1 - Hollow casing; 2 - connecting pipe; 3 - connecting pipe; 4 - guide vanes; 5 - impeller; 6 - four-pole magnet; 7 - cap; 8 - spiral springs; 9 - cap; 10 - thermomagnetic shunt; 11 - transmitting selsyn; 12 - bracket; 13 - disc.

Fig. 5 illustrates the interior arrangement of the hourly consumption transmitter and Fig.6 - its kinematic diagram.

The hourly fuel consumption transmitter has a hollow casing with a passage of 24 mm.dia. As well as the total consumption transmitter, one end of the hourly consumption transmitter casing is threaded for connection to the total consumption transmitter casing by a common nut.

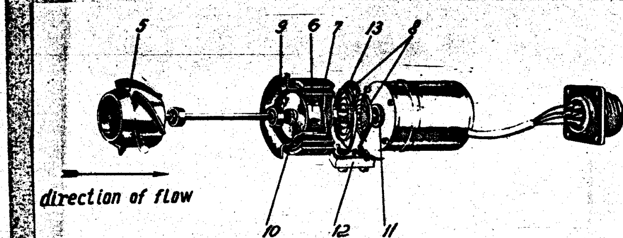

Fig.6. Hourly Fuel Consumption Transmitter
Kinematic Diagram
(For Ref. Nos. see key to Fig.5)

...at an angle of 90° to the casing is the second pipe connection ... intended to connect the transmitter to the fuel pipeline.

Fuel, passing the total consumption transmitter, flows to the hourly consumption transmitter, passes the guide vanes (4) and is supplied to the spiral blades of the impeller (5).

At a maximum fuel consumption of 1,200 kg./hr., the impeller speed is approximately 2,000 r.p.m.

To adjust to the preset speed the impeller and passage (in which it is located) are tapered as well as in the total consumption transmitter.

The change in the speed is obtained due to the impeller axial movement. Attached to the impeller axle is the four-pole magnet (6) with the thermomagnetic shunt (10). The magnet together with the cup (7), made of manganese aluminium, is the inductive mechanism. The cup is attached to the transmitting selsyn (11) rotor axle.

Placed between the cup and selsyn are two spiral springs (8) one end of which is attached to the transmitting selsyn rotor axle and the other - to the bracket (12). When the cup turns, one of the springs is twisted and the other - untwisted.

To prevent the springs contact, a duralumin disc (13) is placed between them; the disc lug restricts the rotor turning angle up to [illegible] deg.

The inner cavity of the transmitter casing is sealed by a manganin cap (9).

The induction system and selsyn are protected with a cover.

The transmitter is provided with five-pin plug connector for connecting to the indicator and [illegible] transformer.

[illegible]-Б [illegible]

(Fig.7 and 8)

Given in Fig.7 is the indicator and in Fig.8 - its kinematic diagram.

The fuel flowmeter indicator is a universal unit and consists of the mag-slip with the reduction gear indicating fuel hourly consumption in kg./hr and electric pulses counter showing fuel reserve in kg. The indicator selsyn (27) is connected to the transmitting selsyn and is actuated by turning angles of the transmitting selsyn.

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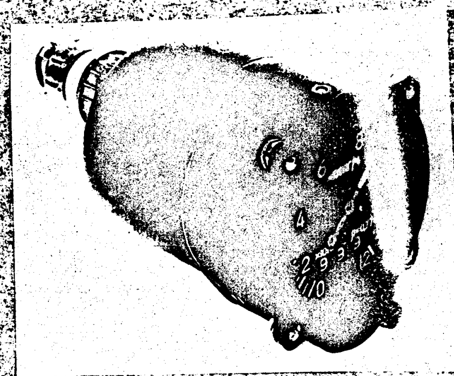

Fig.7. – Indicator

The angular motion to the pointer (28) is through the reduction gear consisting of two gears (21 and 22) having a gear ratio of 1:1. The gear (21) is rigidly attached to the selsyn (27) axle and engaged with the gear (22) which axle is fitted with a pointer (28); the pointer indicates on the dial the quantity of fuel hourly consumption of 0 to 1,200 kg./hr.

To measure fuel reserve three rectangular ports are cut in the dial; seen in the ports are rotating drums having figures from 0 to 9.

The readings shown by the counter drums should be multiplied by 10. Thus, maximum reading by the counter may be 999x10=9,990 kg.

The counter mechanism comprises solenoid, reduction gear and setting device.

a) SOLENOID

When the electric circuit is closed, the counter solenoid (1) is actuated and pulls up the armature (1a) to the solenoid core. With the armature (1a) moving, the driving dog (2), attached to the armature, turns the ratchet wheel (3) by one notch.

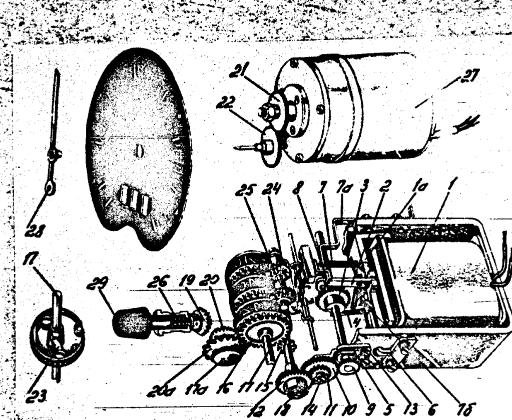

Fig. 8. Indicator Kinematic Diagram

1 - Solenoid; 1a - armature; 2 - driving dog; 3 - ratchet wheel; 4 - locking dog; 5 - eccentric bushing; 6 - stop; 7 - spring; 7a - clamp; 8 - limiter; 9,10,11,12 - gears; 13 - bracket; 14 - eccentric axle; 15 - gear; 16 - drum; 17,17a - axles; 18 - clutch; 19 - gear; 20,20a, 21, 22 - gears; 23 - dog; 24 - carriage; 25 - pinion; 26 - spring; 27 - selsyn; 28 - pointer; 29 - knob.

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The locking dog (4) prevents the ratchet wheel from turning in opposite direction; the engagement of the dogs with the ratchet wheel (3) is adjusted by moving the ratchet wheel due to rotation of the eccentric bushing (5). The armature travel is restricted by the stop (6).

The armature is returned by the spring (7) and adjusted by the clamp (7a) motion.

The dogs are pressed to the ratchet wheel by the spring (7b).

To prevent the ratchet wheel inertial turning for more than one notch during each travel of the armature a special limiter (8) is used; with the armature pulled up the driving dog rests against the limiter.

b) REDUCTION GEAR

The reduction gear transmits rotation of the ratchet wheel to the first drum (16) with a gear ratio of 1:257.7.

The reduction gear consists of two pairs of spur gears (9,10,11,12). One pair of gears (10,11) is installed on the turning bracket (13) which permits to adjust engagement of the gears (11,12); the gears are changed for various calibrations.

To adjust the gears (9,10) engagement, the eccentric axle (14) is provided. The engagement of these gears is adjusted by turning the eccentric axle using a screw driver. The gear (11) rotation is transmitted to the gear (12) and then from the gear (15), secured on the same axle with the gear (12), to the first drum (16). This drum is attached to the axle (17), the other two drums are placed on the axle (17) freely but can rotate in one direction only.

The rotation of the drums in the opposite direction is restricted by the dogs (23) on the drums; the dogs fall in the longitudinal groove in the axle (17). Under the action of electrical pulses supplied to

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the solenoid (1) the armature (1a) oscillates; due to that the driving dog (2) rotates the ratchet wheel.

The rotation of the ratchet is transmitted by the gear train to the first counting drum which at a complete revolution turns the second drum for one figure by means of the pinion (25).

The pinion (25) of the first drum falls in the groove of the second drum at a complete revolution of the first drum and turns the latter for one figure.

The second drum at its full revolution, turns the third drum for one figure in the similar way.

The direction of the drums rotation is chosen so that the quantity of fuel in kilograms set on the counter would not increase but decrease.

c) SETTING DEVICE

The setting devise of the indicator permits to set three drums in any combination of figures on the drums corresponding to the quantity of fuel filled in the tank group for one engine.

The drums are set by the knob (29). When pressing the knob, the gear (19) moves along its axis and engages with the bevel gear (20) which is integral with the spur gear (20a); both gears freely rotate relative to the stationary axle (17a).

When setting the drums, their rotation is not transmitted to the solenoid due to the friction clutch (18) slipping as the ratchet wheel is braked by the locking dog (4).

The gear (19) rotation is transmitted through the gears (20 and 20a) to the first drum which rotates together with the axle (17). If the gear (19) is rotated clockwise, the dogs (23) on the drums fall in a spline of the rotating axle (17); due to that the drums are set for the same figure, as the dogs (23) on all the drums are placed similar relative to the figures on the drums.

Under the action of a mechanical force applied, the carriage (24) with the pinion (25) is pressed out by the drums and the pinions do not prevent the drums from turning.

If the gear is rotated counter-clockwise, the drums rotate in the way they rotate during the counter operation; the drums gradually drop the number of kilograms of fuel set. When releasing the knob, the gear (19) returns to its initial position under the action of the spring (26); the gear (19) is disengaged with the bevel gear (20). The indicator is provided with a seven-pin plug connector for connection to the transmitter, thyratron breaker and transformer.

5. THYRATRON BREAKER Model HT-56

To amplify signals from the inductive-pulse mechanism, the thyratron breaker is used in the flow meter system as mentioned in Section III.

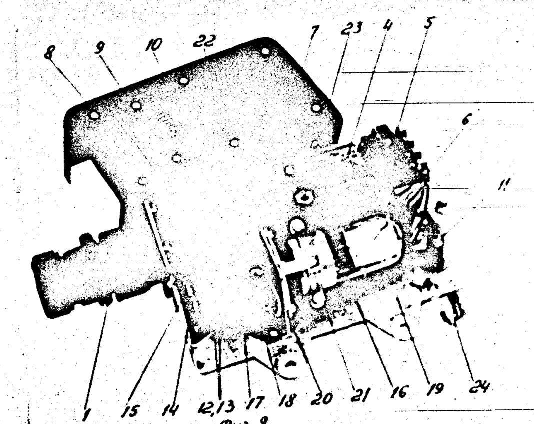

Fig.9. HT-56 Thyratron Breaker

1 – Plug connector; 4,7,8,12,13,16 – capacitors; 5 – power transformer; 6 – thyratron; 9,10,11,17,18 – resistors; 14,15 – germanium diods; 19 – plate; 20 – angle; 21 – clamp; 22 – cover; 23 – support; 24 – ground wire.

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The thyratron breaker (Fig.9) consists of the power transformer (5), ТГI-0.1/1.3 thyratron (6), two Д2Ж germanium diods (14,15), capacitors (4,7,8,12, 13 and 16) and resistors (9,10,11,17,18).

All the elements of the thyratron breaker are mounted on the duralumin plate (19) and connected to each other as shown in Fig.2.

Given in this figure are the characteristics of the capacitors and resistors.

CHARACTERISTICS OF THE TRANSFORMER WINDING

[illegible]inding I, number of turns - [illegible], 0.33 dia - ПЭВ-2

Winding II, number of turns - 16[illegible], 0.41 dia - ПЭВ-2

[illegible]inding III, number of turns - [illegible], 0.59 dia - ПЭВ-2

[illegible]inding IV, number of turns - 2x[illegible], 0.[illegible] dia. - ПЭВ-2

To attach the thyratron securely its base is fastened to the [illegible] (20) by the clamp (21).

The thyratron breaker is provided with a seven-pin plug connector (1) for connection to the transmitter, indicator and a power supply source. To ground the thyratron breaker casing, a flexible bonding strip is provided. All the elements of the [illegible] are protected with the duralumin cover ([illegible]) which is screwed to the support [illegible].

D. [illegible]-52 TRANSFORMER

The [illegible].2 - [illegible] fuel flowmeter selsyns are supplied with [illegible] [illegible], 400 c.p.s. from the ТРН-52 step-down transformer 115/[illegible] V, 400 c.p.s.

Characteristics of the transformer windings:

number of turns of primary winding - [illegible], ПЭВ-2, 0.47 dia.

number of turns of secondary winding - 176, ПЭВ -2, 0.64 dia.

The transformer is provided with a five-pin plug connector for connection to the transmitter, indicator and power supply source.

V. TECHNICAL DATA

1. The fuel flowmeter model PTRC1.2 - [illegible] 1 measures fuel reserve in the aircraft fuel tanks of 0 to 9,990 kg. and hourly fuel consumption by an engine from 0 to 1,200 kg./hr.

2. The flowmeter error under normal conditions of $20 \pm 5^{\circ}C$ and fuel density of 0.776 gr/cm^3 does not exceed:

a) ±2.5% for fuel reserve remaining from nominal fuel load of 5,000 kg.

b) ± 24 kg/hr for fuel hourly consumption of 250 to 800 kg./hr. and ± 3% of the measured value of hourly consumption within the range of 800 to 1,200 kg./hr.

At a fuel consumption below 250 kg./hr. the error is not specified.

3. The flowmeter error at an air temperature of +50 and $-60^{\circ}C$ and fuel temperature of +50 and $-40^{\circ}C$ does not exceed:

a) ±4.5% for fuel reserve of nominal value - 5,000 kg

b) ±45 kg/hr for fuel hourly consumption within the range of 250 to 800 kg/hr and ±55 kg/hr within the range of 800 to [illegible] kg/hr.

±5 kg/hr within the range of [illegible].

NOTE: When measuring consumption and reserve of fuel whose density does not correspond to $\rho = 0.776$ gr/cm^3 the flowmeter does not consider the error. In this case the flowmeter error both on the fuel reserve and fuel hourly consumption scales does not exceed

$$\Delta = \frac{\rho_1 - \rho}{\rho_1} \cdot 100\%$$

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where

ρ_t - actual value of fuel density

ρ - rated value of fuel density equal to 0.776 gr/cm^3.

4. Power drawn by one flowmeter set from a supply source does not exceed 80 Va.

5. Pressure difference across the transmitter at max. consumption of 1,200 kg/hr and fuel temperature of -40^0 does not exceed 0.25 kg/cm^2 with rotating impellers and 0.4 kg/cm^2 with impellers stopped.

6. The inner cavities of the transmitter casings and places of the casing connections are airtight and withstand kerosene test pressure of 3 kg/cm^2.

7. The transmitter, measuring fuel total consumption, transformer and thyratron breaker for other sets are interchangeable.

The transmitters measuring fuel hourly consumption and indicators are not interchangeable.

8. The flowmeter components properly operate at frequencies and overloads given below:

a) indicator withstands overloads of 0.7 to 1.5 g at a vibration frequency of 20 to 80 c.p.s. respectively;

b) transmitter withstands overloads of 1.6 to 4.5 g at a vibratio[n] frequency of 20 to 250 c.p.s. respectively;

c) transformer and thyratron breaker withstand overloads of 1.8 to 3.5 g and 1.8 to 2.5 g respectively at a vibration frequency of 20 to 200 c.p.s.

9. Weight does not exceed:

PTMC1.2A transmitter .... 1,600 gr
PTMC1.2-Б1 indicator .... 1,100 gr
ПП-56 - thyratron breaker .... 1,100 gr
ТРП-52 transformer .... 800 gr

10. Dimensions

TMC1.2A transmitter .... 305x131x135 mm.
TM01,2-A1 indicator .... 182x85 mm.
IT-56 thyratron breaker .... 221x67x130 mm.
TPII-52 transformer .... 146x70x88 mm.

B. FLOWMETER OPERATION AND MAINTENANCE INSTRUCTIONS

VI. INSTALLATION

1. Before installing, depreserve the flowmeter transmitter (if preserved) as indicated in Section XII, paragraph 2, this description.

2. Thoroughly inspect all the flowmeter parts and check them for freedom from external damage.

3. Wire the flowmeter components according to the diagram of external connections (Fig. 10) and proceed as follows:

a) check the marking of the wires laid in the aircraft and intended to connect the flowmeter set.

The wires cross-section area should be not less than 0.[illegible] mm^2.

b) tin the wires ends and strictly observe the wires marking when connecting them to the plug connectors (the numbers of the wire and plug connector socket must coincide);

c) after connecting, check the plug connector for freedom from short circuit (between the wires and plug connector casing);

d) remove the caps from the pipes and install the transmitter horizontally (approximately at $\pm 10^0$) in the pipeline with its arrow set in the direction of the fuel flow.

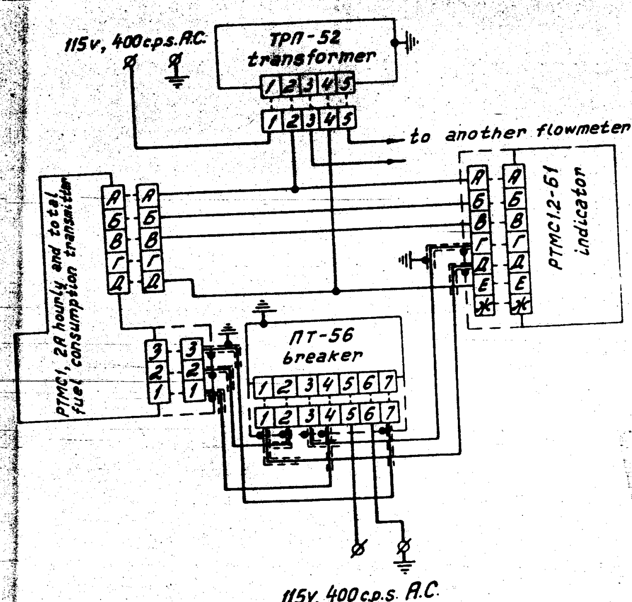

Fig. 10. Diagram of PTMC1.2- Б1 Flowmeter
External Connections

Upstream of the transmitter must be a straight portion of the pipeline not less than 300 mm. long and downstream of the transmitter not less than 200 mm. long.

The transmitter pipe connections should be connected to the inlet and outlet pipes by short hoses; the latter should be attached so that they would not cause tension in the transmitter casing and in the place of connection and would prevent the transmitter from swinging.

e) Install the indicator in a cut out in the instrument panel and fasten it;

f) Install the thyratron breaker vertically (with the plug connector down);

g) The connecting wires should be rigidly secured. The wires, running from the thyratron breaker to the total consumption transmitter and indicator, must be shielded;

h) Attach the wires to the transmitter so that water accumulating on the wires would not get on the transmitters;

i) The shield braiding of the connecting wires and the casings of the transmitter, indicator, thyratron breaker and transformer must be securely grounded to the aircraft structure.

The total consumption transmitter and indicator are connected to the aircraft structure directly at the plug connectors through the connecting wires braidings.

VII. OPERATION INSTRUCTIONS.

1. Before a flight the counter drums should be set for the quantity of fuel filled. The drums are set as follows:

a) Pressing the knob and then turning it clockwise set the drums on the same figure setting up the nearest number which is larger than the required one.

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NOTE: If all the three drums slightly shake within their ports when the knob is turned clockwise or counter-clockwise for a small angle, the drums are set properly.

b) Turning the knob counter-clockwise decrease the number on the drums till the required number is obtained.

If in this case the drums figures are properly set in the port (only one figure is seen in each port) the numbers on the drums are decreased correctly.

If during the first drum rotation (tens of kilograms) two figures appear in the ports of the drums of hundred and thousand kilograms, the numbers on the drums are decreased improperly and the counter should be re-set (see para."a" and "b" above).

EXAMPLE: Aircraft tanks are filled with 3350 kg. of fuel.

This number is set up as follows:

1) pressing the knob and turning it clockwise set up 4440;

2) turning the knob counter-clockwise, decrease this number till 3350 is obtained.

2. The flowmeter-readings are accurate if the instructions given in paragraph 1, this section and the following requirements are observed:

a) the fuel pipelines must be clean and free from leaks;

b) fuel, supplied to the flowmeter transmitters, should be thoroughly filtered to prevent the transmitters from clogging.

VIII. MAINTENANCE OPERATIONS

After every 150 hours of operation the flowmeter should be removed for checking errors.

The flowmeter errors are checked as indicated in Section XI, this description.

NOTE: If during operation the flowmeter functions improperly, remove it to check its serviceability and, if necessary, to check its errors as indicated in Section XI.

IX. SERVICE TROUBLES AND REMEDIES

Trouble	Cause	Remedy
1	2	3
1. Indicator fails to operate for hourly consumption scale but for total consumption scale operates properly.	a) Broken wires in hourly consumption circuit. b) Impeller sticking in hourly consumption transmitter.	a) Check connecting wires with tester and eliminate defect b) Replace hourly consumption transmitter with indicator.
2. Indicator fails to operate for total consumption scale with impeller rotating.	a) Broken wires of total consumption circuit. b) Broken wires of indicator or mechanism sticking c) Defective thyratron in thyratron breaker.	a) Check connecting wires with tester and eliminate defect. b) Replace indicator and hourly consumption transmitter. c) Replace thyratron.
3. Total consumption transmitter fails to operate in case of fuel consumption.	a) Transmitter bearings in guide vanes contaminated - impeller does not rotate.	a) Replace total consumption transmitter.

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4. Considerable positive error of flowmeter (i.e. fuel reserve indicated exceeds actual one).	a) Total consumption transmitter clogging.	a) Replace total consumption transmitter.
	b) Sticking in indicator mechanism	b) Eliminate cause of sticking (burrs, dirt) and replace indicator with hourly consumption transmitter if sticking is not eliminated.
5. Considerable negative error of flowmeter (i.e. fuel reserve indicated below actual one).	a) Alternating contact in connecting wires (most at plug connectors and leads-in).	a) Thoroughly inspect wires and ensure proper contact.
	b) Damage to indicator kinematics; driving dog catches 2 notches for one actuation of relay.	b) Replace indicator and hourly consumption transmitter.
6. Total consumption transmitter and indicator are serviceable but the set does not operate in case of fuel consumption.	a) Defective thyratron or other elements of thyratron breaker.	a) Replace thyratron and change thyratron breaker if the latter fails to function after thyratron replacement.

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X. REMOVING THE FLOWMETER

If the flowmeter operates improperly it must be replaced. Remove the transmitter as follows:

1. Close the fuel pipeline and drain fuel from the pipe-line which the transmitter is connected.

2. Disconnect the transmitter plug connectors.

3. Release the hose clamps and remove the latter from the transmitter pipe connections.

4. Remove the transmitter, close its holes with clean plugs.

Remove the indicator, thyratron breaker and transformer as follows:

a) disconnect the plug connectors;

b) unscrew four attaching screws and remove the indicator from the instrument panel.

XI. TEST INSTRUCTIONS

Before installing the flowmeter in aircraft, make sure it is serviceable; to do this, check the set for serviceability. The flowmeter is connected according to the diagram given in Fig. 10.

Blow the transmitter of the set tested with compressed air or pump clean fuel in the direction indicated by the arrow on the transmitter.

The flowmeter serviceability is determined by the indicator solenoid operation and smooth motion of the hourly consumption pointer at even change in consumption of air or fuel.

The indicator solenoid should operate properly; the pointer should smoothly (without jerks) move over the scale at even change in fuel hourly consumption.

The flowmeter errors are checked by means of a test equipment given in Fig.11.

The test equipment consists of two tanks (service and precisely-calibrated measuring tare) pump for running fuel through the transmitter, throttle valve, which permits to set the required fuel consumption, three-way valve which permits to direct fuel either to the service tank or drain tank and fuel pipeline.

The transmitter is cut in the pipeline between the service tank with fuel and measuring tare and is connected according to the diagram (Fig.11).

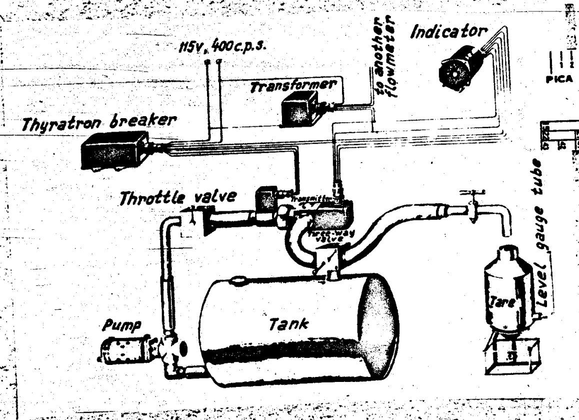

Fig.11. Flowmeter-to-Fuel System Connection Diagram

When checking the hourly fuel consumption section of the flowmeter, pump fuel through the transmitter and using the throttle valve set fuel consumption (by the indicator) which corresponds to one of the divisions marked with a figure on the scale.

Then set the three-way valve so that fuel would flow to the measuring tare. Simultaneously start the stop-watch. As soon as the measuring tare is filled up to the check point, stop the stop-watch and set the three-way valve so that fuel would flow to the service tank.

The flowmeter absolute error on the hourly consumption scale is determined by the formula:

$$\gamma_t = G_{mx} - G_{mg} \text{ (kg/hr)}$$

relative error is determined by the formula:

$$\delta_t = \frac{G_{mx} - G_{mg}}{G_{mg}} \cdot 100\%$$

where

G_{mx} - hourly fuel consumption corresponding to the point marked with a figure on the scale in kg.

$G_{mg} = (\frac{V_э}{t} \cdot 3600)\rho$ - actual fuel consumption in kg.

$V_э$ - capacity of the measuring tare in litres

t - time required to fill the measuring tare in sec.

ρ - rated fuel density - 0.776 gr/cm³

When checking the total consumption section of the flowmeter, set the counter drums for a number as indicated in Section VII, 3,b.

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Pump fuel through the transmitter at a rate which is a half of the nominal value of hourly fuel consumption.

Quantity of fuel pumped through the transmitter should be not less than 250 kg.

The flowmeter error for total fuel consumption is determined by the formula:

$$\delta = \frac{m_2 - (m_1 - V_{\rho})}{m_{nom}} \cdot 100\%$$

where

V_{ρ} - quantity of fuel in kg pumped through the transmitter;

m_1 - instrument readings in kg. set before test.

m_2 - instrument readings in kg. after V_{ρ} quantity is pumped through the transmitter (i.e. after testing).

m_{nom} - nominal value of fuel load of 5,000 kg.

The values of errors should not exceed those given in Section V, "a", "b", this description.

If necessary, check separately the indicator total consumption section; to do this, connect the indicator according to the schematic diagram (Fig.12).

Before testing the counter drums may be set for any figure. Supplied to the indicator through the breaker are pulses, the number of which is checked by the pulse counter.

The frequency of pulsing should not exceed 400 pulses in min.

As the pulse counter is any electric counter may be used which permits to registrate four-figure number and is supplied with 20 v. D.C.

Such a counter is shown in Fig. 13.

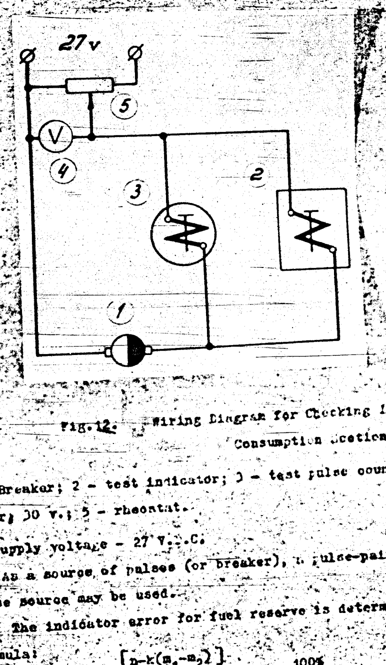

Fig. 12. Wiring Diagram for Checking Indicator Total Consumption Section

1 - Breaker; 2 - test indicator; 3 - test pulse counter; 4 - voltmeter, 30 v.; 5 - rheostat.

Supply voltage - 27 v.d.c.

As a source of pulses (or breaker), a pulse-pair or any other pulse source may be used.

The indicator error for fuel reserve is determined by the formula:

$$\Delta = \frac{\left[n - k(m_1 - m_2)\right]}{k \cdot m_{nom}} \cdot 100\%$$

where

n – number of pulses by the reference counter;

m_1 – number for which the counter drums are set before testing;

m_2 – counter readings in kg. after "n" current pulses are supplied to the indicator;

k – rated value of pulse number per kg. = 2.577 pulse/kg

m_{nom} – nominal value of fuel reserve of 5,000 kg.

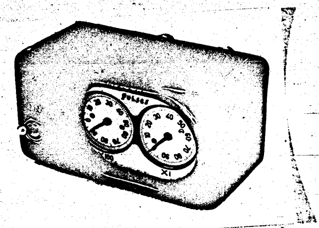

Fig.13. Test Electric Pulse Counter

XII. STORAGE AND PRESERVATION

Store the flowmeter in a dry room at an ambient air temperature of +10 to +35°C and relative humidity of 60±20%.

Protect the instruments from impacts during storage and operation.

In case of an extended storage preserve the transmitters as follows:

1. Remove a cap from one pipe connection of the transmitter. Place the transmitter with an open hole up fill it with oil and keep so for not less than 10 min.

2. Drain oil from the transmitter and pipes and tightly close it with the cap again. For preservation use velocity or spindle oil. Oil should be cleaned from mechanical admixtures by thorough filtering.

When depreserving the transmitter, fill the latter with fuel, keep for 10 min. and then drain fuel.

The indicators, thyratron breakers, and transformer are not subjected to preservation.

CONTENTS

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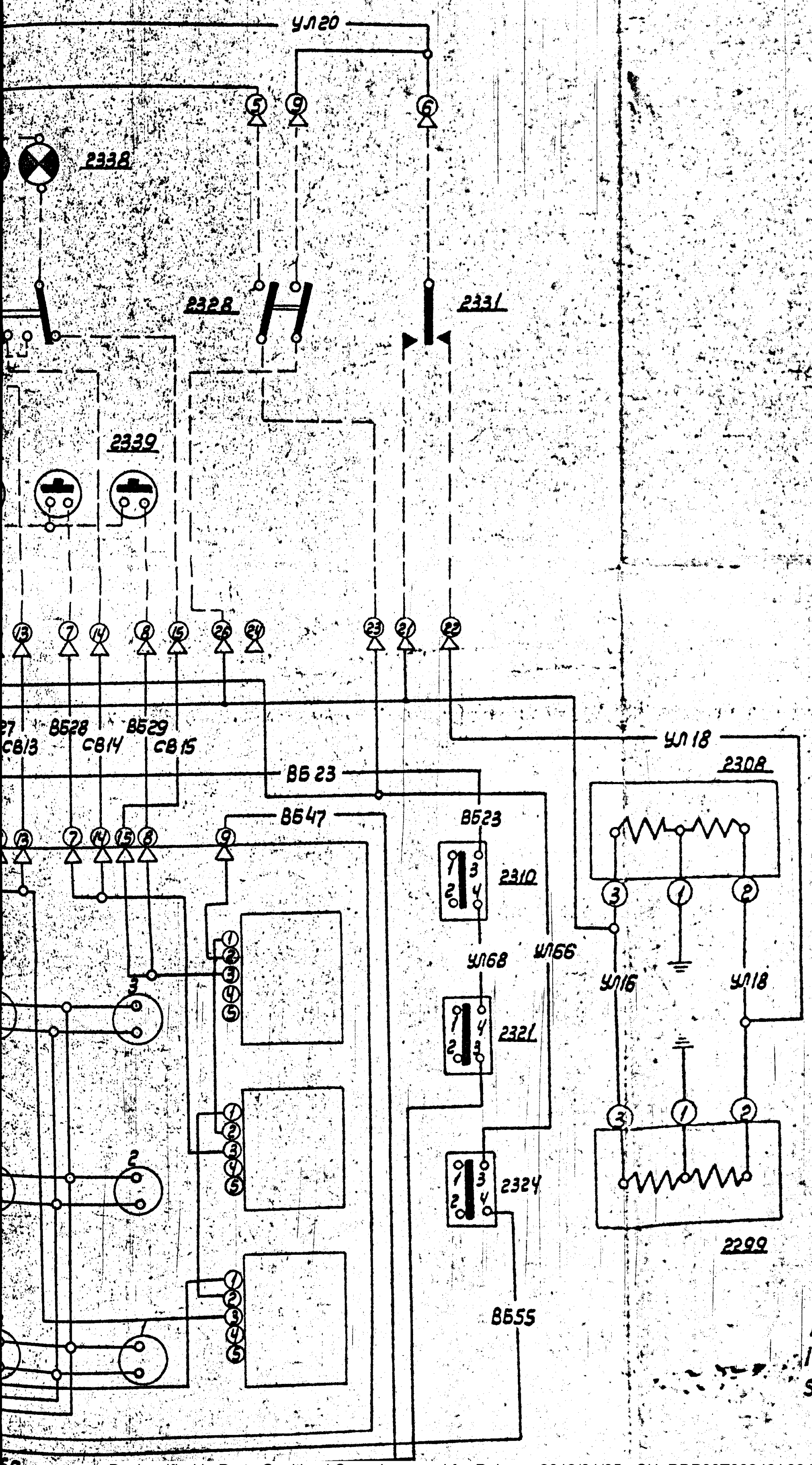
TO INSTRUCTION TO THE CREW ON AH-12 AIRCRAFT MAINTAINCE ARE MADE ALTERATIONS:

On page 137, line 16(from above), after 0,03kg/cm^2 add the text: "Check the system's work turborefrigerator out. To prevent cabin air overheating air feeding must be switched on for a short period of time up to airflow 1-2 divisions of УРВК scale".

On page 139 after line 7 (from above) add the text: "NOTE: The limitation is introduced for the aircraft with turborefrigerator 519-Б at the height of 7000 m and above the turborefrigerator must be switched out".



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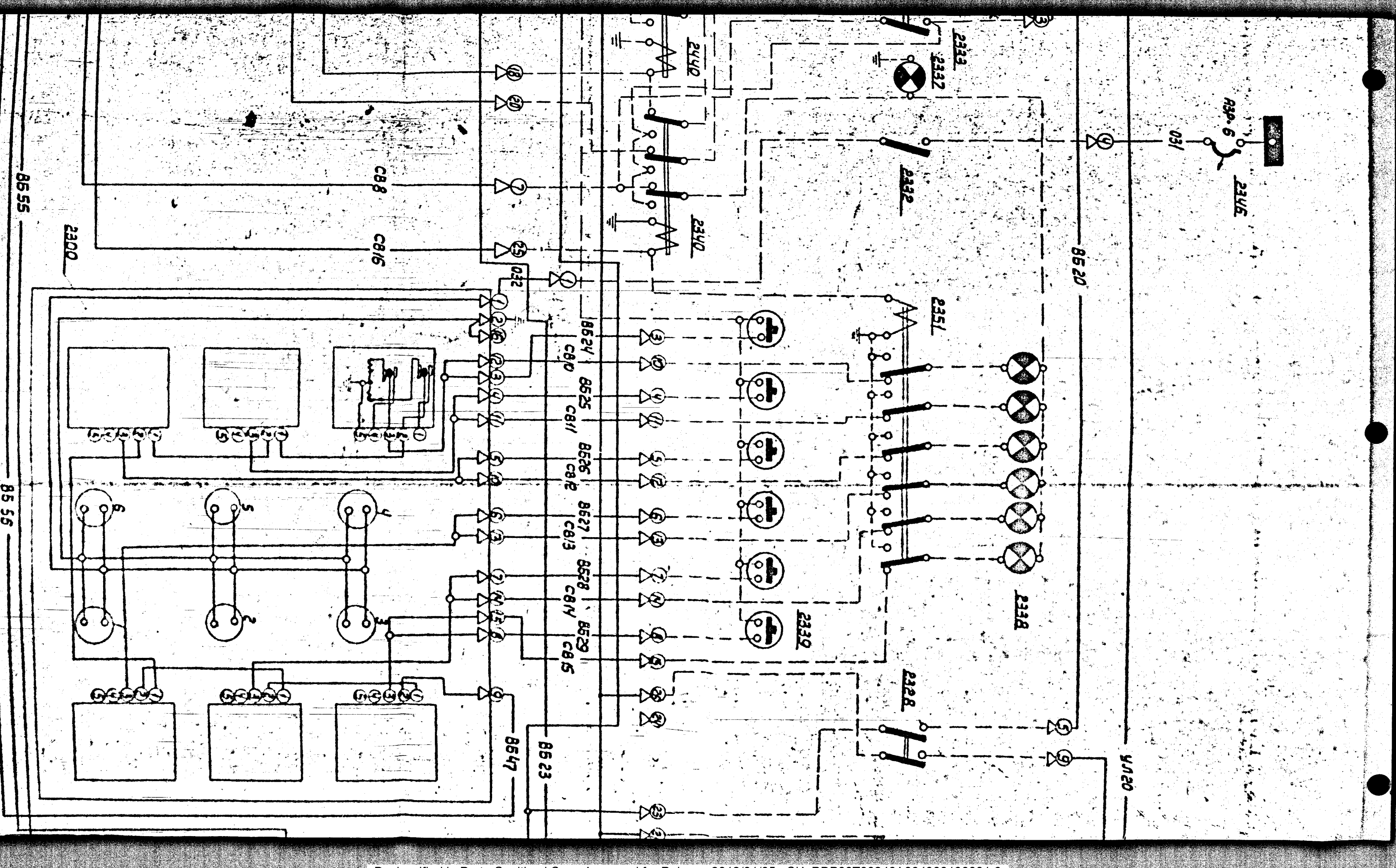

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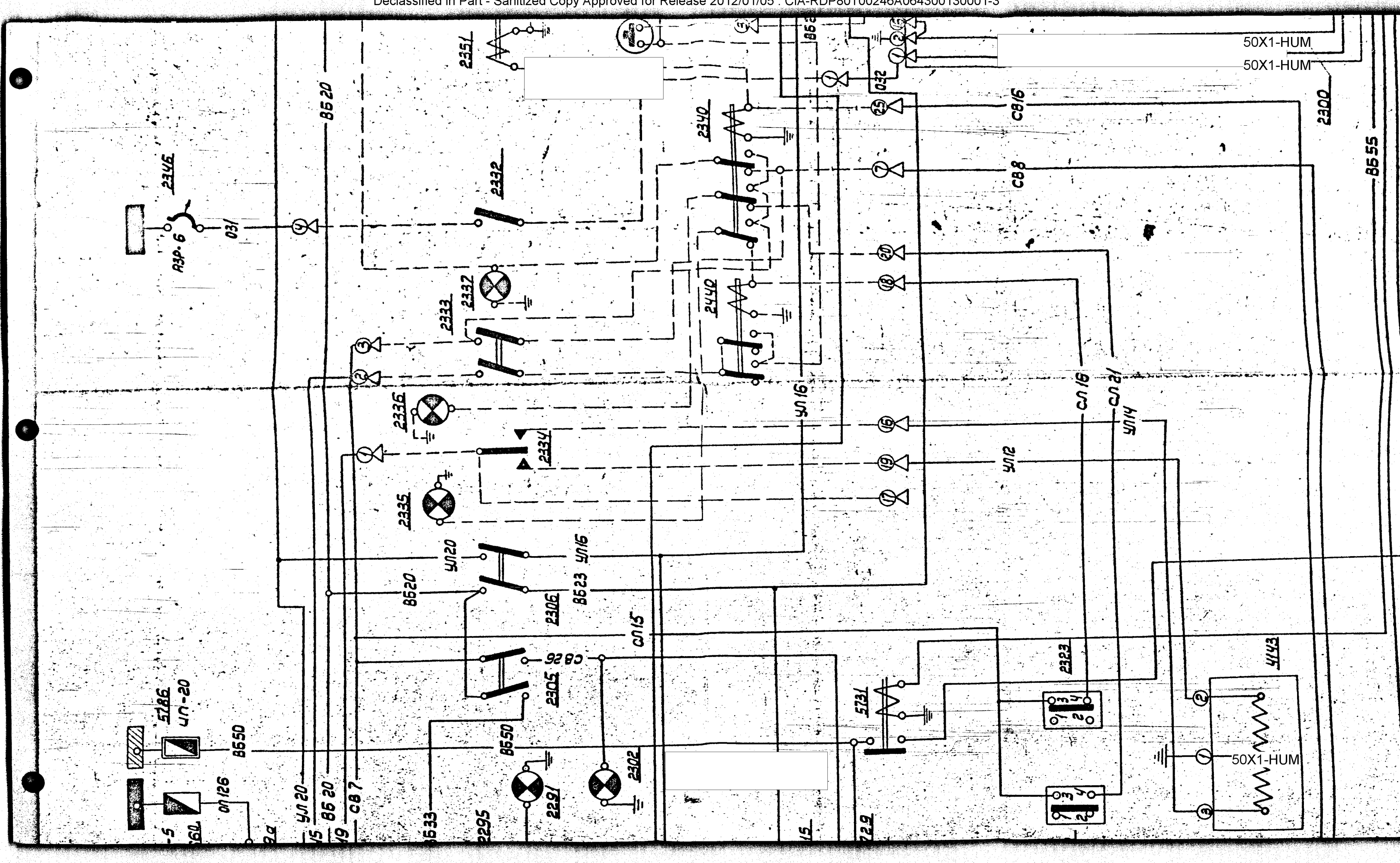
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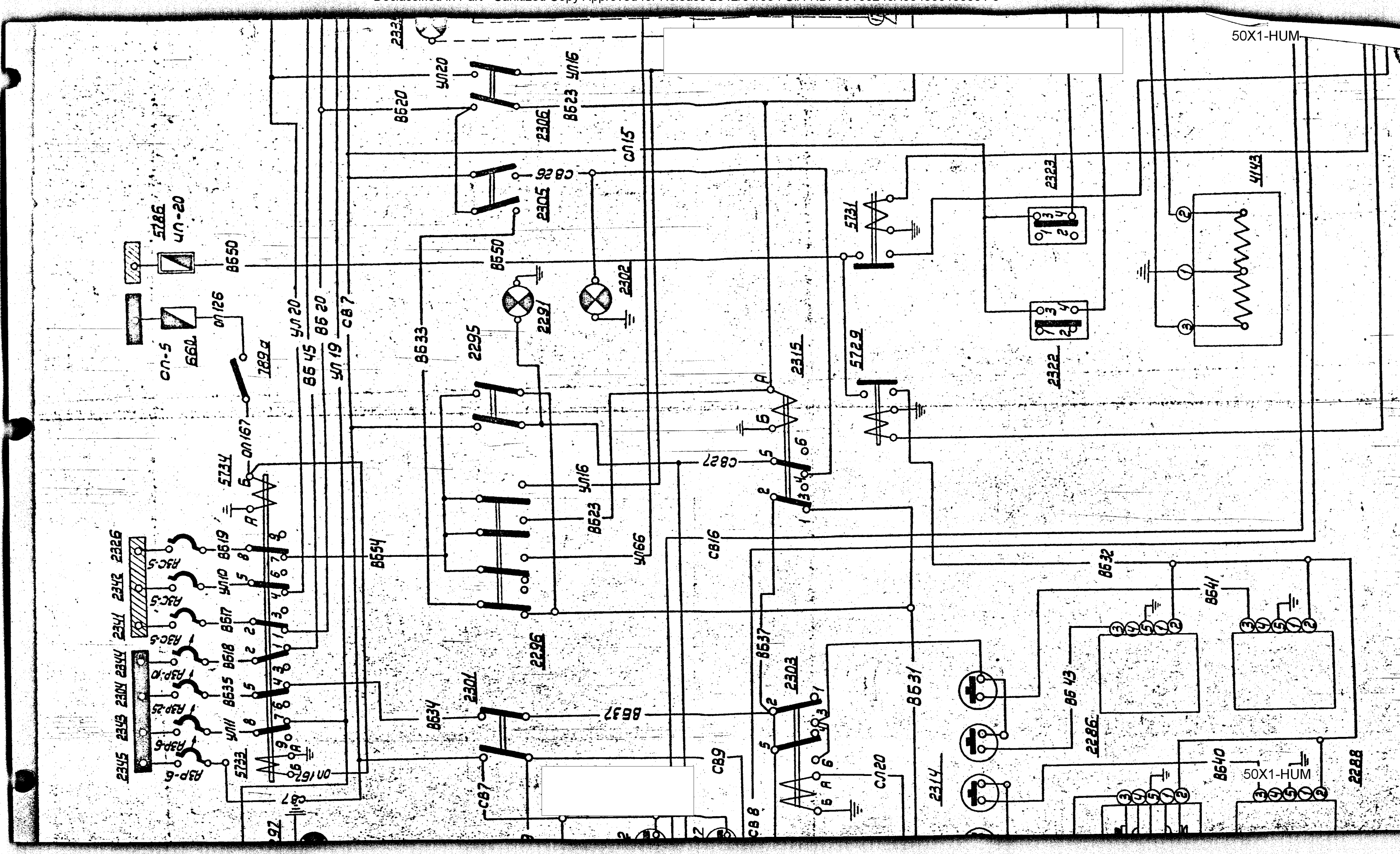

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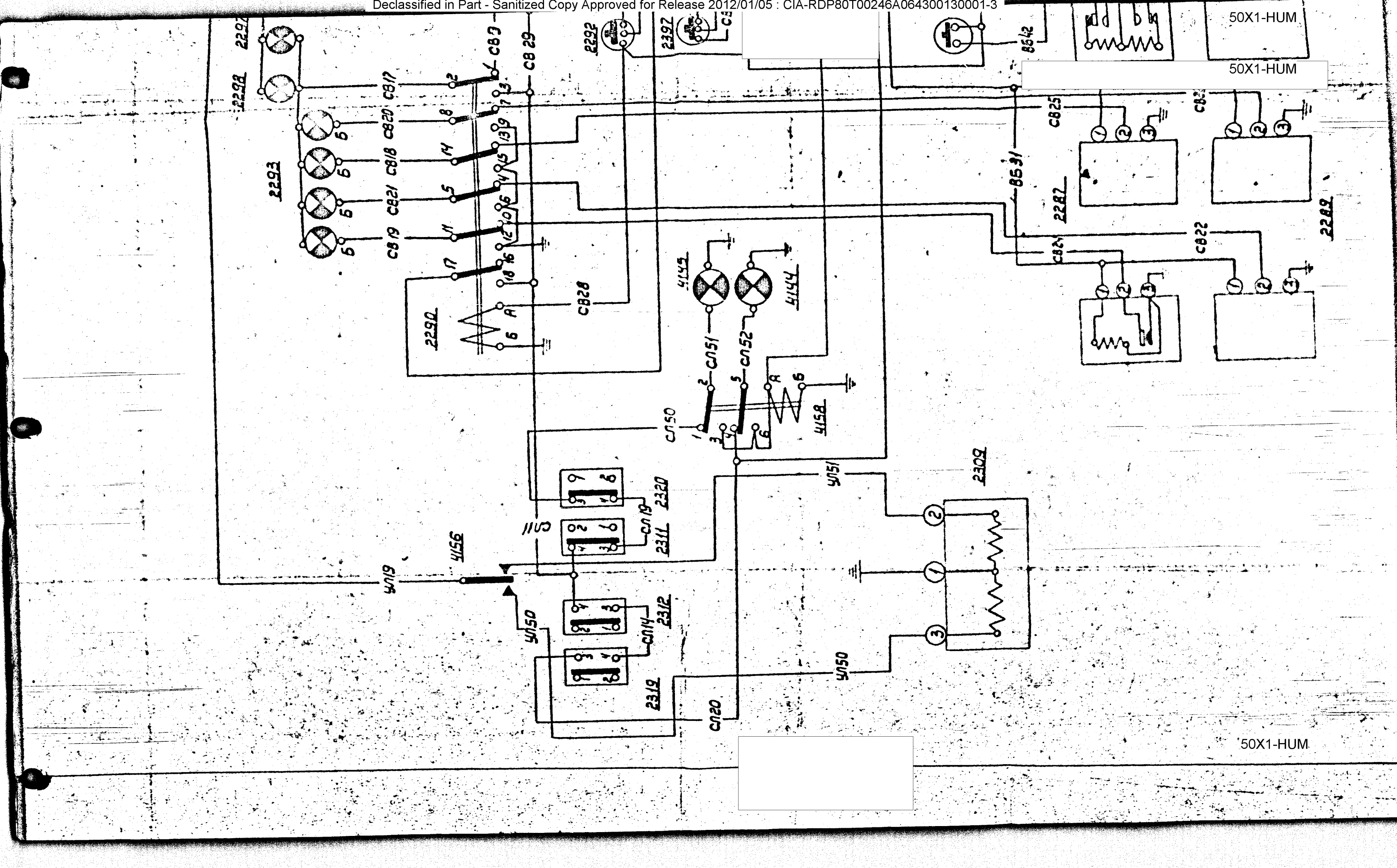

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