INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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COUNTRY Poland

REPORT

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50X1-HUM

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manual on the 50X1-HUM Polish SM-1 helicopter. The manual gives a technical description of the ERNO equipment, i.e., electric-radio-navigational equipment and instruments.

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INFORMATION REPORT INFORMATION REPORT

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SM–1 HELICOPTER

Technical Description of the ERNO Equipment (electric-radio-navigational equipment and instruments)

SM-1 H E L I C O P T E R

Technical Description of the KRNO Equipment

/electric-radio-navigational equipment and instruments/

First edition

- 1959 -

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TABLE of CONTENTS

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C H A P T E R 1

G E N E R A L

1. The technical description of the ERNO equipment /electric -radio-navigational equipment and instruments/ has been based on Mi-1 helicopter drawings, instructions, Technical Requirements, Diagrams, as well as on unit and instruments technical descriptions written in the Factories.
2. It is necessary to know exactly the ERNO equipment, its units and instruments in order to ensure the serviceability and correct service of the ERNO equipment.
3. Electrical thermometers marked P-1 or TEM-48 of oil temperature transmitters are interchangeable. They belong to the three pointer EMI-3K and EMI-3TM indicators serving for checking the engine operation, the main gearbox and the engine gearbox.

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C H A P T E R II

ELECTRICAL EQUIPMENT of the HELICOPTER

A. GENERAL

The electrical equipment of the SM-1S helicopter consists of
- electric power sources
- electric power consumers /receivers/

Electric power sources are: GSK - 1500Z generator, and a 12A1C storage battery.

A ground supply trolley provided with a storage battery is used also as a supplying source.

The board electrical network and units are protected by means of 12 bimetallic automatic fuses: by the help of 6 automatic AZS circuit breakers and of 6 thermal fuses PW-2 type with B2-20 bases. Twos AZS fuses are placed on the instrument panel. Other automatic and thermal fuses are installed on the starboard switchboard. The whole board network is divided into 8 circuits.

B. ELECTRICAL BOARD NETWORK of the HELICOPTER.

B1. General informations

The SM-1 helicopter is outfitted with a single-cable electric system with a supplying voltage equal to 27,5 Volts D.C. All metal parts /mass/ of the helicopter form a common minus for all electrical units.

Network connections are made by means of [redacted]
- BPWL cable, 0,88 sq.mm ÷ 6 sq. mm cross section area [redacted]

In order to facilitate the installation of electrical circuits, all leads have been assembled in 24 bunched cables ended with terminals and/or connectors /Fig. 1/.

In order to protect the bunched cables against mechanical damage, the bunched cables are put inside the vinyl chloride tubes. Places requiring special protection are wrapped and sewed with "dermatin". /leather imitating material/

Following network sections are screened in order to protect the radio units against noises and disturbances due to electric equipment operation:

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1. W-14 cable - from the generator to the voltage regulator and the starboard switchboard.
2. W-13 cable - from the voltage regulator to the filter.
3. W-18 cable - from the starter ignition coil to the magneto.
4. W-17 cable - from the 2 PNP-47 switch to the starter ignition coil.
5. W-19 cable - from magnetos to ignition switch.
6. W-8 cable - from the windscreen wiper filter to the motor.
7. WS-7 cable - from the artificial horizon inverter to the indicator.
8. W-15 cable - from the r.p.m. indicator generator to the indicator.
9. W-20 cable. - from the UKZ-5 indicator to D-5 and P-1 transmitters. From UKZ-1 indicator to P-1B, P-L; P-15B transmitters.

B2. - Cable fastening.

The bunched cables are fastened to airframe parts by means of typical /standardized/ 410 NG clips, /Fig.2/ [redacted] metal band /Fig. 3/ and chlorovinyl tape and eyes.

NG clip consists of a base with two holes for clip fixing, of an upper hinged cover and of a spring fastener.

The clips have following advantages:

a/ They shorten the electrical system installation and dismantling time up to a minimum.

b/ They enable the fastening of cables in places where the access is possible for one hand only.

c/ The fastening of cables is firm and reliable.

B3. Electric network connectors.

Standardized SzR two-pin and 12-pin connectors have been used in SM-1 helicopter electrical equipment in order to facilitate the installation and removal of electrical equipment accessories and units.

The connector is designed to enable to take out from the SzR the optional contact pin with soldered cable. To obtain it it is necessary to unscrew the rear nut, then to take out the fastening spring and the insulating insert.

Cable end fitted for the 6091s and 6094s terminals

No.1

6091s terminal

6094s terminal

Insulate the BPIVL lead

JR-1 terminal

50X1

No.2

To be insulated

Clasp according to Standard

JR-1 plug

Cable marking

Clasp according to Standard

6091s

6094s

Cable marking

Cable end fitted for 5K terminal (posit on lights and instruments)

To be not tinned

No.3

POS-40 on colophony

Electric lead

Cable marking

Typical bunched cable terminal in a pin connector without nut.

POS-40 on colophony

No.4

Cable markings

30

5

To insulate with No 00 threads, then cover with No 17 B

Screened bunched wire end in a pin connector

No.5

On colophony POS-40

Braiding

Sleeve

Pin connector coupling nut

No.7

Cable terminal in form of an eye

POS-40 on colophony

Dia depends on inst. fastening screw.

No.6

C

To insulate depending on the eye diameter

Cable marking

Bunched cable terminal in a vinyl chloride tube for an instrument provided with a flange

Lead

Flange with a pin connector (manufactured as a set)

Screened bunched cable end for an instrument provided with a flange

No.8

Bunched cable braid

Instrument case.

Lead and bunched end fitted to a pin connector

Plug of connector

Marking

No.9

Protection made of threads.

Bunched cable

Cable marking

POS-40 on colophony

5

5

Felt insert, 2mm thickness

Marking

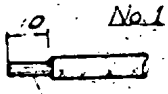
L

Length according to inner circumference.

Fig. 1. Bunched cable ending and terminals.

Cable end fitted for the 6091s and 6094s terminals

No.1

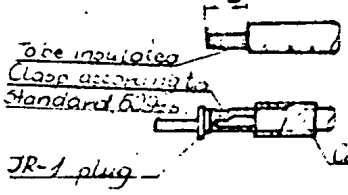


6091s terminal
6094s terminal

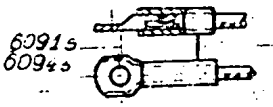
Insulate the BPLVL lead

Cable end fitted for JR-1 terminal

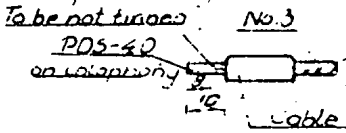
No.2



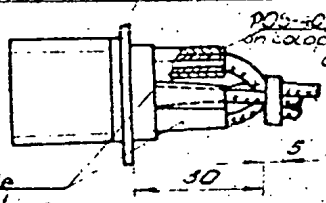
Clasp according to Standard



Cable end fitted for 5K terminal (position lights and instruments)



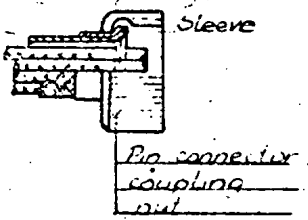
Typical bunched cable terminal in a pin connector without nut



Screened bunched cable end in a pin connector

No.5

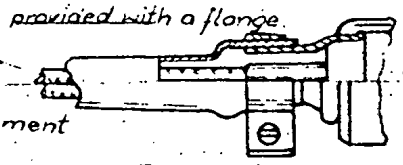
On colophony POS-40



No.7

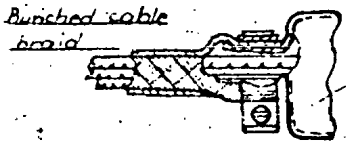
Cable terminal in form of an eye

Bunched cable terminal in a vinyl chloride tube for an instrument provided with a flange



Screened bunched cable end for an instrument provided with a flange

No.8



Flange with a pin connector (manufactured as a set)

Lead and bunched end fitted to a pin connector

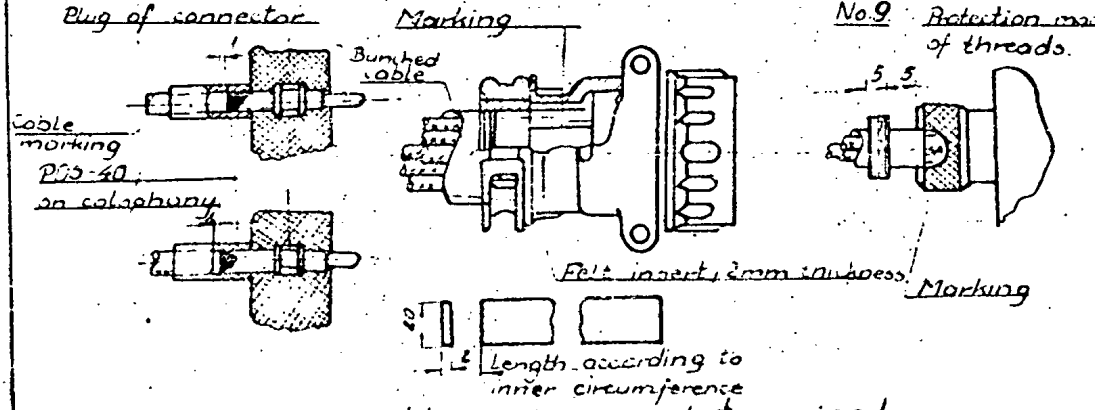


Fig. 1. Bunched cable ending and terminals.

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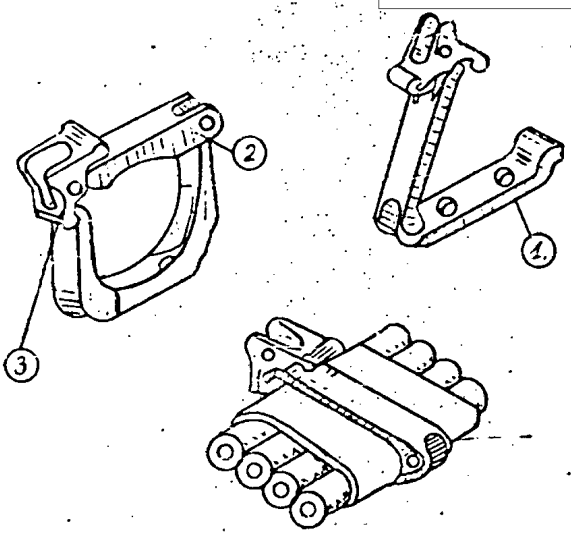


Fig.2. 410 NG locking clip.
1. Base, 2. Cover, 3. Fastener.

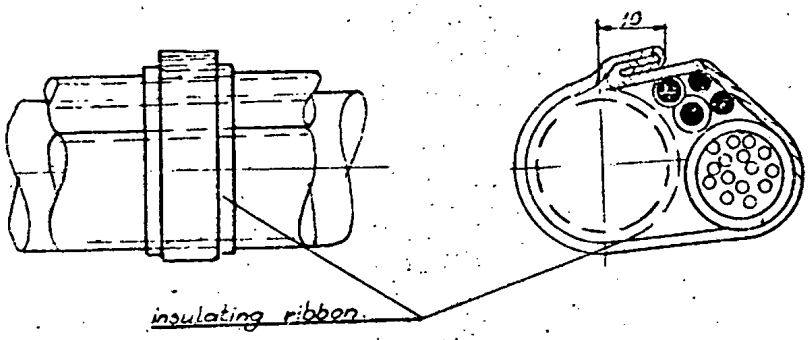


Fig 3 Fastening of bunched cables by means of metal bands.

50X1

The connector consists of two parts connected together by means of a coupling nut.

The correct connecting of pins with sockets is enabled by a protruding cam on the connector and by the help of a groove located in the connector socket cap.

Pins /plugs/ and sockets are located in an insulating insert, the insert being placed inside the cap.

Leads of bunched cable are soldered to the pin sleeve or to the socket.

Joining the vinyl chloride protecting tubes and screening braids is shown in Fig. 1.

SzR connectors have following advantages:

- they enable a correct and easy connection of electrical circuits.
- they facilitate the installation and dismantling of electrical equipments of the helicopter.

Besides SzR connectors, following joints are used:

1. BK and 75 K two - way clips /Fig. 6/.
2. individual connectors type IR-1 /Fig.5/
3. special connectors made according to drawings of instrument equipment.

Minus fasteners according to instrument equipment drawings have been used in order to facilitate the connection of minus leads with the helicopter airframe metal parts.

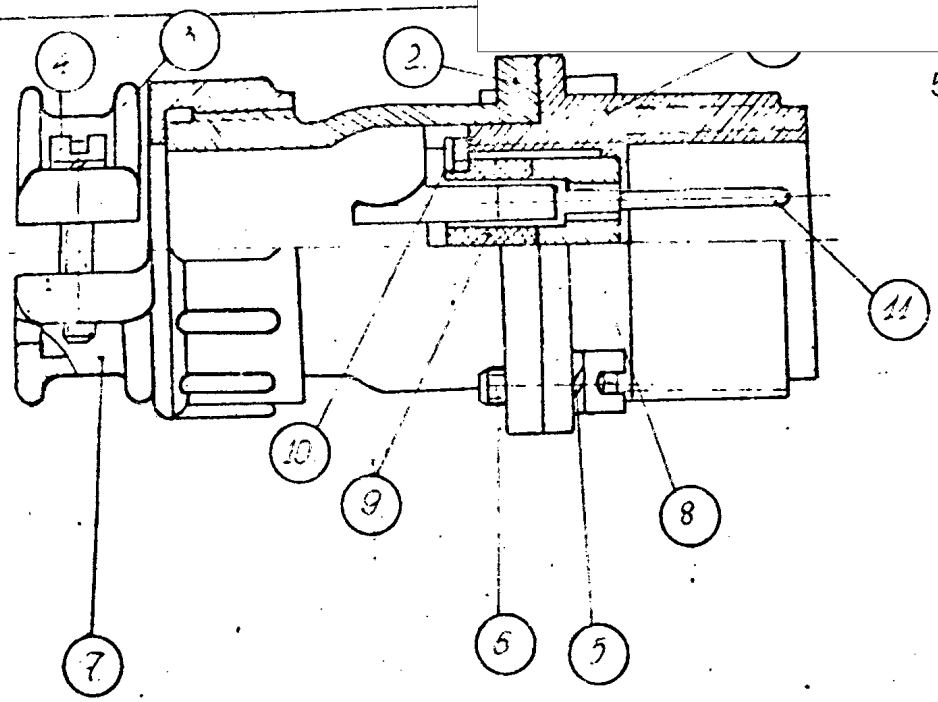
When connecting it is necessary to clean the fastener base and the place on the airframe part so as to obtain a metallic shine. It ensures a good electric conduction. The fasteners are riveted to the helicopter airframe.

They enable an easy, firm and reliable connection of minus leads with the helicopter airframe metal parts enabling at the same time the easy and quick dismantling of the electrical system.

Some minus leads are connected directly under the yoke screws or to the airframe screws in order to facilitate the installation.

All contact points of minus leads and airframe should be cleaned so as to obtain a metallic shine. It ensures a good electric conduction. After installation, all these contact points should be painted with colourless varnish.

50X1



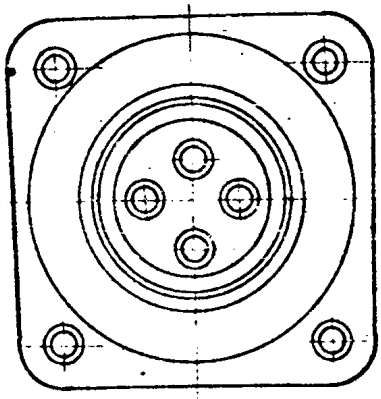


Fig.4. SzR pin connector

1. Sleeve.
2. Sleeve with a flange.
3. Nut.
4. Fastening screw.
5. Screw.
6. Screw
7. Insert
8. Insulating insert.
9. Insulating insert.
10. Spring.
11. Pin

50X1

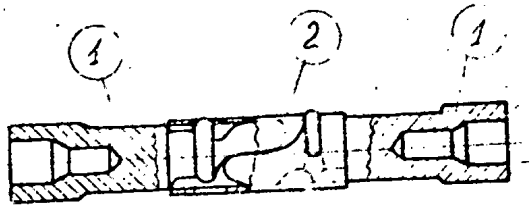


Fig.5. JR-1 individual connector

1 Pin
2 Sleeve

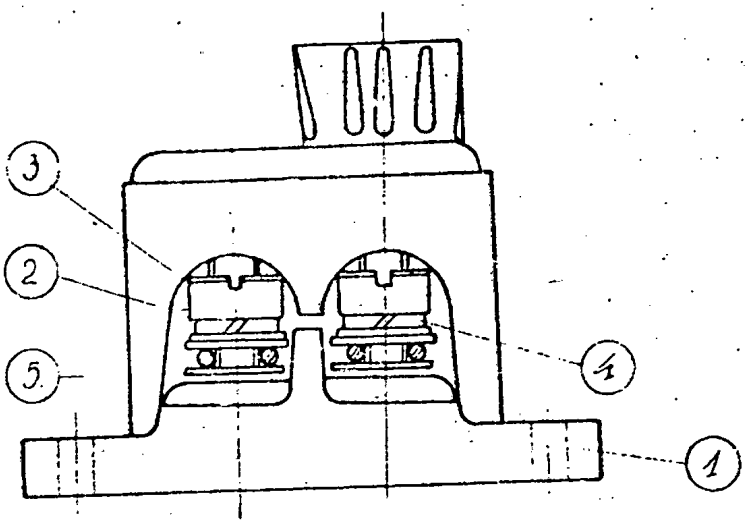


Fig.6. 7D-K two-way fastening clip

1. Base
2. Housing
3. Nut
4. Insert
5. Washer

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B4. Electric network units marking and specification.

Electrical equipment units are marked with numbers in order to facilitate the use of wiring diagrams.

S P E C I F I C A T I O N	M A R K I N G
fuses	I-VI
1. generator	GSK-1 [illegible]
2. mains filter	SF- -3000R
3. voltage regulator	RK- [illegible]
4. storage battery	1[illegible]
5. storage battery socket	7204-20
6. storage battery automatic circuit breaker fuse	AZS-30
7. voltammeter shunt	SzA-240
8. voltammeter	WA-240
9. port magneto	MWL-7
10. starboard magneto	MWL-7
11. starter ignition coil	KP-4716
12. switch	2PNP-47
13. automatic fuse - ignition switch	AZS-5
14. ignition switch	PW-1
15. ground supply socket	7204-307
16. Pitot tube	NiSO
17. Pitot tube switch	W-45
18. cockpit ceiling lamp	P-39
19. cockpit ceiling switch	W-45
20. portable lamp socket	47-K
21. port cockpit light	KŁSRK-45
22. starboard cockpit light	KŁSRK-45
25. port position light	BANO-45
26. starboard position light	BANO-45
27. tail position light	CHS-39
28. two-way fastener	73-K
29. signal light button	5-K
30. autom.fuse of position light circuit breaker	AZS-10
31. magnetic compass light	KF-11
32. magnetic compass light resistor	RI[illegible]49
33. clock heater	AWRM

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34. clock heater switch	W-45
35. generator excitation switch	W-45
36. UF /ultra-violet/ light resistor /port/	RUFO-48
37. UF /ultra violet/ light for the starboard instrument panel part	ARUFOSz-45
38. UF /ultra-violet/ light for the port instrument panel part.	ARUFOSz-45
39. landing light	FS-155
40. fuse of the landing light circuit breaker	AZS-15
41. fuse of the taxying light circuit breaker	AZS-5
42. taxying light	FR-100
43. collective pitch indicator transmitter	SUP-47
44. collective pitch indicator [redacted]	UZP-47
45. oil dilution switch	WN-47
46. fuel contents gauge transmitter	BES-1177
47. fuel contents gauge indicator	BES-1177
48. fuel contents gauge switch	W-45
49. artificial horizon	AGK-47B
50. artificial horizon inverter	PAG-1F
51. artificial horizon switch fuse	AZS-15
[redacted]	
56. longitudinal trim transmitter	UZP-47
57. longitudinal trim mechanical indicator	UZP-47
58. engine r.p.m. indicator generator	4UG-4-48
59. engine r.p.m. indicator	2T..-4-2
60. generator of rotor r.p.m. indicator	4UG-1-48
61. individual connector of the taxying light	IR-1
62. cylinder head temperature transmitter	TCT-9
63. cylinder head temperature indicator	TCT-9
64. 12-pin connector [redacted]	SzR32P12NSzI
65. 12-pin connector [redacted]	SzR32P12NSzI
66. 4-pin connector [redacted]	SzR28P4NSz5
67. radio [redacted] compass switch fuse	AZS-5
68. connector for the port cockpit light	IR-1
69. Pitot tube connector	IR-1
70. 4-pin connector of the rear part	SzR20PK4NSz8
71. two-way fastener	73-K
73. connector of the port ultra-violet light	IR-1
75. 12-pin connector /upper one/	SzR32PI2NSzl

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76. 4-way connecting fastener	75-K
77. ultra-violet /UF/ light resistor /starboard/	RUFO-48
78. fuel reserve signalling light	SŁC-51
79. 2-way connector socket	from MA-250M set
80. 4-way connector	75-K
81. three-pointer engine indicator	UKZ-1
82. oil pressure gauge transmitter of 3-pointer indicator	P-15B
83. oil temperature transmitter of 3-pointer indicator	P-1
84. Fuel contents gauge transmitter of 3-pointer indicator	P-1B
85. three-pointer indicator for the gearbox	UKZ-5
86. oil pressure gauge transmitter of 3-pointer indicator	D-5
87. oil temperature transmitter of 3-pointer indicator	P-1
88. oil pressure gauge transmitter of 3-pointer indicator	D-5
89. [redacted] switch fuse of R/T set	AZS-30
[redacted]	[redacted]
91. [redacted] socket MA 250M	48K
92. fire detecting warning lamp	SŁC-51 red
93. Fire extinguisher pushbutton	5K
94. fastening plate	7204-330
95. relay	RT-40
[redacted]	[redacted]
97. thermo-signalling device contact point	bimetallic thermo signalling device
98. thermo-signalling device contact point	
99. thermo-signalling device contact point	
100. thermo-signalling device contact point	
101. cartridge on the bottle	PP-3
102. electromagnetic valve for oil dilution system	EKR-3
[redacted]	[redacted]
104. PAG-1F inverter connector	IR-1
105. windscreen wiper switch fuse	AZS-5
106. windscreen wiper mains filter	F-14-A
107. windscreen wiper electric motor	AS-2

108. anti-icing system switch fuse	AZS-15
109. anti-icing fluid pump switch	2PPN-[illegible] 50X1
110. anti-icing pump starting button	5-K
111. anti-icing pump starting switch	K-25-A
112. anti-icing fluid pump operation signal lamp	SD-16A
113. anti-icing fluid operation signal light	SAC-51 Green
114. anti-icing pump	SCN-1
115. cockpit ceiling lamp switch fuse	AZS-5
117. Radio compartment light	KLS-39
118. Radio compartment light switch	W-45
119. Radio compass automatic fuse	AZS-3
120. Port pos. light relay	TDJe-210
121. Remote control box of ARK-5	ARK-5 set
122. Starboard pos. light relay	TDJe-210
123. Fastening plate of starboard pos. light relay	NU7200-27-3
124. Radio compartment light	KLSRK-45
125. Indiv. connector of ARK-5 light	JR-1
126. Pos. light at the starboard litter	BAN0-45
127. Pos. light at the port litter	BAN0-45
128. Indiv. connector - PAG - IF	JR-1
129. Two-clamp distribution plate	73-K
130. 4-pin connector	SzR20PK4NSz8
131. 4-pin connector	SzR20PK4NSz8
132. Starboard litter pos. light switch	W-45
133. Port litter pos. light switch	W-45
134. Starboard litter light	P-39
135. Port litter light	P-39
136. Clamp plate of port pos. light relay	NU7200-27-3
137. Radio compartment light connector	JR-1
138. Starboar pos. light connector	JR-1
139. Port pos. light connector	JR-1
140. Port pos. light relay connector	JR-1

B5. Specification of cables.

All cables are marked by numbers and letters in order to facilitate the installation, removal, trouble shooting and replacement. More-over a vinyl chloride tube /conduit/ is put on every one lead, the conduit being marked too.

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The whole board electric network has been divided into 25 parts according on their destination.

Code marking consisting of two letters is reserved for all circuits of each of 24 parts /circuits/.

Therefore, there are 24 different markings.

Order No.	S P E C I F I C A T I O N	M A R K I N G
1.	Generator	IG
2.	storage battery	IA
3.	ground supply source	IJ
4.	voltameter	PI
5.	ignition	MP
6.	Pitot tube	TP
7.	portable cockpit lamp	OB
8.	cockpit lights, litter lights	CC, CG
9.	position lights	SA, SP
10.	magnetic compass /light/	PK
11.	ultra-violet cabin lighting	OU
12.	cloak heater	M4
13.	flood light	OF
14.	fuel system	PB
15.	Collective pitch indicator	UR
16.	artificial horizon	PA
17.	lubrication system device	PM

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18.	thermometer	PT
19.	r.p.m. indicator /tachometer/	PC
20.	radio transm.-receiver, radio-comp. light	RZ,RW
21.	radio-[redacted]-compass	RK
[redacted]		[redacted]
23.	oil dilution	UM
24.	fire extinguisher	SP
25.	anti-icing device and windscreen wiper	TA

The first two letters written on the cable and on the vinyl chloride tube /conduit/ form a marking appropriate to a given circuit.

The first cipher behind the marking letters gives the cable order in the circuit /it depends on number of cable sections of which the given circuit consists/.

The second cipher or letter placed after a streak /-/ indicates the number of terminal which should be connected to the cable.

For instance, let us consider a cable and a vinyl chloride conduit /tube/ marked as follows:

PB1 - 3

PB1 - 3

length 25 mm.

Letters PB indicate that the cable belongs to the fuel system circuit, the cipher 1 indicates the cable order number in the circuit, the cipher 3 indicates the number of terminal, which should be connected to the PB1-3 marked cable.

Numbers of connectors and accessories, which are connected by the cable can be read in the wiring diagram.

Markings are written on the cable and on the vinyl chloride conduit by means of unwashable black drawing ink. /conduit length is equal to 25 mm/.

Moreover, duralumin sheets with bunch number are placed on all bunched cables.

The full identification of electrical system is possible only by the help of wiring diagrams /Fig. 8 and 9/.

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B6. Switchboards.

The helicopter is outfitted with a central system for electric power distribution.

The electric power distributing device is located on the starboard switchboard. Its wiring diagram is shown in Fig. 7.

A central main cable is supplied by individual current sources by means of following cables:

a/ IG cable from the inverter

b/ IG cable from the storage battery through the automatic fuse type AZS-30.

c/ IN cable from the ground supply socket through the RT-40 relay.

The current is conducted from the main central cable to a part of electric power consumers directly by means of 6 leads protected by PW-2 fuses. Two other leads conduct the current from the central main cable to two auxiliary cables and further to the rest of electric power consumers /receivers/ through the AZS automatic fuses.

The right switchboard is extruded of duralumin. Accessories and switches are installed on the switchboard upper surface. The side flanges serve for fixing the switchboard and fastening it to the helicopter airframe in the cockpit.

The switchboard is fastened by means of screws. In the upper part of the switchboard a holder for the cockpit lamp type KLSRK-45 is installed.

Below, three ranges of W-45 and AZS automatic switches /fuses/ are installed /five switches in one range/.

The switches are mounted so that their levers protrude out of switchboard.

Plexiglass protective limiters are installed over the switch levers. They separate the levers and protect them against inadvertent switching on.

Under the switches, a panel is mounted. It is provided with a rheostat RUFOSz-45 type /upper part/ for the ultra-violet lights as well as with a RIK-49 rheostat /centre/ for the magnetic compass light.

Under the panel, a hinged cover is installed outfitted with a handle and lock. When open, it enables the access to

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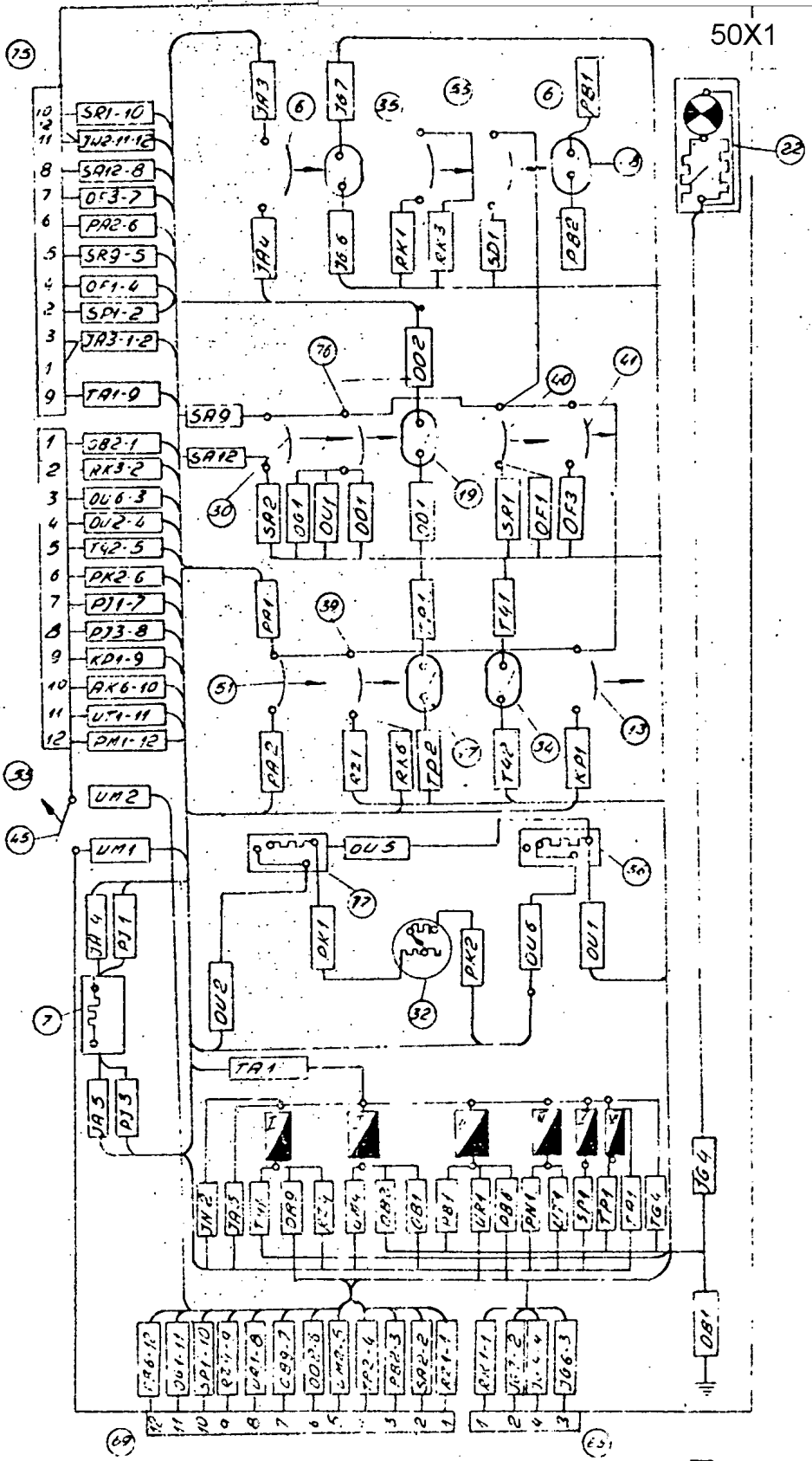

Switch board diagram. Org. 7

SECRET

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the fuses which are installed on the cover inner side. The fuses are installed in one range, they are connected to the main central cable. The board network is connected with the fuses by means of thin, flexible leads.

The oil dilution switch is mounted on the port side of the hinged cover.

Four pin connectors type SzR are used to facilitate the service and maintenance, the installation and removal of connections to the helicopter network. Two of them are mounted at the starboard side of the cover, two other are located in the cover lower part.

After having installed the hinged cover on the helicopter, it is necessary to connect its connectors with suitable bunched cables connectors.

The switchboard is outfitted with placards concerning every switch, rheostat or fuse. These placards are made in form of metal plates with luminous inscriptions.

B7. Automatic circuit breakers type AZS.

The automatic circuit breakers installed on the helicopter are operating at direct current voltage up to 30 V at nominal current 5, 10, 15 and 30 A. They serve for automatic switching off the electric power consumers in case of dangerous overloading and short-circuits.

The automatic circuit breaker /Fig. 10./ consists of a single-pole circuit breaker, bimetallic plate, enabling the automatic disconnection of the instrument protected by the AZS automatic circuit breaker.

The circuit breaker mechanism is placed inside the case. The case is in two parts.

Movable and fixed contactors /16 and 17/ are placed inside the case upper part /8/ as well as the lever /14/ with spring /15/ and textolite pin /13/ for manual switching on and off.

In the case lower part /1/ a bimetallic plate /22/ is installed. The plate is touching two limiters, it is connected with two terminals /23 and 24/ led out of circuit breaker case.

The automatic circuit breaker starts its operation when the bimetallic plate is heated due to overloading or short -

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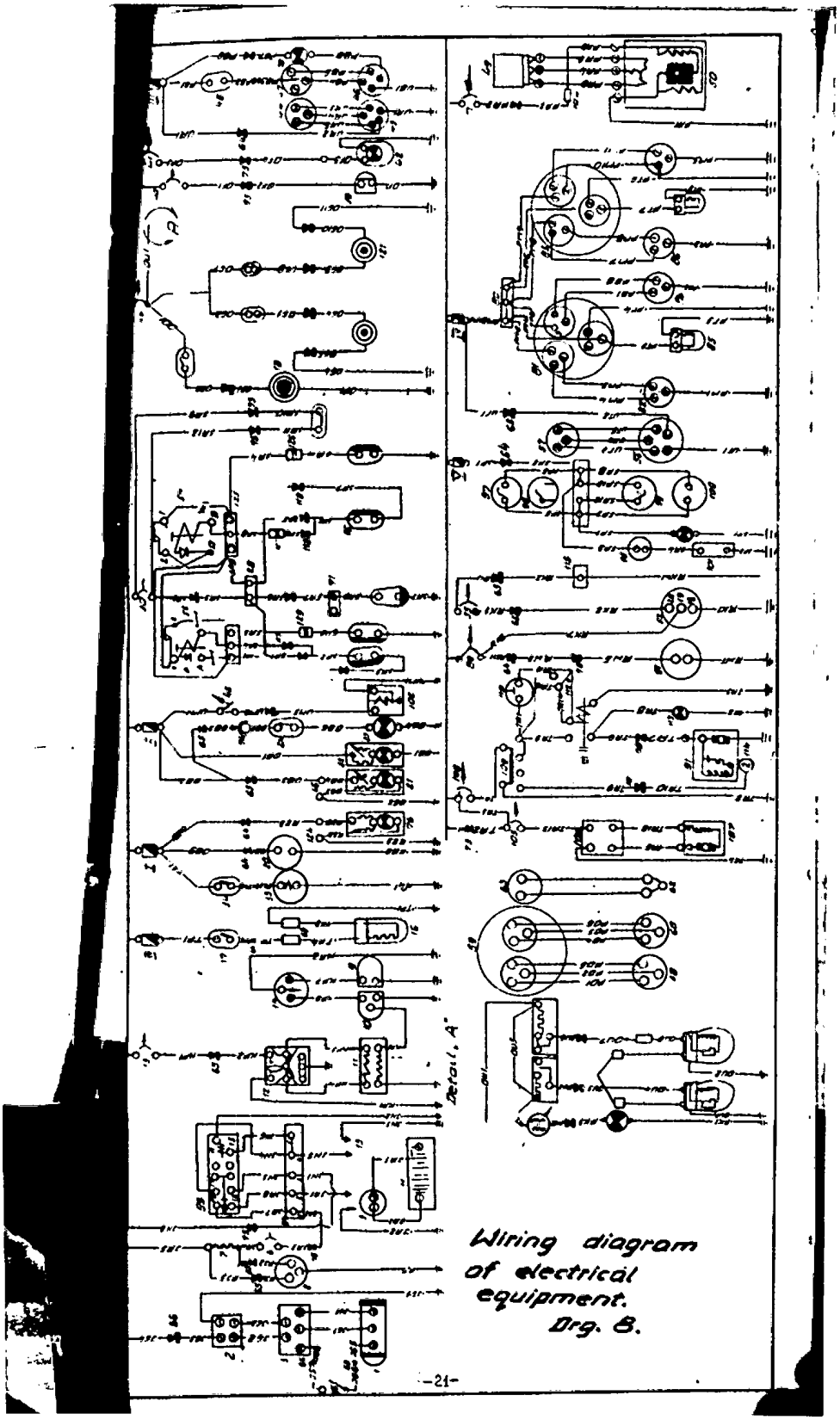

Wiring diagram of electrical equipment. Drg. B.

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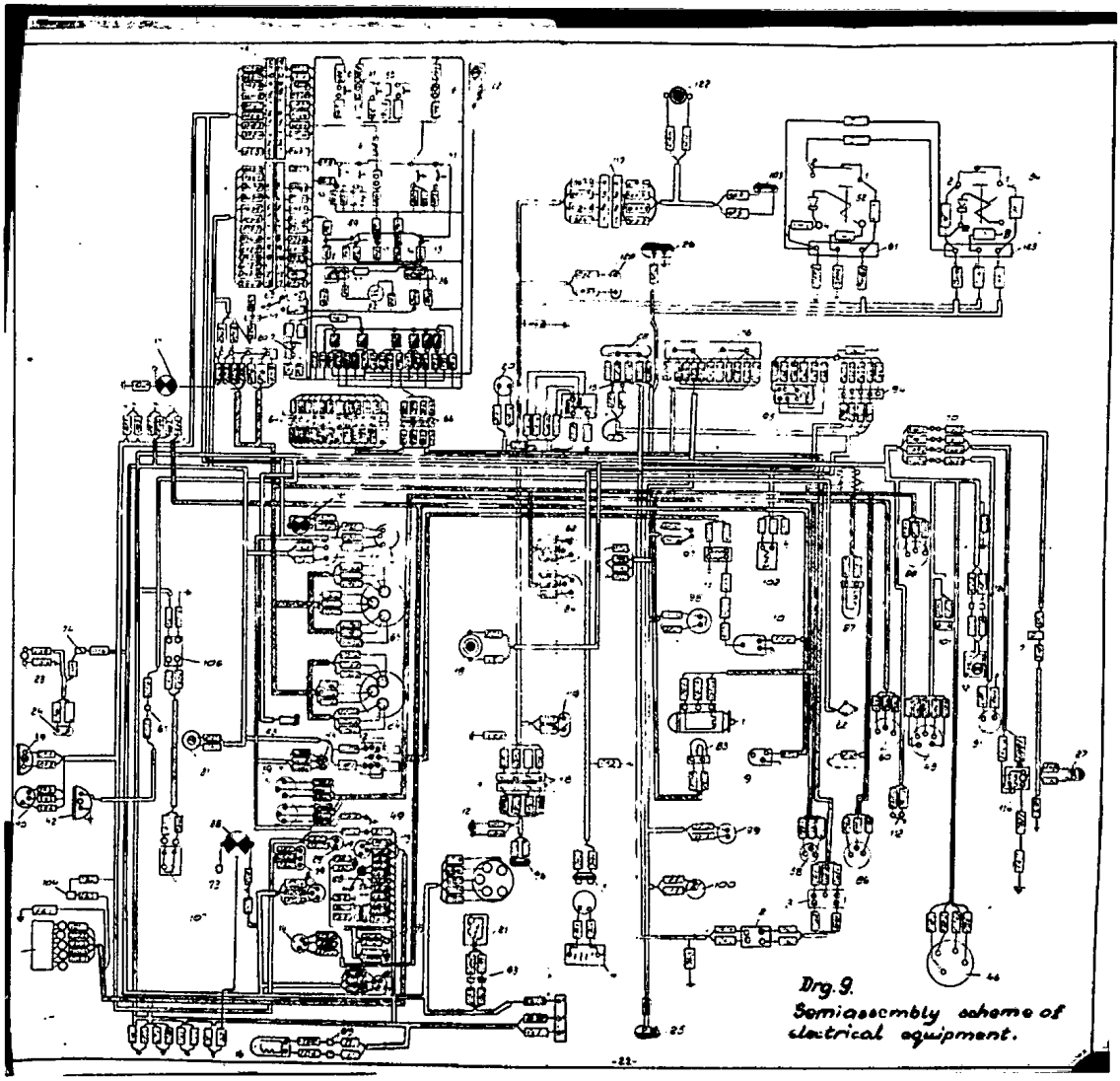

Drg. 9.
Semiassembly scheme of electrical equipment.

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-circuit. Owing to this fact the bimetallic plate deflects releasing thus the ratchet.

To facilitate the automatic circuit breaker use in darkness the lever is outfitted with a luminous eye.

The nominal voltage is equal to 28 Volts D.C., the max. admissible voltage is 30 V. The switching off current at 5, 10, 15 and 30 A is equal to 1,3 nominal current.

The breakdown voltage of the autom. circuit breaker insulation is equal to 500 Volts at 50 c/s frequency during 1 min.

The AZS circuit breaker service life is equal to 10.000 switching procedures /on and off/ at: nominal current, nominal voltage, real load.

The circuit breakers are operating as follows:
AZS5 circuit breaker enables three breakings at 1000 A short-circuit current at 760 mm Hg and 20 deg.C.
AZS 10 circuit breaker enables three breakings at 1000 A short-circuit current at 760 mm Hg and 20 deg.C.
AZS 15 circuit breaker enables three breakings at 1500 A short-circuit current at 760 mm Hg and 20 deg.C.
AZS 30 circuit breaker enables three breakings at 1500 A short-circuit current at 760 mm Hg and 20 deg.C.
AZS 5 circuit breaker enables two breakings at 500 A short-circuit current at 90 mm Hg and 20°C.
AZS 10 circuit breaker enables two breakings at 500 A short-circuit current at 90 mm Hg and 20°C.
AZS 15 circuit breaker enables two breakings at 1000 A short-circuit current at 90 mm Hg and 20°C.
AZS 30 circuit breaker enables two breakings at 1000 A short-circuit current at 90 mm Hg and 20°C.

The automatic circuit breaking time is equal to 5 sec at least at + 50°C temperature after heating 15 min. at nominal current.

The weight of AZS automatic circuit breaker does not exceed 90 gm.
The AZS circuit breakers are serviceable within the ambient air temperature range + 50°C ÷ - 60°C at relative humidity up to 98%, at pressure equal to 760 ÷ 90 mm Hg.

The AZS circuit breakers are fastened by means of two M4 screws. When connecting the leads hold the terminals by

hand in order to avoid their releasing.

The positive cable /plus/ should be connected to the terminal connected with the fixed contactor /marked with "+"/

It is forbidden to hold the lever in "on" position, since, the circuit breakers have no special disconnecting mechanism. The switching on should be fast without holding the lever in "on" position.

The defective autom. circuit breaker should be replaced by a new one. Do not open the circuit breaker, its overhaul or adjustment is not admitted.

B8. Bonding.

The helicopter airframe serves as a minus lead of the electrical network: in order to ensure an equal electric potential on the whole helicopter, all metal parts of the helicopter assemblies /tubes, control levers, hinges, instrument panel, tanks and so on/ are bonded i.e. interconnected electrically in a reliable manner.

In order to diminish noises and disturbances in radio transmission and reception, all movable connections must be bonded if these connections can cause sparking.

Following helicopter assemblies should be bonded: /Fig. 12 and 13/

1. both helicopter control systems /for hands and feet/
2. fuel system
3. oil system
4. engine assembly
5. landing gear assembly
6. instrument panel
7. radio and electrical equipment which requires bonding
8. main rotor blades with rotor hub.

Moreover, all conduits, braids and protecting tubes of electric and radio equipment leads are connected to the helicopter airframe metallic mass by means of fasteners.

The helicopter should be grounded during parking time. The cable which is fastened to the port framework of the landing gear should be driven into the ground.

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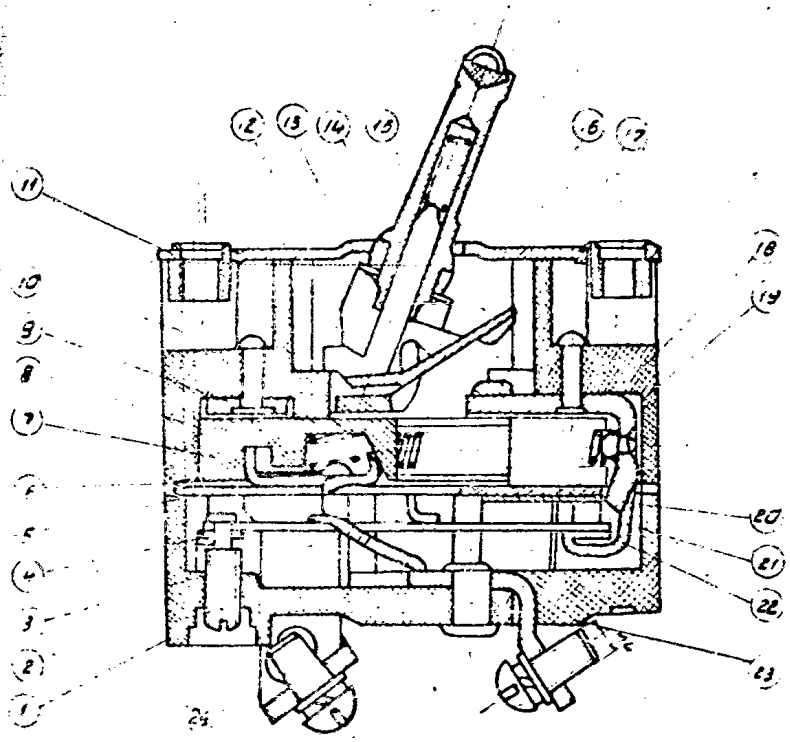

Fig 10 Automatic circuit breaker, type AZS

1. Lower case
2. Adjusting screw
3. Angle plate
4. Spring
5. Insert
6. Ratchet
7. Rod
8. Upper case
9. Contact plate
10. Rivet
11. Cover
12. Sleeve
13. Pin
14. Lever
15. Spring
16. Movable contactor
17. Fixed contactor
18. Angle plate
19. Spring
20. Flat spring
21. Rivet
22. Bimetallic plate
23. Angle plate terminal
24. Terminal

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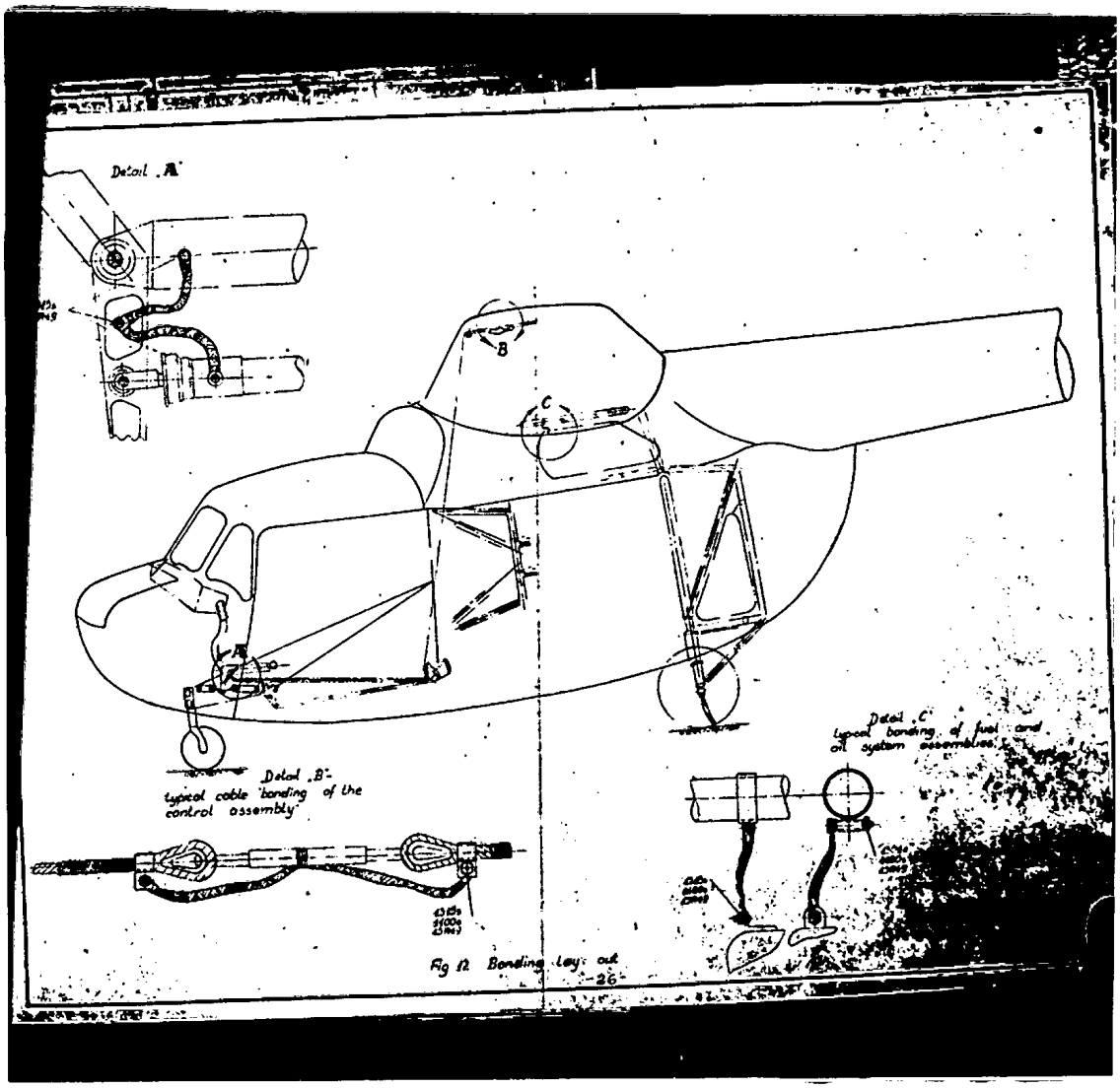

Fig 12 Bonding Lay out

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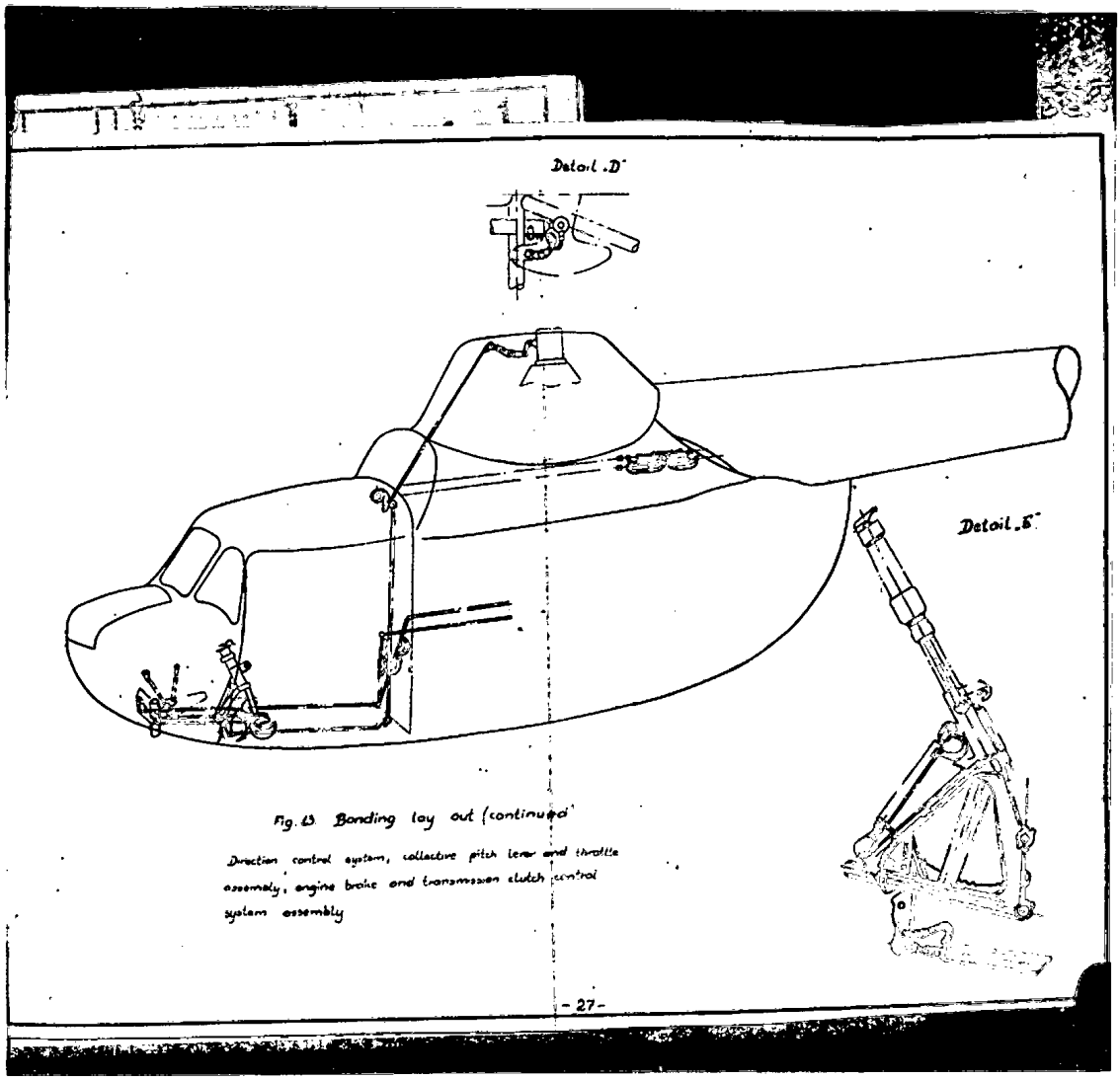

Fig. 13 Bonding lay out (continued)

Direction control system, collective pitch lever and throttle assembly, engine brake and transmission clutch control system assembly

B 9. Electric power consumers.

Order No	Specification	Type	Quantity	Load/Watts/ continuous	Load/Watts/ for a short time	Load/Watts/ momentary	Location
1	2	3	4	5	6	7	8
1.	Starter ignition coil	KP-4716	1				Fuselage framework starboard side
2.	Magnetos	MVE-7	2				Engine
3.	Pitot tube heating	PVD-4	1	40			cockpit port side
4.	cockpit ceiling light	P-39	3	15			cockpit
5.	portable lamp	PF-5-36	1	5			cockpit
6.	cockpit light	KSRK	3	3 x 5			cockpit
7.	radio compartment light	KTS-39	1	5			radio compartment cover
8.	side position lights	BAKO-45	4	4x25			cockpit, port and starboard side
9.	tail position light	CKS-39	1	10			end boom
10.	watch heater	AVRM	1	10			instrument panel
11.	ultra-violet /UFO/ light	ARUFOSz-45	2	220			cockpit
12.	landing light	FS-155	1	70			fuselage
13.	taxying light	FR-100	1				fuselage
14.	collective pitch indicator	UZP-47	1	80			rotor
15.	fuel contents gauge	BES-1177	1				fuel tank and instrum panel
16.	artificial horizon inverter	PAG-1F	1	270	415		cockpit
17.	radio receiver--transmiter	R-800	1	[redacted]			[redacted] behind main fue
[redacted]			1				[redacted]

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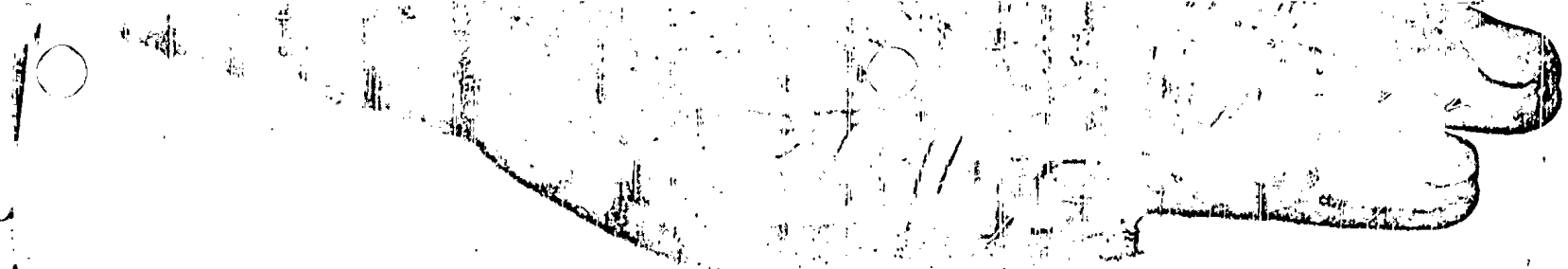

1	2	3	4	5	6	7	8
	[redacted]	[redacted]	[redacted]				[redacted]
20.	longitudinal trim indicator	UZP-47	1				cockpit
21.	fuel residual warning lamp	SŁC-51	1		5		instrument panel
22.	three pointer indicator for engine operation checking	EMI-3K	1				instrument panel
23.	three pointer indicator for both: the engine gearbox and the main gearbox	EMI-3WM	1				instrument panel
	[redacted]						
25.	fire detecting lamp	SŁC-51	1			5	instrument panel
26.	pyro-cartridge on the bottle	PP-3	1				-
27.	relay	RT-40	1	5			engine bay
28.	oil dilution electromagnetic valve	EKR-3	1				-
29.	windscreen wiper	AS-2	1				cockpit
30.	anti-icing pump	SCM-1	1				tail boom
31.	anti-icing pump contactor	K-25A					cockpit
32.	anti-icing pump operation signal light	SŁC-51	1	5			instrument panel
33.	anti-icing pump operation signalling device	SM-16A	1				engine bay /port/
34.	Radio compass /D/F/	ARK-5	1	85	165		[redacted]
35.	Starboard pos. light relay	JDJe-210	1				fire wall
36.	Port pos. light relay	JDJe-210	1				fire wall

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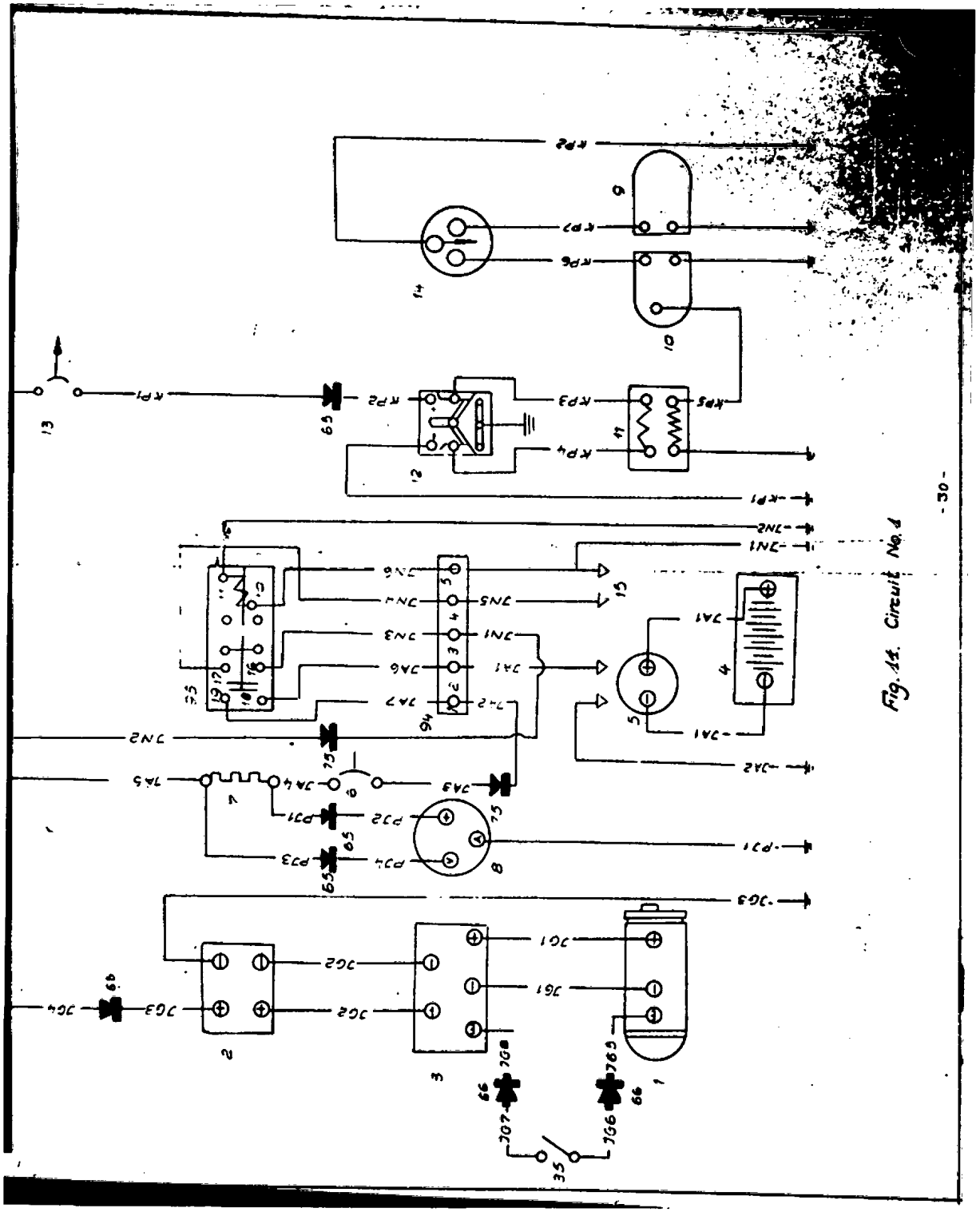

Fig. 14. Circuit No. 4

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Fig. 14. Circuit No 1

1 - GSK-1500 generator
2 - SF-1A filter
3 - RK-1500 W voltage regulator
4 - 12A10 storage battery
5 - storage battery sockets 7204-20
6 - AZS-30 automatic circuit breaker for the storage battery
7 - SzA-240 voltammeter shunt
8 - WA-240 voltammeter
9 - port magneto MWL-7
10 - starboard magneto MWL-7
11 - KP-4716 starter ignition coil
12 - 2PNP-47 switch
13 - AZS-5 automatic circuit breaker for switching off the ignition.
14 - PN-1 ignition switch
15 - ground supply source socket
66 - four pin connector type SzR 28 P 4 N Sz 5
35 - generator excitation circuit breaker W-45
65 - SzR32P12NSz1 connector
75 - SzR32P12NSz1 connector
95 - RT-40 relay /storage battery switching/
94 - cable cleat /cable fastening plate/

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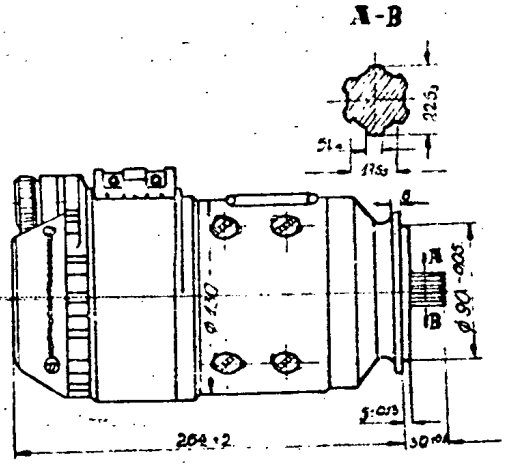

Fig. 15. GSK-1500 generator adjusted for 1000 W.

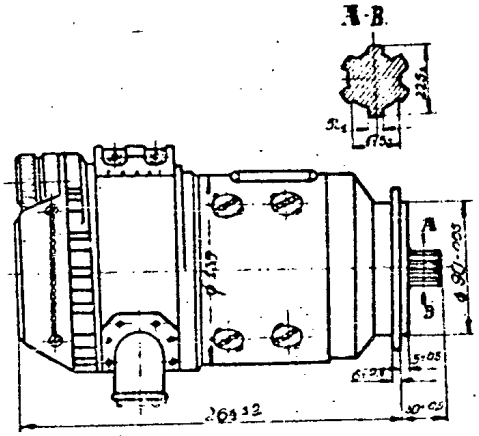

Fig. 16. GSK-1500 generator with additional cooling.

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C. CIRCUIT No 1

The circuit No 1 /Fig. 14/ consist of electric power sources, instruments for measurement of electrical parameters, voltage regulation instruments, electrical power switching assembly, engine ignition system.

C1. Generator GSK-1500Ż

Main source of electric power is the GSK-1500Ż generator. The GSK-1500Ż is designed for direct current. It is designed for two continuous power values dependent on the kind of cooling. The generator continuous power is equal to 1000 W in case of own cooling /Fig. 15, band without connecting mouth/. The generator continuous power is equal to 1500W in case of supplementary cooling besides own cooling /Fig. 16, band outfitted with connecting mouth/.

The helicopter is provided with a generator operating at 1000 W continuous power.

Generator leading particulars are as follows:

- nominal voltage	27,5 V.D.C.
- nominal current	36 A
- admissible overload current	54 A
- overload time	2 min.
- excitation current at 3800 r.p.m. 27,5 Volts, nominal current /generator warmed up/ should not exceed	1,35 A
- MGS-8 /Factory mark "8"/ brushes dimensions	7x25x22 mm
- spring-on-brush press force	900 ÷ 1000 gm
- maximum weight	12,6 kgs.

The generator consists of following main parts: stator, armature, commutator and brushes.

The stator is a fixed outer part of the generator. It forms a body of the generator. The stator consists of yoke and magnets. Yoke is made of a steel tube. A steel plate is welded to this tube; the plate serves for fastening the generator on the engine. Four magnets with coil shunt windings are mounted to the yoke by means of screws.

Magnetos are made of special AlAP steel /used in electrical constructions/.

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The shunt winding coils are made of enamelled copper wire. The magnet windings are shunted i.e. they are connected in parallel with the armature winding.

Only a part of armature current goes through the shunt.

The armature is a rotating part of the generator. An electro motive force is generated in it.

The armature consists of sets of sheets with grooves and of the armature winding.

Armature winding is placed in the grooves. Sheets are made of electrical steel /used for electrical constructions/.

The set of sheets is fastened on a shaft. On the sheet set vent channels are made. The armature has a wave winding made of copper wire in cotton insulation.

Armature winding ends are led to the collector; they are soldered with tin in the collector grooves.

Steel wire band is wound on the armature winding front surfaces.

When the armature is rotating the steel wire protects the winding against being deformed. The steel wire band is insulated from the winding by means of electric cardboard insulation. The armature winding is fixed in the grooves by means of electric insulating cardboard wedges.

The commutator is made of separate copper plates put on a steel sleeve.

The plates are separated by micanite insulation. The commutator and armature are placed on a common shaft. The commutator is placed above the commutator.

The cover is made of aluminium alloy together with the terminal box: in a hole a plate is fastened to the cover ribs. A support is fastened to the inner side of the cover front bulkhead. In the cover an aperture is provided in order to enable access to brushes and collector. The aperture and terminal block are protected by a band.

The kind of protective band depends on the generator power. A connector with a nut is installed on the cover outer side in place of terminal block. The connector fastens the cables which connect the generator with the helicopter board network.

The support is made of two brass inter-brush connectors

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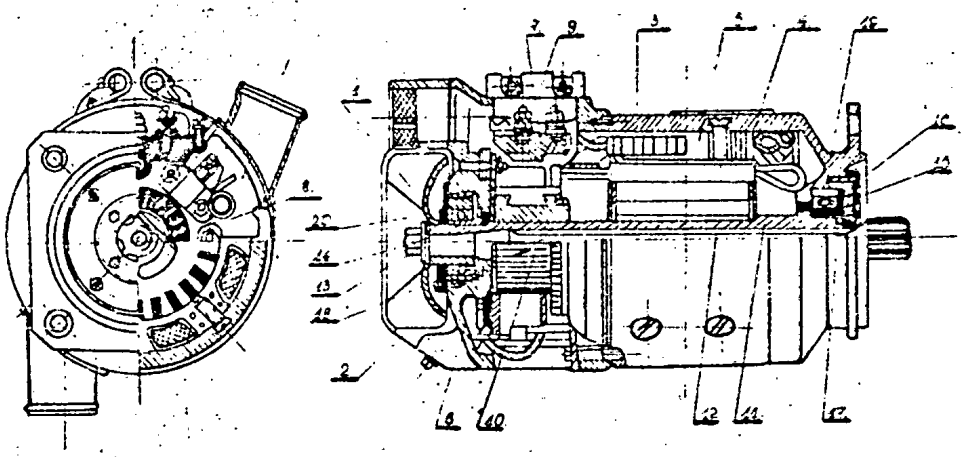

Fig. 17. GSK-1500 generator.

1 - ventilator
2 - housing
3 - armature
4 - stator
5 - pole
6 - commutator cover
7 - plate
8 - support
9 - band
10 - commutator
11 - hollow shaft
12 - flexible shaft
13 - nut
14 - washer
15 - oil sealing nut
16 - collar
17 - washer
18 - ball bearing
19 - ball bearing
20 - collar /flange/

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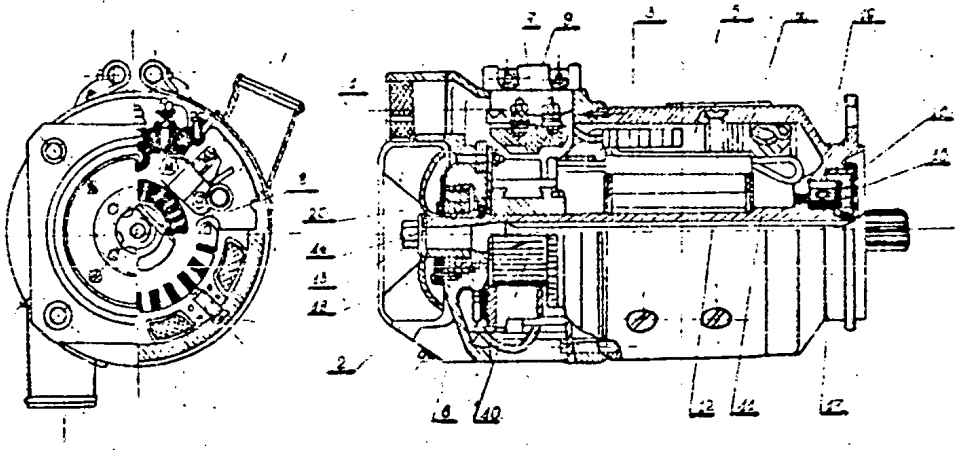

Fig. 17. GSK-1500 generator.

1 - ventilator
2 - housing
3 - armature
4 - stator
5 - pole
6 - commutator cover
7 - plate
8 - support
9 - band
10 - Commutator
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12 - flexible shaft
13 - nut
14 - washer
15 - oil sealing nut
16 - collar
17 - washer
18 - ball bearing
19 - ball bearing
20 - collar /flange/

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insulated by means of textolite inserts.

To these connectors brass screws are soldered. Brush holders are fastened by means of these screws.

The inter-brush connectors have contact arms, which are connected with terminals of the terminal block.

The generator shaft is made of 45 carbon steel. It rotates on two ball bearings installed in the housing. The shaft splined end serves for connecting the shaft with the engine drive. A ventilator /fan/ is placed on the other shaft end at the commutator disc side. The ventilator cover serves for conducting the air stream. The cooling air circulates through the armature winding front part. Ball bearings are installed on the shaft by the help of nuts, which have a thread on their external surface. When the nut is rotating, the threaded part acts as oil thrower moving oil towards the drive.

Moreover, sealing gaskets are used in order to protect the generator against oil.

The direction of generator rotation is marked on the nut by an arrow.

The nut serves for one determined direction of rotation. Two different threads /left and right/ should be made on two nuts serving for clockwise and counterclockwise rotation.

In case of generator rotation direction change, the arrow on the terminal block must be turned, the oil thrower nut should be replaced by a new one, which corresponds to the new direction of rotation.

The nut-collar lapping should be performed according to generator rotation only, since in the contrary case the aluminum particles may fall into the ball bearing. The generator excitation can be switched on by a M-45 switch installed on the right hand switchboard. The generator is mounted on the engine collar.

The generator type GSK-1500Z circuit is provided with RM-1500M voltage regulator and a RF-1A filter in order to keep the voltage constant, to protect against reverse currents as well as to suppress noises.

22. RM-1500M voltage regulator:

The RM-1500M voltage regulator is destined to keep the

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constant value of the voltage generated by the GSK-1500 generator.

The wiring diagram of the voltage regulator is illustrated in Fig. 18.

The voltage regulator is fastened to the framework at the left side of the engine bay.

C3. SF-1A filter.

The SF-1A filter serves for high frequency noise suppression in the radio units operation. Noises appear due to generator and voltage regulator operation.

The filter circuit diagram is shown in Fig. 18a. The diagram illustrating the connection with generator and voltage regulator is shown in Fig. 18b.

The mains filter is placed at the engine left side near the voltage regulator.

C4. 12A10 storage battery.

A 12A10 storage battery is connected to the board network in parallel with the generator. The storage battery serves for supplying the electrical equipment as well as for starting the engine if there is no ground supply electric power source on the aerodrome.

The storage battery enables the operation of the electric system also in case of generator failure.

The storage battery leading particulars are as follows:

- nominal voltage 24 V.D.C.
- capacity /fully charged/ should be not less than 10 Ah under following conditions:

1A discharging current causes the fall of voltage to 1,7 Volts on the first discharged cell during 10 hours, at 1,285 ± 0,005 initial specific gravity of the electrolyte, at + 25 deg.C. mean temperature of the electrolyte.

The storage battery is installed in a container. The container is a metal box. Inside the box a layer of sponge rubber is put.

Gases resulting from the electrolyte chemical process are led out of container by means of a durite hose. One end of the durite is connected with the connecting mouth on the container, the second end with a metal joint installed on

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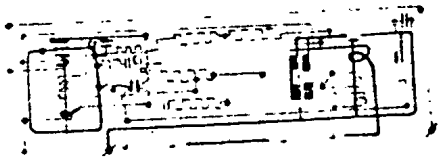

Fig. 18. BK-100 voltage regulator wiring diagram.

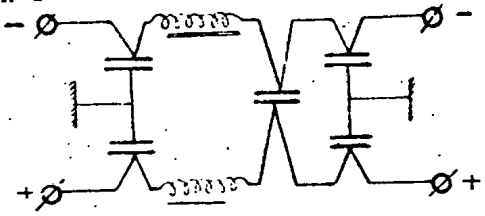

Fig. 18a. Circuit diagram of the 3F-1A filter

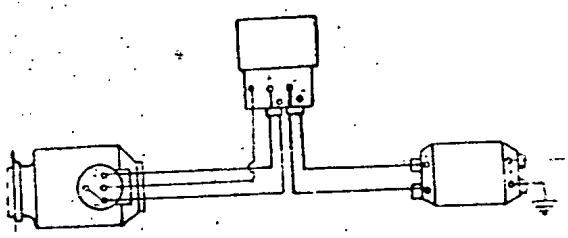

Fig. 18b. 3F-1A filter ... regulator

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the fuselage port side. The storage battery with its box is pushed on guiding rails into a special compartment in the fuselage front part /left side/.

A two-pin connector is installed on the storage battery container in order to facilitate the storage battery connecting with the helicopter board network.

The supplying current is led from the storage battery to the board network when the AZS circuit breaker is in "on" position. The AZS circuit breaker is located on the right hand switchboard above the placard with inscription "[redacted]", "ACCUM."

An electrical ground supply cart can be used for supplying the helicopter electrical board network on aerodromes with suitable ground equipment.

The cart /ground supply trolley/ should be connected by means of special bunched cable which should be connected with the ground supply pin connector.

The ground supply pin connector is placed in a special inspection hole at the right hand side of the engine bay.

A RT-40 relay /Fig.19/ is installed on the helicopter in order to avoid the case of simultaneous switching on the board storage battery and the ground supply electric power source.

C5. RT-40 double pole relay.

The RT-40 relay /Fig. 19 a b/ serves for disconnecting the board storage battery circuit at the moment of switching on the ground supply electric power source.

The relay consists of body 1, which forms a part of magnetic circuit. The body is made in form of a steel cylinder; on the cylinder surface two grooves are made for return springs 18. A fixed steel disc with cylindrical steel core 3 is fastened on the steel rib 2.

An inner cone is turned inside the core 3 end.

A steel plate 4 is riveted to the rib. A lever 6 is connected with the steel plate 4 by means of pivot 5.

A brass sleeve 7 is put on the core 3. A steel core 8 moves inside the sleeve.

One end of the core 8 is made in shape of a cone, the other one is threaded. The core 8 can move freely along the

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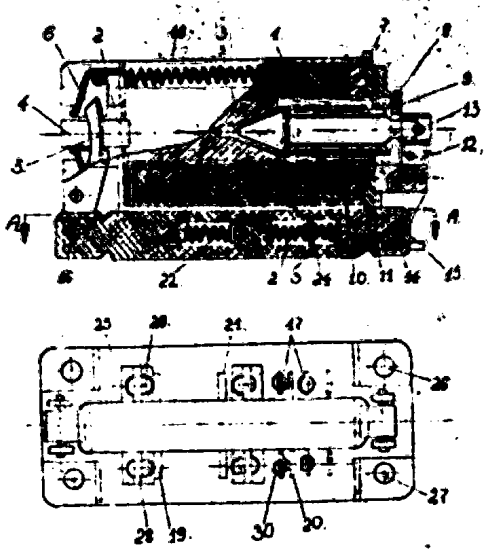

Fig. 19a. RT-40 relay

1 - body
2 - rib
3 - core
4 - plate
5 - pivot
6 - lever
7 - brass sleeve
8 - core
9 - limiter
10 - carcase with winding
11 - rib
12 - lever
13 - pivot
14 - pivot
15 - clamp
16 - pivot
17 - silver contact points
18 - return spring
19 - contact plate
20 - contact plate
21 - contact plate
22 - spring
23 - spring
24 - synthetic resin inserts
25 - contact plate
26 - fastening screws
27 - locking screws
28 - rib
29 - silver contact points
30 - main cable

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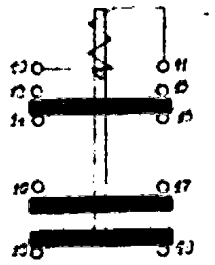

Fig. 19b. ЭТ-40 relay wiring diagram /ciphers indicate contact points No-s/

sleeve till it meets the core of the core 3 or till it touches the limiter 9.

A coil carcase with winding is put on the coil. A steel rib 11 with a clamp is installed on the sleeve end which protrudes outside the coil carcase.

The lever 12 is connected with the core 8 threaded end by means of a bronze pivot 13. It is connected with a synthetic clamp 15 with contacts /the clamp is made of two identical parts/ by means of pivot 14.

The clamp 15 second end is connected with the lever 6 lower part by means of pivot 16.

The return springs 18 are joint to the lever 6 upper end. Three silver contact plates 19, 20, 21 are installed in the clamp 15 holes. A spring 22 is pressing the plates 19, 21 to the clamp opposite holes edges.

The plate 20 takes a central position in the hole under the pression of springs 23, which are identical.

The plate is insulated from the springs by means of synthetic inserts 24.

The relay is mounted on a contact plate 25. It is fastened to the plate by means of two locking screws 27 and by two fastening screws 26. Four ribs 28 with silver contact points 29 are mounted on the contact plate as well as six small auxiliary current conductors 30. /four of them have silver contact points 17/.

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When the relay is installed on the contact plate 25 the plate 19 ends touch the 22 rib contacts.

The plate 19 is pressed by the spring 22. The plate 19 ends protrude outside the holes of the clamp 15.

The plate 20 touches the contacts 17 of two current conductors 30. It is pressed by the spring 23.

Two extruded steel ribs with flanges are mounted beneath the contact plate.

Steel clamp are fastened to the ribs. Inside the clamps a spring and a lock are installed. An extruded steel placard is put on the relay body 1; the placard covers the return springs 18.

The relay is covered by an extruded steel cover.

The RP-40 relay principle of operation can be described as follows:

A magnetic field is generated when the coil 10 is connected with the helicopter network. This magnetic field moves the core 8 into the sleeve 7 till the core meets the core 3.

The core 3 pulls the lever 12. The lever 12 pulls the clamp 15, which moves the lever 6. The lever 6 stretches the return springs 18. When the clamp moves, the plates 19. 20 are pushed away from the rib 22 contact points and from the current conductor 30.

During the further movement of clamp 15, the plate 21 touches the contact points of two opposite ribs and it is pressing the contacts by means of spring 22. The plate 20 is acting in an analogous manner; the pression being due to spring 23.

If the current is cut off, the magnetic flux disappears and the return springs 18 cause the return of the whole system to initial position.

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Main technical data of the PT-40 relay.

Voltage	24 Volts D.C.
Current broken by main contact points	40 A
Current broken by auxiliary contact points	10 A
kind of operation:	continuous one
Weight	not greater than 330 gm
Service life	10.000 switchings

C6. WA-240 voltammeter

A voltammeter type 240 is installed on the helicopter in order to enable the testing of electrical power consumers operation. The voltammeter is outfitted with a shunt SzA-240.

The elementary graduation on the dial is equal to 20-0--60 for current measurement. It corresponds to 5A for measurement of current. It is equal to 2,5 V for measurement of voltage.

The voltammeter is mounted on the port part of the instrument panel. The SzA-240 shunt is istalled on the left panel of the starboard switchboard.

C7. Units of engine ignition system.

The ignition system of the engine consists of following electrical equipment:

KP-4716 starter ignition coil
MWL-7 starboard magneto
MWL-7 port magneto
PM-1 ignition, sparking plugs

C8. PM-1 ignition switch and KP-4716 starter ignition coil.

The PM-1 switch serves for switching off and on the engine ignition.

The ignition switch is located on the instrument panel at the port side.

The KP-4716 starter ignition coil serves for feeding the starting terminal of the starboard magneto. The coil is mounted on the framework in the engine bay at the starboard side near the firewall.

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C). [redacted]-2 magneto.

The [redacted]-2 magneto with the ignition clutch serves for generating high voltage pulses and for distributing them to sparking plugs.

The magneto has a double pole armature /rotor/. It produces two sparks for one crankshaft revolution.

The sparking order is even.

The magneto is of clockwise rotation. It is entirely screened and fit to screening braiding. /the high voltage cable braiding with plug connector/.

A clutch type [redacted]-2 serves for sparking advance under engine operation conditions. It forms an elastic element of the ignition drive. /engine drive/. Sparking advance is adjusted without cam contour change.

The magneto is mounted on the engine by means of a holder.

The: the rotor /permanent magnet/ is rotating a magnetic flux arises in the magnetic field between the magneto on the housing. The magnetic flux goes through the transformer core generating thus low voltage pulses in the transformer primary winding.

When the winding current reaches its maximum value the breaker points open, breaking thus the magneto primary circuit.

At the moment of disappearance of the magnetic field /produced by the primary winding around the secondary one/ a high voltage pulse is generated which is capable to go across the spark gap of the sparking plug electrodes.

The initial section of the secondary winding is led to the magneto "earth" /by means of primary winding/ and therefore to the engine "earth".

The end of the secondary winding is connected directly to the rotating disc electrode by means of a carbon contact.

The rotating disc contacts by turns with the distributor electrodes located symmetrically on the circumference edge.

At the moment of breaking the magneto primary winding by the breaker i.e. at the moment of high voltage pulse generation, the electrodes of both rotating disc and distributor are connected.

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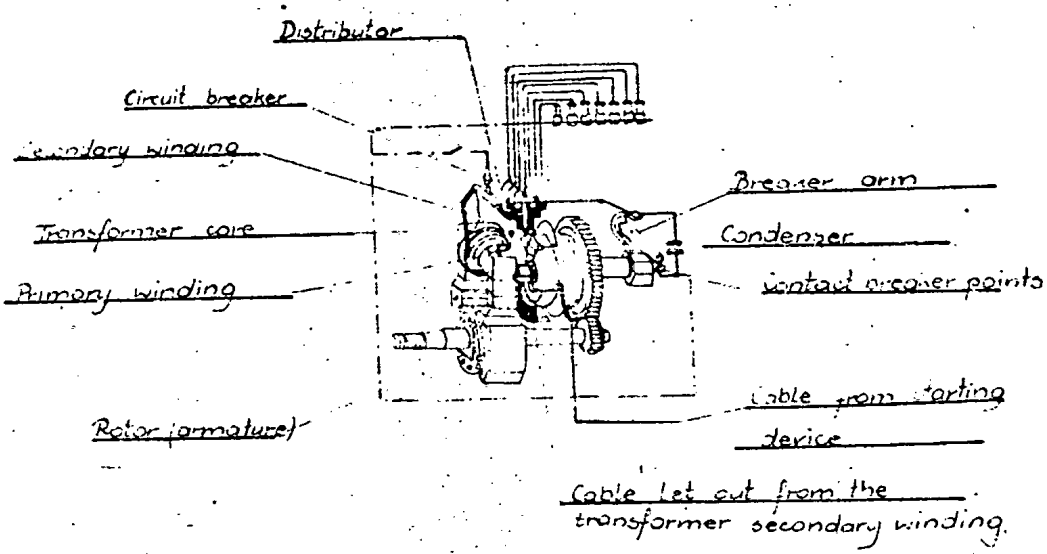

Fig. 20. Wiring diagram of the magneto.

1 - distributor
2 - circuit breaker
3 - secondary winding
4 - transformer core
5 - primary winding
6 - rotor /armature/
7 - breaker arm
8 - condenser
9 - contact breaker points
10 - cable from starting device
11 - cable let out from the transformer secondary winding

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The electrode of the sparking plug is connected to the engine mass "earth"/. Owing to this fact the high voltage pulse produced in the magneto transformer secondary winding goes to the sparking plug central electrode /by means of the distributor/. The spark appears across the spark gap causing the combustion mixture ignition in the engine cylinder.

The condenser in parallel with the magneto primary winding breaker points serves for diminishing the spark between these points and therefore: for reducing the "burn" effect on the breaker points surfaces.

The increase of engine revolutions changes the spark advance. The spark advance change is done automatically due to centrifugal clutch operation.

The sets of centrifugal weights, which connect the driven and driving parts of the clutch, change their relative position influenced by the centrifugal force. They turn the clutch halves by an angle, which corresponds to the spark advance change angle. Flat springs in the centrifugal weight assemblies are chosen so, as to cause the automatic device operation start within the desired range of the engine crankshaft revolutions /or of the magneto shaft revs./

Mixture ignition in the AI-26 engine combustion chambers is done by the help of two M-7 magnetos installed on the engine rear housing. High voltage current is driven from the magneto to sparking plugs by means of cables, which are fastened to the sparking plugs and to the magneto distributor. The distributor has special sockets provided with numbers indicating the firing order. Cables plugged into the magneto sockets have brass connections on their ends, provided with socket number. The port magneto serves for front sparking plugs; the starboard one serves for rear spark plugs.

The firing order is as follows: 5 - 7 - 2 - 4 - 6 - 1 - 3.

The normal advance /both magneto/ is equal to 25° [illegible]. The advance adjustment should be done after the cylinder No 5. Fix this cylinder starting cable in the magneto socket marked with No 1.

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Cables of other cylinders should be connected to 50X1
the sockets according to the firing order: 6-2-4-5-1-3.

Plates and rotating discs are shown from the magneto rear cover side.

"R1", "R2", "M", "RDM" are markings corresponding to terminals on the switch.

Both magnetos are of clockwise rotation.

The current is fed from the starter induction coil to the starting terminal of the starboard magneto.

Further, the current goes to the starting breaker points of the distributor rotor /rotating disc/ and then, to the sparking plugs. Firing order is as follows: 6-2-3--4-5-1-3.

Ignition system control i.e. switching "off" and "on" of the magnetos /individual and collective way/, is done by the help of a switch provided with a lever installed on the cover.

The switch lever can take four positions.

- The first one: - "0" - both magnetos and the starting magneto are switched "on".
- Second position: - "1" - port magneto off; starboard magneto and the starting magneto switched "on".
- Third position: - "2" - starboard magneto switched "on" Port magneto and the starting one are switched off.
- Fourth position:- "1+2"- both magnetos and the starting magneto switched on.

Starting the engine and the engine normal operation require the fourth position /1 + 2"/ of the ignition switch lever.

To facilitate the connection of cables to the switch, the switch is provided on its rear side with four terminals marked R_1; R_2; M and RM". The R_1 and R_2 terminals are connected with magneto terminals by means of cables. The terminal marked "M" is connected with the helicopter mass /airframe metal part assembly/, the RM terminal is connected with the starting magneto.

To kill noises in radio equipment as well as in order to increase the mechanical resistance, all ignition system

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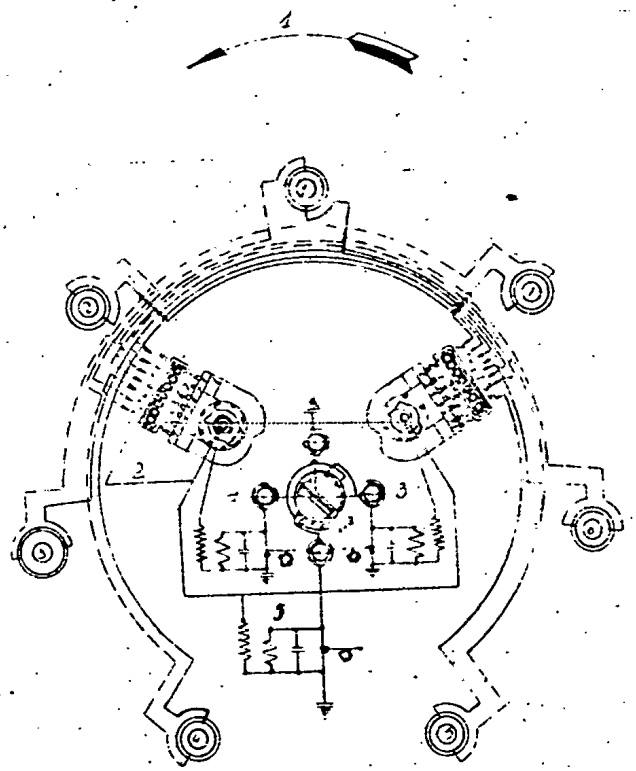

Fig. 21. Ignition system diagrams.

1 - crankshaft rotation
2 - cylinder numbering
3 - starboard magneto
4 - port magneto
5 - starting device.

cables /led between the magneto distributor and spar plugs/ are screened by a metal braiding fastened directly on the engine. The screening braiding has a good electric contact with the engine parts.

The collector is formed by a cut out ring made of a steel tube. It is festened to the front part of the push rod guide by means of six bolts.

16 screening braidings are fastened to the steel tube by means of special connections and coupling nuts: 14 of them of small diameter are led from the collector ring to front and rear sparking plugs, they are provided with special coupling nuts. Other two cables of great diameter connect the collector ring with magneto distributor screening.

These cables are outfitted with special terminations made of alumin alloy casting, they serve for connection with the magneto coller.

C10. SD - 4855 sparking plugs.

The sparking plugs serve for ignition of combustion mixture in the cylinder combustion chamber, the aviation gasoline being used.

Main technical data concerning the spark plugs are as follows:

- spark gap is equal to 0,3 ÷ 0,4 mm
- sparking plug average weight is equal to 110 gr.

The SD-4855 sparking plug is screened. It cannot be dismantled. The sparking plug is provided with a ceramic insulation of the central electrode.

The SD-4855 sparking plug consists of: /Fig. 22/

- body
- side electrodes
- core
- screening
- contact points

The steel body lower part has an external metric thread 18 x 1,5 serving for fastening the spark plug in the engine cylinder.

The upper part has a thread serving for spark plug connection with the ignition cable contact termination.

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The lower part of the sparking plug body is provided with four side electrodes. In order to enable the spark plug screwing into the cylinder, the spark plug body is hexagonal shaped for the spanner.

The sparking plug core consists of:

- ceramic insulator "5"
- central electrode "2"
- contact head /point/ "6"
- other component parts.

The insulator is force fitted in the copper sleeve 7. The spark plug screening is made of steel. It serves for fastening the core in the body as well as for screening the current conducting parts.

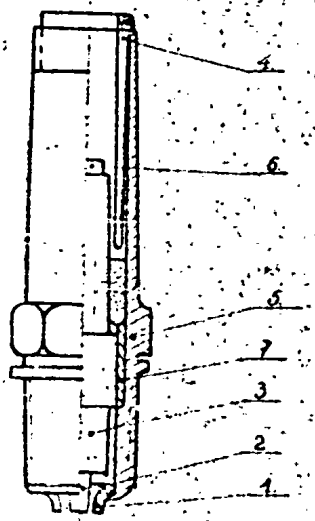

Fig. 23

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The high voltage current is taken from the magneto and driven to the sparking plug central electrode. The gap between the central electrode and side ones becomes ionized and a spark appears, which causes the ignition of mixture in the cylinder combustion chamber.

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D. C I R C U I T No. 2

The circuit No.2 /Fig.23/ consists of:
- Pitot tube heating
- watch heating
- portable lamp socket
- radio compartment light

D1. Pitot tube heating.

The impact pressure head /Pitot tube/ heating is protected by VI fuse type PW-2. The heater can be switched on by a W-45 switch which is installed on the right hand switchboard.

Two individual connectors type IR-1 are installed in the circuit in order to make easy the heater disconnection from the helicopter network.

D2. AWRM clock heater, portable lamp socket, and radio compartment light.

The AWRM clock heater, the portable lamp socket type 47 K, and KLSRK-45 bulb are protected by a I fuse type PW-2.

The current is driven directly through the fuse to the portable lamp socket 47 K. The 47 K socket is placed on a bracket under the elbow rest at the cockpit starboard side.

The clock heater is placed in clock casing that is fastened to the starboard. This heater is switched by W-45 switch placed on the starboard panel. KLSRK-45 light is located on the support above the R-300 receiver. The light design makes possible, after undoing the screw, to remove it from the support and lighten the transmitter front panel.

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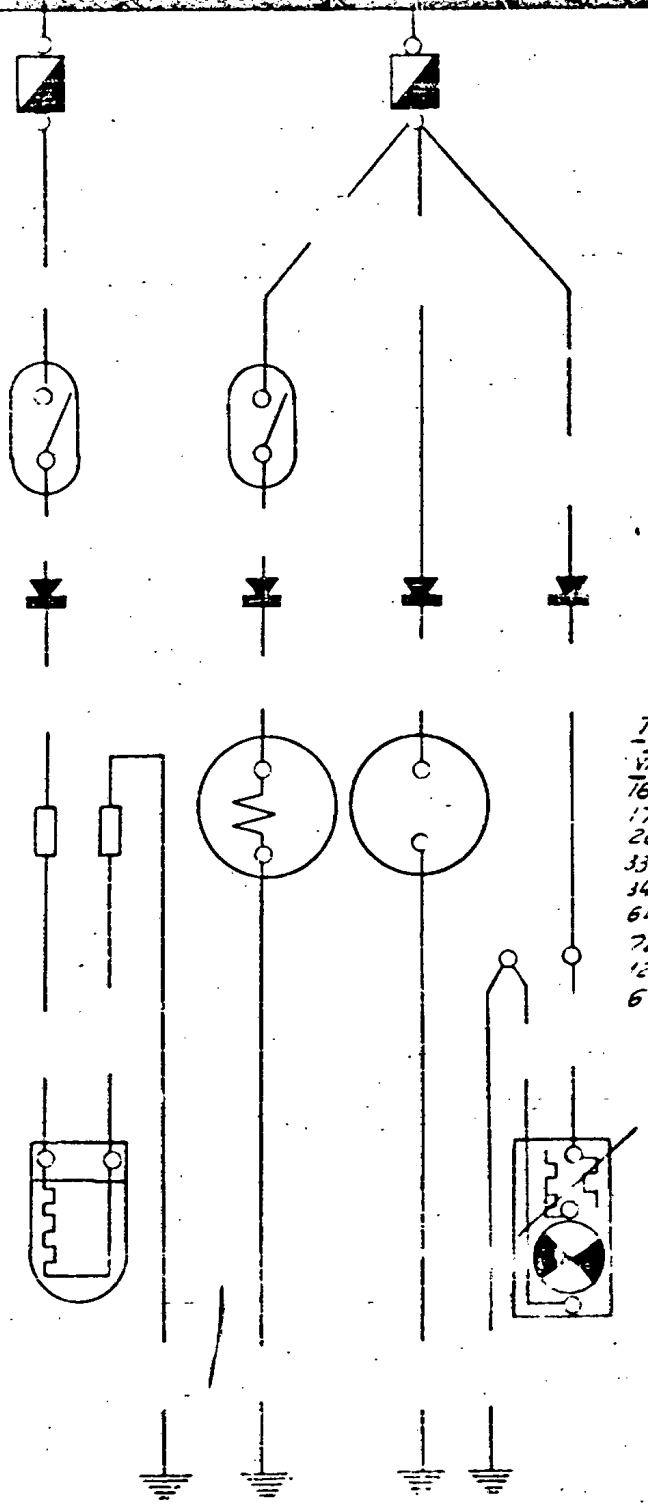

Fig. 23 Circuit No. 2

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B. C I R C U I T No. 3.

The electrical circuit No. 3 consists of:
- cockpit lights
- oil dilution electromagnetic valve
- position /navigation/ lights
- pos. light relays
- magnetic compass light
- cockpit ceiling lamp
- litter lights
- UVL /ultra-violet/ light /Fig. 24/
- radio compartment light

B1. Cockpit lights.

Two lamp KLSRK-45 type are installed in the cockpit in order to illuminate the instrument panel and the right hand switchboard with white light. The KLSRK-45 lamps are outfitted with a magnifying glass, which enables the focusing as well as with a rheostat enabling the light intensity adjustment. Switching the lamp is done by means of the rheostat. Moreover, in the lamp holder, a pushbutton is installed which serves for switching the full light intensity for a moment regardless to the rheostat position.

Both lamps are protected by II fuse type PW-2, One lamp is installed directly on the right hand switchboard, the second lamp is placed at the cockpit left hand side. This second lamp is connected with the helicopter board network by means of two individual JR-1 connectors.

B2. - Radio compartment lighting.

In the circuit protected by fuse II there is also the KLS-39 light of ARA-5 compartment. This lamp is switched by W-45 switch. The light is connected with mains by JR-1 indiv. connector. The supports for fastening the lamp and switch are riveted to the fuselage skin.

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b. AKA-3 electro-magnetic valve.

The oil dilution AKA-3 electro-magnetic valve circuit is protected by II fuse.

The valve is switched on by means of a AK-49 switch. This switch is installed on the left hand side wall of the right hand switchboard.

24. Position lights.

There are on the helicopter double side position lights, type-SAU-49 as well as rear position light, type - SHS-39.

First pair of side pos. lights is placed on the fore part of the fuselage, second one is on the litters. The starboard lights are with green filter and the port lights are with red filter

The rear position light is on the tail boom and is with a white filter.

All position lights are switched be automatic circuit breaker AKB-10 placed on the starboard panel. The position lights located on the fuselage are circuited through PKE-410 relay with its operating contact at rest. This circuit is open/relays operate/ in the moment of connecting and lighting up of litter light. Supply of pos. light and relays is led up from 75 A fusetelly clamp, placed on the firewall.

The PKE-410 relay operates in direction set by rectifier. There is a pushbutton - P-2 in the pos. light circuit that serves for light signalling and that may be done at AKB-10 being switched off.

25. A I-11 magnetic compass light; P-39 cockpit ceiling lamp; litter light-P-39

The A I-11 magnetic compass light the P-39 cockpit and P-39 litters light ceiling lamp are supplied by the current, when the AKB-5 automatic circuit breaker is switched "on". This circuit breaker is located on the right hand switchboard above the placard with inscription: "U.V. Ceiling Light",/automatic ultra-violet light, ceiling/.

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The light intensity of the compass light can be controlled by a RIK-49 rheostat, which serves as a circuit breaker too. The rheostat is located on the central part of the left hand switchboard. The ceiling lamp is located in the cockpit central part. The lamp is shining when the S-45 switch is in "on" position; the switch is located on the right hand switchboard.

The lamp illuminates the cockpit with white even light. The latter lights are placed in the fore upper part of the starboard port lifters; this lights are switched by S-49 switch that is located in the cabin on the firewall above the passengers' seat.

E6. UFO lights /ultra-violet lights/

ARUFOSz-45 assemblies with UFO-48 bulbs are installed on the port and starboard side of the cockpit in order to illuminate the dials, placards and switch levers by an ultra-violet light.

They are supplied by the current, when the AZS-5 circuit breaker is in "on" position. The circuit breaker is placed on the right hand switchboard over the placard with inscription: "U.V. Ceiling Light" /automatic ultra-violet lighting, ceiling/.

Two RUFO-48 rheostats, located on the central part of the right hand switchboard, serve for the lamps switching and control.

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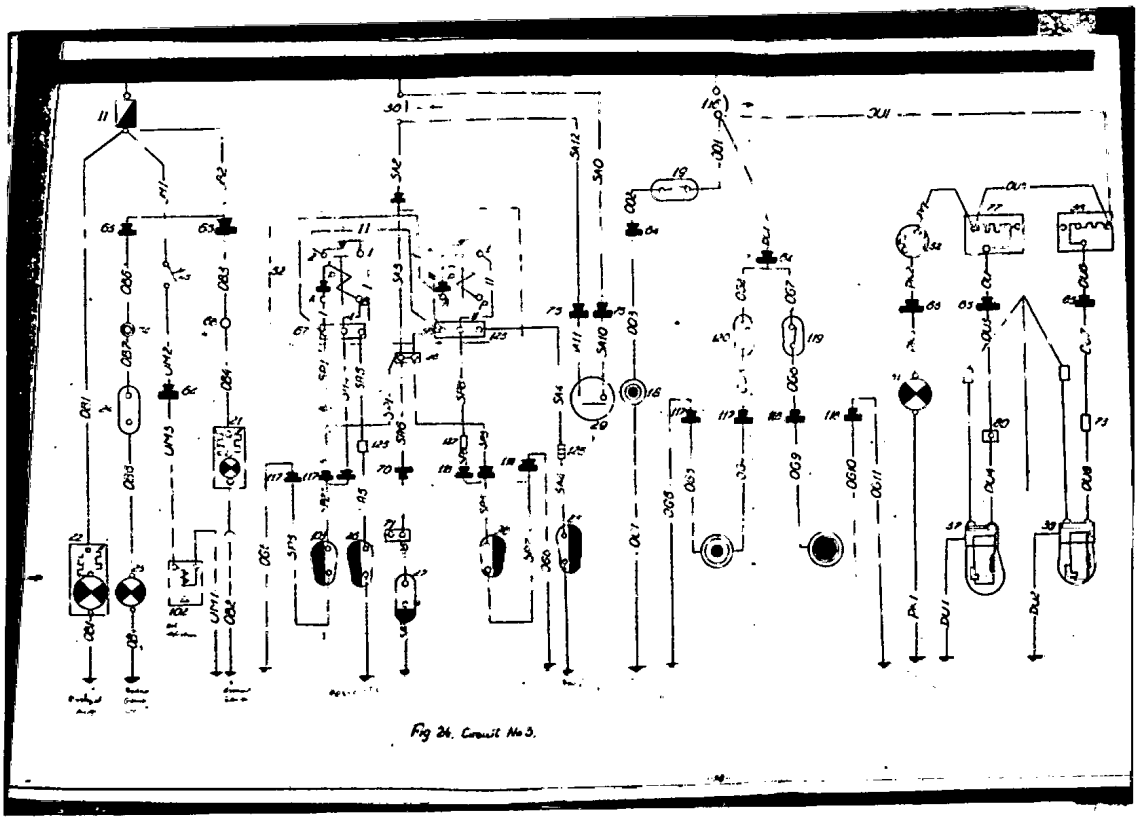

Fig 24. Circuit No 3.

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Fig. 24. Circuit No 7.

-11 - fuse type PM-3
13 - cockpit ceiling light type P-39
19 - cockpit ceiling light switch W-45 type
21 - MSRK-45 cockpit lamp, port
22 - MSRK-45 cokpit lamp, starboard
25 - BANO-45 port position light
26 - BANO-45 starboard position light
27 - SHS-39 tail position light
28 - four terminal block 75K
29 - SK - signalling pushbutton /lights/
30 - position light autometic circuit breaker SK type
31 - magnetic compass light type MI-11
32 - magnetic compass light rheostat MIT-49
35 - RUFO-48 port rheostat for ultra-violet light
37 - RUFOSz-45 ultra-violet lamp for the instrument panel port part.
38 - RUFOSz-45 ultra-violet lamp for the instrument panel starboard part.
45 - oil dilution switch MT-45
64 - SzR32P12NSzl connector
65 - SzR32P12NSzl connector
68 - IR-1 connector
70 - SzR32TK4N32S connector
71 - two terminal block, 73Y type
73 - IR-1 connector
74 - single-plug connector
75 - SzR32P12NSzl connector
77 - RUFO-48 ultra-violet light rheostat, /starboard/
80 - four-terminal block 75Y
102 - oil dilution electromagnetic valve, type ZWR-3
116 - cockpit ceiling lamp autometic circuit breaker type AZS-5.
23.- Radio compartment light KLS-39
24.- Radio compartment light switch W-45
110.- Ceiling light aut. circuit breaker AZS-5
92.- Starboard pos. light relay TDJe-210
94.- Port pos. light relay TDJe-210
103.- Starboard litter pos. light BANO-45
96. Port litter pos. light BANO-45

125. - Starboard pos. light connector JR-1 50X1
122. - Starboard litter light P-39
126. - Port pos. light connector JR-1
123. - Port pos. light relay clamp plate MU-7200-27-3
57. - Starboard pos. light relay clamp plate MU-7200-27-3
127. - Port pos. light relay connector MU-7200-27-3
118. - 4-pin connector SzRZOPKUNSz8
119. - Port litter light switch W-45
120. Starboard litter light switch W-45
121. - Port litter light P-39
117. - Starboard litter light P-39
P. - Rectifier

50X1

Each rheostat controls the light intensity and switching on one lamp only.

The left hand ultra-violet lamp is connected to the helicopter network by an IR-1 connector, the right hand one is connected to the network by means of a 75K terminal block.

The UFO-4A lamp is destined to illuminate the instrument dials and luminous coat covered control levers by ultra-violet light.

The UFO-4A lamp /Fig.25/ has a conical bulb. On the inner surface of the bulb there is a fluorescent layer.

The cathode is formed by a wolfrom spiral fire t heated by the current after the switching on. The anode A is ring-shaped. The U.O-4A lamp is filled with mercury vapour and argon under low pressure.

The switching on of the lamp occurs by turning the UFO-4A rheostat knob clock ise /switching the limit position is not necessary/. At the moment of switching on the lamp to the network, the bimetallic plate B closes the circuit, then the current driven through the anode and cathode is heating the cathode. At the same time, the plate B is heated, its bending occurs causing thus the circuit breaking. At the moment of circuit opening by the B plate, an electric arc appears in mercury vapour between the heated cathode and anode. The lamp is shining. The current goes through following circuit parts: terminal 1 - fixed part of the rheostat /end part of the adjustable winding section/ - movable contact - terminal 2 of the rheostat - cable - anode A - mercury vapour - plate B - cathode - lamp holder - corcenite braiding - network minus.

When turning the rheostat knob in the /"on"/ position, do not exert a great effort since in such a case the rheostat movable contact can be broken.

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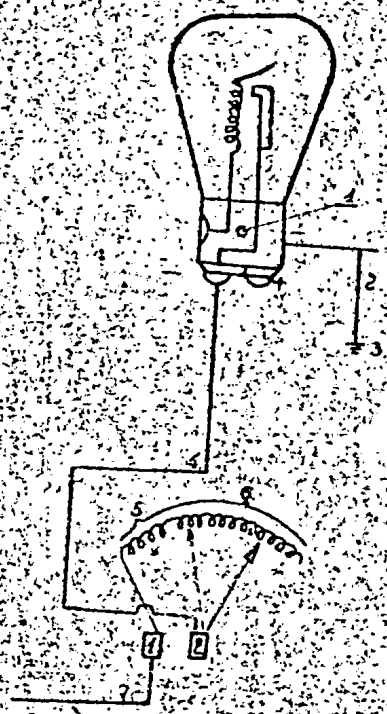


Fig. 25. Principle of operation of the UFO-4A lamp

1 - upper pin
2 - screening braid
3 - network minus
4 - white lead
5 - resistor
6 - rheostat
7 - network positive lead
A - anode
B - bimetallic plate
K - cathode

F. C I R C U I T No. 4. 50X1

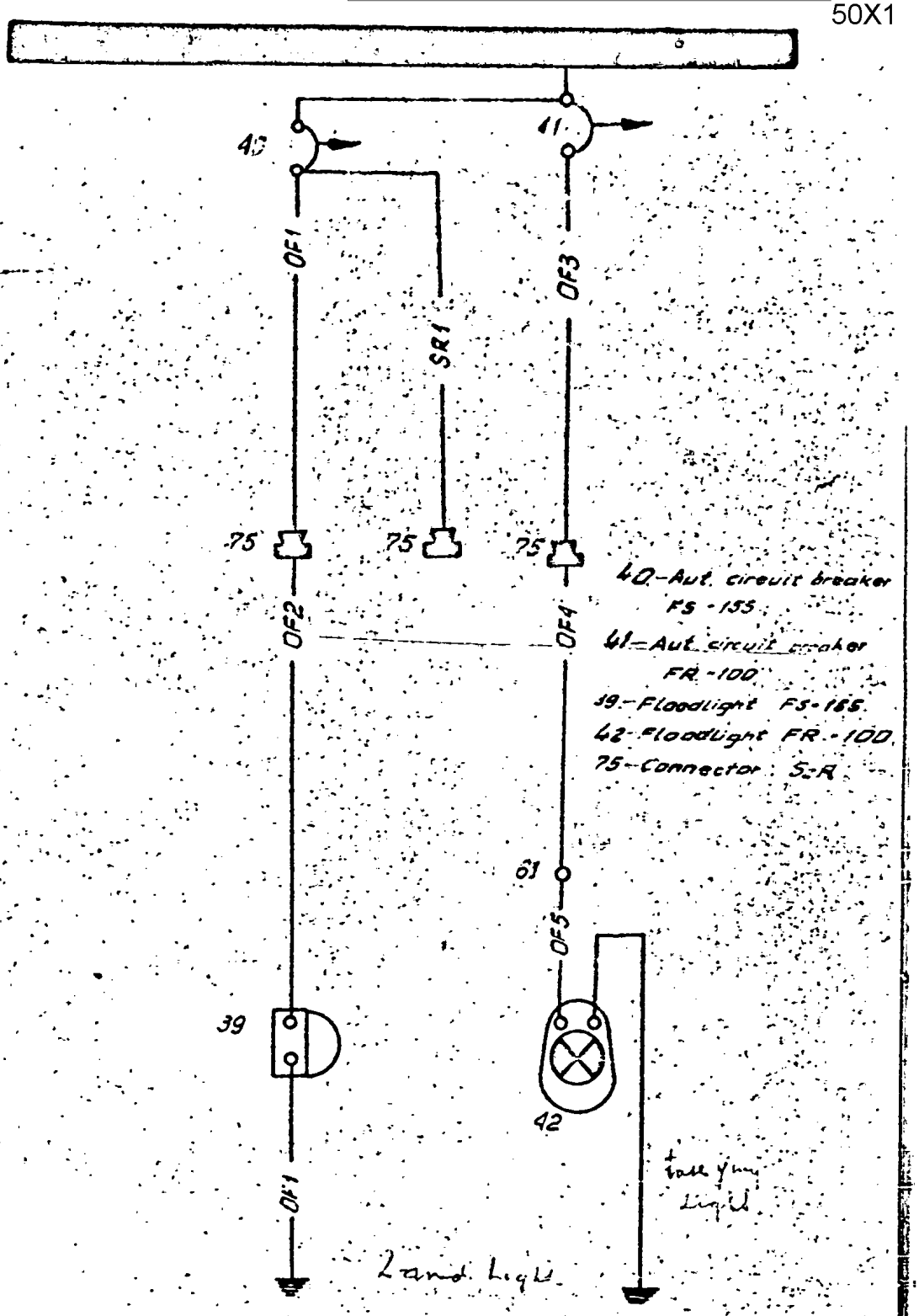
The leading light and the taxying floodlight belong to the circuit No. 4.

F1. Landing light.

FS-155 landing light with PZ-25 bulb /220 W power/ is placed in a special recess in the fuselage fore part under the radio recess.
From the outside this landing light is protected by convex plexiglass.
Landing light is mounted in such a manner that it may be inclined for 69° from horizontal plane.
This inclination enables to use the landing light as a search-light.
There is a special lever for landing light inclination. This lever is placed in the cabin on the right of the collective-pitch lever.

F2. Taxying light.

FR-100 taxying light with 70 W bulb is located in the fuselage front part on the front leg. The candle power should be 5000 candles at least.
Light dissipation /dispersion/ angle in the level plane is equal to 26° at least.



Electric circuit No 4

Drg. 26

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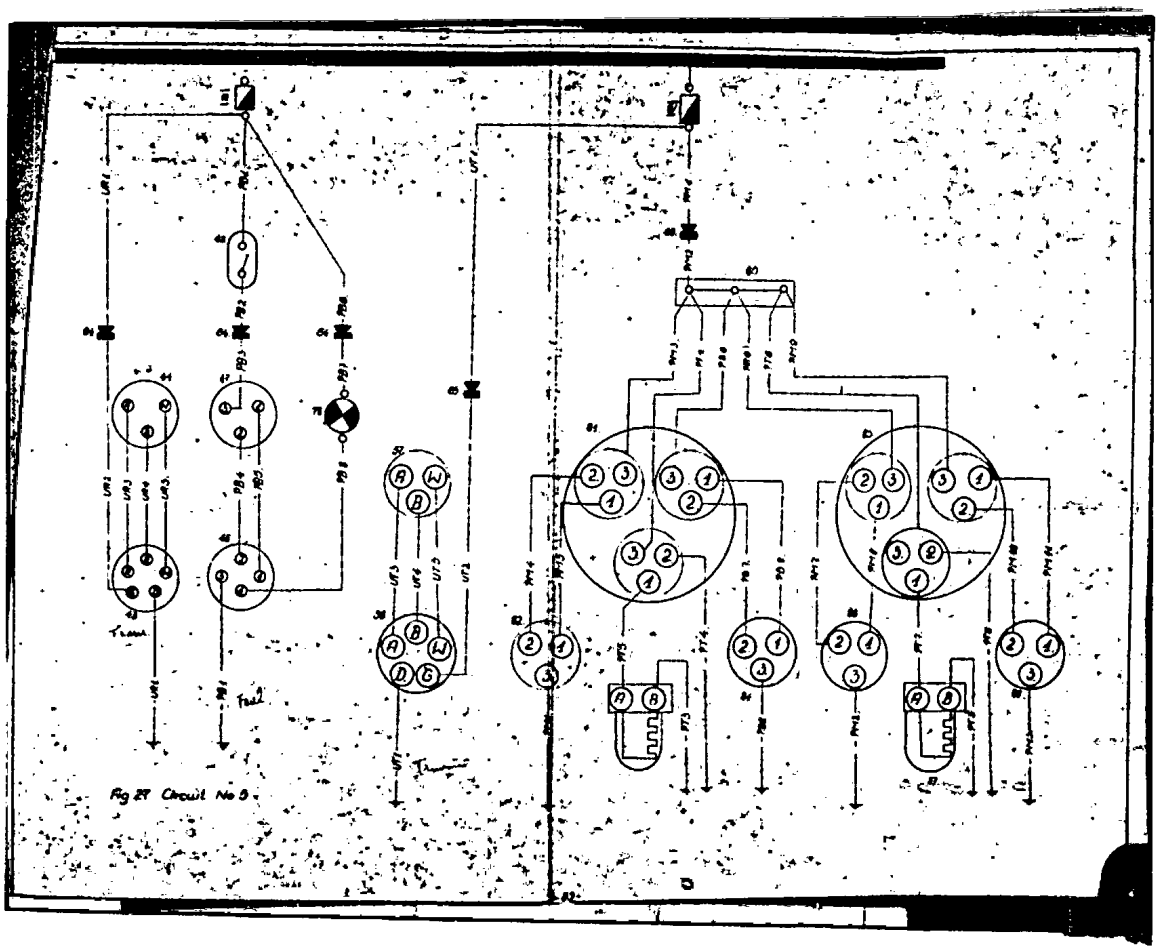

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Fig. 27. Circuit No 5.

43 - UZP-47 collective pitch indicator transmitter
44 - UZP-47 collective pitch indicator
46 - transmitter of BES-1177 fuel contents gauge
47 - BES-1177 fuel contents indicator
48 - M-45 switch of the fuel contents gauge
56 - UZP-47 transmitter of the longitudinal trimmer
57 - UZP-47 indicator of the longitudinal trimmer
64 - SzR32P12NSz1 connector
65 - SzR32P12NSz1 connector
78 - fuel reserve signalling light SzC-51
80 - four-terminal block, 75K type
81 - three-pointer indicator EMI-3K for engine operation checking
82 - oil pressure gauge transmitter of the three-pointer indicator
83 - oil temperature transmitter of the three-pointer indicator
84 - fuel contents gauge transmitter of the three-pointer indicator
85 - EMI-3WM three-pointer gearbox indicator
86 - oil pressure gauge transmitter of the three-pointer indicator
87 - oil temperature transmitter of the three-pointer indicator
88 - oil pressure gauge transmitter of the three-pointer indicator
III - PW-2 fuse
IV - PW-2 fuse

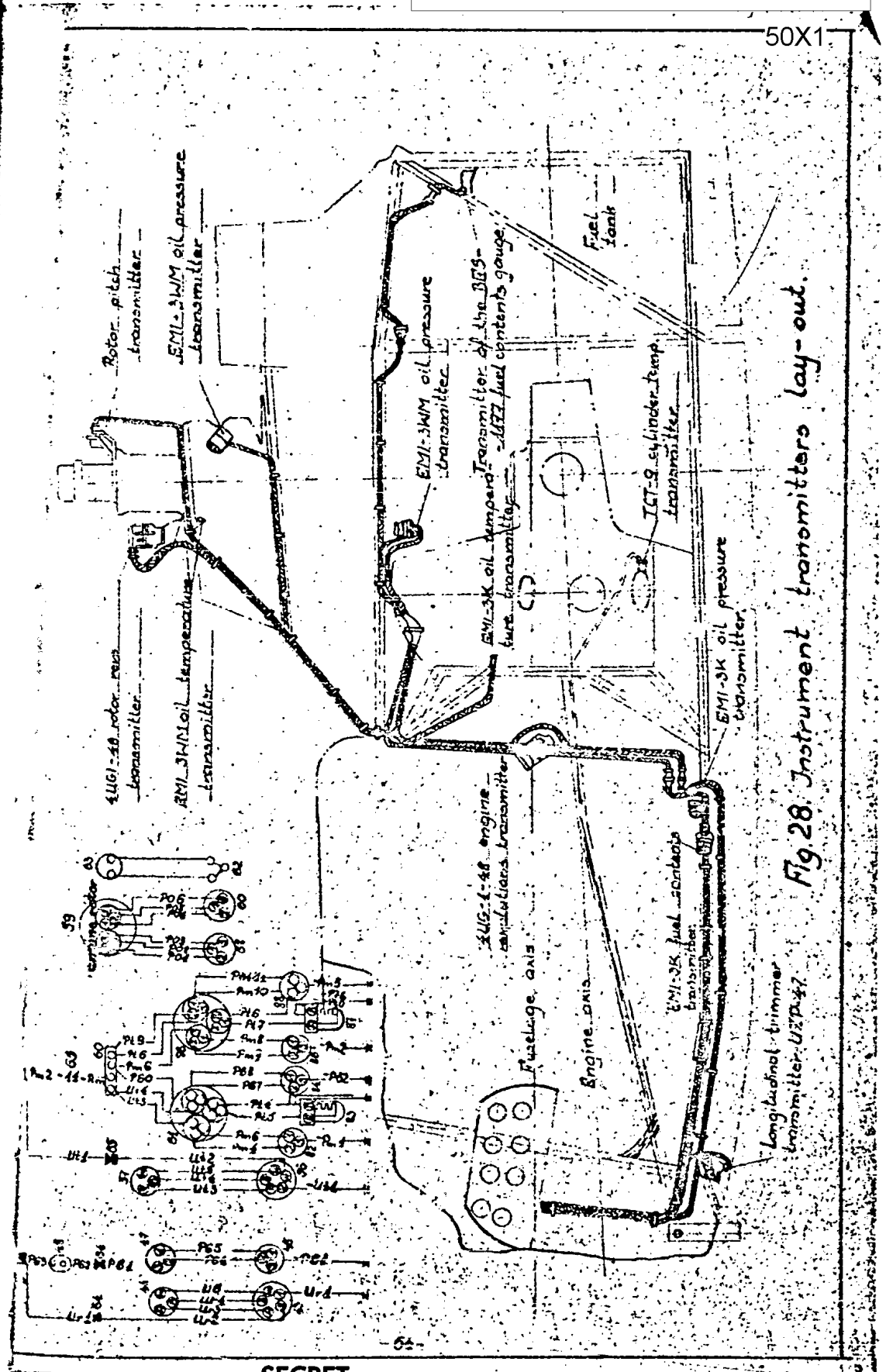

Fig. 28 Instrument transmitters lay-out.

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G. C I R C U I T No 5.

The circuit No 5 /Fig.27/ consists of:

- collective pitch indicator
- fuel contents gauge
- longitudinal indicator
- three-pointer indicator for engine operation checking
- three-pointer indicator of both the main gearbox and the engine gearbox.

G1. UZP-47 collective pitch indicator, BES-1177 fuel contents gauge.

III fuse PW-2 protects the supplying lead of both the collective pitch transmitter and the UZP-47 collective pitch indicator.

The transmitter is installed on the engine, the indicator is located on the instrument panel starboard part.

The fuse protects also the supplying lead of both the indicator and the fuel contents gauge transmitter as well as the fuel reserve signalling light.

The BES-1177 fuel contents gauge is installed on the instrument panel, it is switched on by means of W-45 circuit breaker placed on the right hand switchboard.

The SZC-51 fuel reserve red signalling light is connected in parallel with the fuel contents gauge. The signal light is located on the instrument panel above the fuel contents gauge.

G2. UZP-47 longitudinal trimming indicator, three-pointer engine operation indicator type E.I-3K, three-pointer indicator for both engine gearbox and main gearbox.

IV fuse PW-2 protects the supplying lead of both the transmitter and longitudinal trimming indicator as well as the four-terminal block 75K. The UZP trimming transmitter is placed at the cockpit port side, the UZP-47 indicator is installed on the instrument panel left hand part.

50X1

Therefore, following units are protected by the PT-2 fuse /by means of 75K terminal block/:

a/ UKZ-1 engine operation three-pointer indicator and following transmitters:
- oil temperature transmitter P-1
- oil pressure transmitter P-15B
- fuel pressure P.1B

The indicator is placed on the instrument panel, the transmitters are mounted on the engine /Fig.28/.

b/ UKZ-5 gearbox three-pointer indicator and following transmitters:
- upper gearbox oil temp. transmitter P-1
- upper gearbox oil pressure transmitter D-5
- engine gearbox oil pressure transmitter D-5

The indicator is placed on the instrument panel, the transmitters are mounted on the engine gearbox /Fig.28/.

50X1

H. C I R C U I T No 6.

Fire extinguishing system and the artificial horizon belong to the circuit No 6 /Fig. 29/.

H1. Fire extinguishing system.

V fuse PV-2 type protects the helicopter fire extinguishing system. The fire extinguishing system consists of following assemblies and accessories:

1. Terminal block installed on the firewall
2. Four S6601-10 thermal signalling devices /fire detectors/ are installed in the engine bay; the detectors contact points are open under normal conditions. In event of fire the contact points close causing thus glowing of the fire warning light.
3. The red fire warning lamp SEC-51 is located on the instrument panel left hand part.
4. Near the fire warning light a 5-K pushbutton is installed under a cap. It is necessary to press this button in order to fire the PP-3 cartridge which starts the extinguisher.

H2. AGK-47B artificial horizon.

The artificial horizon is switched on by means of an automatic circuit breaker AZS-15 placed on the right hand switchboard. The artificial horizon is placed on the instrument panel. The artificial horizon inverter PAG-1-F is supplied through the AGK-47B artificial horizon. The inverter is mounted to the radio bracket at the cockpit port side.

The PAG-1F inverter is designed for supplying one or two AGK-47 artificial horizons by three-phase alternating current at 400 c/s frequency. It consists of a D.C. motor /with in series shunt excitation/ and a three-phase A.C. generator /with excitation by a rotor permanent magnet/.

In order to kill noises in radio communication, the inverter is outfitted with a special filter which consists of three blocking condensers, one pass condenser and one choke.

The inverter is connected with the circuit by means of fire-plug connector.

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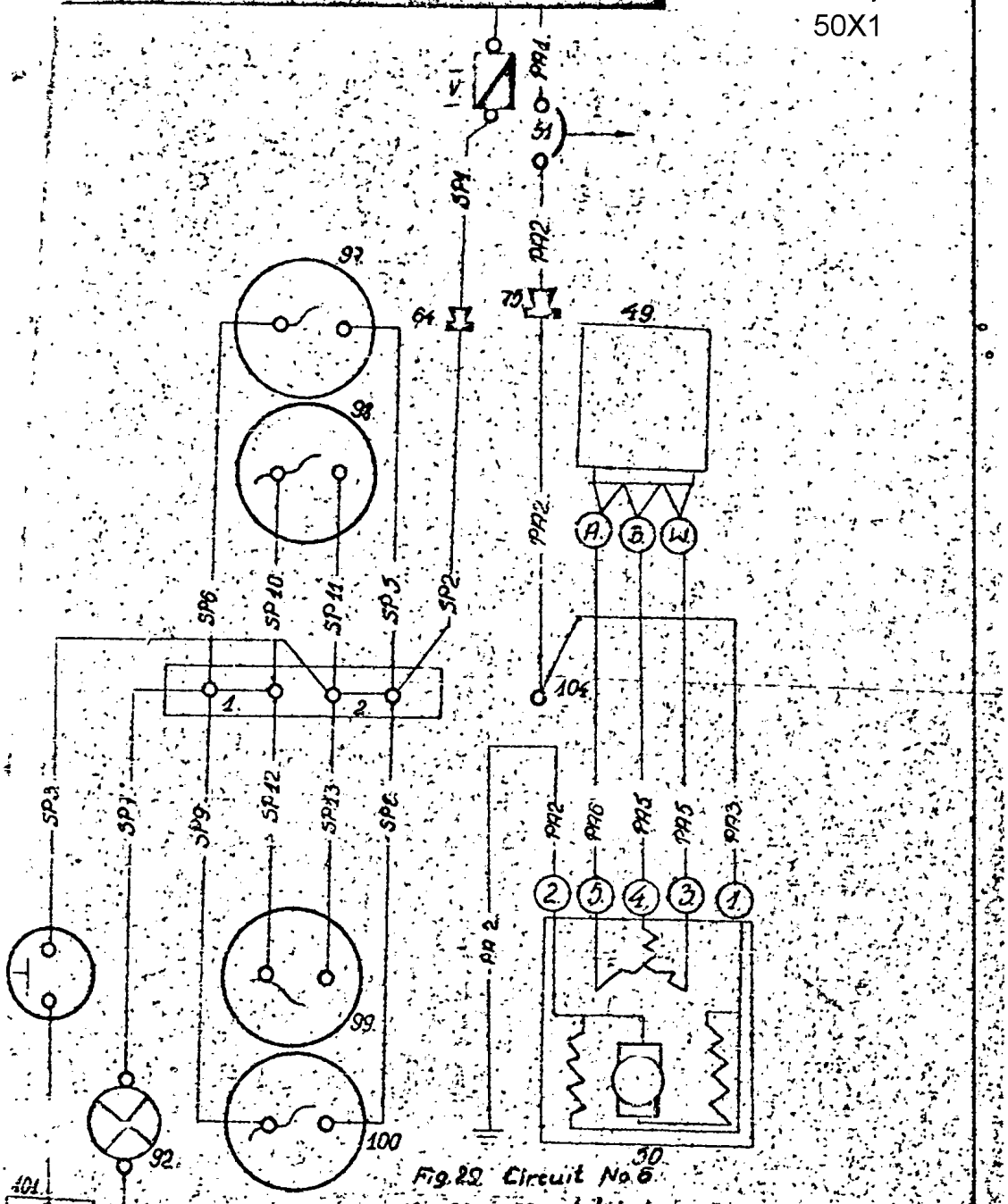

Fig. 22 Circuit No. 6

49 - AGK-47B artificial horizon
50 - PAK-47B artificial horizon inverter PAG-1F
51 - AGK-47B artificial horizon automatic circuit breaker AZS-1A
64 - Sz 32P12N5z1 connector
70 - 73K four-terminal block
92 - SLC-51 fire warning light
93 - fire extinguisher button 3K
98 - thermal signalling device contact point
99 - thermal signalling device contact point
99 - thermal signalling device contact point
100 - thermal signalling device contact point
101 - PP-3 cartridge on the battle
104 - JR-1 individual connector
V - fuse PW-2 type

The inverter has an adjustable rheostat installed in the motor shunt circuit. The rheostat serves for keeping the frequency constant as well as for keeping the constant voltage of the generator under different operation conditions.

Generator leading particulars are as follows:

A. Electric motor data:

1. Voltage on terminals 27 ± 10% V.
2. Input current /supplying current/:
   a/ not greater than 3A-for operation with one instrument.
   b/ not greater than 3,5A - for operation with two instruments
3. Idling current at 27 V. input voltage:
   a/ not greater than 2A - inverter adjusted for one instrument
   b/ not greater than 2,2A - inverter adjusted for two instruments.
4. revolutions 8000 ± 10% r.p.m.
5. operation conditions continuous operation
6. direction of rotation /view from the collector/: clockwise

B. Generator leading particulars

7. Voltage 36 ± 4 V.
8. Current
   a/ 0,32 A - operation with one instrument
   b/ 0,65 A - operation with two instruments
9. Power factor not less than 0,65
10. frequency 400 ± 10% c/s

C. MGS 7 brushes

11. dimensions 6,5 x 7 x 14 mm
12. quantity two brushes
13. brush contact pression force 225 ± 25 gm

D. Magnetic ball bearings
two No 6007 CPZ bearings

E. Weight not greater then 3,5 kg

The wiring diagram of the inverter is shown in Fig. 30.
The inverter is installed inside a housing, it has its own

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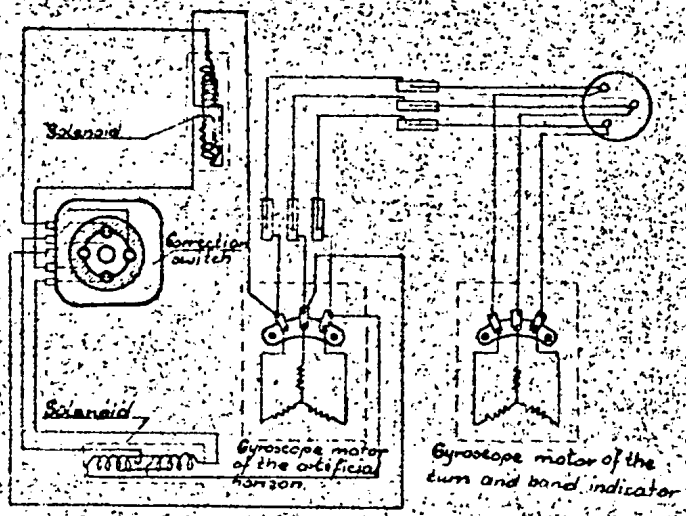

Fig.29a. AGK-47B wiring diagram

1 - solenoid
2 - correction switch
3 - solenoid
4 - gyroscope motor of the turn and bank indicator
5 - gyroscope motor of the artificial horizon

50X1

cooling system /Fig.31/

The yokes of motor and generator stators are mounted inside a common housing 1, which forms whole assembly with the cast base. The motor rotor and the generator armature are mounted on a common shaft 2. The motor magnetic system is a double-pole one.

Motor field coils winding 3 is connected in series, one winding end is connected to the positive bruch holder terminal.

The shunted field coil end is connected with the rheostat terminal 12. The rheostat is installed in the base.

Brush holder minus output is led directly to the plug connector. The common end of excitation /field/ winding is led to the pin connector /Fig. 30/ through the pass condenser and choke installed in the cover 4. The generator stator output and the motor filter output are led to the terminal block 5 through the holes in the cover.

Pin connector markings on the inverter are the same as markings given in the wiring diagram /Fig. 30/.

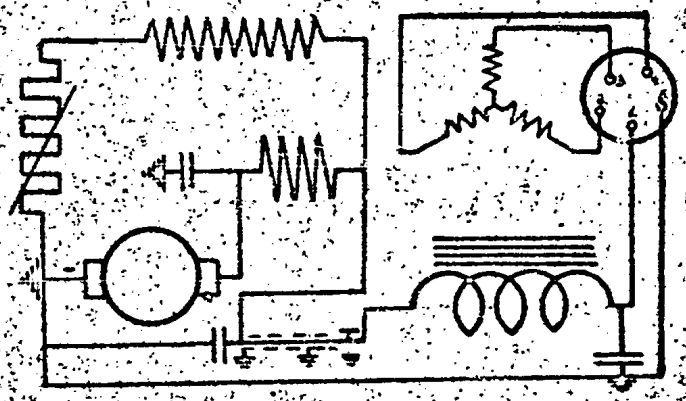

Fig. 30. Wiring diagram of the PAG-1F inverter.

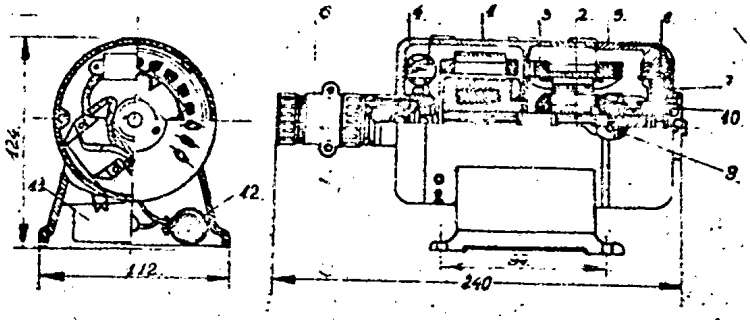

Fig. 31. PAG-1F inverter.

1 - body, 2 - shaft, 3 - field winding, 4 - cover, 5 - cover, 6 - terminal block, 7 - support, 8 - cap, 9 - cotter pin, 10 - ball bearing, 11 - condenser, 12 - rheostat.

The rheostat 12 installed in the base is destined for fixing the A.C. frequency when the inverter co-operates with one or two instruments. The rheostat slider position dependent on load is fixed according to dashes made inside the base.

Moreover, a condenser 11 which belongs to the filter circuit is installed in the base, besides the rheostat.

Generator armature is made as a permanent magnet shaped in form of a six-ray star.

Brushes are fixed in brass holders fastened on rotable brush support 7. Two apertures in the cover 6, closed by the cap 8 enable the brush inspection after removal of the cap.

Covers are made of aluminium alloy; they are fastened to the housing by means of two pins 9.

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The armature is mounted on two magnetic bearings 10, which enable simple dismantling and easy assembling of the inverter. The axial clearance of the armature is compensated by four cylindrical springs, which transfer the axial pressure force on the ball bearing outer ring from the collector side.

I. C I R C U I T No. 7.

50X1

The circuit No. 7 supplies the radio transmitter-receiver, /Fig. 32/.

11. R-800 radio transmitter-receiver supply.

The current supply of both the R-800 radio set and ARK-5, /D/F/ radio compass is done by means of switching on the AZS-30 automatic circuit breaker which is installed on the right hand switchboard above the plate with inscription "RADIO".

The D.C. supply of ARK-5 is led to Nos. 19 and 18 clamps on the ARK-5 remote control box.

This box is located on the port panel. The A.C. 115 V, 400 Hz is switched by AZS-2 /automatic circuit breaker/ and given to ARK-5 circuit. This current is led up from the MA-250M inverter to No. 20 clamp on the remote control box.

By switching on the AZS-30 /automatic circuit breaker/ the current is led up to 48 K socket that is placed on the inclined frame of the end beam. From 48 K socket the supply is given to MA-250M inverter and from it through the block V / rectifier / goes to transmitter and receiver of R-800 /R/T set/.

K. C I R C U I T No 8.

Anti-icing system and the windscreen wiper belong to the circuit No 8 /Fig. 33/.

K1. Anti-icing system.

The anti-icing system consists of:

a/ anti-icing fluid pump SCN-1
b/ K-25A contactor of the anti-icing fluid pump switching
c/ anti-icing pump operation signal light SLC-51
d/ anti-icing pump operation signalling device SD.-16A
e/ pump starting pushbutton 5-k
f/ 2PPN-45 switch for pump operation switching

The anti-icing system is switched to the network by means of an AZS-16 automatic circuit breaker, located on the instrument panel left hand part. A green SLC-51 signal light is installed also on the instrument panel as well as the 2PPN-45 switch and 5K button. The K-25A contactor is placed at the cockpit starboard side near the socket for ground power supply. The SCN-1 pump is placed in the end boom, the SD-16A signalling device is installed at the left side of the engine bay.

After having switched on the AZS circuit breaker in order to introduce the anti-icing fluid into the system under normal or overloaded conditions, the 2 PPN-45 switch should be shifted in suitable position and the 5K pushbutton pressed /the 5K pushbutton switches on the K-25A contactor/.

The contactor starts the pump and switches on the signal light. The pump starts its operation, when the pressure increases up to 0,25 atm., the pressure signalling device is connected in parallel with the 5K button, keeping thus the contactor in "off" position. Then, the pushbutton should be released but the pump does not stop its operation.

In case of pressure drop i.e. when the pump does not operate correctly, or there is no fluid in the reservoir, the signalling device switches off the contactor causing thus the pump operation stop while the pump stop signal light dies out.

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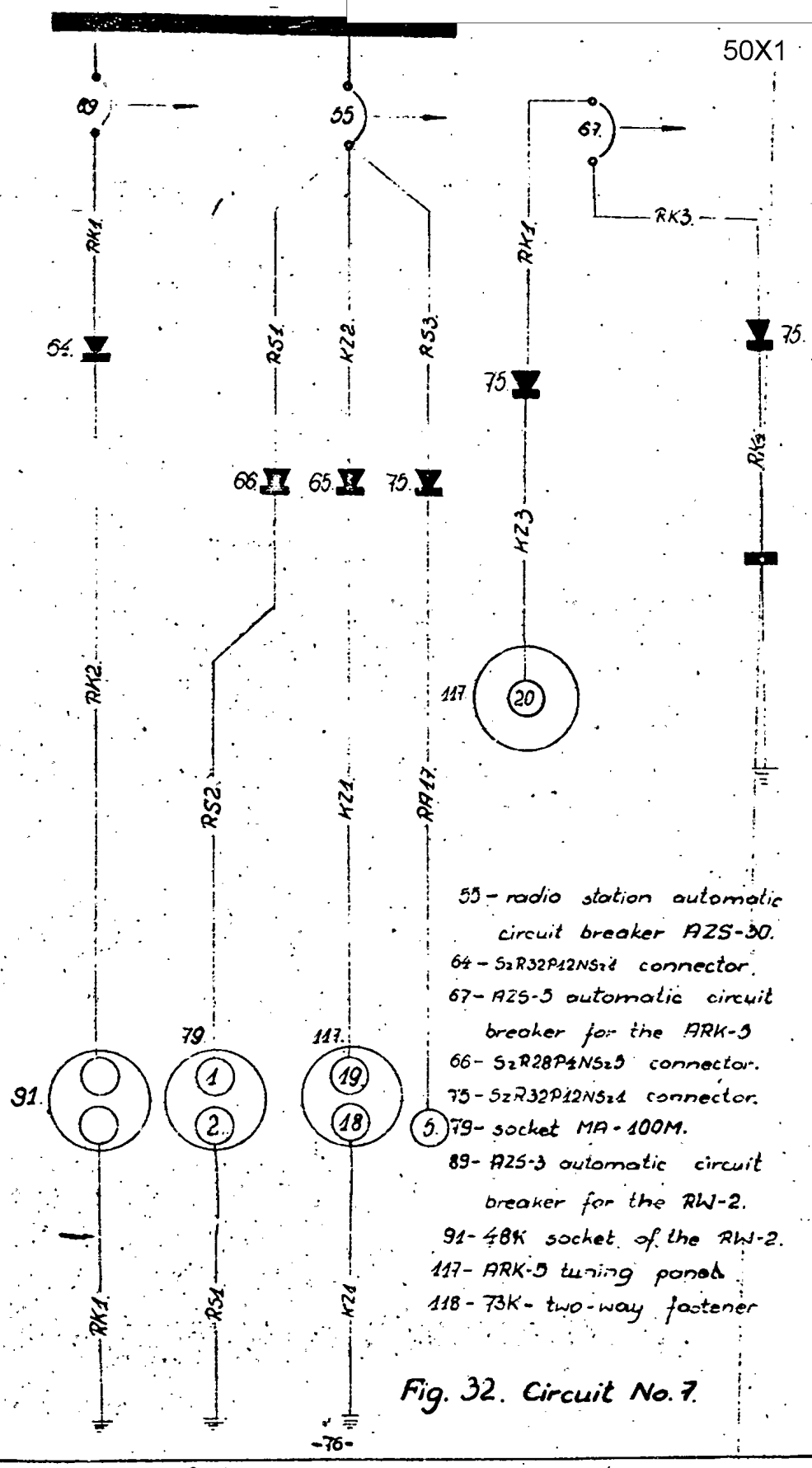

55 - radio station automatic circuit breaker AZS-30.
64 - 5zR32P12NSz1 connector.
67 - AZS-3 automatic circuit breaker for the ARK-3
66 - 5zR28P4NSz3 connector.
75 - 5zR32P12NSz1 connector.
79 - socket MA-100M.
89 - AZS-3 automatic circuit breaker for the RW-2.
91 - 48K socket of the RW-2.
117 - ARK-3 tuning panel
118 - 73K - two-way fastener

Fig. 32. Circuit No. 7.

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K2. AS-2 windscreen wiper.

The AZS-5 automatic circuit breaker, for AS-2 windscreen wiper switching, is installed on the instrument panel right hand part.

In the windscreen wiper assembly a F-14A filter is operating. The filter serves for killing noises which appear during the operation of the AS-2 electric motor.

The wiper is placed at the cockpit left side.

The windscreen wiper assembly consists of:

- wiper mechanism
- brush
- electric motor with flexible shaft

The windscreen wiper should be used when it rains, snows or ice appears on the windscreen.

In case of ice formation use spirit at the same time. Spirit is an anti-icing mean.

Wiper-to-pane contact can be adjusted by means of screws located on the wiper brush.

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Fig 33 Circuit No 8.

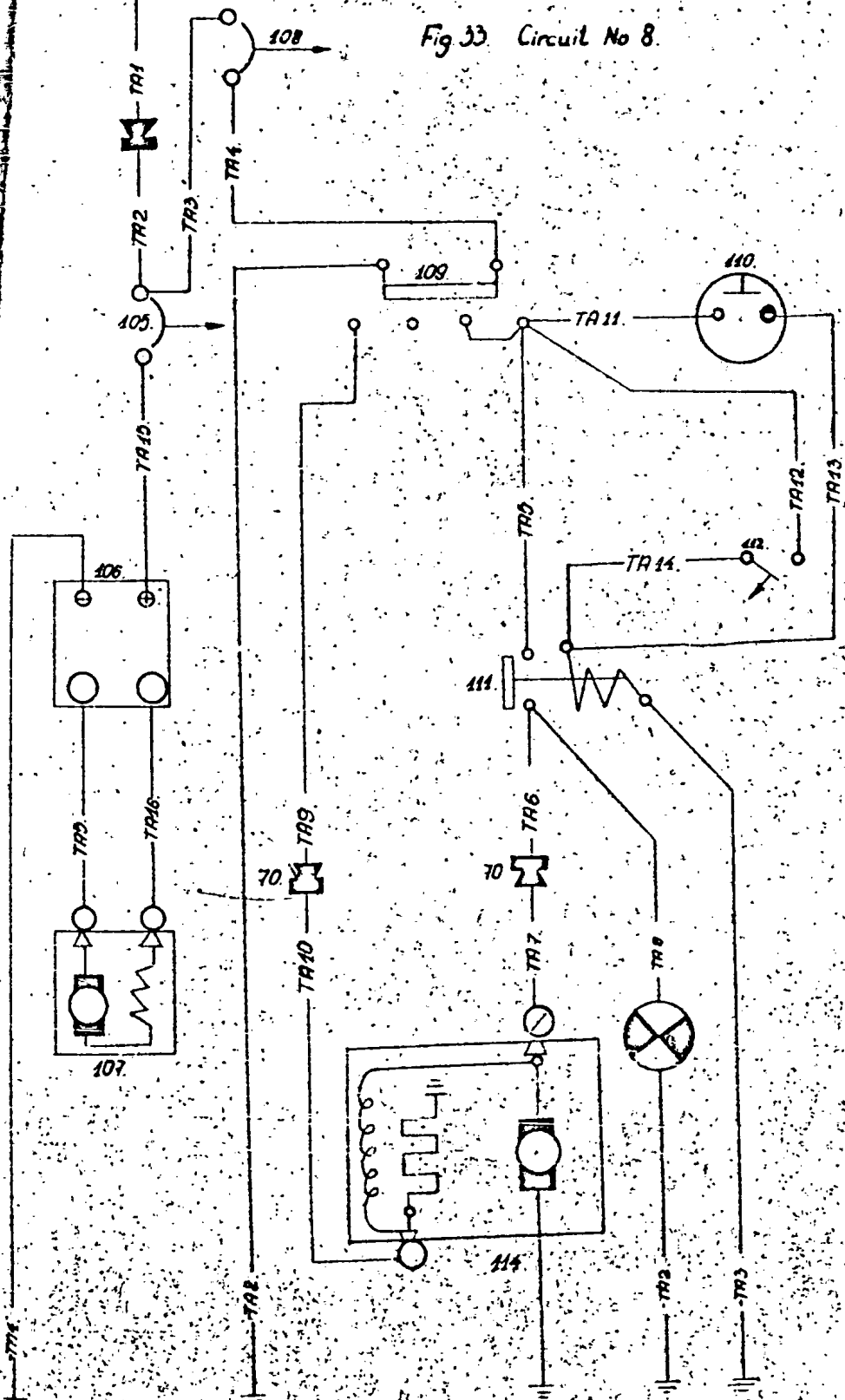

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Fig. 33. Circuit No 8.

70 - SZR20PK4NSz8 connector
75 - SzR32P12NSz1 connector
105 - AZS-5 automatic circuit breaker of the windscreen wiper assembly.
106 - F-14A mains filter of the windscreen wiper
107 - AS-2 electric motor of the windscreen wiper
108 - AZS-15 automatic circuit breaker of the anti-icing system.
109 - 2PPN-45 switch for the anti-icing pump
110 - 5K starting button of the anti-icing pump
111 - K25A contactor for the anti-icing pump switching
112 - SD-16A device for signalling the operation of the anti-icing pump.
113 - anti-icing pump operation signal light SLC-51
114 - SCN-1 anti-icing pump.

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CHAPTER III - INSTRUMENTS

L. GENERAL INFORMATIONS

The instruments installed on the helicopter are destined to enable the checking of helicopter attitude and movement as well as the checking of power plant operation.

In order to ensure a safe flying and a correct use of aviation equipment it is necessary to check accurately the parameters of helicopter operation.

Such a permanent checking is done by the board instruments.

The instruments enable to perform a pre-flight preparation of the helicopter for the flying task.

Instruments installed on the helicopter can be divided into groups according to their parameter checking:

a/ flight and navigational instruments

b/ instruments for checking the engine, rotor and control system operation.

All indicators are installed on the helicopter instrument panel /Fig. 34/.

The instrument panel is located in the cockpit before the pilot's seat. It is mounted on four shock absorbers standard type. The instrument panel can be easily removed after unscrewing four cap-shaped nuts. The instrument panel is inclined by 12 deg relatively to the horizontal plane.

All instruments /except for artifical horizon/ are installed in the plane of the instrument panel.

The artificial horizon is installed in the vertical plane.

The instruments are mounted to the panel by means of special fastening rings or collars.

The magnetic compass is located outside the cockpit, above the instrument panel, on the fuselage front part, in a special fairing. The compass is easy visible from the pilot's seat. Helicopter instruments are connected with the board network by means of special connectors.

All instruments, installed on the instrument panel have standard dimensions. Dial graduations and pointers are covered with fluorescent coat.

M. INSTRUMENTS LEADING PARTICULARS.

Order No	Specification	quantity p.one copter	Instrument type	measurement unit	measurement range	elementary graduation value	Notes
1	2	3	4	5	6	7	8
	FLIGHT INSTRUMENTS						
1	artificial horizon	1	AGK-47b	-	-	-	-
2	altimeter	1	WD-10	m	0-10000	100,1	WD-12 can be used
3	airspeed indicator	1	US-250	km/h	0-250	5,10	-
4	rate of climb indicator	1	WR-10	m/sec	0-10-0	1	-
5	magnetic compass	1	KI-11	degree	0-360	-	-
6	watch	1	AWRM	hour	12	0,12	-
8	course indicator	1	SUP-7	degree	0°-360°	5°	-"-
9	suction pressure gauge	1	MV-16	atm	16	0,20	-"-
	INSTRUMENTS FOR CHECKING THE POWER PLANT OPERATION						
1	rotor and engine r.p.m. indicator	1	2TE4-2	r.p.m.	0÷4000	50	
2	cylinder head thermometer	1	TCT-9	deg.C	0÷300	20	
3	fuel contents gauge	1	BES-1177	litre	0÷240	20	
4	three-pointer indicator for engine operation checking a/ fuel pressure gauge b/ oil pressure gauge c/ oil thermometer	1	UK 2-1	atm. atm deg.C	0÷1 0÷15 0÷150	0,10 1 10	

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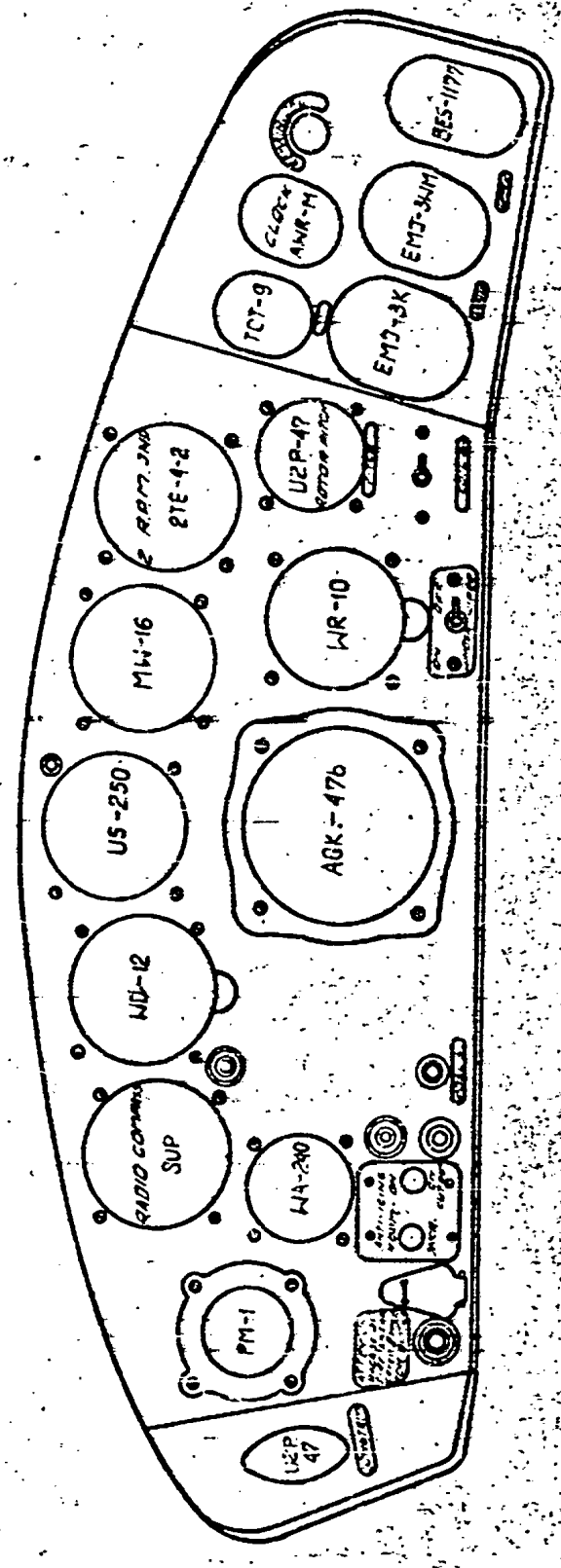
1	2	3	4	5	6	7	8
	three-pointer indicator for main gearbox operation checking	1	UK 2-5	atm	0÷5	0,20	
5	a/ oil pressure gauge			atm.	0÷5	0,20	
	b/ oil thermometer			deg.C.	0÷150	10	
	c/ oil pressure gauge	1	UZP-47	deg.	1,5÷13,5	1	
6	rotor pitch indicator	1	UZP-47	-	2-0-2	1	
7	longitudinal trimming indicator						



Instrument panel.
Dig. 34.

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N. ENGINE INSTRUMENTS.

Engine instruments are checking the operation of both: the engine and the main gearbox.

Engine instruments are distant reading instruments: transmitters placed in measurement points give pulses to indicators installed on the instrument panel.

N1. Three-pointer indicator EMI-3K for engine operation check.

The three-pointer EMI-3K indicator serves for measuring the fuel and oil pressure as well as for temperature measurement.

The EMI-3K assembly consists of:

- three-pointer UKZ-1 indicator which indicates the fuel pressure /dial left part/, the oil pressure /right part/ and the oil temperature /upper part/
- fuel pressure transmitter P-1B located in the cockpit rear part
- oil pressure transmitter P-15B located in the cockpit rear part.
- electrical thermometer of the oil temperature transmitter, which is placed inside the engine.

P-1B and P-15B transmitters are pressure gauges with relais.

A reliable resistance potentiometer is installed inside the transmitter. The deflections of an elastic element according to measured pressure values cause the potentiometer slider movement changing thus the current.

The P-1 transmitter is an electric resistance thermometer. Its principle of operation is based on the metal resistance variation dependent on temperature.

N2. 2TE 4-2 electrical r.p.m. indicator.

The 2TE4-2 electrical r.p.m. indicator serves for a continuous r.p.m. indicating concerning both the engine shaft and the rotor.

A three-phase A.C. generator is the transmitter. The indicator is a double magnetic-induction instrument.

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Two interchangeable 4UGI-48 transmitters are operating in the 2T34-2 two-pointer indicator assembly.

The principle of r.p.m. measurement is based on the relation between the engine /rotor/ speed and the electro-motive force with frequency proportional to shaft angular velocity i.e. proportional to r.p.m. value.

When the engine shaft /or rotor/ is rotating, a three-phase current is generated in the transmitter stator. The current is driven to the synchronous motor = indicator by means of three cables. In the synchronous motor = indicator stator winding a rotating magnetic field appears owing to driven current. This magnetic field causes the rotation of the rotor which is formed by a permanent magnet and the cage winding mounted on a common shaft.

The cage rotor speed is equal to the rotating magnetic field speed.

The ~~indicator permanent magnet serves for involve~~ a suitable starting and synchronous moment at low speed when the magnetic flux is small,

The cage winding serves for generating a starting moment at high r.p.m., when the magnetic flux is great and the permanent magnet cannot move. The cage winding plays the role of asynchronous starting device.

When the indicator is switched on at high r.p.m. of the generator, the cage winding enable to reach the rotor revs. near the synchronous ones. Then, the permanent magnet enables to reach fully synchronous r.p.m.

The permanent magnet is mounted on the shaft so, as to get a free movement. The permanent magnet is connected with the shaft by means of a spring. This spring transmits the turning moment to the synchronous motor shaft. So, the magnet can make freely one rotation before the spring is turned; then at the rotation end the shaft engages.

Owing to this device the motor can get suitable synchronous revolutions before the load application.

A four-pole permanent magnet is mounted on the synchronous shaft end. The permanent magnet turns inside a sensitive element inducing Eddy currents in it. Owing to Eddy currents influence on the permanent magnet magnetic field a turning moment of the sensitive element appears. The turning moment is

proportional to magnet revolutions, being proportional thus to the shaft revolutions. A spiral spring fastened on the sensitive element pivot gives a moment acting in the opposite direction. The revolutions are transmitted to the great pointer by means of a toothed wheel mounted on tube axle.

The pointer indicates r.p.m. in hundreds and thousands.

The small pointer mounted on a sleeve receives the revolutions from the sensitive element by means of toothed wheels. The great pointer axle goes through the sleeve centre axis. The small pointer indicates the rotor revolutions or the engine r.p.m.

N3. 2CT-9 thermometer.

The TCT-9 thermometer consists of an indicator, which is formed by a galvanometer and of a thermo-couple.

The thermo-couple principle of operation is based on the phenomenon which occurs in a thermo electric junction.

The thermometer is calibrated with cables. The cables resistance is equal to 7,15 ohms /independent on length/. at 20 ± 5 deg. C. temperature.

The advantage of a thermo-couple consists in its simple construction, small delay in indication, small size of the transmitter. The transmitter is mounted under the sparking plug.

N4. BES-1177 fuel contents gauge.

An electrical fuel contents gauge BES-1177 indicates the fuel quantity in the fuel tank. The fuel contents gauge is provided with a warning light signalling the fuel rest 25 liters. The fuel contents gauge has a float-transmitter. The transmitter consists of a mechanical assembly and of an electrical assembly; both assemblies are separated hermetically in order to avoid danger of fire.

The float transmitter moves the relay of the remote type potentiometer, which is connected electrically with the indicator. The indicator dial is graduated in litres. If the fuel level in the tank falls to 25 litres, the float-transmitter switches on the warning light automatically.

N5. Three-pointer indicator type EMI-3MM for bo 50X1

the engine gearbox and the main gearbox.

The EMI-3MM assembly consists of a UK2-5 three-pointer indicator and of following transmitters:

- D-5 oil pressure gauge in the main gearbox
- D-5 oil pressure gauge in the engine gearbox
- electrical thermometer
- P-1 oil temperature transmitter

The indicator has three dial parts: the upper one for temperature measurement, the side dial parts for pressure measurement. The EMI-3MM construction is an analogous one to the EMI-3K assembly construction.

N6. Collective pitch and longitudinal trimming indicators type UZP-47.

UZP-47 instruments are used for checking the control system i.e. for measuring the collective pitch and the longitudinal trimming.

The UZP-47 consists of indicator and transmitter. The transditter can co-operate with different electrical distant reading indicators indicating the position of different helicopter parts.

One UZP-47 assembly has been used to checking the helicopter longitudinal trimming.

The transmitter is located at the left side of the cockpit front part. The indicator is placed at the left hand side of the instrument panel.

The instrument dial is graduated from 2 to 0 and from 0 up to 2, each elementary graduation being 1.

The second UZP-47 assembly serves for checking the main rotor pitch; the transmitter is installed on the main roter; the indicator is placed on the instrument panel right hand part.

The UZP is supplied by a 27V. current taken from the helicopter board network.

The UZP-47 indicates the rotor pitch in degrees.

The instrument dial is graduated /calibrated/ in degrees from 1,5 up to 13,5.

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The UZF-47 principle of operation is based on potentiometer system which consists of a ring shaped potentiometer and of a three-coil electro-magnetic indicator with movable magnet.

The transmitter guide rod connected with the trimmed element displaces the ring potentiometer brushes /by means of lever and rod system/ dependent on position of trimmed element.

The potentiometer brushes move, distributing thus the indicator coil supplying current. Consequently the magnetic flux variation occurs in indicator coils.

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The UZT-47 principle of operation is based on potentiometer system which consists of a ring shaped potentiometer and of a three-coil electro-magnetic indicator with movable magnet.

The transmitter guide rod connected with the trimmed element displaces the ring potentiometer brushes /by means of lever and rod system/ dependent on position of trimmed element.

The potentiometer brushes move, distributing thus the indicator coil supplying current. Consequently the magnetic flux variation occurs in indicator coils.

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0. FLIGHT and NAVIGATIONAL INSTRUMENTS

01. AGK-47B artificial horizon.

The electrical artificial horizon with turn and bank indicator is destined to indicating the helicopter attitude direction and turn velocity /about the vertical axis/, as well as the helicopter bank.

A three-phase inverter PAG-1F is used as a supplying source for the artificial horizon. The artificial horizon is supplied by A.C. at 400 c/s, 0,45 A and 36 Volts.

The wiring diagram of the artificial horizon is shown in Fig. 29a.

The AGK artificial horizon consists of three instruments installed in a common case:

a/ artificial horizon
b/ turn indicator
c/ bank indicator

A gyroscope with three degrees of freedom is installed inside the artificial horizon. The gyroscope has a gravity correction. It has a rotor, which is connected by means of universal joint.

The rotor revolutions reach about 20.000 r.p.m.

The rotation axis is not vertical, it is inclined forward /in the flight direction/ by 2^{0}. This angle of rotor axis inclination is necessary in order to compensate errors appearing after turns.

The gyroscope horizon indicator is a miniature aircraft mounted on universal joint.

The rotor axis position is determined and kept by correction potenticmeter, which is installed at the left side of the case.

Glide and climb angles can be read on a graduation fixed on universal joint frame.

The center part of the gliding angles graduation /20^{0} above the miniature aircraft, 40^{0} under it/ is paint in black. The upper part is brown, the lower one is paint in blue. During the descent /glide, dive/ the miniature aircraft goes out of visibility field, the brown part of the graduation is visible. The blue part is visible in case of climb.

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The gliding angle graduation is connected rigidly with the bank graduation.

The connection of bank graduation with gyroscope assembly facilitates the reading of helicopter bank angles, when the miniature aircraft centre does not cover the movable pointer of the horizon line.

The turn indicator is made as a separated unit. It has a gyroscope with two degrees of freedom. The gyroscope axis is parallel to the helicopter longitudinal axis.

Owing to this fact each helicopter movement around the vertical axis causes the gyroscope deflection from the neutral position.

The turn indicator mechanism is located in the instrument rear part.

The bank indicator /cross level/ is formed by a glass tube bent under a certain angle. A ball placed inside the glass tube indicates the bank.

At the right hand side of the front part of the artificial horizon a blocking device is installed which enables the gyroscope assembly to return in normal position /from any what position.

The return to the normal position is necessary at instrument starting as well as in order to remove instrument false indications, which may appear during the aerobatic manoeuvres.

Maximum stopping time of the artificial horizon should not exceed 1[illegible] sec.

02. Pitot tube /pressure head 954 type/

The pitot tube 954 type is installed on the fuselage port part.

The pressure head fastening to the bracket is done by 3 screws.

The bracket is mounted by 2 screws.

The pressure head should be installed parallel to the fuselage axis. The 954 pressure head is outfitted with an electrical heating.

The Pitot tube is destined for measuring the impact pressure /static pressure+total pressure/ which arises

50X1

during the helicopter movement as well as for static pressure measurement.

To the static pressure line following instruments are connected:

- rate of climb indicator
- altimeter
- fuel contents gauge /Fig. 35, 36/.

The connection of instruments with the Pitot tube is shown in Fig. 35.

The air-tightness of instruments connected with the pitot tube should be checked by means of a special device /except for rate of climb indicator/.

C3. WD-10 altimeter

WD-10 two-pointer altimeter is designed for indicating the flight altitude within the range from 0 up to 10.000 meters.

WD-10 altimeter is an aneroid type instrument. An aneroid canister deflects under the influence of barometric pressure. The canister deformations are transmitted to the instrument pointer.

One full rotation of the great pointer corresponds to 1000 m altitude variation. The small pointer driven by a 1 : 10 reduction gearing indicates thousands of meters on the same dial.

The altimeter is connected to the static line of 9S4 impact pressure head system as shown in Fig. 36.

When the flight is performed after aneroid type altimeter indicators, the helicopter is not flying at constant absolute altitude but it is flying along an isobar.

The isobar shape depends on the pressure distribution along the flight line. Then, to know the absolute altitude it is necessary to use the radio altimeter.

The pilot must know this altitude to perform certain tactical flight tasks.

C4. WR-10 rate of climb indicator.

The WR-10 rate of climb indicator indicates the vertical speed of climbing or sinking of the helicopter.

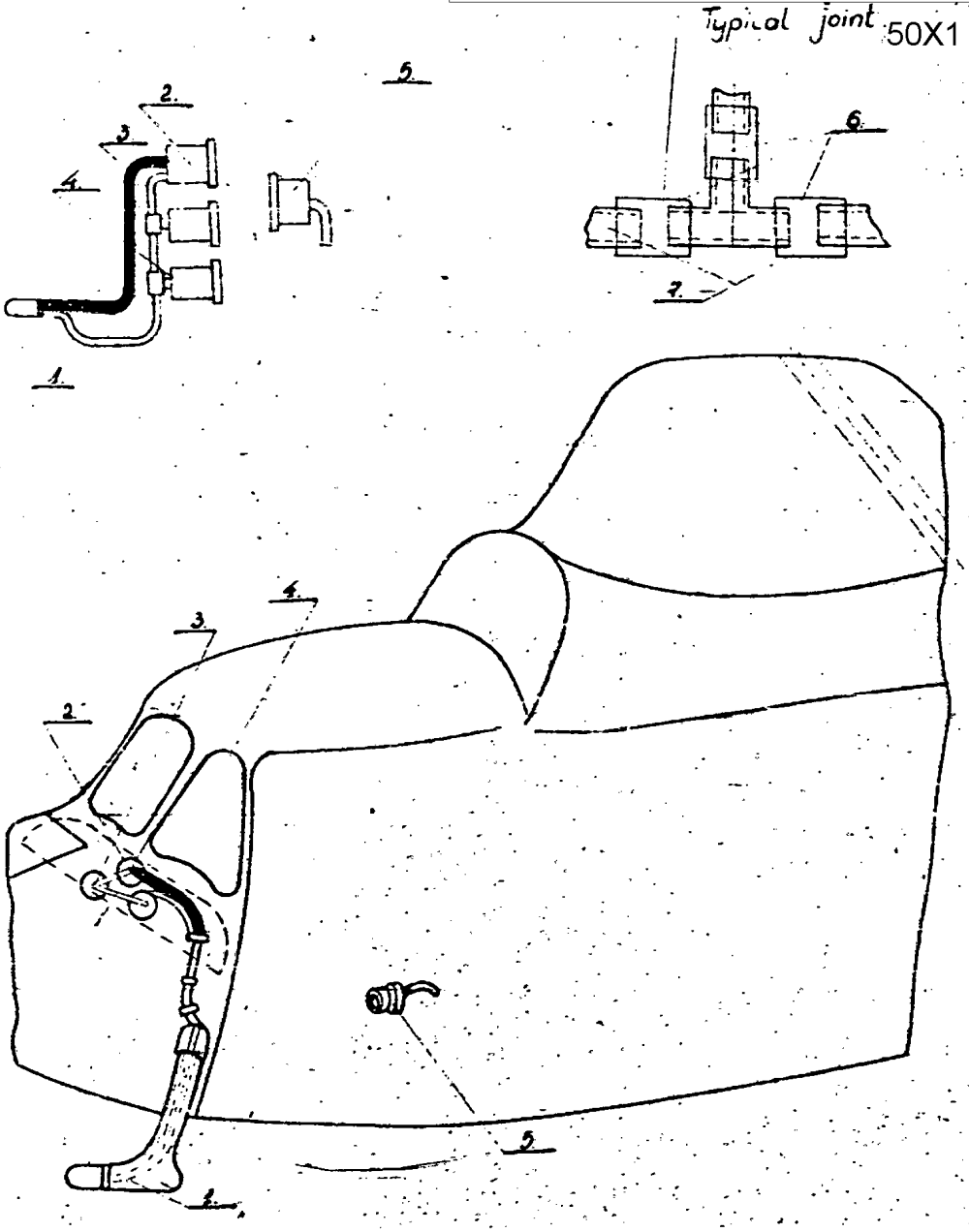

Fig 35 Lay out of instrument connection with pressure head.

1.— PWD pressure head 954 type
2.— US-250 airspeed indicator
3.— WD-10 altimeter
4.— WR-10 rate of climb indicator
5— oil pressure transmitter EMI-3K.
6— durite hose 4×11 type GOST W 19-1942
7— pipe LMG-MT6-4 GOST W 1947-42.
8— typical joint.

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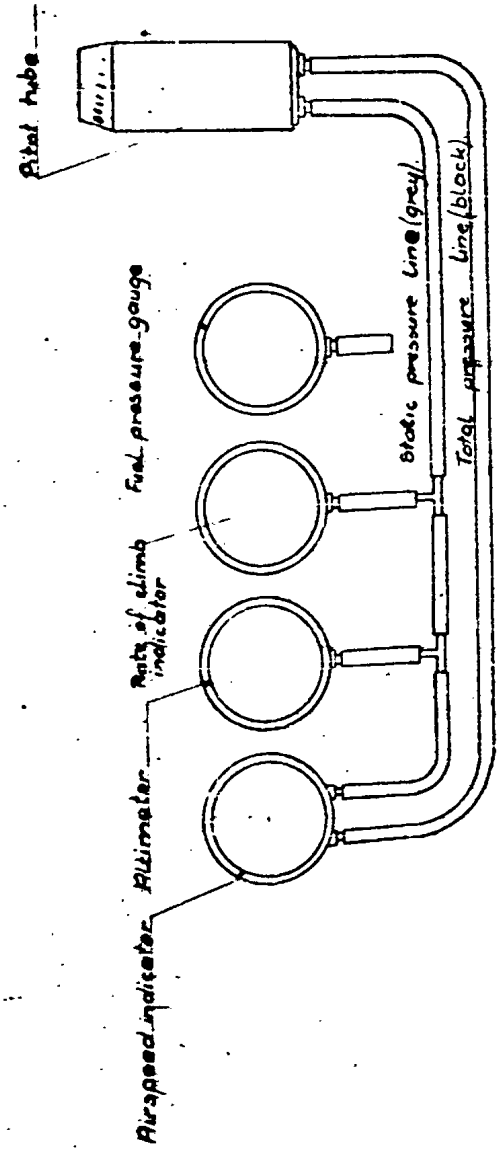

Fig.36. Connection of instruments with Pitot tube.

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The pilot must know exactly the rate of climb or the sinking speed to keep constant altitude as well as to perform blind flying.

The MR-10 rate of climb indicator is an aneroid canister type instrument.

It indicates the rate of climb and the sinking speed within the range from 0, up to 10 m/sec.

The indication principle is based on measurement of difference between the static pressure and a comparative pressure.

The rate of climb indicator is connected to the 954 impact pressure head as illustarted in Fig. 36.

05. US-250 airspeed indicator

The US-250 airspeed indicator measures the helicopter flight speed relative to ambient air. The pilot must know this speed. The instrument principle of operation is based on measurement of dynamic pressure i.e. on measuring the difference between the total pressure and the static pressure.

The 954 impact pressure head /Pitot tube/ plays role of the US-250 transmitter.

The indicator has a differential aneroid canister. Owing to pressure difference between the ambient air pressure and the pressure inside the canister, the center of the aneroid canister displaces in a linear way so, that the airspeed indicating pointer deflects moved by means of a suitable mechanism. The dial is calibrated in km/h.

The US-250 airspeed indicator is illustrated in Fig.37.

The basic component part of the instrument is an aneroid canister - 1. It is connected by means of pipe 2 to the connecting mouth 3. Through the connecting mouth 3 the total pressure is given to the aneroid canister.

The connecting mouth 3 is fastened to the case 4 by means of screw 5. A sealing insert 6 is put under the screw 5.

The rubber gasket 7 ensures an air-tightness.

A fixed pipe end 8 is connected with the fastening plate 10 by means of nut 9.

When the pressure comes into the canister, the movable pipe end 11 displaces and transmits its motion to the pivot 13 with segment 14 by means of pushrod 12.

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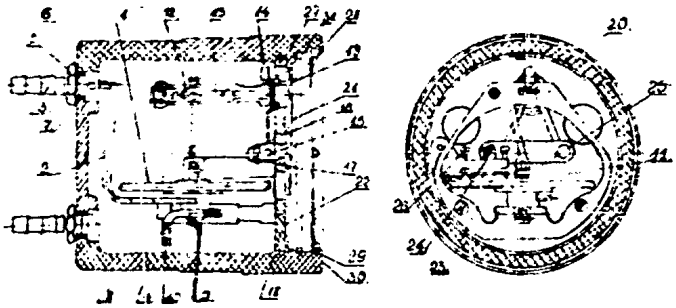

Fig. 37. US-250 airspeed indicator.

1 - aneroid canister
2 - pipe
3 - connecting mouth
4 - case
5 - screw
6 - sealing insert
7 - rubber gasket
8 - pipe end
9 - nut
10 - plate
11 - pipe end
12 - push-rod
13 - pivot
14 - segment
15 - tube
16 - bearing
17 - fastening plate
18 - case
19 - eccentric screw
20 - spring
21 - pointer
22 - dial
23 - spring
24 - support
25 - pin
26 - screw
27 - ring
28 - glass
29 - ring
30 - gasket
31 - gasket

The segment turns the tube 15 installed on bearings 16, located in fastening plate 17 and in mechanism case 18.

The adjustment can be done by an eccentric screw 19 with bearing 16. The screw 19 with bearing 16 serves for pivot 13 clearance adjustment. In order to remove the clearance a fine spring 20 is fastened on the tube 15/rod/pivot.

A pointer 21 is fastened on the tube conical end. The pointer deflects on the dial 22.

A spring 23 fastened on support 24 is installed in order to make even the movement. The support is fixed to the mechanism case 18 by means of screws. The spring movement is limited by pin 25, therefore the canister deflection being limited.

The spring stretching increases with the deformation increase, being proportional to spring length variation.

The spring position and length can be adjusted by screws 26. So, the smooth movement of pointer is enabled within whole dial range.

The mechanism is installed in case 4 by spring ring 27. The glass 28 is installed in case by means of a threaded ring 29. The rubber gasket 30 enables the air-tightness between the glass and instrument case.

A sealing gasket 31 is put between the glass and the threaded ring.

Through the "S" - marked connecting mouth the static pressure comes into the instrument case.

The airspeed indicator withstands an overload which corresponds to 300 km/h airspeed.

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2. PART IV - Helicopter Radio Equipment.

S. General Information

The radio equipment of the helicopter consists of: R/T set - R-800, and radio compass D/F - ARK-5. The R/T set consists of: transmitter - block A, receiver - block B, remote control box - block P, rectifier - block W and VA-250 inverter.

Transmitter and receiver are placed on the support behind the fuel tank, beside the transmitter and receiver there is underhung to the fuselage rear part the VA-250 inverter and in the fuselage rear part above the inverter the rectifier is located. The above accessories are attached to the supporting frames with the set screws and such attachment enables quick and easy dismantling of appropriate accessories. Remote control box-block P is situated on the support in the cabin between left panel and radio-recess. The radio compass - ARK-5 consists of: receiver /placed/ in the radio recess and remote control box /placed on the left panel/. The SUP-7 indicator is located on the instrument panel and the frame aerial is fastened to the cabin lower skin under the passenger seat.

T. Communication R/T set - R-800.

T1. General Data.

Radiostation /mark R-800/ is VHF R/T set, 4 channels and a talkie one. For this set the piezoelectric stabilization is used for receiver heterodyne frequency and transmitter oscillator and that assures the use of communication without tuning getting incorrect. This set mounted in the helicopter assures faultless communication for a distance of 120 km at flight altitude of 1000 m. The R/T set control is a remote one and it is done by means of remote control box that switches on required channels. This R/T set is tuned on the ground to 4 optional frequency bands that can be used in flight. The tuning frequency must be set independently for either of receiver or transmitter.

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Tuning is executed by means of special instrument - block 5. The R/T set is ready for operation after 1-1,5 minutes from the moment of switching on, the period of changing channels is 3 seconds. Transfer from reception to transmission is done by pressing the pushbutton placed on the cyclic-pitch stick. The period of transfer from reception to transmission-approx.0,5 second.

The transmitter assures long operation cyclically - transmission-2 minutes, reception-2 minutes, as well as non-stop transmission for 15 minutes afterwards to start transmission again is only allowed after full cooling down of the transmitter.

The power of the supplied D.C. current from the aircraft mains at the 27 V voltage does not exceed 415 W during transmission and 270 W during reception.

The R/T set diagram - see fig. 38 on page 99.

12. Transmitter.

The transmitter consists of four high frequency stages:

1/ Oscillator
2/ First frequency multiplier /tripler/
3/ Second frequency multiplier /tripler/
4/ Power amplifier

as well as control circuits of high frequency oscillations and they consist of submodulator and modulator. Transmitter block scheme - see fig. 39 on page 100.

The frequency stabilisation of the transmitter is piezo-electric.

All transmitter stages except the power amplifier are of up to 18 times amplification.

The aerial feeder can be switched by means of aerial relay.

The relay switches the R/T set from transmission to reception by blocking modulation stage /1-152 and 1-153 / and transmitter high frequency valves /1-101, 1-103 and 1-104/ and by increasing bias voltage on the control grids of these valves as well as connects the aerial to the receiver. During transmission bias voltage blocks all receiver valves except 1-209, 1-210 and 1-202 valves. At this time the aerial is switched from receiver to transmitter.

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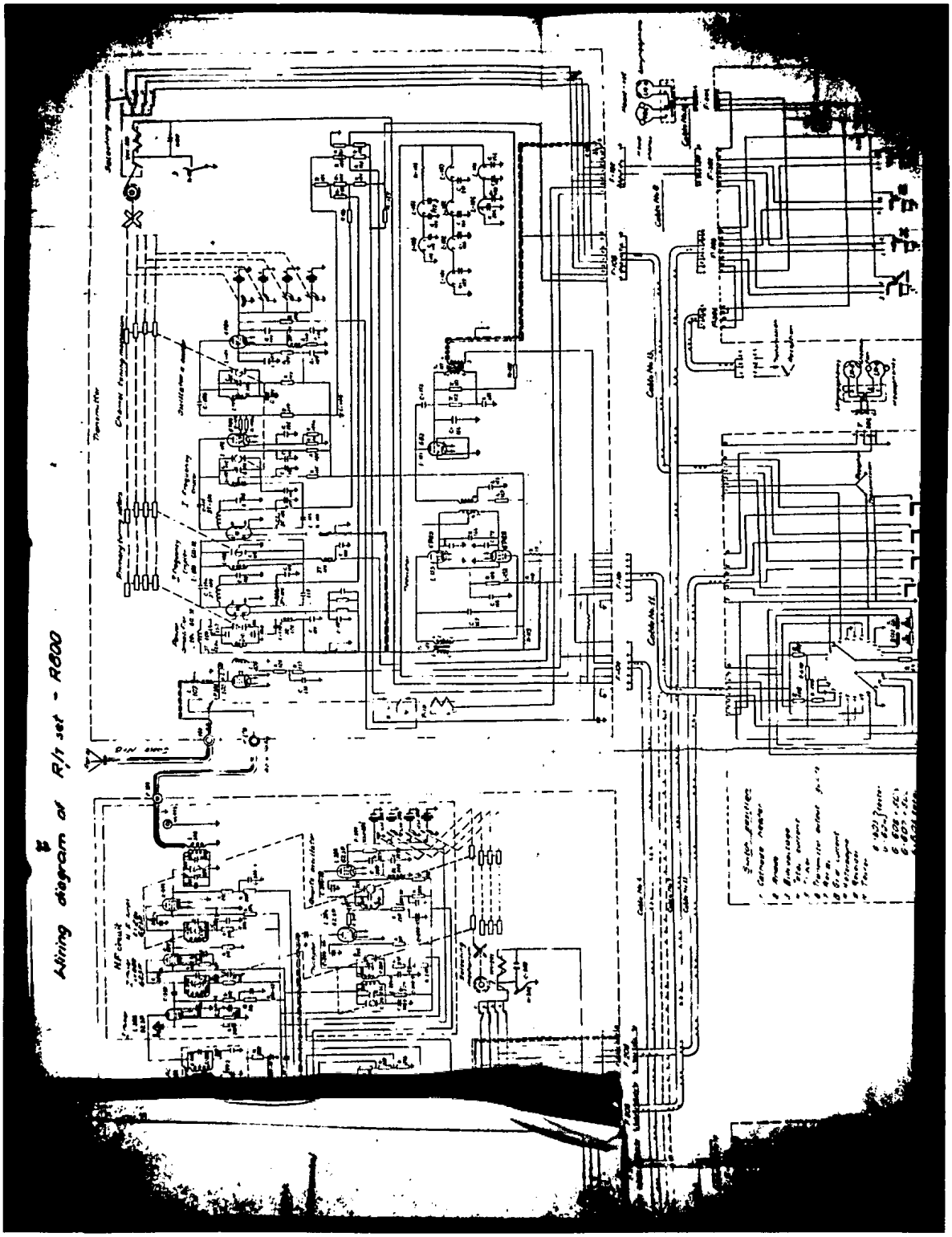

Wiring diagram of R/T set - R600

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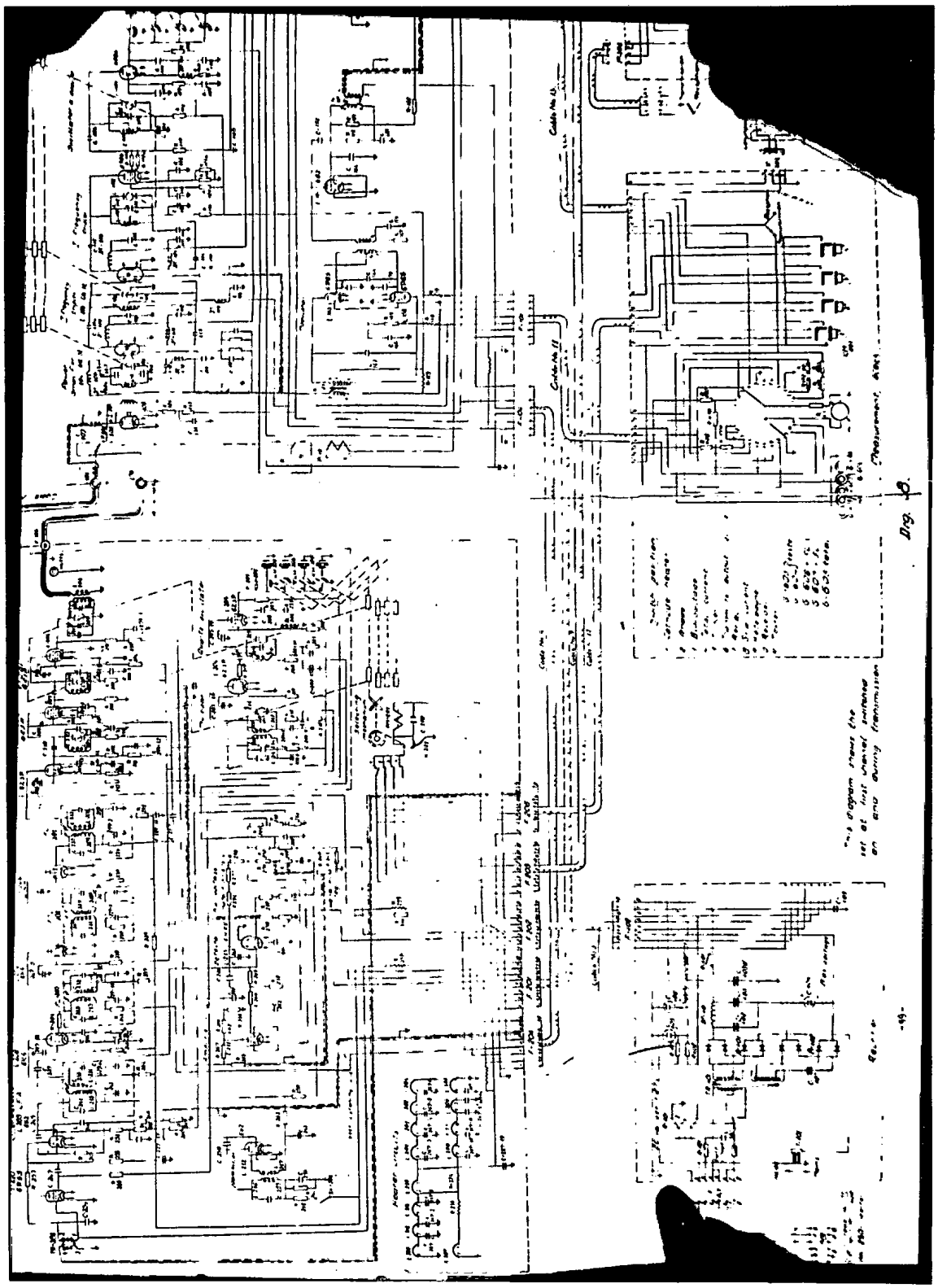

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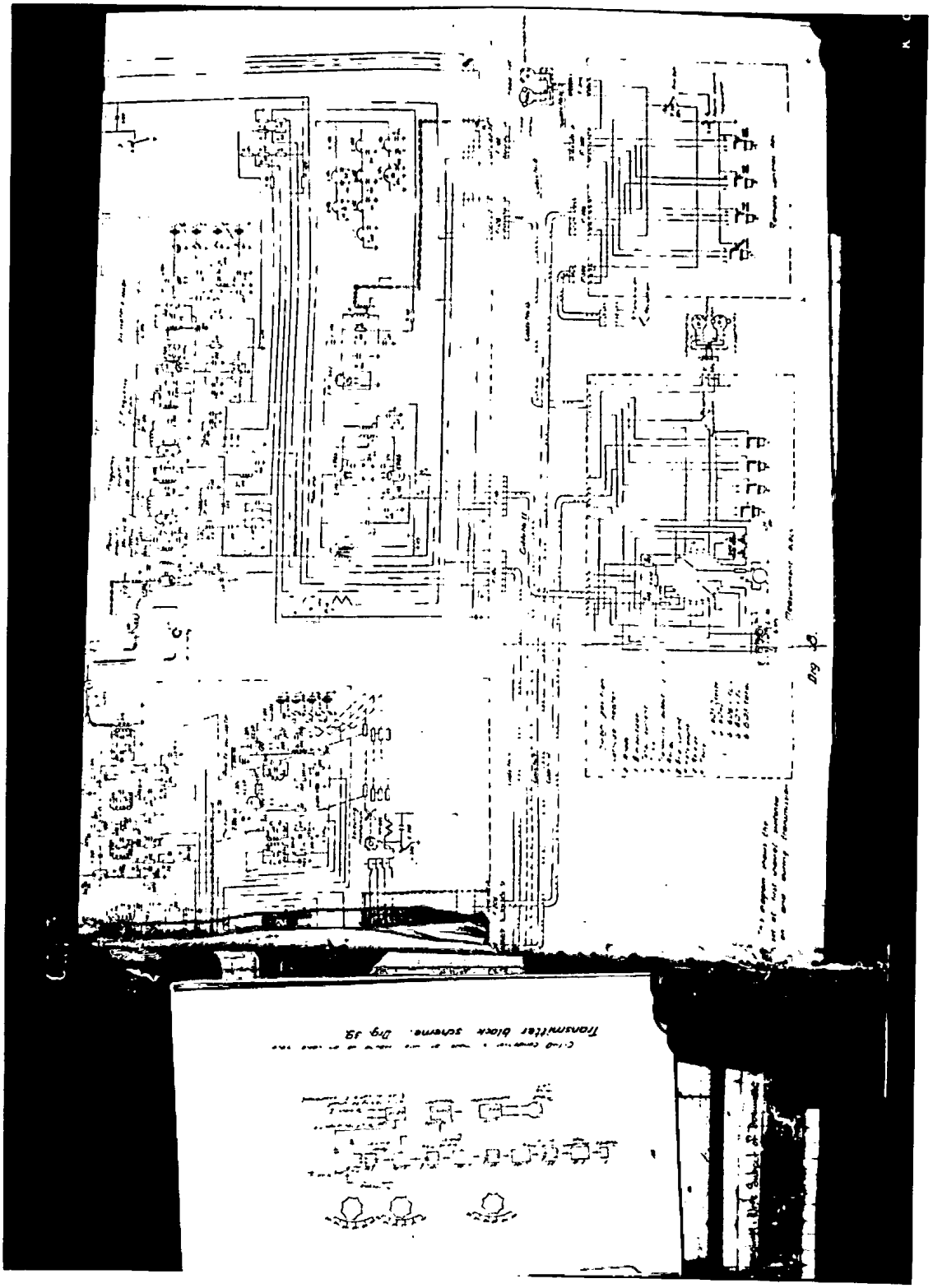

C.1140 condenser is made of wire wound on ceramic base.

Transmitter block scheme. Drg. 39.

It is possible to listen to own transmission /at the moment of own transmission/. Checking of the transmitter operation conditions is performed by means of a special measurment instrument located in measurment block "I".

The measurment of the anode current in the transmitter is done by detection on the 6D2 /L-105/ valve.

From the load divider of this detector, the voltage is received by self-listening to and this voltage is given to first stage of the frequency amplifier.

T3. Oscillator and frequency doubler.

The oscillator is built on 6P6/L-104/ with electron coupling and supplied in series. The oscillating circuit is formed by a quartz with condensers C-101 and C-102 and connected between the valve grid and the transmitter "earth" /metallic mass/. The valve anode circuit which contains variable condenser - C-105, tuning condenser /trimmer/ C-104 and coil L-101 are tuned to quartz second harmonic. In this way the quartz doubled frequency in the oscillator valve anode circuit is obtained.

The voltage of this frequency is given by coupling condenser C-106 and resistances R-108 and R-108a to the control grid of the next stage. The resistances R-108 and R-108a prevent the triplar stage against self-excitation. Chake Dt-101 and resistance R-120 are connected in series to the cathode-earth circuit. Choke Dt-101 stops the flow of the high frequency currents to earth. This choke lets through only constant component of the current. Voltage drop of the constant component on the R-120 resistance forms automatically the bias voltage of the oscillator R-106 is the resistance of the grid flowing off. This resistance [redacted] is connected to earth by one contact of the aerial relay. In the moment of change from transmission to reception the relays opens up, bias potentiometer disconnects from the core and full bias voltage from the rectifier /-105 V/ through the R-106 resistance goes to the control grid of the oscillator valve and the oscillator stops working. The valve screen grid is supplied through reduction resistance R-107. The C-103 condenser shunts the screen grid for high frequency. The voltage to the anode is given through the R-122

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resistance which is shunted by C-121 condenser. The L-101 coil contains ferromagnetic core serving for changing the coil inductance in order to tune it when making agree the first and second stage.
To decrease the influence of the output capacity [redacted], the L-101 valve anode is connected only to some rounds of the coil. The voltage for the next stage is obtained from the coil circuit part.

2. First frequency tripler.

The hight frequency voltage from the oscillator is given through the distribution condenser C-106 to the grid of the valve of the first frequency tripler.
The stage is based on 6F6S /L-102/ valve and operates as oscillator with/from another stage/ excitation. In the valve anode /circuit/ there is a circuit /C-111, C-112 and L-102/ tuned to the third harmonic given to the frequency grid /quarts sixth harmonic/. This circuit is symmetric, and the anode supply is given through R-125 resistance to the middle point of L-102 coil. The R-125 resistance is blocked to high frequency by C-113 condenser. To balance L-102 valve output capacity, connected into one circuit leg, there is connected into second leg the balancing condenser C-109. The screen voltage is given through R-109 resistance which is blocked by C-110 condenser. Automatic bias is obtained from R-121 and R-121a resistances connected in parallel. R-117 is the leakage resistance in the anode circuit. During transmission the R-117 is connected to earth through the P-101 relay, and during reception the relay opens and the valve is blocked in the same way as the oscillator valve. The high frequency voltage from the first tripler circuit is given through coupling C-114 and C-115 condensers to the valve grid of the second tripler.

3. Second frequency tripler.

The second frequency tripler is built in push-pull circuit on the UHF special valve - double tetrode type GU-32 /L-103/. This valve contains two separate tetrodes placed in one glass bulb. The screen grids of tetrodes are connected inside the valve and have a single lead out.

In the same manner the cathodes of triodes are connected and have single lead out /common leg/. There is a blocking condenser blocking screen grids to cathodes. The tetrode cathode heaters are connected in series and from the connection point there is lead out that enables parallel connection of the heaters. At parallel connection the heaters should be supplied with 6,3 V voltage and in series with 12,6 V /as it takes place in the R/T set/. In this valve the increase of amplification is performed and oscillation frequency tripling, that is the outcoming frequency is equal to the quartz eighteenth harmonic. Anode loading consists of a circuit /C-118 and L-103/ tuned to the quartz eighteenth harmonic /third harmonic of the previous stage frequency/. This circuit lets to cover the operation frequency range. The voltage to the valve anode is given through Dt-105 to the middle point of the circuit. Bias voltage is obtained from resistances R-102 and R-104 and from divider /R-127, R-101, R-102 and R-104/ and through Dt-103 and Dt-104 chokes, decreasing shunting of the first tripler circuit and is given to the control grids of the valve. C-116 and C-117 condensers protect the divider against high frequency current. When this stage is operating then the valve bias voltages is approx. -90 V. During change from transmission to reception, the high frequency voltage to the control grids of the second tripler is not given, because the valves of the oscillator and first tripler are blocked. Besides that the bias voltage on the control grid of the L-103 gets increased to-105 V. Screen voltage is given to the second tripler valve through the R-110 resistance. Modulating voltage is given from Tr-153 transformer to screen grid also through R-110 resistance. From the second tripler anode circuit, the high frequency oscillations are given through C-119 and C-119a condensers to the nut valve i.e. power amplifier. The anode current is measured by means of measurement block which can be connected to P-101 socket. To that socket is connected lead out from R-116 shunt that is put in series into valve anode circuit.

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It is possible to listen to own transmission /in the moment of own transmission/. Checking of the transmitter operation conditions is performed by means of a special measurment instrument located in measurment block "I".

The measurment of the anode current in the transmitter is done by detection on the 6B32 /L-105/ valve.

From the load divider of this detector, the voltage is received by self-listening to and this voltage is given to first stage of the frequency amplifier.

T3. Oscillator and frequency doubler.

The oscillator is built on 6P6/L-101/ with electron coupling and supplied in series. The oscillating circuit is formed by a quartz with condensers C-101 and C-102 and connected between the valve grid and the transmitter "earth" /metallic mass/. The valve anode circuit which contains variable condenser - C-105, tuning condenser /trimmer/ C-104 and coil L-101 are tuned to quartz second harmonic. In this way the quartz doubled frequency in the oscillator valve anode circuit is obtained.

The voltage of this frequency is given by coupling condenser C-106 and resistances R-108 and R-108a to the control grid of the next stage. The resistances R-108 and R-108a prevent the tripler stage against self-excitation. Choke Dt-101 and resistance R-120 are connected in series to the cathode-earth circuit. Choke Dt-101 stops the flow of the high frequency currents to earth. This choke lets through only constant component of the current. Voltage drop of the constant component on the R-120 resistance forms automatically the bias voltage of the oscillator R-106 is the resistance of the grid flowing off. This resistance [redacted] is connected to earth by one contact of the aerial relay. In the moment of change from transmission to reception the relays opens up, bias potentiometer disconnects from the core and full bias voltage from the rectifier /-105 V/ through the R-106 resistance goes to the control grid of the oscillator valve and the oscillator stops working. The valve screen grid is supplied through reduction resistance R-107. The C-103 condenser shunts the screen grid for high frequency. The voltage to the anode is given through the R-122

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26. Power amplifier

The power amplifier is built on GI-32 valve /double tetrode/ and operates in push-pull set-up. The circuit /C-123, L-104/ is the valve lead and is connected to valve anodes through C-130 and C-130a condensers.

The voltage to the valve anode is given through Dt-105 and Dt-102 chokes that are blocked by C-137 condensers. C-120 and C-120a are for thermocompensation. The screen voltage is given through R-111 and R-112 resistances, blocked by C-122 condenser through secondary winding of the modulation transformer. In series with this winding the R-119 shunt is connected, which enables to measure the current of the power amplifier by means of "block I".

The grid voltage /bias/ is received from divider consisting of R-127, R-101, R-102 and R-104.

During transmission the 45-50V voltage is given to the valve grids. During reception this stage is completely blocked by giving high negative voltage from the same divider. In the grid circuit there are placed Dt-106 and Dt-107 chokes with C-132 and C-133 condensers. Their purpose is the same as Dt-103 and Dt-104 chokes in the circuit of the frequency second tripler. Coupling of the anode circuit of the frequency second tripler with grids of power amplifier valve is done through C-119a condensers. Anode coil of the power amplifier consists of 4 rounds placed on the both sides of the coupling coil with aerial. On the output stage the modulation on the anode and valve screen is obtained. For this purpose the voltage of audial frequency is given from Tr-103 modulation transformer through Dt-102 and Dt-108 chokes and R-111 and R-112 resistances. In order to transfer the energy of high frequency oscillations to the aerial, the L-105 coil is induction coupled with circuit of power amplifier. The aerial output is asymmetric. One end of the coupling coil /L-105/ is connected to earth, and the other end through the aerial relay is connected to P-103 aerial socket.

To this socket, the aerial cable is connected. The coupling coil is fastened on the movable base that enables the change of coupling by turn of the screw which head is

taken to the transmitter from ...

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I.7. High frequency oscillation control of the transmitter.

1. Submodulator.

Submodulation stage that is low frequency amplifier is built on 6G2 /L-151/.

Audial oscillations from throat mike /laryngophone/ after going through Tr-151 transformer are given to the L-151 valve grid in which the amplification is accomplished. Negative voltage on the valve grid is obtained from R-161 and R-162 to which the negative voltage /-120 V/ from bias rectifier. To the valve anode a constant voltage is given through primary winding of the Tr-152 intervalve transformer. The supply voltage to throat mike is received from R-403 resistance of the R-402 and R-403 divider that is located in the rectifier block.

2. Modulator.

The transmitter modulator is built on beam tetrodes /type 6P8, L-152, L-153/ in push-pull set-up. Push-pull set-up enables to get higher efficiency and what is connected with it using much less power from supply sources. There are also less no-linear deformations given by valves and transformers as well as decrease of interference from supply sources . The audial frequency oscillations are given to control grids of modulator valves from secondary winding of Tr-152 intervalve transformer. The low frequency oscillation, amplified on L-152 and L-153 valves, induct in Tr-153 modulation transformer secondary winding and are added to constant voltages of anode and screen of L-104 power amplifier valve as well as to screen voltage of the L-103 second tripler valve. As an effect of that the voltage supply of anodes and screen grids changes in time /beat/ with audial oscillations and it causes the changes with audial frequency of anode current and aerial current. The negative voltage /bias/ is given to the valve grids from R-163 and R-164 bias divider through the lead out from middle point of the Tr-152 transformer secondary winding. Anode voltage is given to valves from the middle point of Tr-153 modulation transformer primary winding.

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Rs. Receiver of R-800 R/T set

This is 13 valves, superheterodyne, radio, with quarts frequency stabilisation R-800 receiver. Receiver block scheme is on fig. 40 page 407...

This receiver is tuned before flight to 4 chosen frequencies /channels/ in range of operation frequencies.

This receiver is remote controlled and the choice of any of four channels and sound volume regulation are performed with remote control box. Double frequency transformation is used in the receiver. The signal from the aerial is amplified by high frequency amplifier then it goes to first mixer where is also given the voltage from first heterodyne. As a result of mixing of signal frequency and first heterodyne the first intermediate frequency is obtained and its voltage amplified by first intermediate frequency amplifier is given to second mixer. In second mixer valve the first intermediate frequency gets mixed with second heterodyne frequency and as an outcome the second intermediate frequency voltage is obtained in the anode circuit of second mixer.

In R-800 receiver both mixers get the voltage from the same heterodyne and because of that the number of valves is reduced by one i.e. second heterodyne valve. R-800 receiver heterodyne consists of quartz oscillator and multiplier. The heterodyne frequency equals to ninth harmonic of the quartz plate. First intermediate frequency is a variable one and depends on signal frequency. There is no amplification on this frequency in R-800 receiver. First intermediate frequency is given to second mixer, where as a result of mixing of first intermediate frequency with heterodyne frequency, the second intermediate frequency is obtained and on this frequency the basic signal amplification is done on three intermediate frequency amplification stages.

Second intermediate frequency differs from first by being constant. From third stage of intermediate frequency amplification the voltage is given to: receiver detector, noise killer device and A.V.C. /automatic volume control/

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Receiver block scheme with double frequency transformation. Drg. 40.

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After detection the signal is subjected to preliminary amplification by low frequency amplifier and then is given receiver output stage. The negative voltage received from noise killer is given to first amplification stage of the low frequency. Negative voltage from A.V.C. stage is given to to grids of there stages of the receiver. There is also given the audial frequency voltage to the amplifier from check detector of own transmission in order to hear own transmission.

The A.V.C. used in receiver removes also deformations due to reception of strong signals from near by radiostations.

Amplitude characteristic of the receiver, with signals in receiver input higher than 50 μV, is a straight line i.e. when receiving high power stations located near by or far away low power stations /in the operation range of the R/T set/ the sound volume obtained in the receiver output is the same. There is electronic noise killer included in the receiver i.e. a device that during absence of frequency of the transmitting to aircraft R/T set, switches off automatically the receiver /closes down low frequency amplifier valve/ and automatically switches it on at the moment of appearance of senders frequency. This device is installed in order to relieve operater from listening to noises and cracks.

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T9. R/T set automatization

R/T set - R-800 is equipped with remote control device. By pressing down one of the pushbuttons on the remote control box-block "P" the supply circuit of the impulse motor, built into transmitter and receiver switching set-up gets closed. During turning of the ratched wheel the motor moves the lever of tuning mechanism. After lever shifting that corresponds to switched channel the motor stops operate, because the supply circuit is open by second cam that is this time rots against group of switch contacts. The axles of variable condensers are coupled to lever mechanism axles and so the mechanism revolution causes revolution of axles of condensers and tuning of oscillation circuits of receiver and transmitter.

T10. R/T set supply.

The supply set of R-800 R/T set consists of MA-250K inverter and block of rectifier /block"B" /. Switching on of supply is simultaneous with switching on of ARS switch "RADIO".

T10a. MA-250K inverter.

The MA-250K inverter changes D.C. from aircraft mains of 27,5 V to one phase A.C. current of 115 V and frequency 400 cycles/second and this voltage is used to supply radio-navigation and radiolocation instruments of the aircraft. The inverter supply is switched by ARS switch "RADIO". This inverter can operate for a long time no matter what loads changes in limits of 70-100 % are and supply voltage changes in limits ± 10 % /the A.C. voltage remains constant in limits ± 3 %/.

Basic technical data of MA-250K inverter.

1/ Supply voltage	27 V
2/ Supply current	22 A
3/ Maximum supply current under nominal load	24 A
4/ A.C. voltage	115 V
5/ Output power	115 V
6/ Frequency	400 c/s

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Block of rectifiers

Block "V" consists of two selenium rectifiers and server for rectification of A.C. current that goes out of DC-DC inverter.

The voltages received from block "V" are of approx. values:

a/ supply of valve anodes during transmission equals + 340 V, during reception equals + 275 V,

b/ supply of bias circuits during transmission equals - 120 V, during reception - 109 V.

Supply of cathode heaters is direct from aircraft using /27 V/ after voltage drop on R-115 and R-275 resistances that are located in transmitter and receiver.

211. The aerial of R/T set - R-800.

The aerial of R/T set - R-800 is made as bored quarter - - wave wide band vibrator, made of copper sheet and painted with grey enamel. Vibrator is set with its one end on the textolite insulator. This vibrator is fastened on a support under tail boom near the tail skid. The vibrator is connected with R/T set by concentric cable of 7 m length and 75 Ω wave resistance. Aerial can be connected either to transmitter output or to receiver input by means of relay that is located in block "A". The switch for setting the relay to reception or transmission is placed on the hand grip of the cyclic-pitch

212. R/T set tuning.

To tune the R/T set a special tuning device - block "I" is used. The sectionassembly scheme of the R/T set - see Fig. 41. page 111.

1. Transmitter tuning.

Set the switch on the block "I" in "TRANS". position. A-101-201 and A-101 plugs of block "I" should be at this time connected to corresponding sockets in the receiver. Press the button "TRANSM" and after releasing the lever rotation side knobs by turning small knobs half of the [illegible] direction.

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Semi-assembly scheme of R/T set, Erg. 41.

Press the button of the first channel of button mechanism of switching channels on the block "I". Set the selector switch in "MULTPLIER" position and first knob from the left of transmitter tuning turn to the max. indication of the instrument. Check approx. that the knob dash is in line with corresponding dial division. In order to tune the transmitter fine, set the selector switch in "GRID CURR". position and set first two knobs on the left acc. to min. instrument indications. Transmitter fine tuning acc. to grid currents increase the stability of transmitter operation during changes of climatic conditions, because due to such tuning the resonance frequencies of two circuits of V.H.F. set-up and second trigler circuit are practically tuned to corresponding - second, sixth and eighteenth harmonic of quartz frequency.

Set the selector switch in "AERIAL" position and set the third knob acc. to max. deflection of the instrument pointer. Check approx. that the knob dash is in line with corresponding dial division. During transmitter tuning the order of switching channels must be kept. Begin with switching first channel and tune it as indicated above, then switch on the second third and fourth ones, in order one after another and at each channel tune the receiver as at the first one. After tuning all four channels release the levers. To do that release the channel release buttons then immobilize in sequence all three knobs to the one in C.W. dir. what would fix. the knobs in turned up position. It is allowed to fix small knobs only when the levers of channel switching mechanism are released, otherwise the mechanism might be damaged. After tuning is ended and the knobs fixed, make sure that the transmitter is properly tuned i.e. aerial indicator indications correspond to indications obtained at tuning up to the moment of fixing the knobs. If any channel indications is diminished, then tune this channel again.

2. Receiver tuning.

After tuning the transmitter tune the receiver by connecting P-101-204 and P-206 plugs to the receiver and execute its tuning in following manner:

1/ Set the switch "REC. - TRANS". on the block " I " in

"MIC." position. Press and release the release button and after releasing lever mechanism undo the tuning knobs by turning small knobs for half revolution in a.c.w. dir. 50X1

2/ Switch on the first channel.

3/ Set the selector switch in "CRISTAL" position and set the first /from the left/ receiver tuning knob acc. to max. deflection of the instrument pointer. Check approx. that the knob dash is in line with corresponding dial division.

4/ Set the block " I " in "CRISTAL." position and set the receiver tuning second knob acc. to min. deflection of the instrument pointer. Check approx. that the knob dash is inline with corresponding dial division.

5/ Tune both tuning knobs acc. to max. noise in earphones /the noise killer must be switched off and hand sensitivity regulator knob should be in position of max. sensitivity/. Tuning acc. to max. noise should be done in sequence by both knobs several times until the max. noise in earphones is obtained. After such tuning check the instrument indications on the block "I" in positions - "CRISTAL" and "SABER." during this operation small decrease of instrument indications is permissible.

6/ All operations connected with tuning perform in sequence on 1, 2, 3 and 4 channel, after that release the lever of lever mechanism and immobilise small knobs of receiver tuning by turning them to the end in C.W. dir.

7/ Check the receiver for tuning out by comparison the noise magnitude in earphones and instrument indications with magnitudes that were obtained before immobilization of all channel knobs.

8/ After receiver and transmitter are tuned up, set the switch on the block "I" in "TRANS". position put on the head phones and by talking, check the operation of "self-listening to" circuit. Then set the switch in "REC." position and check the operation of noise killer. During switchin on and off the noise killer receiver own noise should appear and disappear.

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9/ Check the R/T set operation by establishing radio-c50X1.
nication with the ground R/T set.

T.13. Exploitation of R/T set.

When the R/T set is in exploitation /worked on/ it is forbidden to:

1/ Turn the immobilized lever mechanism knobs in the moment of channels being switched on. It might cause the damage of lever mechanism.

2/ Connect the R/T set to aircraft mains with its voltage being lower than 24,3 V or higher than 29,7 V. Bear it in mind that the lowered voltage is as much dangerous to the R/T set as heightened one.

3/ During replacement to put the valves in the incorrect place.

During R/T set exploitation do periodically:

1/ check the contact state of aerial relay, rectifier relay and impulse motor. If there are any burns clean them with a rag watted in petrol. In case of finding burns on the breaker of impulse motor - clean them.

2/ Check the reliability of valve fastening in the valve [illegible] operation ability and cleanliness of valve base legs.

U. ARK-5 radio compass.

Automatic radio compass is purposed:

1/ For guiding the helicopter acc. to guiding station or commercial station.

2/ Calculation of helicopter position

3/ Performance of go down for landing acc. to instruments.

Besides that it is possible to solve following navigations problems:

1/ Homing flight to guiding station acc. to course indicator.

2/ Radial homing flight to guiding station.

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3. [illegible] military [illegible]
4. [illegible] ing angle of [illegible] vector.
5. [illegible]
[illegible]

[illegible] receiver [illegible] [illegible] central [illegible] vice of [illegible] aerial revolutions.

[illegible] range = 100 – 1500 [illegible] [illegible] into three [illegible]

a/ 100 – 310 [illegible]
b/ 310 – [illegible]
c/ [illegible] – 1500 [illegible]

Receiver sensitivity = 1[illegible] – 1[illegible] μV
[illegible] sensitivity [illegible]
[illegible] aerial [illegible] μV

[illegible]

[illegible] 115..

[illegible]

[illegible]

a/ [illegible] directional [illegible] – [illegible] indicator
b/ [illegible] directional [illegible] aerial [illegible] receiver/ of [illegible] aerial/
c/ directional [illegible] aerial/

[illegible] with [illegible] aerial.

[illegible] directional [illegible] aerial [illegible] receiver [illegible]

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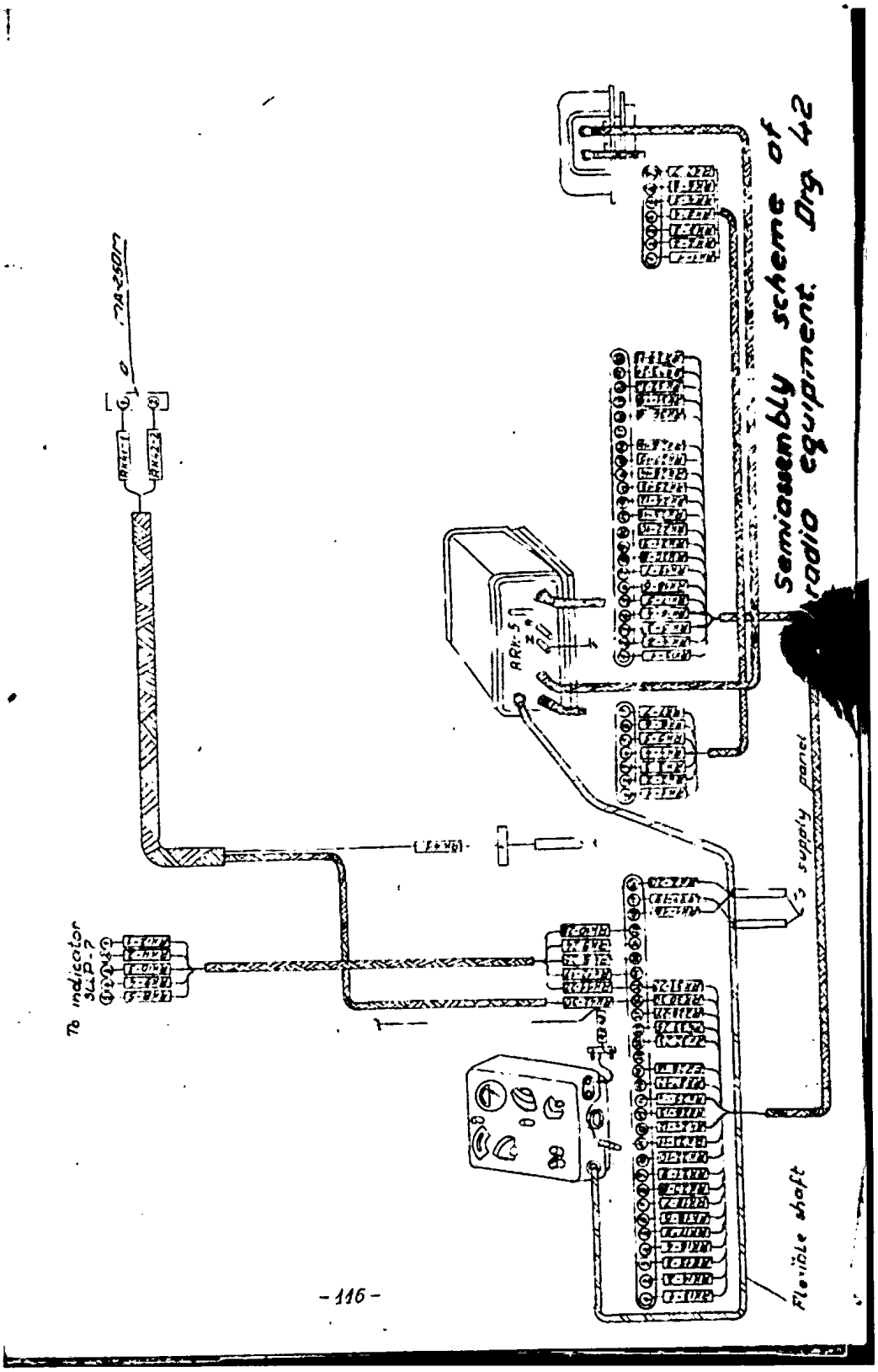

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[illegible]

[illegible] frequency control of frequency variations.

[illegible] 118.

[illegible] frequency control of frequency variations.

[illegible]

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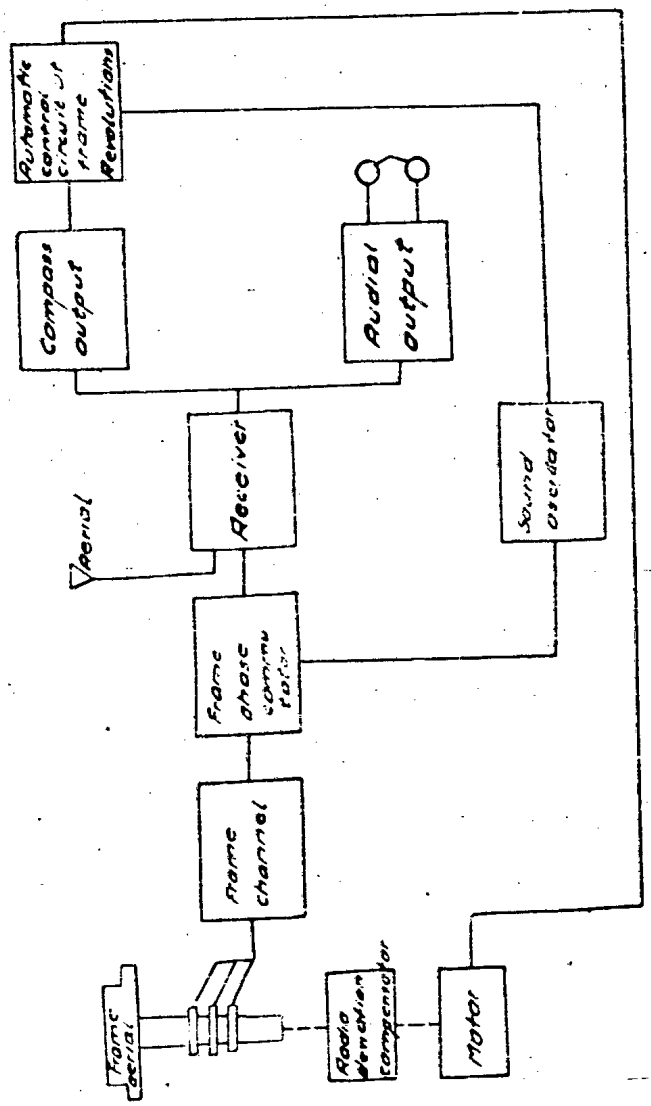

Block scheme of ark - 5. Drg. 43.

The change of frame aerial revolutions speed is obtained by closing the middle contact of "L - R" switch with 1,-,3,4 contacts. This results in connection or disconnection of R-76 additional resistance to the motor circuit and so when the R-76 resistance is connected into the motor circuit it will turn slower when the resistance is short-circuited /disconnected/ is will turn faster. 50X1

Radio scheme of ARK-5 - set drg. 44 page 120...

35. Automatic control of frame aerial revolutions.

To switch on the automatic circuit it is necessary to set the selector switch in "R.C." position.
In this position both ends 6 and 8 of T-81 transformer winding are connected to earth through 3-4 winding of T-76-I and T-76-II transformers and C-101 condenser. The end No. 3 of 1-3 motor phase winding is also earthed. In this way the ends of this winding are connected between middle points of the bridge that is formed by 6-7 legs of T-81 transformer and 3-4 windings of T-76-I and T-76-II transformers. Since the EMFs inducted in 6-7 and 7-8 legs of T-81 transformer winding are the same /equal/ and taken to motor winding in anti-phase, so the currents made by those EMFs would flow through motor winding opposite each other, and the magnitude of them would depend on resistance of 3-4 legs of T-76 transformer. The resultant current in motor winding shall be equal to the difference of those currents and shall have the phase of the biggest one. In this manner the magnitude and phase of currents in the motor winding shall be determined by resistances of 3-4 windings of T-76-II transformers. If the resistances are the same /equal/ so the bridge is balanced, resultant current equals zero and the motor rotor would not turn. If one of resistances would be smaller, so the bridge balance shall be disturbed and through motor winding the current shall flow causing rotor to turn. /note DKR - asynchronous motor/.

36. Radio compass supply.

The radio compass is supplied from A.C. converter 115 V /400 c/s / through T-81 power transformer. Supply of all motor relays, and band switchings is taken from

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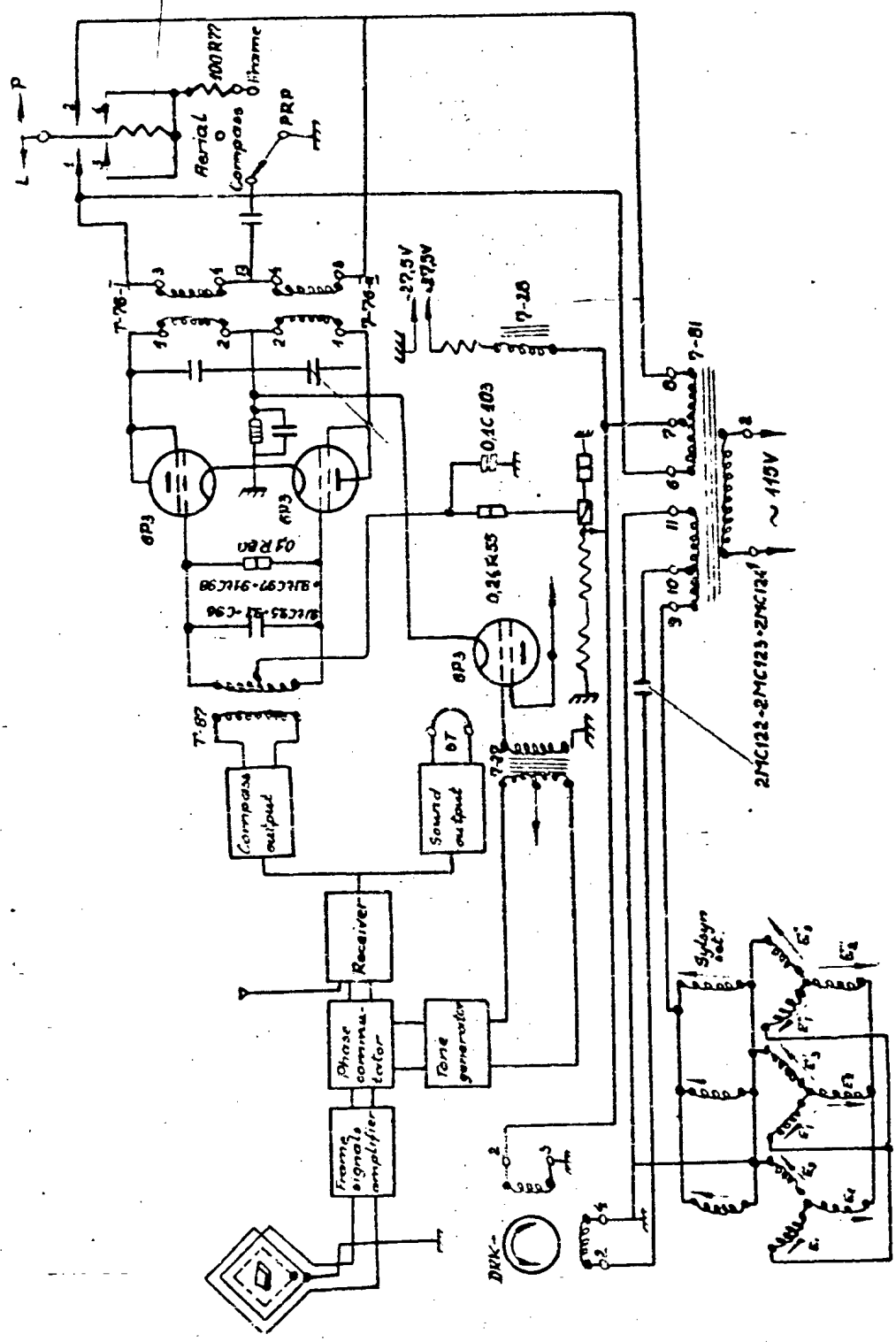

Basic scheme of ARK-5-set. Drg. 44.

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[illegible] 27,5 V D.C. Supply of D.C. motor voltage of 27,5 V not exceed 3,5 [illegible] D.C. motor voltage of 115 V not more than 1,4 A.

17. Inside fuselage arrangement.

It possess a property of rotational reaction given by means of relay circuit transmitting motion bearing gear on the course indicator.

The aerial block consists of: frame, frame electric motor, rotation gearbox, radio equipment for relay circuit and others. Inside fuselage the aerial is fixed on [illegible] parallelepiped ferromagnetic core /3 sections - [illegible]/ with winding on it covered with chloroviny[illegible] tube. The end of frame windings are connected through slip rings that are placed on the frame axle through brushes to the cable connecting frame with receiver.

Relay circuit.

The relay circuit is purposed for automatic transmission of the angle of frame revolution to the course indicator. The scale of course built on gyro stabilized base. Rotors are connected in parallel. The stator has 3 windings one stator of indicator. Stator windings of the relay of the indicator are connected opposite each other. [illegible] windings in each stator have [illegible] on rotor position in relation to stator windings. Like the stator windings are connected opposite each other, so [illegible] in the rotor of indicator opposite each other too. [illegible] of corresponding phase windings are in opposite phases, that is, connected with each other and the current in the circuit of windings would be equal zero. There would be no turning of the rotors, so it is stationary. Since the [illegible] on the axle, the [illegible] voltage would be observed at the axle of rotors having the same position in relation to stator phase windings. [illegible] the frame turns for [illegible] part of the circle /angle/ [illegible] the axle of relay gearbox coupled with it /frame/ shall turn for the same angle too. [illegible] also starts will be disturbed and the operating current shall flow, which with its magnetic field shall start to turning [illegible].

50X1

Because of that solar receiver the rotor will try to align itself to the actual position to obtain the least resistance to the passage of the air or other medium and hence to the angle of the true elevation.

[illegible]. Radio deviation compensator.

All aircraft metal [illegible] the earth's magnetic energy [illegible] part of the energy is absorbed by the aircraft metal, some of it is reflected [illegible] the electromagnetic field around the aircraft is [illegible] the direction of [illegible] station [illegible] bearing or guiding station [illegible] is necessary to [illegible] the correction [illegible] for [illegible]. An [illegible] is placed in the aircraft [illegible] surrounding it metal [illegible], so that [illegible] regular [illegible] rotor [illegible] radio deviation curve. [illegible] regular [illegible] rotor [illegible] allow to correct the [illegible] radio [illegible] deviation compensator. [illegible] compensator [illegible] to [illegible] vertically [illegible] other [illegible] the [illegible] compensator is [illegible] direct [illegible] of [illegible] to compensator is [illegible] obviously [illegible] to it [illegible] of rotation [illegible] it to it [illegible] in [illegible] from [illegible] the [illegible] or [illegible] of [illegible] to [illegible] [illegible] to the [illegible] direction of the [illegible] [illegible] should [illegible] to the compensator [illegible] it [illegible] part [illegible] this [illegible] of [illegible] compensator [illegible] to [illegible] to [illegible].

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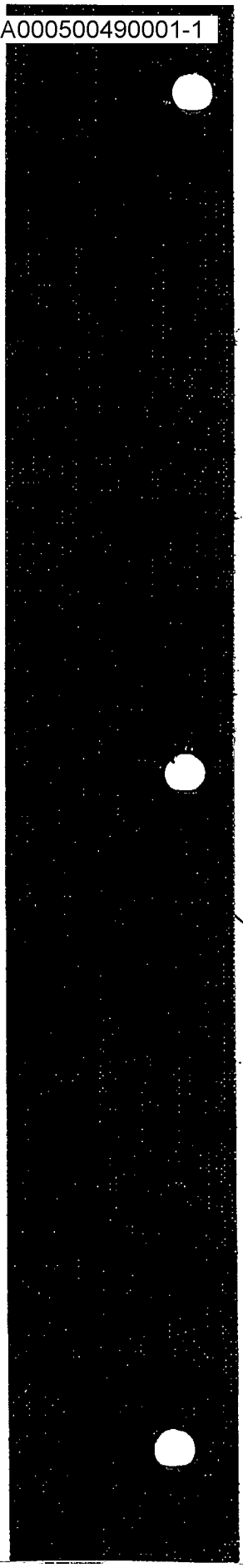

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